th MAY, 1922. THE PRICE 6D. NET.

THE WIRELESS WORLD AND RADIO REVIEW

VOL. X. No. 6 6th MAY, 1922. Registered at the G.P.O. as a Weekly Newspaper.

THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 6. MAY 6TH, 1922. WEEKLY

The Johnsen Rahbek Amplifying Loud Speaker

By F. H. HAYNES.

A METHOD of amplification which has not to any extent become popular is that employing the adhesive action between an agate cylinder and a metal face when subjected to a difference of potential. This method, due to Messrs. Johnsen & Rahbek, two Danish engineers, was fully described by Mr. P. R. Coursey in his articles on "Loud Speaking Telephones"* and the following gives practical details for the construction of a set employing the principle described.

The agate selected for making the cylinder should be, as far as possible, grainless, and that known as chalcedony, is particularly suitable owing to its homogeneous structure. Should any parallel markings exist they should be such that their plane permits of being arranged at right angles to the axis of the cylinder. Suitable dimensions are given in Fig. 1 (*a*) and it is advisable to purchase a cylinder made to these dimensions. If it is desired to make the cylinder, one must be skilful in the processes employed for working hard stones. In brief, the turning of the outer face is effected by using a lathe tool of copper with a square face of about 2 mm. sides and feeding it with a diamond dust paste. As the paste is applied to the tool it is immediately apparent how effectually it is cutting. The boring of the centre hole is not an easy task and consequently it is advisable to make a smaller hole at first and enlarge it to the final dimension by means of a boring tool such as is used in lathe work for boring a tunnel. The first hole is put through in the lathe by holding the cylinder in the chuck and forcing into it an iron tube of external diameter of the size of the desired hole. A hole is made in the side of the tube for the purpose of feeding the diamond dust, and the tube is driven forward from the point of the back centre. All the precautions have to be taken, of course, with regard to accuracy such as are usual in lathe work. After the hole has been put through it should be secured to a spindle in order that it can be revolved for the purpose of polishing. A piece of wood is prepared with a semicircular hollow face, covered with a strip of sheet lead. Ruby powder is mixed to a paste and is used on the face of the lead, pressed hard against the revolving cylinder. Great care must be exercised to prevent any trace of diamond dust getting into the ruby powder during polishing. The presence of the merest particle will produce scratches that are difficult to get out and if not entirely removed will cause noises in the operation of the finished instrument.

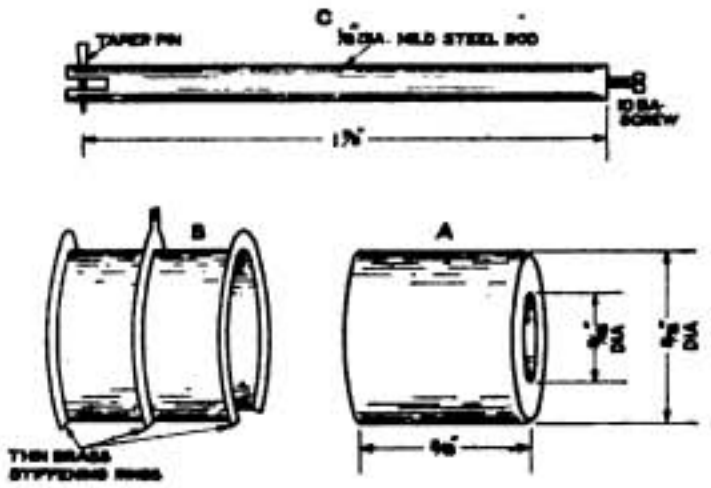


Fig. 1.

The design of the shoe is shown in Fig. 1 (*b*). The rubbing portion is of copper and can conveniently be made from a piece of hard drawn copper tube. The inside face must be highly polished and entirely free from scratches, and should be just a slipping fit on the cylinder. Thin brass rings are attached to its ends and middle in order to stiffen it and give even pressure at all points on the inner surface of the copper. These rings can, of course, be soldered on and in the construction of this fitment it should be borne in mind that it must be kept as light as possible without sacrificing any stiffness. The shoe, together with all the other parts which are required to vibrate at sound frequency, must be kept to the smallest mass in order that there may be a minimum of damping. The middle ring has an extension for coupling up a rod which transmits the vibrations to the diaphragm. This rod is shown in Fig. 1 (*c*) and is

* *Wireless World*, Vol. IX., pp. 225, 256, 289, 311 and 371.

made of mild steel and slotted at its end for making a union with the ring. The diaphragm can be made of mica or compressed silk and the mounting of any convenient pattern, such as is used in the construction of gramophones (Fig. 2).

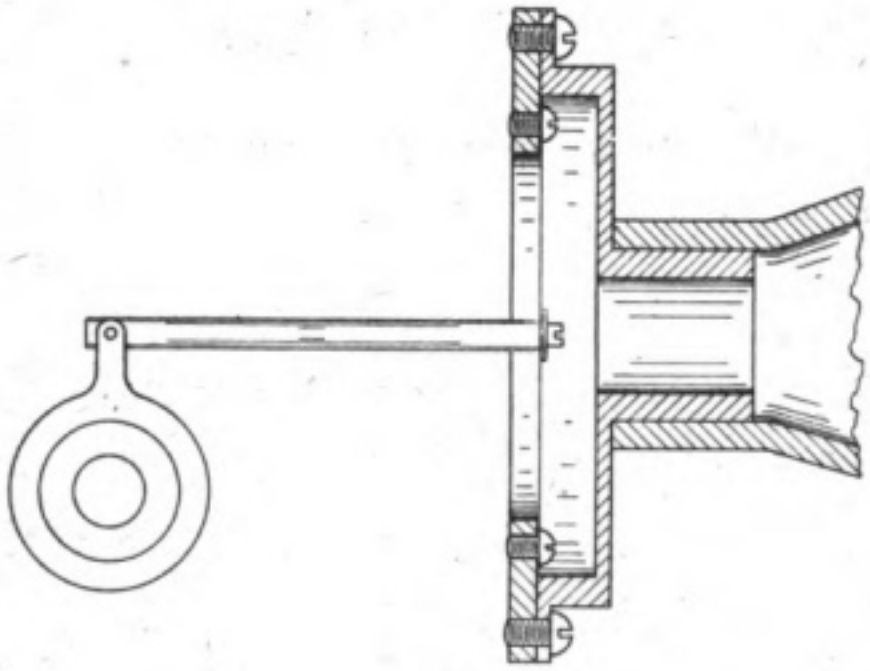


Fig. 2.

The cylinder is mounted on a spindle which is a fit. It is essential that the cylinder and spindle make good electrical contact. If there is any difficulty in securing the cylinder, the spindle may be coated with copper by immersion in copper sulphate solution and then evenly and thinly tinned. The cylinder is driven on over the tinning and a good grip effected. Fig. 3 shows the method of setting up the cylinder and a convenient way of mounting the spindle.

The spindle is driven by a worm-gear and if the usual type of small fan motor is used to drive the instrument a reduction gear of 4½-1 on the worm screw and a previous gear reduction of 8-1 gives a convenient running speed, assuming that the motor speed is about 900 r.p.m. It may be mentioned here that clockwork has been tried for the purpose of revolving the cylinder but the writer is not aware of any clockwork on the market sufficiently powerful and it must be borne in mind, of course, that the very large patterns of gramophone motors do not provide more power than the smaller ones, but that they rotate for a longer period on one winding. Fig. 4 shows a convenient lay-out for the driving mechanism.

The instrument can be operated by connection in a valve circuit of a receiver amplifier and the plate circuit battery can be used to provide the polarising voltage, but a better method, when signals are strong enough, is to operate the loud speaker from a microphone, which is coupled to a telephone earpiece. The circuit is shown in Fig. 5. The method of coupling is worthy of attention and Fig. 6 shows a good method of effecting it. The spacing shown proportionately in the figure between the earpiece and microphone should be adhered to, and the fitting of an iris diaphragm is very effective for producing maximum transmission of energy across the air space. It will be found that a certain definite adjustment of the aperture gives maximum amplification.

The polarising voltage can be derived from D.C. public supply mains, or if not available, from the usual H.T. batteries. The transformer in the

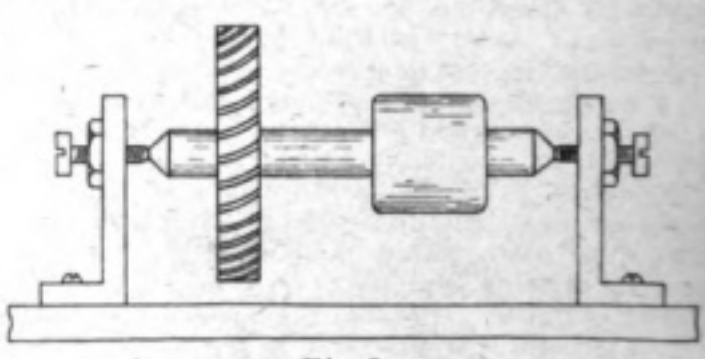


Fig. 3.

microphone circuit may be a small spark coil with its contacts screwed up. A variable resistance is connected in the microphone circuit to adjust the current to a suitable value at which the microphone will give maximum results.

This type of instrument is successful for the amplification of telephony as the results it gives

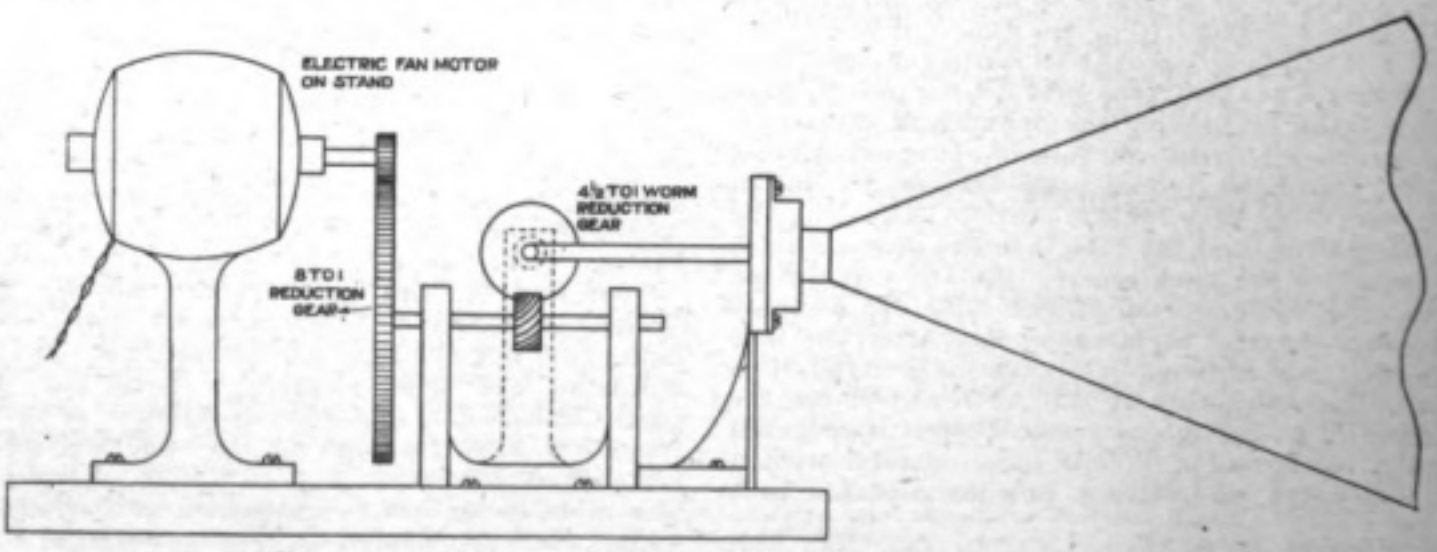


Fig. 4.

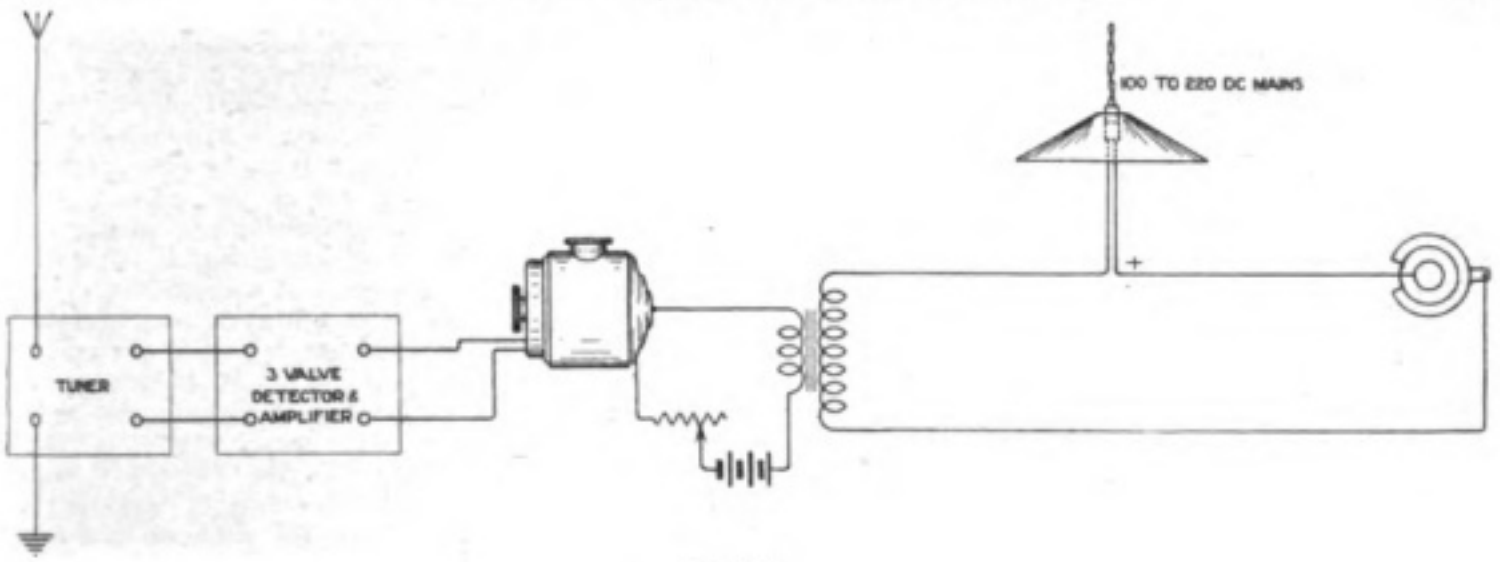


Fig. 5.

are entirely free from distortion and, to the author, is the only known method for rendering wireless telephony audible to large audiences. The volume of sound produced is tremendous, and it is essential that the receiver amplifier and microphone gear are not installed in the same room as that in which the loud speaker is operating, as the vibrations set up are so great that not only will they react on the microphone but, also, they will set up mechanical motion in the valve parts which will give rise to very considerable howling.

The vibration imparted to the shoe is sufficiently great to be easily visible and if its movements are sufficiently damped so that a buzzed signal will have an accumulative effect, the outfit can be used for the purpose of recording. A stylus is attached to the rod in place of the diaphragm and signals will produce ripples in a line that it will inscribe on a tape running beneath it.

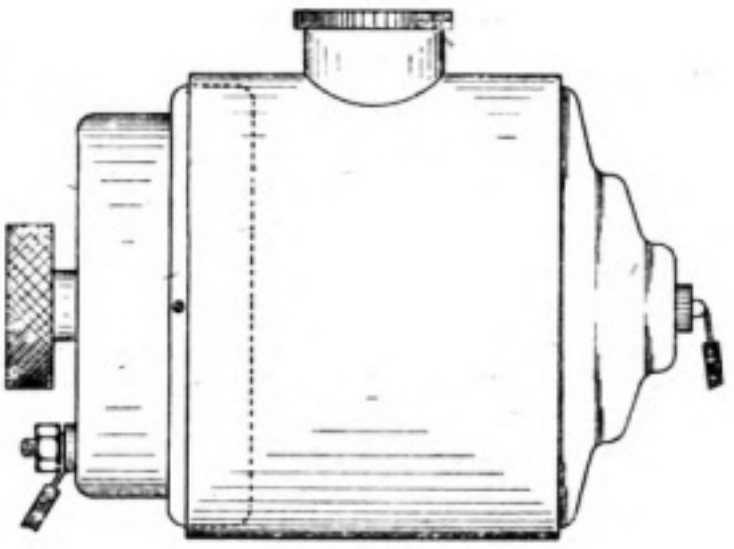


Fig. 6.

On Heterodynes

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

THE general principles underlying the reception of C.W. signals by the heterodyne method are sufficiently well known not to require repetition here, as it is the purpose of this article to describe the main features of some arrangements of separate heterodyne oscillators and to give directions for building simple forms of such apparatus. As is generally well known, the use of a separate heterodyne oscillator as distinct from autodyne receivers in which the oscillations are set up by the detector valve itself using one of the many reaction circuits, possesses several advantages particularly when the longer wavelengths are to be received. With the separate heterodyne, the tuning circuits of the receiver itself can be brought exactly into resonance with the wavelength of the incoming signals, thus minimising loss, while in addition a limited amount of reaction can also be employed to still further strengthen the signals when necessary.

For use as a separate heterodyne it is merely necessary to provide a three-electrode valve with the usual L.T. and H.T. batteries, and appropriate circuits that will enable oscillations to be generated of any wavelength within the range in which it is desired to work. This can of course be done with any of the several types of reaction circuit, given a proper design for the coils, etc., but some arrangements are superior to others as regards stability, ease of adjustment, etc. Another point to be borne in mind is that with some arrangements the waveform of the oscillations is distorted more than it is with others, with the result that a greater number of harmonics will be set up in the former case than in the latter. This may or may not be a disadvantage depending upon circumstances, and to what other uses it is desired to put the apparatus besides ordinary reception.

A very simple arrangement suitable for use as a heterodyne with any ordinary form of receiving

apparatus can be made up by using a set of any of the well-known interchangeable coils — Honeycomb; Duolateral; Burndept; Pancake or Slab inductances—fitted with plugs, or some equally convenient means of rapidly changing one coil for another. For convenience these coils may be plugged into one of the well-known forms of coil holder, one coil being used with a tuning condenser (variable) to form the oscillation circuit, and the other connected up as a reaction coil, as in Fig. 1.

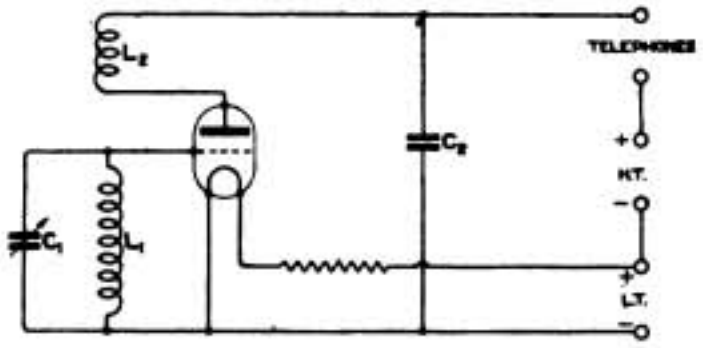


Fig. 1.

In that diagram, L_1 and L_2 are the two coils, referred to as mounted in a two coil holder, and C_1 is the variable air condenser for tuning, C_2 being merely a blocking condenser. This latter should have a capacity of at least 0·01 microfarad, and should preferably be much larger than this value. Terminals marked "telephones" are shown in Fig. 1 in the anode circuit of the valve. These will generally be joined together by a strap when the heterodyne is used normally, but it is convenient to provide them so that the apparatus can be used for other purposes, and for special tests. Either high resistance telephones can be used, or preferably a telephone transformer can be fitted in the instrument with low resistance telephones. This latter arrangement possesses some advantages besides the usual one of removing the steady direct plate current of the valve from the telephone windings, in that it also removes some of the stray capacity effects which may be produced in the circuit when the telephones are moved about when in use.

The chief disadvantage of an arrangement of this form is that the frequency of the oscillations that are set up depends to some extent upon the relative positions of the tuning and reaction coils, so that it will not be possible to obtain a stable wavelength calibration for the instrument. These changes will be more important the smaller is the capacity that is used in the tuned circuit, as the small stray (and variable) capacities between the coils and the other parts of the circuit will then be a greater percentage of the main capacity. To a limited extent this trouble can be got over by using a fixed form of coil holder in which the distance between the coupling coils cannot be varied as in the usual forms. This, however, introduces a further disadvantage that the separation of the coupling coils must be given some mean value that can be used for all the pairs of coils that it is intended to use with the instrument, and consequently the coupling may be tighter than the optimum in some cases, and looser in others. If the coupling is tighter than necessary there is a tendency to emphasise the amplitude of the harmonics generated by the valve as compared with the strength of the main oscillations of the fundamental frequency. While in many cases this may be no disadvantage—and may in fact be quite useful—in others it may be troublesome and become desirable to avoid. It is, however, difficult to eliminate this effect and at the same time to retain stability of the calibration. Usually constancy of calibration is all important if the instrument is to be used as a form of wavemeter, so that other disadvantages are allowed provided this desideratum can be secured.

The general arrangement of a heterodyne of this type is sketched in Fig. 2, which also shows leading dimensions. By using steps of fixed capacity in parallel with the variable tuning condenser, the effective wavelength range of the instrument can be increased without using an excessive number of coils. When a fixed condenser is in parallel with the variable, the accuracy of setting to any given wavelength can be much increased, since each division of the scale of the variable condenser then corresponds to a smaller percentage change in the total capacity of the circuit, and consequently a smaller change in wavelength. While not of such great importance

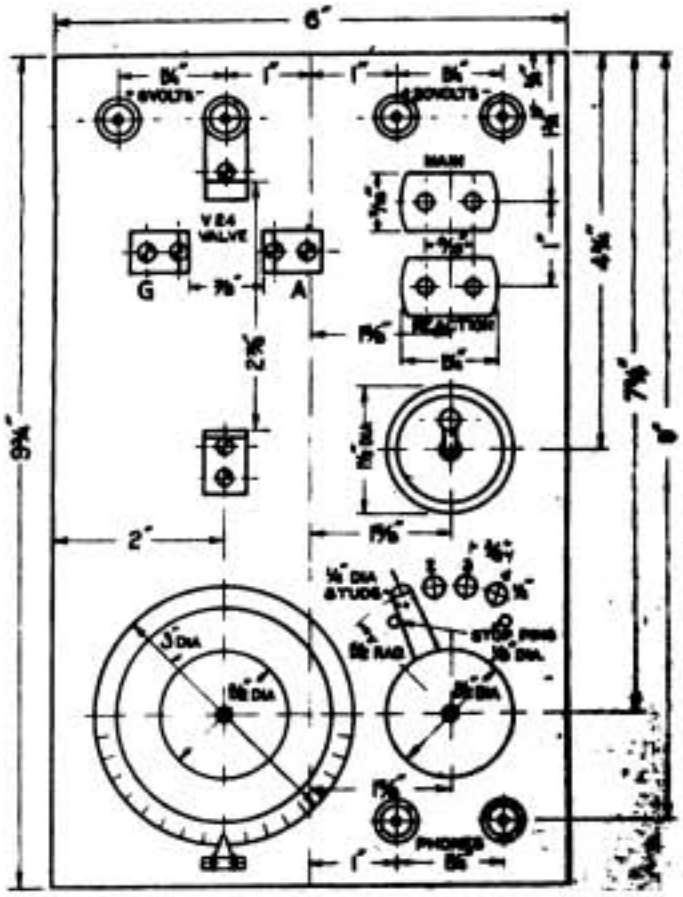


Fig. 2.

at the higher wavelengths, this spreading out of the wavelength scale is very useful on the shorter waves, since with these wavelengths the necessary tuning is much sharper as a smaller change in wavelength suffices to take the heterodyne beat note to the upper limits of audition. Using a set of "Burndept" coils, the tuning capacity can be taken up to 0·005 microfarad on each range without any trouble from difficulty in securing oscillations. Using the maximum capacity, it is only necessary to have four coils to cover a wavelength range of about 250 up to 30,000 metres, these coils being

arranged in pairs so that one serves as the main tuning coil and the other for reaction. The approximate wavelength ranges obtainable are set out in Table I, which gives the coil numbers required in each case :—

TABLE I.

Main Coil No.	Reaction Coil No.	Wavelength Range (metres).
50	150	250–1,550
300	150	1,300– 9,000
750	300	4,500–30,000

The wavelength ranges given in this Table have been calculated on the assumption that the maximum value of the tuning condenser is as stated above, viz., 0·005 μF. Although it is possible to obtain variable air condensers having a maximum value of 0·005 μF, it is not desirable for the purpose of this instrument to do so, as by using a condenser having a smaller maximum value in conjunction with fixed condensers which can be connected in parallel, the ease and accuracy of setting the instrument to any given wavelength is increased. A convenient value to make the variable is 0·0015 μF, and to use three fixed condensers of values 0·00125; 0·0025; and 0·00375 μF respectively which can be connected in circuit by a four-way switch. Alternatively three equal condenser units of 0·00125 μF each can be used with a special switch arranged so that it connects either one, two or three units in parallel with the variable condenser, so as to give the following capacity ranges in each position :—

TABLE II.

0·000100 (approx.) to	0·0015	Variable condr. only.
0·00135	to 0·00275	Variable + 1 unit.
0·00260	to 0·0040	Variable + 2 units.
0·00385	to 0·00525	Variable + 3 units.

There will thus be a convenient overlap on each range so as to avoid gaps in the wavelength scale. As, however, the price of the condenser units, if purchased ready made, will vary very little, if any, with their capacity over the range of values here required, it is often more convenient to give the successive units different values, viz., 0·00125; 0·0025; and 0·00375 μF, as stated above, so as to enable a simple four-point switch to be used. The connection scheme for the whole instrument will then become as in Fig. 3.

It will be noted that in this diagram, as also in Fig. 2, a holder for a V-24 valve is shown. For heterodynes of this type it is recommended that these valves be used, since it will be found that they give steadier oscillations over the range of capacities here described, and using 30 volts on the plate circuit, than are generally obtainable with most R valves.

Reverting to Fig. 3, it may be noted that a fixed resistance of about 1 ohm is shown inserted in the filament circuit of the valve. With 6 volts on the L.T. terminals such a resistance will give about the correct working voltage on the filament of the valve. The use of a fixed resistance for this purpose is preferable to employing a filament rheostat of the usual type, since the frequency of the oscillations set up by the valve is dependent upon the filament temperature, and upon the plate potential as well as upon the constants of the oscillation circuit. Great care must therefore be taken to maintain these supply voltages as steady as possible if it is desired to obtain a wavelength calibration for the instrument that will be in any degree permanent.

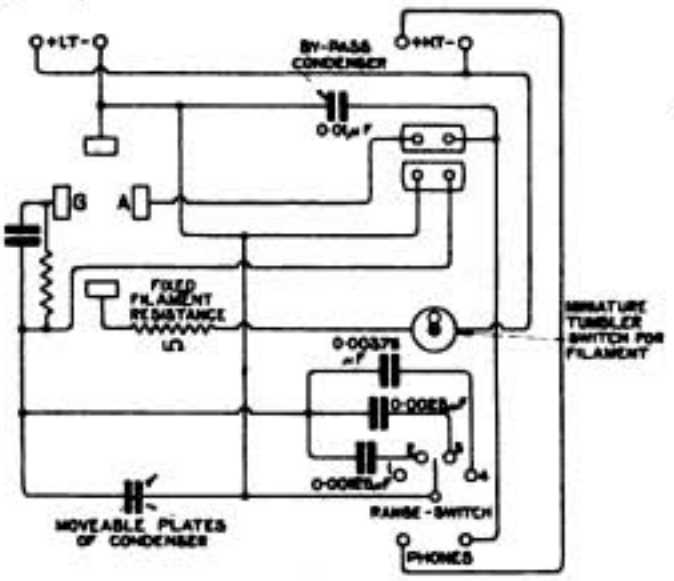


Fig. 3.

Another difficulty experienced in operating any form of heterodyne arises from the capacity of the parts of the instrument to the hand of the user. This "hand effect" will be found to depend very largely upon the exact arrangement of the oscillation circuit. This effect can be reduced by arranging the moving vanes of the variable condenser to have the lower potential of the two sides of the condenser—*i.e.*, they should be made the terminal which is joined to the filament of the valve. Similarly the arm of the four-point range switch should likewise be connected to the filament of the valve, since the capacity of the batteries, etc., to earth being large, the valve filament and the parts directly connected thereto will be at the lowest potential of the system and will consequently be least affected by stray capacities to earth. The effect of the capacity of the telephones can be reduced by using a telephone transformer as has already been pointed out.

The general arrangement shown in Fig. 2 is laid out to overall dimensions of 9½" × 6", so that if mounted as the top of a box 4½" deep (outside) the instrument will be uniform in style with the short wave heterodyne which has already been described in these columns.* The bulk of the instrument can be assembled from standard parts purchasable from most dealers of wireless apparatus, but for those who wish to build as much as possible of the instrument themselves more detailed dimensions and instructions, will be given in the second instalment of this article, as although similar in function, the dimensions of some of the parts have been somewhat modified as compared with those which were described in the article on the short wave heterodyne to which reference was made above.

(To be continued.)

* *Wireless World*, Vol. 9, pp. 461–464, 493–497.

Some Experiments in Radiotelephony

By G. PESSION.

1. As is known, in order to produce good radiotelephonic transmission, it is necessary to obtain a generator that will maintain alternating current of constant amplitude and frequency in the transmitting antenna for the radiation of continuous electromagnetic waves of convenient length.

The continuous waves constitute the "carrier" of the radiotelephonic emission and their amplitude and frequency must be modulated by the voice by means of a suitable microphonic device. In the absence of modulation continuous current is produced in the telephone at the receiver, by the known processes of amplification and rectification, but this does not give rise to any sound; it is the variations of the amplitude or frequency of the carrier wave that produce in the telephones the variations of current reproducing the voice or the sounds emitted before the microphone transmitter. The length of wave used in radiotelephony ranges in general from some hundreds to some thousands of metres.

The generators of damped trains of waves following one another at supersonic group frequencies are now entirely discarded.

2. The methods for the production of the carrier wave for radiotelephonic transmission have been much improved by the use of three-electrode thermionic valve generators. This type of generator undoubtedly offers for small and medium powers, exceptional advantages on account of its simplicity, the ease with which it is handled, and the relative purity of the emitted wave that can be obtained with proper precautions. In large power undertakings, high frequency alternators in conjunction with magnetic amplifiers or frequency multipliers are used with success.

In the experiments described below, which were undertaken in the months of May and June, 1921, I used instead the Poulsen arc as generator of the continuous waves. The purpose of these experiments was to obtain in as quick and simple a manner as possible, a good adjustment of the arc for long distance radiotelephony. Hence many of the arrangements employed are not new, but simply the repetition with suitable alterations of experiments already performed by others. However, considering the results obtained in relation to the simplicity of the means employed, it is believed that these experiments, looked at as a whole, will not be found altogether devoid of interest.

3. The Poulsen arc as generally employed in radiotelegraphy is connected directly in the aerial circuit on account of the great simplicity of this arrangement and the relatively high efficiency obtained by virtue of the absence of a primary or intermediate circuit. For radiotelephony, however, an inductive coupling is preferable in order to obtain a greater purity of the emitted wave, and especially also a diminution of the troublesome "rustling" noises, which can be heard in a receiver close to a transmitter employing the direct connection of the arc. In the primary circuit, it is better that the capacity should not be too large, in order to obtain greater steadiness of the oscillations. The coupling should not be too tight. Very good results were obtained with the following constants (Fig. 1):—

$C_1 = 0{\cdot}007\ \mu F.$
$C_2 = 0{\cdot}002$ to $0{\cdot}008\ \mu F.$
$\lambda = 2{,}600$ to $3{,}000$ m.
$\lambda_0 = 600$ to $1{,}900$ m.

where λ is the wave emitted and λ_0 the natural wavelength of the aerial.

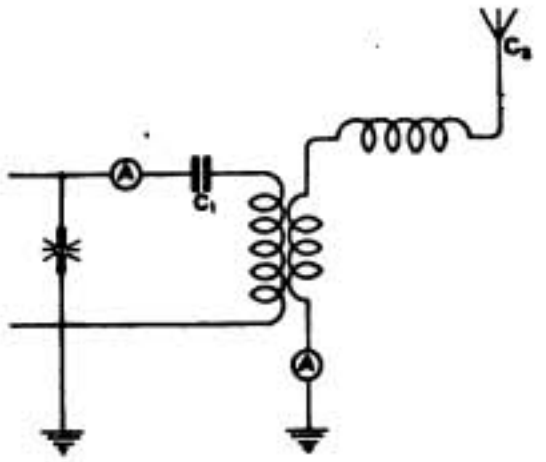


Fig. 1.

4. An inquiry was made at first as to what results could be got by using simple carbon microphones. The method shown in Fig. 2 first suggested by Stone, was adopted, using four Kellog microphones in series and coupled inductively to the aerial inductance. The coupling and the number of turns on the coils were regulated so that

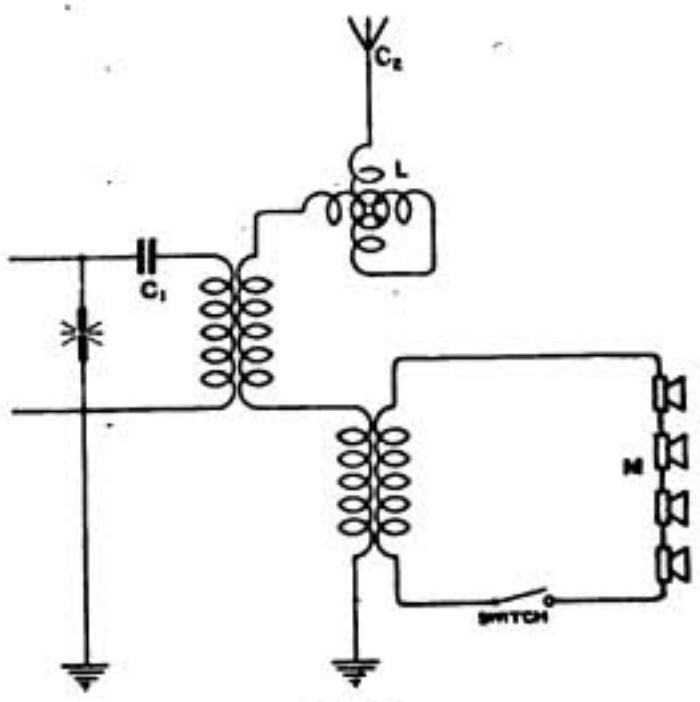


Fig. 2.

on closing the switch the current in the antenna fell to about half its previous value. With four microphones the value of the antenna current with switch closed could be kept at 3 amperes without undue heating.

By suitable regulation of the variometer very good modulation, as recorded by the aerial ammeter, could be obtained, and the voice received by an ordinary thermionic valve receiver was clear and perfect, leaving nothing to be desired as compared with the results obtained with a valve transmitter. With this simple contrivance some tests were carried out between Rome and the yacht *Electra*, belonging to Senatore Marconi. The *Electra* was employing a thermionic valve transmitting apparatus, and good communication up to about 400 km could be obtained without difficulty, by using a receiver of medium sensibility (two valves—one detector and one low frequency amplifier) on an aerial of moderate dimensions.

The principal condition necessary for the success of the experiment is that the four microphones function acoustically in phase and that is secured by having the four tubes carrying the vibrations of the voice to the microphones of exactly equal length. Fig. 3 shows the construction of the multiple microphones actually employed in the tests which were carried out near the Radiotelegraphic Station at Centocelle (Rome). The method of modulation employed is a detuning method, that

Fig. 3.

is to say, the antenna current is modulated principally in consequence of the variations of syntony with the primary circuit that takes place through the variations of the resistance of the microphone circuit. The variations in the resistance of this circuit produce, in fact, changes in the effective inductance of the antenna and hence alterations of tuning.

This is easily seen by observing that when the switch (Fig. 2) is closed, the antenna circuit can, by changing the adjustment of the variometer, be brought back into resonance with the primary circuit, and the original antenna current restored. The functioning of the radiotelephone under conditions of greater or less initial detuning between the primary circuit and the antenna is therefore possible.

It has been maintained, however, that for best working the initial detuning should be such that the working point is not too far removed from the top of the resonance curve, such, for example, as the point marked with a cross in Fig. 4. Under these conditions, when speaking in front of the microphone, there is a perceptible lowering of the effective value of the antenna current.

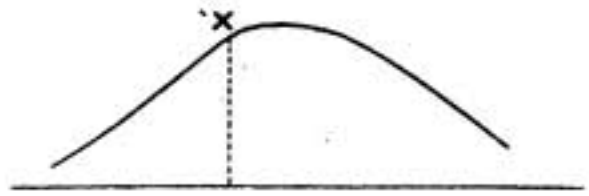


Fig. 4.

It is certain that by increasing the number of microphones, even with the simple arrangement just described, results far superior to those above referred to could be obtained, but further experiments were not carried out, as it was thought preferable to have recourse to more powerful methods of modulation by the employment of thermionic valves.

5. Various systems were tried with the object of obtaining a suitable modulation of the antenna current generated by the arc. The results showed that it was best to act on the secondary circuit in such a way as to produce simultaneous variations of its wavelength and of its resistance.

An absorption method was therefore chosen constituting a simplification of one proposed by Hund, which has been adopted by several firms in their telephonic apparatus. Several schemes were then investigated, one after the other, and after some trials, the one shown in Fig. 5 was decided upon. This method is very effective and practical, since the transformer T permits of the regulation at will of the voltage applied to the valves and hence the use of types of valve adapted for various voltages. The effect of this contrivance is principally to produce variations in the resistance of the antenna by reason of the shunt to earth constituted by the thermionic valve V_1 the resistance of which varies according to the voltage on its grid produced by the microphonic current.

In order to study the working of the set, a curve was plotted out which might be called "the static modulation characteristic," that is, a curve connecting the intensity of the antenna current with the value of the grid voltage of the valve V_1. It can be seen from Fig. 6 that as the grid is gradually made positive, the antenna current diminishes on account of the increased absorption and consequent expenditure of energy in the coupled circuit.

Given a relatively low frequency for the telephonic modulation it may be assumed that the static modulation characteristic gives useful information as to the operation of the apparatus when the voice vibrations produce variations in the grid voltage of V_1 which are superimposed upon the steady voltage of the battery P, by means of the transformer T_1. The best conditions of working were investigated by experiment, and it was proved that the best initial value of the grid voltage is that corresponding to the upper bend of the modulation characteristic so as to have a perceptible lowering of the effective value of the antenna current during speech. Such a lowering

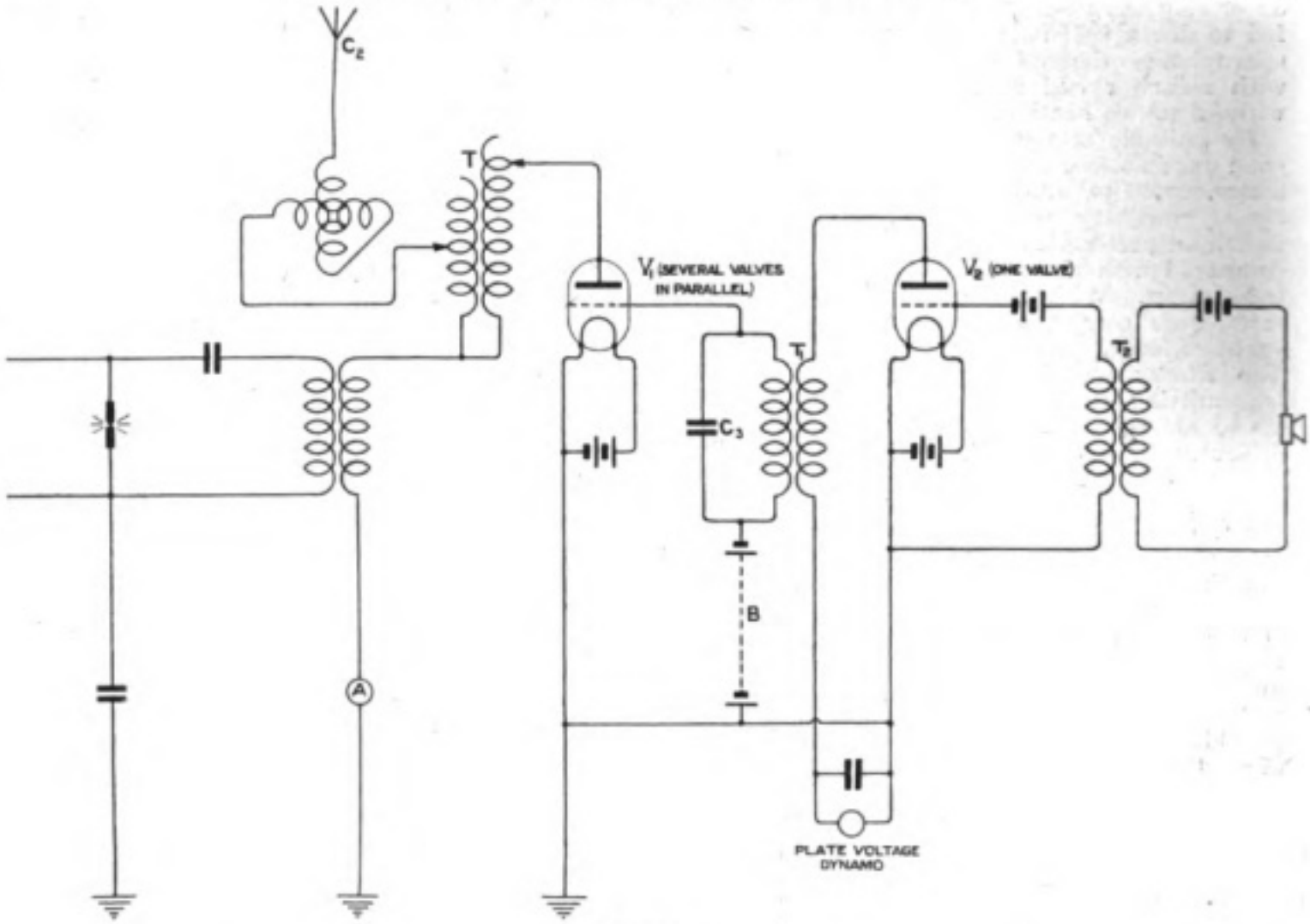


Fig. 5.

can easily be noticed by emitting a constant musical note in front of the microphone. The negative voltage of the grid may be regulated either by the insertion of a steady e.m.f. of suitable value in the grid circuit, or by regulating the value of the capacity C_3 (Fig. 5). The action of the condenser C_3 can readily be seen by noting that through the effect of the unilateral conductivity of the valve it becomes charged to a potential which depends on the value of its capacity and the time constant of the circuit shunted across it—which in this case is the primary of the transformer T_1.

6. It is at once seen that when working at the

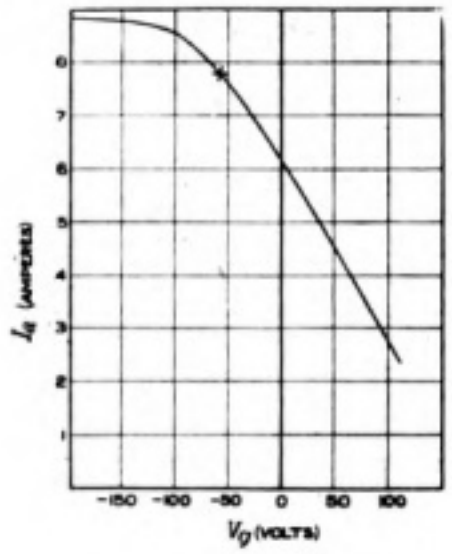


Fig. 6.

point of the modulation characteristic marked with an X in Fig. 6, the modulated oscillations become unsymmetrical, the increments of current being much less than the diminutions.

By way of confirmation, oscillograph tests were carried out, using a Gehrcke's tube and a revolving mirror. The tube was connected between the antenna and the earth through a suitable high resistance or a small capacity. In the first place it was ascertained that the tube gave indications approximately proportional to the antenna current. In Fig. 7 are reproduced three photographs of the oscillograph line traced out with three values of the antenna current, from which it is evident that the proportionality is approximately satisfied.

If we examine the oscillograph tube with a rotating mirror we obtain oscillograms such, for example, as the one reproduced in Fig. 8, which corresponds to the continuous emission of the vowel "O" before the microphone. Fig. 9 shows the cathode illumination of the tube spread out by means of a mirror, under the same conditions as in the preceding experiment, only in the absence of sounds in front of the microphone.

It is easily seen that the increase of amplitude of the oscillations under the influence of the voice is very small, though perceptible and distinct, but that the diminution reaches as far as the dark part of the tube.

The conditions during the experiments were as follows:—

Antenna current with modulating valve out 13.A

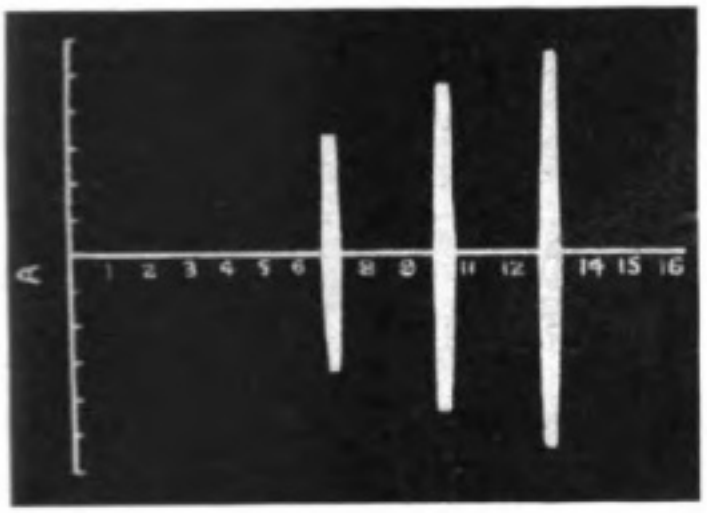


Fig. 7.

Antenna current with modulating valve alight - - - - - - - 14A
Antenna current during the continuous emission of the vowel sound "O" - 9A

The increase in the modulation cannot therefore exceed one ampere in fourteen, that is 15 per cent., while the diminution is very much greater.

Another oscillogram (Fig. 10) was obtained by adjusting the apparatus so as to obtain a more regular modulation, both by producing a greater initial diminution of the current and by thus obtaining more symmetrical variations of antenna current. The intensity of the signals was inferior to that obtained with unsymmetrical modulation,

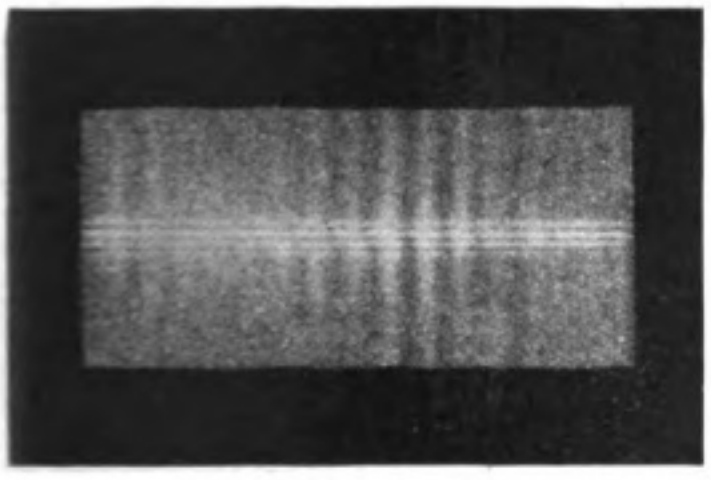


Fig. 8.

while there is also the added disadvantage of greater danger to the absorbing valves due to the greater energy dissipation in them. No perceptible increase in clearness was observed.

7. At first sight it would seem that the unsymmetrical modulation produced near the bend of the modulation characteristic would constitute an unfavourable control, and that considerable distortion in the voice would be produced.

In practice this effect was not noted, and the voice always came out clear and without defect, so that one could at once recognise who was speaking or singing in front of the microphone.

As regards this point, some experiments were also made on a wire telephone circuit, and an attempt was made to reproduce the condition that obtains in radiotelephonic transmission with unsymmetrical modulation. The arrangement shown in Fig. 11 was used for this purpose. By means of the battery B, it was possible to give to the grid positive or negative voltages, and therefore to vary the working point of the valve characteristic. The continuous current milliammeter A gave indications of the line current.

It was clearly proved that the articulation always remained good for all the points comprised between A and B (Fig. 12) though a certain improvement in the timbre was observed about the middle point C. At this last adjustment the milliammeter A (Fig. 11) in the line did not show any perceptible variations during modulation, while at the points A and B there was respectively a distinct increase and a distinct decrease of the current on account of the dissymmetry of the line telephone current. Only by going a long way beyond the points A and B did one notice a marked distortion of the voice. Taken together then, these tests enabled it to be established that in order not to overload the absorption valves it is permissible to use a markedly unsymmetrical modulation in the scheme here described, with no detriment to the clearness and quality of the transmission.

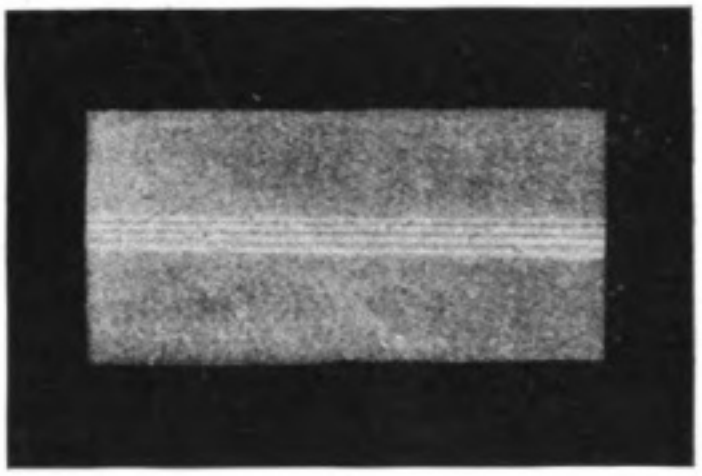


Fig. 9.

It is apposite, too, to observe that in radiotelephonic reception, when employing a crystal detector or a non-oscillating triode valve, there is a tendency to introduce additional dissymmetry at the receiver, in that the increases of current are magnified in comparison with the diminutions. By allowing the modulation to take place at the point indicated on the characteristic in Fig. 6

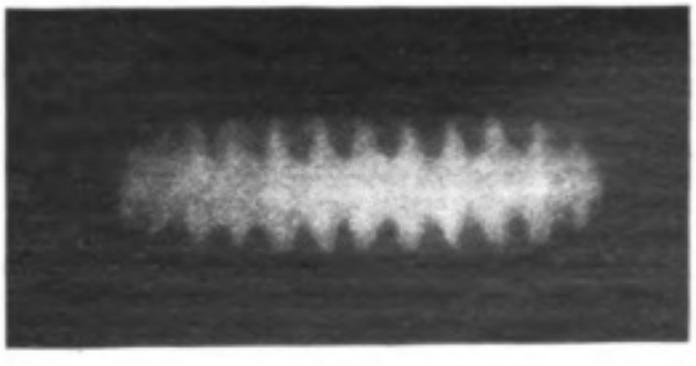


Fig. 10.

there is therefore a certain compensation between the two distortions produced respectively at the transmitter and at the receiver.

8. The results obtained by applying the above described methods to the arc radio transmitting station at Centocelle (Rome) were truly remarkable. With an antenna current of 14

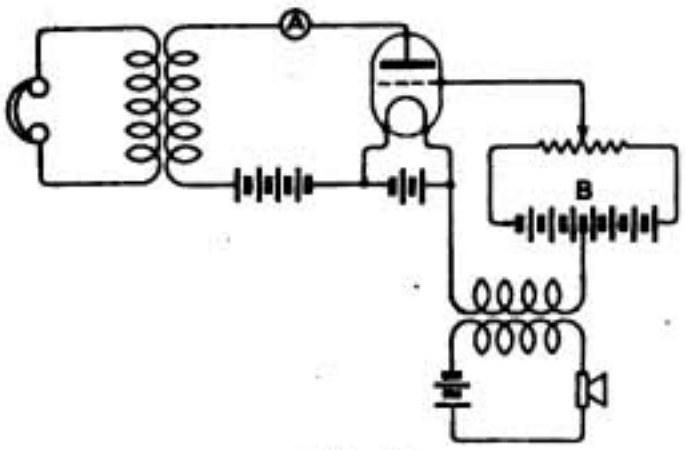


Fig. 11.

amperes modulated in the above very unsymmetrical manner, the voice was intensely clear and strong over distances up to more than 1,800 km.

The data relative to the aerial used in these tests is as follows :—

Natural wavelength - -	1,890 m
Length of wave emitted - -	2,700 m
Static capacity of the aerial -	$8{\cdot}26 \times 10^{-3} \mu F$
Effective height - - -	40·3 m
Effective resistance - -	7·3 ohms
Antenna power - - -	1·46 kW

The signals were received exceedingly well over the above-mentioned distance with a three-valve receiver, one of the valves being for rectifying, the other two low frequency amplifying valves used on a naval type of aerial. Stronger signals were obtained by using 7-valve high-frequency amplifiers of the Marconi type 55D and 8-valve French amplifiers, having five high-frequency valves, one rectifying valve, and two low frequency amplifying valves. At distances of the order of 500 km with a ground aerial of modest dimensions, the radiotelephonic signals were received loudly and perfectly even with an ordinary crystal receiver, and it was even possible to insert the radiotelephone receiver in an ordinary telephone circuit.

9. Extensive experiments were then made in order to ascertain whether the system of modulation employed deformated the carrier wave in such a way as would cause abnormal interference, or give rise to harmonics of excessive amplitude. For these tests, there was a choice of two receiving stations, one about 5·68 km and the other about 27·4 km distant from the transmitter. The first of these stations was provided with a large T-shaped aerial, a Navy type of receiver was used with two valves, one rectifying and the other amplifying. In this receiver the grid of the rectifying valve is connected directly to the inductance of the aerial, thus giving easy reception of signals and only a moderate degree of selectivity. In the second station, provided with a very low and directive aerial, several types of amplifiers were used in a secondary circuit loosely coupled to the aerial.

It was observed, as was to be expected, that the tuning of the radiotelephonic transmissions was

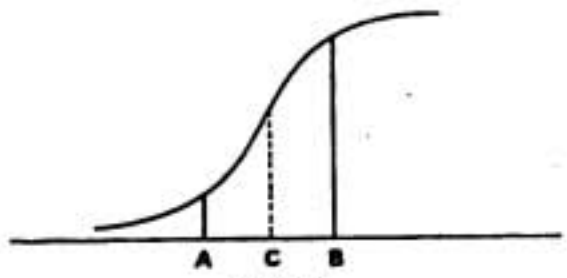


Fig. 12.

a little less sharp ($\lambda = 2{,}500$ m) than that of the continuous non-modulated wave, but no trace of harmonics or abnormal disturbances was found.

In one particular instance, by allowing another continuous-wave station to transmit at the same time as the radiotelephone at Centocelle it was possible to pick up in a receiving station situated about 24 km from the two above-mentioned stations, either of the two transmissions without interference, although the difference of wavelength could not have been as much as 4 per cent.

The continuous wave station used a much lower voltage than the radiotelephone transmitter. As a matter of fact, the product of the radiation height of the aerial expressed in metres and the effective value of the antenna current expressed in amperes was 521·6 for the station at Centocelle, while the same product for the continuous wave station was only 188. It was distinctly noticed that the disturbance produced by the voice was smaller than that produced by the "rustling" noises of the arc. The disturbance was also much reduced by virtue of the inductive coupling adopted.

10. It thus results that the Poulsen arc used with inductive coupling in conjunction with a good system of modulation lends itself admirably to the purposes of radiotelephony, and enables distinct and loud communication to be effected over a considerable distance. The disturbing noises are greatly reduced in the arrangement described, and do not prejudice in any way the quality of the radiotelephonic signals.

The apparatus in use at Centocelle was constructed with material at hand by the Chief Torpedo Constructor and the experiments were conducted by the chief officer of the station.

Commercial Wireless Conference

The Commercial Radio International Committee composed of the representatives of the Radio Corporation of America, Compagnie Générale de Télégraphie sans Fil, Gesellschaft für Drahtlose Telegraphie m.b.H. and Marconi's Wireless Telegraph Co., Ltd., has completed its Conference held at Cannes under the Presidency of Senatore Marconi.

As a result of agreement between the four Companies, a number of new international wireless telegraph services will be opened in the early future. A very considerable development of communications generally has been discussed and agreed upon.

Wired Wireless*

By F. Mallett, M.Sc., Assist. Prof. City and Guilds (Eng.) College.

(1) Introduction.

THE title "Wired Wireless" is the popular term that has come to be applied to the system of multiplex telephony and telegraphy which employs high frequency currents. It is sometimes referred to also as "Carrier Wave Telephony," but this is hardly a correct description, as will be evident from the fact that in the latest practice the "Carrier Wave" is not propagated through the line at all.

"High Frequency" telephony was first achieved by G. O. Squire in 1911, using a H.F. alternator and working in one direction only over a telephone line which at the same time carried ordinary telephone traffic. He recognised the possibilities of the system for multiplex telephony, and took out master patents. It was not, however, until the advent of the three-electrode valve as a generator of H.F. current that any progress towards a practical realisation of the scheme was made, and "Wired Wireless" is one of the many branches of communication engineering that has been revolutionised by the pioneer efforts of J. J. Thomson and Richardson, and others on the side of the physicists, and Fleming and Lee De Forest on the engineering side, in their work on electrons, thermal emission of electrons and valves.

In the actual problems of making a practicable multiplex telephone circuit, the honours seem to be divided between America and Germany. In America the research staffs of the W. E. Co., and the A.T. and T. Co., led by Colpitts and Blackwell, and in Germany K.W. Wagner, have been responsible for elucidating the many problems and overcoming the many difficulties that arose.

(2) Main Aspects of the Problem.

The original idea was simple. The æther waves of Wireless Telephony were simply to be guided by wires. Tuned circuits for transmission and reception were to be used, and so these various channels, employing different "wavelengths," would be received each on its tuned circuit.

(a) Line.

The idea was held and persisted for a long time, that in some mysterious way the losses normally associated with telephone transmission would not occur; the energy would be propagated through the æther—which is true—and that in consequence there would be no losses or only small losses in the line, which would merely guide the energy propagation. The theory as to no losses was quite untrue. H.F. waves in wires follow exactly the same laws as telephone waves; the only difference is that owing to their higher frequency the losses are much greater.

The first attempts in this country were made with an Air Force telephone set working on about 600 metres (frequency 500,000). The wireless transmitter was inserted in the aerial line through a loosely coupled coil, and the receiver was taken to a point about five miles away. Good speech was received and the length was extended up to about twenty miles, but that was the limit. That was at the time when the "no loss" theory held. Actually, of course, owing to the H.F. resistance and increased leakance at the frequency employed, the losses were so great as to limit the range to twenty miles. Better results would probably have been obtained without the wires.

When these H.F. losses became realised the frequency was very much lowered, but this introduced a further problem.

(b) Modulation.

Wireless telephony is achieved by altering the amplitude of the H.F. wave in accordance with the speech wave at the transmitting end, and at the receiving end the wave is rectified so that its varying amplitude is reproduced as a speech wave.

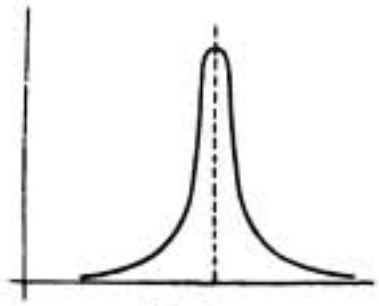


Fig. 1.

Thus, if $Q/2\pi$ is the frequency of the "Carrier Wave" and $P/2\pi$ that of one of the constituent waves of the complicated speech wave, then for the carrier wave at any instant we may write—

$$i = A \sin Qt \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and for the modulated amplitude A—

$$A = a(1 + k \sin P t) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where a and k are constants and k is less than unity and depends upon the completeness of the modulation; and a is the unmodulated amplitude.

Combining (1) and (2) we have—

$$\begin{aligned} i &= a(1 + k \sin P t)(\sin Q t) \\ &= a \sin Q t + k (\sin Pt \sin Qt) \\ &= a \sin Qt - ak/2 \cos (Q + P) t + ak/2 \\ &\qquad \cos (Q - P) t \quad . \quad . \quad . \quad . \quad . \quad . \quad (3) \end{aligned}$$

So that for every telephone frequency $P/2\pi$ we have introduced two frequencies $(Q + P)/2\pi$ and $(Q - P)/2\pi$, and in order that there may be no distortion all of these must be propagated with equal attenuation and be equally dealt with by the receiving apparatus. $P/2\pi$ comprises all frequencies say between 200 and 2,000 per second; so that the speech modulated wave is equivalent to a complicated wave having a band of frequencies on each side of the carrier frequency.

Now at the high frequencies used in Wireless Telegraphy, say 500,000 ± 2,000 is a small quantity, and the whole band will be very little distorted by the receiving aerial.

* A Presidential Address read before the City and Guilds Wireless Society on February 8th, 1922.

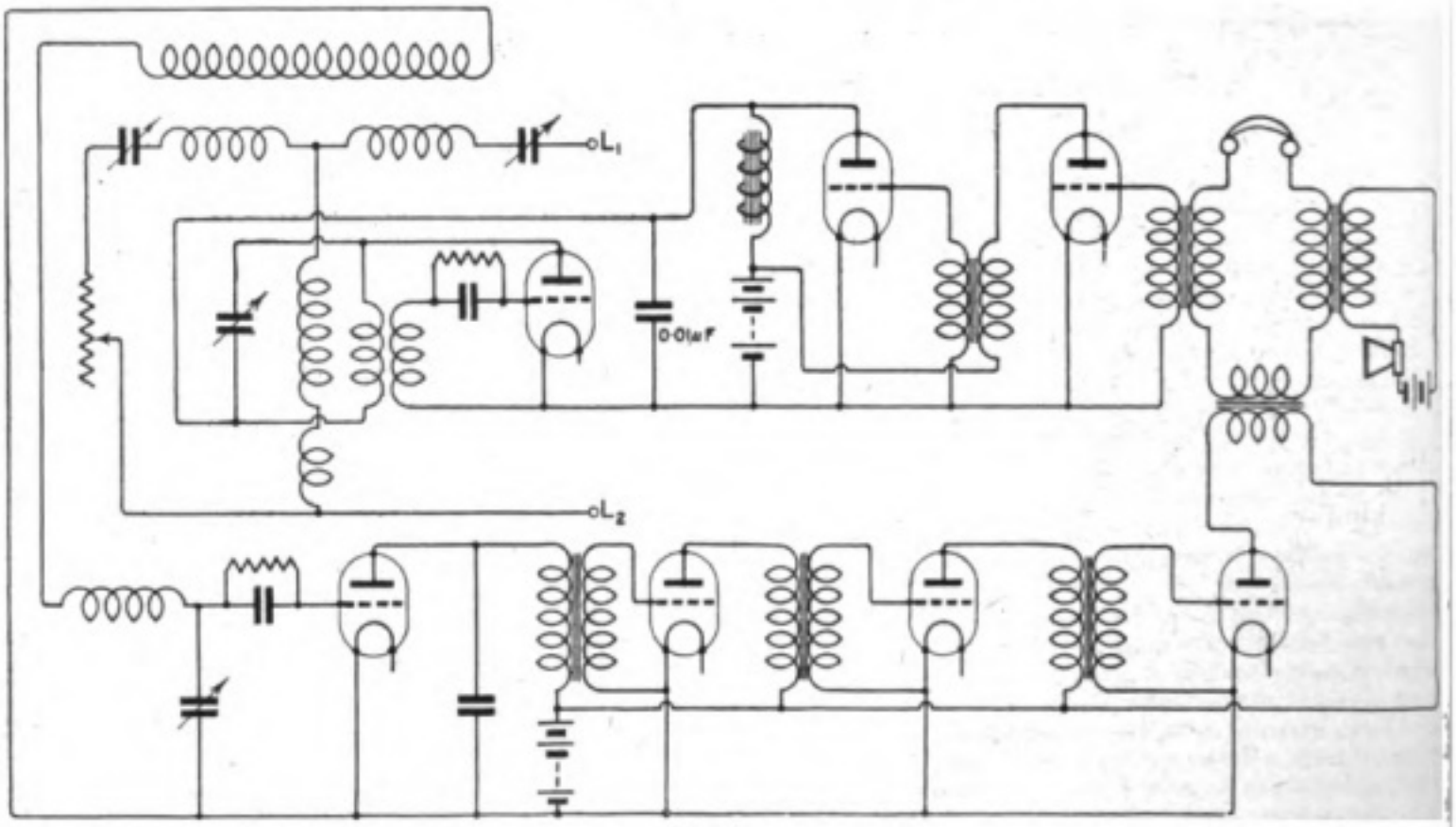


Fig. 2.

But if we employ a carrier wave of 10,000, we shall have all frequencies from 8,000 to 12,000 and the resonance curve, if sharp (as in Fig. 1), will cause very unequal treatment and consequent distortion.

Hence, sharp tuning is impossible, and recourse has to be made to " filters " to separate the various channels, since we must employ the lower frequencies to avoid very high attenuation.

(*c*) *Both way working.*

All telephone systems must be capable of being worked in either direction without switching. This can be achieved in Wired Wireless by using a different carrier frequency in each direction, or by using the same frequency and a bridge. The latter is much the more difficult method, but allows more channels.

(3) First Circuit in this Country.

The diagram (Fig. 2) shows the first circuit that was set up in this country, nearly two years ago now, from London to Bristol. Although different carriers were used in each direction, it was found necessary to use a bridge arrangement in addition, as no filters were used.

This circuit was set up before the publication of the American and German articles, and represents the very little that we in the Post Office were able to achieve independently. The circuit is working to-day.

(4) The " Wireless " Problems.

(*a*) *Filters.*

Much has been written recently about filters, and the design of suitable filters is a great problem that has been solved with apparent success by K. W. Wagner.

The filter must pass a band of frequencies from $Q/2\pi$ to $\pm P/2\pi$, where $P/2\pi = 2{,}000$.

Of the two bands $(Q/2\pi + P/2\pi)$, and

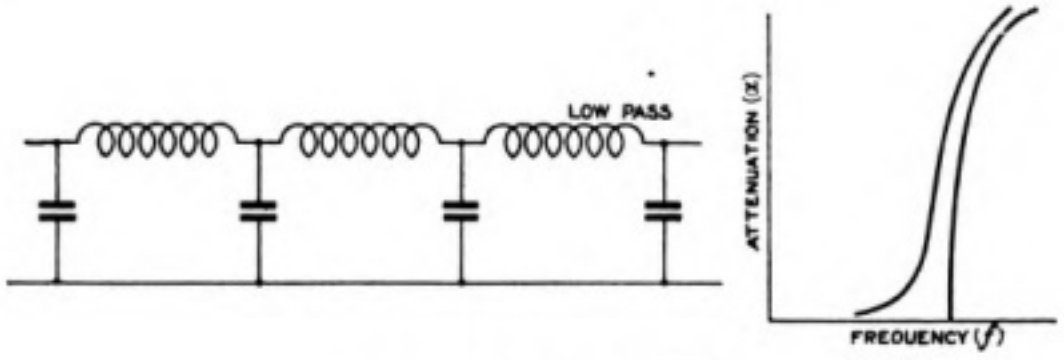


Fig. 3. Campbell's Filter.

$(Q/2\pi - P/2\pi)$, it can be shown that one may be suppressed without serious distortion, so that our filters must then pass a band of frequencies 2,000 per second wide with very small attenuation, and offer a large attenuation to all frequencies

outside this range. Also, the carrier frequency itself can be suppressed if it is supplied again—on the heterodyne principle—by an independent oscillator at the receiving end.

be reflection unless the chain impedance is the same as the line impedance.

So the ideal to be aimed at is to make the two characteristic impedances the same.

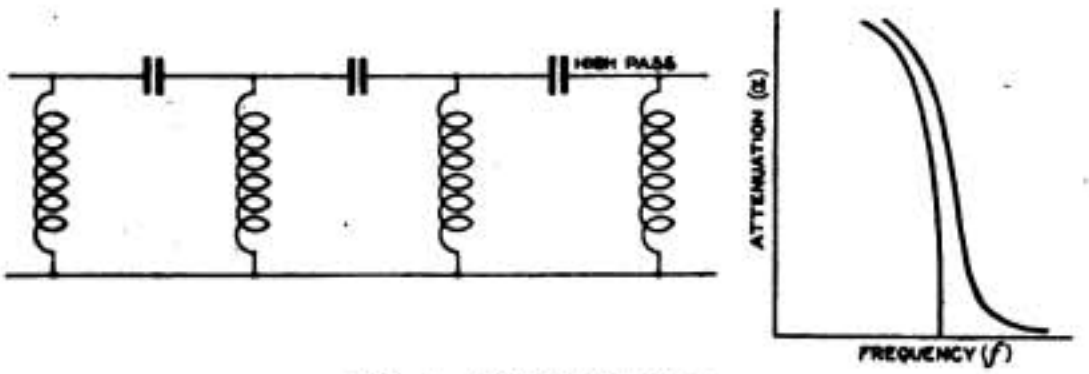


Fig. 4. Campbell's Filter.

Fig. 3 shows a filter chain (due to Campbell) which will pass low frequency currents, and Fig. 4 one that will pass high frequency currents.

So that two such chains in series will give the required characteristic (Fig. 5).

A neater way is due to K. W. Wagner.

This gives a curve similar to the above, and the band can be made the correct width and the actual frequencies desired by suitable choice of the inductances and capacities.

Another chain used in America and also giving a band characteristic is shown in Fig. 6.

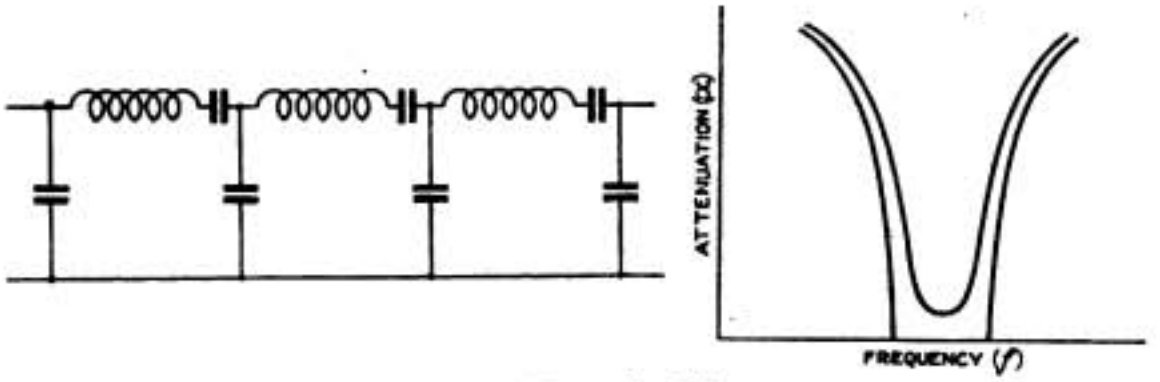


Fig. 5. Wagner's Filter.

The theory of these filters has been very completely given by K. W. Wagner in *Archiv für Elektrotechnik*, Vol. (3), 1915.

He shows that with a chain as in Fig. 7.

where R and G may be complexes representing impedances of any sort, the total attenuation is given by the real part of $n\gamma$ where n is the number of links and $\gamma = \alpha + j\beta$ = the propagation constant per link.

$$\text{Sinh } \tfrac{1}{2}\gamma = \tfrac{1}{2}\sqrt{RG}$$

and the characteristic impedance is given by

$$W = R/2 \tanh \tfrac{1}{2}\gamma$$

If the chain is arranged as in Fig. 8.

the attenuation is the same, but the characteristic impedance is:—

$$W = 2 \tanh \tfrac{1}{2}\gamma/G$$

These are the impedances for infinite chains. If the chain is not infinite we have all the complicated expressions that are obtained in telephone line problems owing to reflections.

When the chain is joined to a line there will

(b) Modulation and Rectification or Demodulation.

The method usually employed for modulation is shown in the previous diagram (Fig. 2). It depends on working the oscillator so that the amplitude of the oscillations is limited by the anode potential, and then modifying this anode potential by means of the speech wave as in Fig. 10.

The Americans in their wired wireless schemes use a different method (Fig. 9). In this country we have developed a valve with a straight characteristic. The coated filament valve of the Americans gives a curved characteristic $-I = \alpha(V + \mu E)^2$ very nearly.

So that if the carrier wave and the speech wave are impressed simultaneously in the grid, the carrier wave is modulated because of the curved characteristic.

A development is the "balanced modulator" which suppresses the carrier wave while passing the side bands. One side band is then cut off by the filter (Fig. 11).

Current only flows to line when the speech currents are present.

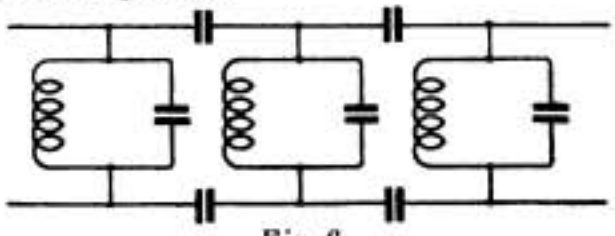


Fig. 6.

Harmonic Generator.

The various channels have carrier waves which are multiples of a fundamental, say, 5,000. In this

way Difference Waves within the speech range are avoided. The main oscillator produces an oscillation of frequency 5,000. This is amplified by another triode, which is overloaded and so produces harmonics. The harmonics are led through suitable circuits, where they are amplified and supply

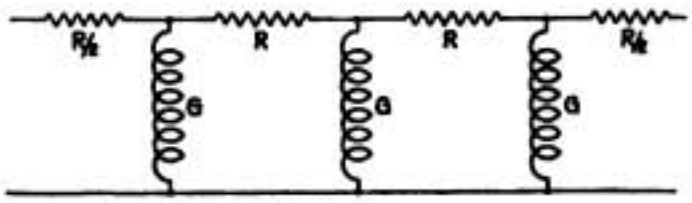


Fig. 7.

the carrier wave. The fundamental is transmitted through the line and at the far station an amplifier in a similar manner supplies the carrier waves which are necessary but have not been transmitted.

The *rectifier* or demodulator also depends upon the curved characteristic of the valve.

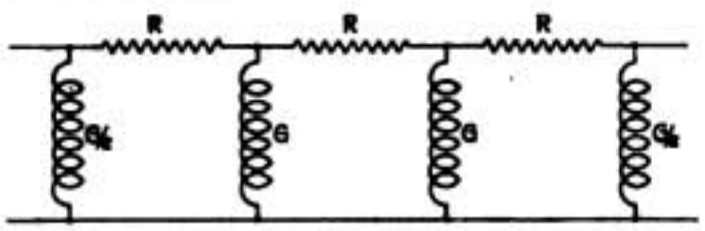


Fig. 8.

It follows from the previous analysis that on the output side of the rectifier we shall have sum and difference waves. The difference are the speech frequency waves that we want, and their amplitude is proportional to the product of the amplitudes of the speech wave, and the carrier wave. Hence that of the latter must be made large, as it can with the locally amplified carrier wave that is used, for efficient working. Another reason for making the carrier wave amplitude large is that there will be present sum and difference waves of the speech waves P_1 P_2 P_3. These will seriously distort speech unless their amplitudes are small compared with the desired waves, and this they will only be if the products $(k_1\ k_2)$ $(k_1\ k_3)$, etc., are small compared with ak_1 ak_2 ak_3, etc.

The speech wave is amplified after rectification.

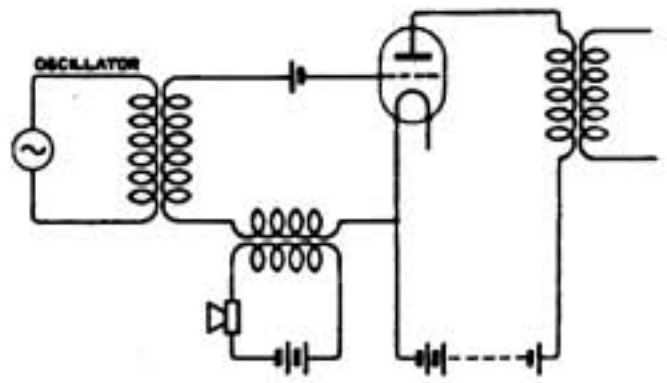


Fig. 9.

(5) The Wire Problems.

In an infinitely long perfectly uinform line, the attenuation is given in the real part α of the expression :—

$$\sqrt{(R + j\omega L)\ (G + j\omega C)}$$

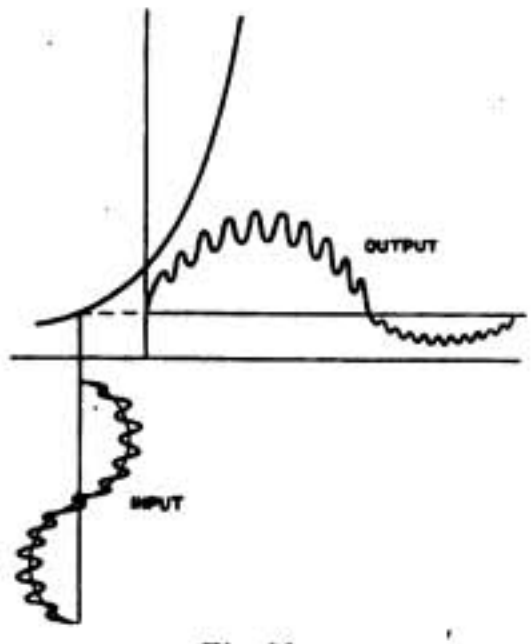


Fig. 10.

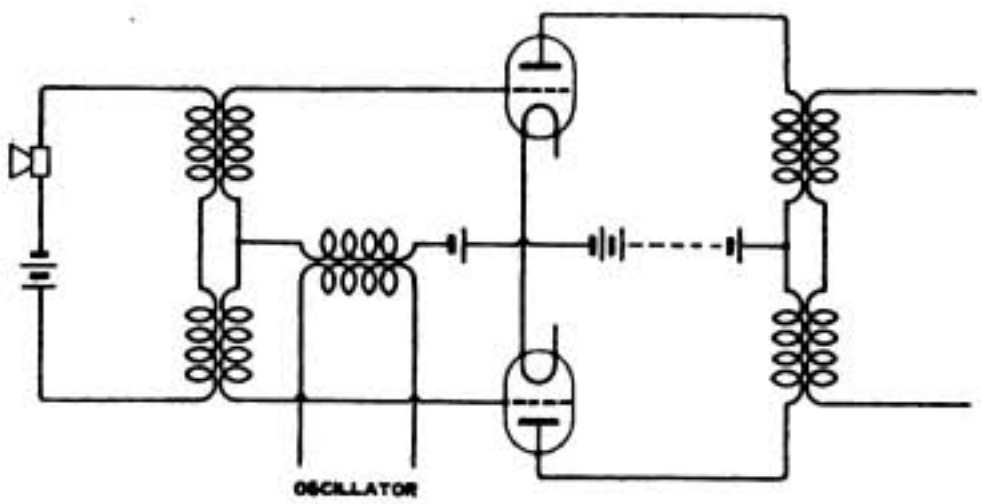


Fig. 11.

L and C are practically the same as at low frequencies, but R is increased by the skin effect and G also is increased with frequency.

A typical attenuation frequency curve would be as shown in Fig. 12.

The impedance of the line is of great importance

as it must be balanced for repeaters to be used. This is given in an infinite uniform line by $\sqrt{R + j\omega L/G + j\omega C} = \sqrt{L/C}$ at the higher frequencies. Thus it could be balanced by a pure resistance.

Actually, however, when the impedance of the

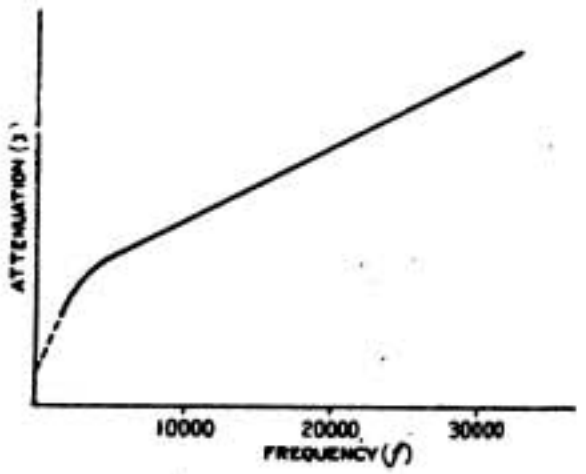


Fig. 12.

line is measured for various frequencies, one usually finds marked humps, caused by reflections from some impedance discontinuity, such as a length of underground cable through a town or across a river.

These must be got rid of as far as possible by suitably loading the cable length or inserting autotransformers at the beginning and end.

Where more than one pair on the same pole route is used for Wired Wireless, troubles from "cross talk" arise. The balancing transpositions for cross talk, which suffice for ordinary telephony are quite inadequate for the higher frequencies of Wired Wireless, and the transpositions must be much more frequent.

The repeaters used are inserted more frequently than the repeaters of ordinary telephony, but in general follow the same lines. To avoid the modulation that would normally occur when all the various frequencies are passed through the one valve, an arrangement of two valves is employed in what the Americans call the "push-pull" scheme. It is similar to that employed to suppress the carrier wave.

The above is only intended as an introductory outline to a large and interesting subject. Fuller details may be found in—

(1) **E. H. Colpitts and C. B. Blackwell** "Carrier Current Telephony and Telegraphy," A.M.I.E.E. (*Journal of the American Institute of Electrical Engineers*, 40, pp. 301-315, April; pp. 410-421, May; and pp. 517-526, June, 1921).

(2) **K. W. Wagner.** Electrotech. Zeitschrift Nos. 32 and 33, 1919 (Wired Wireless).

(3) **K. W. Wagner** (*Archiv für Elektrotechnik* 3, 1915). (Filters.)

The Romance of Wireless Calls

By *Laurence le Brun.*

YOU may ask a hundred wireless men a simple question about wireless calls, and probably not one of them will be able to give you a definite answer. Just ask, "Why is the distinguishing call for Fishguard Wireless Station **GRL**?"

Yet there is a reason, and a little romance is attached to it. Twenty years ago five coast stations were opened in England and Ireland for communication with ships at sea: Crookhaven, co Cork; Rosslare, co. Wexford; Holyhead; Caister, near Yarmouth, and North Foreland. And they were each given call-letters, which told the listener the stations' names. Thus: Crookhaven became **GCK**; Rosslare, **GRL**; Caister, **GCS**, and North Foreland, **GNF**. These abbreviations were very useful at that time; the "G" gave the nationality and the two other letters were taken from the name of the locality of the station. Later, the Rosslare station was dismantled and erected at Fishguard, South Wales, and even to-day, hanging on the dusty file which covers the long-forgotten records of great distances and primitive administration, may be seen typewritten orders bearing the heading "Rosslare Wireless Station."

The pioneer wireless stations in Great Britain were originally allotted "calls," which followed a preconceived plan and told at a glance the name of the station. Poldhu, beloved of the pre-war "listener-in," but to-day almost forgotten and sadly neglected for the greater glories of Annapolis and Long Island, was familiar to all as **MPD**, a call she (wireless stations are human and very feminine) retains even now. In this case, the letter "M" was used to denote "Marconi," the other two, of course, being merely the usual abbreviation of the station's name.

Cookhaven, the station mentioned above as being one of the pioneer British stations, is very silent nowadays. Sometimes, perhaps, if you can get down to 300 metres, on a very good night you may hear Crookhaven. But you will not hear **GCK**. Crookhaven no longer holds her own original call, for an upstart has claimed it and poor old Crookhaven has had **GXO** flung at her, whilst Valentia (the first short wave station the trans-atlantic operator hears as he nears Ireland) flings the time-honoured "call" halfway across the Atlantic. Crookhaven is one of those little low-power stations which did such good work twenty years ago. But wireless has progressed, and low, croaky notes like Crookhaven used to emit have given place to blatant, musical ones. Hence, Crookhaven has had to get off 600 metres altogether, and the five-kilowatt-proud Valentia has taken her place and call. To add insult to injury, in exchange, the authorities who do these things have given her a call-sign **GXO**, which conveys nothing of her past glories and vaguely reminds one of beef-extract.

Only a comparatively small number of calls telling at first glance the name of the ship or station now remain. In the beginning, the ships and stations of Great Britain were distinguished by their calls commencing with one of the letters G, M, or B. Those using the latter letter as initial

were in the first place naval ships and stations. For instance, **BYA** still remains the Admiralty's call, whilst **BYB** and **BYC** (Cleethorpes and Horsea) are quite familiar to every man who dons the telephones with a knowledge of the Morse Code.

It soon became evident that all ships fitted with wireless in the British Mercantile Marine could not be accommodated under three letters commencing with "G" and "M," and eventually the ships of the Navy, having private call-letters as well, discarded their Berne calls. As time went on, other letters were allotted and various combinations constructed. **GNF** is still North Foreland; **GLV**, Liverpool (Seaforth); **GNI**, Niton (I.O.W.); **GMH**, Malin Head; **GLD**, Land's Head; **GCC**, Cullercoats; **GNV**, Newhaven, and **MPD**, Poldhu. Ship stations retain more of the old romantic calls, as **MAA**, "Carmania"; **MRA**, "Caronia"; **MPA**, "Carpathia"; **MDC**, "Cedric"; **MLC**, "Celtic"; **MCL**, "Colonia"; **MCN**, "Corsican"; **MPB**, "Empress of Britain"; **MPJ**, "Empress of Japan"; **MRN**, "Grampian"; **MGN**, "Virginian"; **MSA**, "Saxonia"; **MDN**, "Scandinavian"; **MNN**, "Numidian"; **MTN**, "Tunisian," and perhaps a few others that I have overlooked.

Abroad, the custom of making the "call" similar to the name of the station continues, and in order to do this we find many foreign stations encroaching upon the preserves of other countries. Moscow poaches an "M" from Britain's conservation and says "I am **MSK.**" According to my list of call-letters, **MSK** belongs to a British ship one "City of Vienna," and Moscow has no right at all to use it. Constantinople (Osmanie) appropriates one of Belgium's "**O's**" and disturbs the region of 7,000 metres as **OSM.** Again, the Polish station at Posen until recently used one of Portugal's legal calls and boomed across the North Sea as **PSO.** Now, however, Berne has decided to make all countries toe the line and use only their allotted call-signs. Hence, Posen is familiar to us all as **AXJ.** Petrograd, on 1,600 metres, is really infringing the International Regulations by using **PTG** as a call; this actually belongs to Brazil, whilst the famous Nauen station, **POZ**, has another "appropriated" call belonging rightly, as in the case of Petrograd, to Brazil.

Other countries also have their "romantic" calls. Ostend could not be better designated than by **OST**, and she is quite justified in using it because Belgium's Berne-allotted calls include all those between **ONA** and **OTZ.** **PRG**, Prague, is one of the most striking abbreviations in daily use, whilst **BUC**, Bucharest, is another case in which Britain's conservation has been encroached upon.

The tell-tale type of call is, however, rapidly dying out. So great has become the number of ships fitted with wireless that three-letter call-signs will not be sufficient. To-day Britain has as initial distinguishing letters B's, C's, E's, G's, L's, M's, O's, X's, Y's and Z's, besides a whole list of four-letter calls beginning with the letter "G." America, too, has used up all her three-letter calls, and has quite a formidable list of four-letter ones.

If an operator in a ship with a name something like "War Weezlewood," and a call-sign possibly like **GXYZ**, reads this article, I hope he will forgive me. For there is no call-sign romance for him; I can imagine nothing worse than having a call-sign like that.

An Experimental Station in Yorkshire

THE accompanying photograph shows an experimental station, and is of particular interest as it gives a good method of arrangement. All of the instruments have assumed fixed positions and the wiring up, though accessible, is hidden away, which adds much to the general appearance and facilitates manipulation. It may be argued that the disposition of the instruments

does not lend itself to experimenting, but the advantage of always being able to find a station by recorded adjustments is a distinct feature in these days of interesting telephony transmissions. Moreover, experimental work can be conducted with auxiliary gear, and when a definite improvement is found, it can, after careful trial, be incorporated in the station.

This set consists of a six-valve French amplifier, L1, 1917. The tuner is a Marconi M 12. To the left of the photograph is seen a smaller set which consists of a Mk. I** single valve receiver and transmitter. With this set a C Mk. III amplifier is used, and works very satisfactorily, giving a tuning range of from 80-1,600 metres. The aerial is a twin-wire 70 feet long, and 42 feet high.

The glass case above contains the switches and metres, as well as the aerial and earth switch.

Both signal and telephony are very clear on French amplifier. Croydon and Pulham also the Dutch concert have been heard. Local stations, **2AW, 2KD, 2JP, 2IQ, 2GU** and **2QK** come in very clear and loud, and can be heard with the telephones laid on the table. Ships and other 600 metres stations are received well. W. GILL.

Progressive Amplifier Design*

By W. J. JOUGHIN.

IN this paper it is my endeavour to give a description of the difficulties encountered, and how they were overcome, in an endeavour to build an efficient amplifier.

Having obtained an early pattern de Forest Audion valve, I built it up into a detector panel, using the tuning coils of an early crystal receiver as aerial inductance and reactance. This pattern valve has a grid on each side of the filament, and also a square plate similarly placed.

Being a soft valve it gave much trouble in initial adjustment, and since my knowledge at that time was practically nil, I had to experiment, as it were, in the dark. The circuit was quite normal as can be seen by Fig. 1, using a potentiometer for adjusting the grid potential. Having tried every possible variation in arrangement of coils and L.T. battery, I was unable to produce the least sign of a signal until I made what I then thought was a mistake. Having switched on the filament, I omitted connecting one side of the potentiometer to the filament battery, and immediately heard quite good signals. By substituting a grid condenser, I dispensed with the potentiometer. This type of valve I found extremely sensitive, and after having been accustomed to crystal detectors was a revelation in signal strength. In common with all soft valves, the value of high tension required is extremely critical, the one in question requiring 40-45 volts. I also experienced the unstable working due to the comparatively large quantity of residual gas.

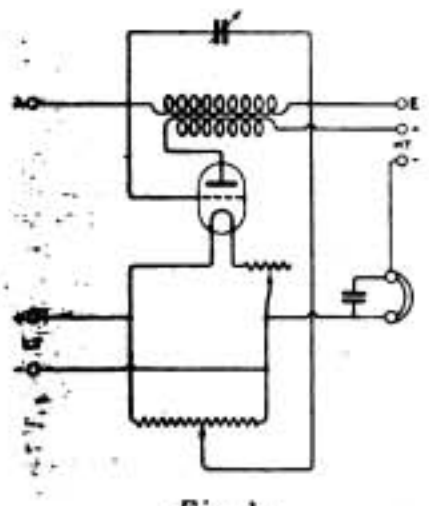


Fig. 1.

Having gained some experience, I then built up a two-valve receiver using an aerial coil of 4½ ins. diameter, 10 ins. long, wound with 26 gauge enamelled wire. The reaction coil was 8 ins. long and 4 ins. in diameter wound with 30-gauge S.C.C. wire, and fixed right inside the aerial coil. Since this was so tight I had to take off several tappings. The amplifier arrangement is shown in Fig. 2, the only item to comment on being a condenser between the intervalve transformer secondary and grid of No. 2 valve, which I found made a slight increase in signal strength. This condenser caused a temporary wipe out of signals when a strong X came along, and by the addition

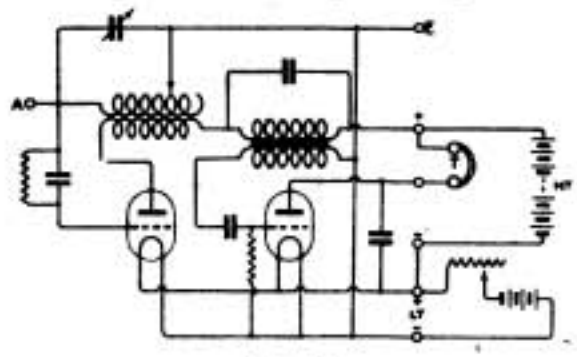


Fig. 2.

of a grid leak I cured the trouble and lost the advantage previously gained. Since the wipe out effect was not very troublesome, I left the condenser in as shown. In operating the set I had as much reaction in as possible. It can be imagined to what extent I was oscillating, since I usually worked just short of the howling point. Fortunately, I was about twenty miles from any other station, so that there were no pertinent questions asked. It should be note , however, that the signal strength was quite good, especially just short of the howling point of L.F. oscillations.

The next venture was, as I subsequently learnt, an impedance amplifier. The lines I worked on, were to see if it were possible to make an amplifier where the variations in plate current could be transferred direct to the next grid. Since the high tension must be kep from the grid, it was necessary to insert a small condenser and then devise some means by which the high tension could reach the plate without the signals leaking away through the same path. This was easily accomplished between the second and third valves (Fig. 3) by using the secondary of an intervalve transformer. When the set was working, I put a pair of telephones across the idle transformer primary and could not hear the strongest of signals, thus showing that I had attained my object.

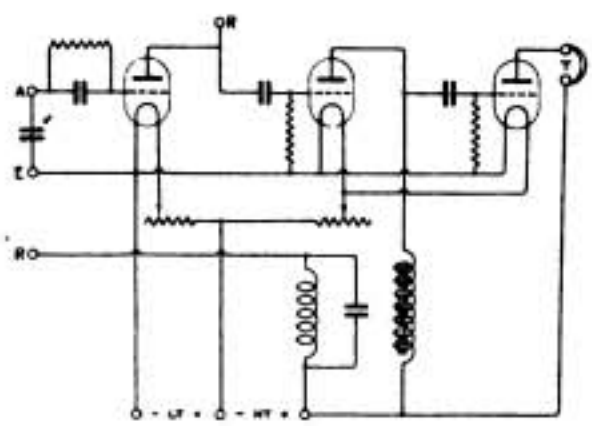


Fig. 3.

* Paper read before the North London Wireless Association.

This effect was what I had set out to obtain, and by using a still higher impedance I was able to increase the signal effect. But turning to the coupling between the first and second valves, I was in a quandary, since my impedance must allow the high frequency component from the reactance to pass, and also the high tension supply, but yet hold back the low frequency signals. For some time I used an inductive air core resistance with a small condenser in parallel. The condenser was sufficient to bypass the H.F. oscillations, the the resistance to pass the high tension, and but to a small extent to retard the signals.

I found it essential, however, to replace this most inefficient arrangement by an intervalve transformer which was but a compromise on what I had originally set out to make.

With the experience gained, together with quite protracted study on the theoretical side of the question, I evolved the following low frequency amplifier of quite normal wiring, but carefully studied accessibility of controls. From Fig. 4 it can be seen that there is a small variable capacity across the reactance, which, in spite of statements made by good authorities to the contrary, is found

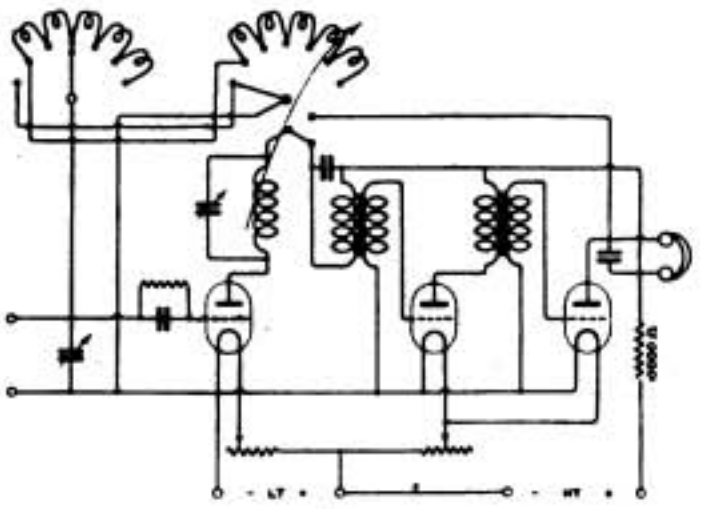


Fig. 4

to be very useful for efficient telephony reception. Those who have tried it will certainly agree that no tuner is complete without it. It will be noticed that the aerial and earth are connected direct to the two switch arms, one switch being for the 400-1,200 metre coil, and the other to the 900-5,000 metre coil. The beginning of each coil is connected to the first stud on other switch. This is a method of using just an extra stud on each switch as a change over from one inductance to the other, and entirely cutting out the one not in use. When using coil No. 1, the switch of No. 2 is put on the first stud. The circuit is then from the aerial terminal to switch arm No. 1, through the amount of inductance being used, to switch arm No. 2, *via* the first stud, and, of course, the same applies when using inductance No. 2 by putting switch No. 1 to the first stud.

For using one or three valves, the plate of the rectifying valve goes to a two-way switch. For single-valve working it connects direct to the plate of No. 3 valve (*i.e.*, telephones) and for three-valve working, it connects to the first intervalve transformer primary. For telephony it may be found better to use a low value grid leak, say ·5 megohms, since the question of grid leak values is so contradictory, I just put forward my suggestion as ground for experiment. Two filament resistances are used, since it is advisable to have full control over the rectifying valve.

To save the danger of shorting the high tension battery when experimenting, it is advisable to put a resistance in the positive lead, of suitable value to the voltage being used. For 100 volts, a resistance of 10,000 ohms non-inductive, is quite suitable.

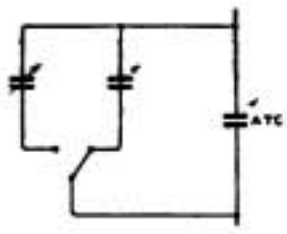


Fig. 5.

Only one reaction coil is used, a pancake coil mounted so that it can be coupled to either of the two inductances, and is found sufficient and quite efficient over the whole range.

Another useful item for telephony reception is the arrangement of two small variable condensers with a two-way switch, in parallel with the tuning condenser (Fig. 5). If two stations are in communication, each is tuned to on one of the small condensers so that when they change over, it is only necessary to move the switch.

Hourly Weather Messages on Civil Air Routes

THE hourly meteorological reports for aviation issued by W/T from the Air Ministry are being sent in the revised code forms adopted by the International Commissions for Weather Telegraphy and for the Application of Meteorology to Aerial Navigation at the meetings held in London in September, 1921. While the new code forms differ from the one formerly in use, the specifications of the code figures remain practically unchanged, the only important alterations being found in the specifications and of speed of low cloud.

Reports are issued daily, Sundays included, according to the following schedule :—

Wavelength.—1680 m.

Nature of transmission.—Continuous Wave.

Call sign.—GFA.

Times of issue. G.M.T.	Times of observations. G.M.T.
0735	0700
0835	0800
0935	0900
1035	1000
1135	1100
1235	1200
1335	1300
1435	1400
1535	1500
1635	1600

After the call sign GFA, comes the word

"METEOR," indicating that a meteorological message is being transmitted. This is followed by one 4-figure group giving the hour (G.M.T.) at which the observations were made. The time group is followed by a series of figure-groups indicating the stations and the meteorological conditions thereat. The group giving the index number of the station consists of 2 figures (3 figures in the case of a station reporting sea visibility); this group is followed by groups of 5 figures giving the meteorological conditions at the stations. The index figures are as follows:—

Index Figures.	Station.
61	Croydon.
62	Biggin Hill.
66	Lympne.
75	Beachy Head.
76	Dungeness.

In the case of Dungeness (76) only one group is sent, including the index figures and the Channel visibility there, while in the case of Lympne the last figure of the first group gives the Channel visibility from Hythe.

The word "BOTLEY," when it occurs in a message, is followed by a statement in plain language of the conditions of the North Downs (Botley Hill) as viewed from Biggin Hill, when such a statement adds material information to that contained in the rest of the message.

At the end of the messages issued at 0835, 1135 and 1435, a short forecast is given in plain language of the meterological changes anticipated in S.E. England in the period of daylight following the time of issue.

This begins with the word "FORECAST."

The complete results of a pilot balloon ascent at Croydon or Lympne, when available, are given at the end of the messages at 0735, 1135 and 1335.

This part of the message is preceded by the index figures of the station and by the four figure index group 49tt—where tt = hour of ascent (G.M.T.).

Reports similar to the above are issued from Le Bourget (ZM), Brussels (HS) and Soesterberg (STB).

In the case of the reports from Brussels and Soesterberg the codes employed are identical with those used in the collective reports for S.E. England.

Synoptic Reports and General Inferences are issued from (*a*) the Air Ministry (GFA) on 1400 metres at 0200, 0600, 0800, 0915, 1400, 1900 and 2000 G.M.T., and (*b*) from Aberdeen (BYD) on 3,300 metres at 0830 G.M.T.

Notes

The Postmaster-General and Broadcasting.

As we close for press, we learn that it is anticipated that an important announcement will be made in the House of Commons on Monday, May 1st, regarding the facilities to be given by the Postmaster-General for wireless telephony broadcasting.

Amateur Wireless in Buenos Aires.

We learn that the Radio Club Argentino is progressing most satisfactorily, there being now well over 100 members. A receiving station and telephone transmitter have been installed in the club house in Buenos Aires. Amateur apparatus is now more easily obtained than in the past.

Association des Ingénieurs (Liége).

We are notified that the celebration of the 75th anniversary of the foundation of the Association des Ingénieurs sortis de l'École de Liége is postponed one week till Sunday, June 18th, on which day the formal opening of the Technical Exhibition will take place. On June 19th, 20th and 21st, Congress meetings will take place, and on June 22nd, 23rd and 24th, excursions will be made to various technical works.

Norway: New Wireless Society formed.

"A society has been formed in Christiania under the name of Norsk Radio-Amatörklub. The membership of the club is very rapidly increasing, showing the great interest taken in radio in Norway, an interest which has been concealed under the Government ban on amateur wireless, but which is now at last coming into its own. Our plan is to collect the necessary number of members, and then make the Government a proposal that amateur work may be permitted under certain conditions. Rules have been worked out by our committee and will accompany our proposal as a base for further considerations from both sides. In this way we hope to get rid of the absurd prohibition of amateur work.

In the meantime we propose to hold lectures and demonstrations, so as to arouse still more interest in this most fascinating science.

We shall be glad to answer questions regarding our club, both from British amateurs and especially from the other Scandinavian countries."

Address of Hon. Secretary: 30, Industrigaten, Christiania.

Wireless Exhibition in Rome.

Arrangements are being made to hold an Exhibition of Wireless Telegraphy shortly in Rome. Eighteen firms will be represented, and different types of instruments, including the latest developments, will be shown working.

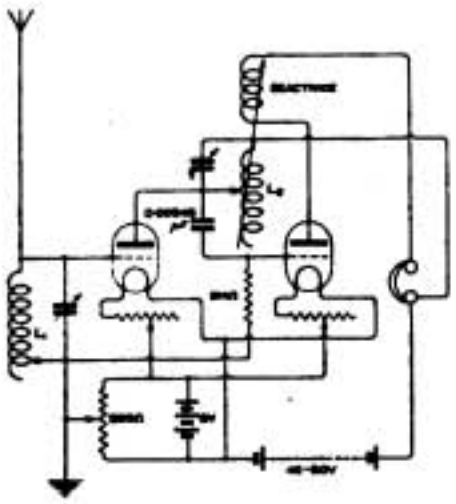
Wireless for Polar Expedition.

Captain Amundsen, of arctic fame, is at present organising an expedition to the North Pole in which aeroplanes will be used to reach points beyond which the mother ship can go. The aeroplanes will be equipped with wireless apparatus capable of maintaining communication with the mother ship, whilst the latter will carry a sufficiently powerful equipment to be in a position to maintain communication with such relaying points as Nome and Alaska.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I and my son have experimented for several years with various receiving circuits and have decided upon a very simple two-valve circuit which gives excellent results on all wavelengths and is extremely efficient for telephony.



It may be necessary to add that tuning coil L2 must of course always synchronise with aerial tuner (single layer coils).

We have endeavoured to make the diagram as clear as possible.

W. SMITH.

P.S.—Using two "R" valves the Dutch concerts are very clear, also Croydon, Fulham aircraft telephony, and Eiffel telephony very loud.

Royal Arcade,
Weymouth.
February 24th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In answer to your note re French Amateur Transmitting Stations of your issue of April 1st, I wish to say that I received **8 AB** (Nice) last night at about 9.15 p.m., B.S.T. His note is rather difficult to read, and appears to be rectified A.C. of about 50 cycles. The signals were of fair strength and quite steady. He asked British amateurs to "tell **2 CV** how they were receiving," but as **2 CV** has not appeared in any of your lists to date I have not his address. I may say I get **2 CV** strongly.

With best wishes for your excellent paper.

G. W. G. BENZIE.

Denmill Cottage, Peterculter,
Aberdeenshire.
April 18th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

EVOLUTION OF WIRELESS

SIR,—I have just been looking up some of your old numbers, and it is highly interesting to note how far we have travelled in wireless during, say, the last two years. It is like a peep into the Dark Ages, and the growing army of amateurs would open their eyes wide to read some of the learned discussions on the science in those days. The infant has certainly grown apace. For instance, in your issue of June 26th, 1920, we read an account of the wonderful installation at the *Daily Mail* office. How it could detect signals so far distant as 3,000 miles! But it appears to have taken an elaborate and costly apparatus to accomplish this wonderful result on fourteen valves! True, it was with a frame aerial, but presumably a very efficient one. To-day, if we amateurs could not get readable American signals on one valve, a P.M.G. aerial and a largely home-made apparatus, we should have serious misgivings about our set. The modern amateur is stepping straight into music from the æther and realises none of our early struggles with crystals, coils, condensers and connections. One thing stands out very clear in reading these early numbers. Many pet theories have gone sky-high, and the amateur has taken a leading part in exploding them.

E. B. GRINDROD.

April 20th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

WIRELESS "DISCOVERIES."

SIR,—All of us interested in wireless research are deeply grateful to the press for its many favours, but when one sees the crass ignorance of wireless displayed by some of our great daily and weekly newspapers one is given to wonder whether a little class of elementary instruction might not be given to the sub-editors of those journals.

The *Daily Mail*, which really ought to know better, when it set up its receiving set and did the "suit-case" stunt, astounded the world that at Carmelite House the Marconi station at Poldhu had actually been heard! I have to think for how many years we old experimenters have heard him, even on an odd piece of wire. "And the Eiffel Tower came in quite clearly," declared the gentleman who wrote the article on wireless. We have had the latter for years on an iron bedstead, an iron fence and on a little bit of wire strung up over the cabbages! When one reads articles on wireless in our daily press—and I place the *Daily Telegraph*, the *Daily News*, the *Daily Chronicle*, the *Evening News* and the *Observer* all in the same pillory—one draws a long breath at the lack of scientific knowledge displayed by those who give us our "news," or feed us upon radio science!

But the latest insult to the public intelligence is in an article, with a big printed diagram, with crystal detector, which I read in the *News of the World* of April 16th, under the title "Kissing by Wireless." The "kiss" from Miss Anderson of Brooklyn, to Mr. Hugo Estburg, chief operator on the liner "America," may or may not have been heard, but I would call the attention of my fellow-wireless experimenters to a singular fact which the *News of the World* states as follows:—

"The President of the United States is singularly fortunate, for his set can take a wavelength

of 25,000 metres, *while the average amateur cannot receive on a wave much longer than 375 metres.* Under ordinary conditions the President can hear not only all the stations in the continental United States, but also those in Hawaii and Panama, although these overseas stations do not send in voice but in the Morse Code. The receiving set is placed in a bookcase near the President's desk, in the White House. A vacuum tube detector and a two-stage amplifier make up the Presidential set. Without doubt wireless telephony has captivated every class in America, and there appears to be no stopping the wave of enthusiasm."

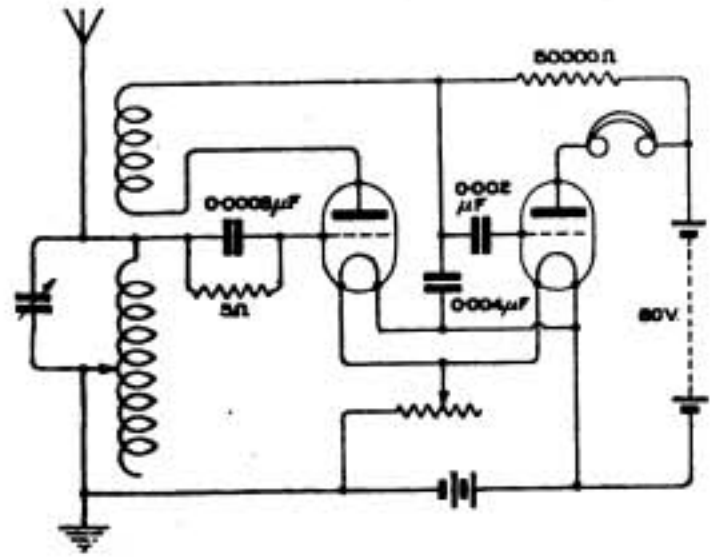
Comment is needless. Perhaps the *Daily Express* may discover I.D.O., or the *News of the World* may tell us all about Nauen. Who knows? We live in an age of discovery!

WILLIAM LE QUEUX.

Devonshire Club, S.W.

Resistance Capacity Amplification

Mr. B. L. Stephenson, author of the paper published in the issues of April 1st and April 8th,



asks us to insert the accompanying diagram as a revision to that published with his paper on page 47 of the issue for April 8th.

Books Received.

THE CONSTRUCTION OF AMATEUR VALVE STATIONS. By Alan Douglas. (London: *The Wireless Press, Ltd.* Crown 8vo. Pp. 78. Figs. 55. Price 1/6 net.)

THE RADIO EXPERIMENTERS' HANDBOOK. By Philip R. Coursey. (London: *The Wireless Press, Ltd.* Pp. 113. Figs. 99. Price 3/6 net.)

PRACTICAL PHYSICS. By W. R. Bower, B.Sc., and J. Satterly, D.Sc. (London: *University Tutorial Press,* Second edition. Price 7/- net).

ELECTRICITY. By Sydney G. Starling. (London: *Longmans, Green & Co.* 1922. Pp. 245. 8½" × 5½". Figs. 127. Price 10/6 net.)

LEXIQUE TECHNIQUE ANGLAIS-FRANÇAIS. By G. Malgorn. (Paris: *Gauthier-Villars et Cie.* 1920. Price 10 francs.)

Calendar of Current Events

Friday, May 5th.

ROYAL SOCIETY OF ARTS.

4.30 *p.m.* — John Street, W.C.2. "Imperial Wireless Communication," by Professor W. H. Eccles, D.Sc., F.R.S.

Saturday, May 6th.

LUTON WIRELESS SOCIETY.

Exhibition.

Tuesday, May 9th.

TRANSMISSION OF TELEPHONY at 7 *to* 7.25 *p.m.* on 700 metres, followed by C.W. Calibration Signals on 1,000 metres, by **2 MT** from Writtle, near Chelmsford.

Thursday, May 11th.

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Demonstration of Recording, by Mr. W. A. Brooke.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Transformer Coupled H.F. Amplification," by Mr. Edward McT. Reece.

RADIO EXPERIMENTAL ASSOCIATION (NOTTINGHAM AND DISTRICT).

7.30 *p.m.*—At the Mechanics' Hall (Room 71). Lantern Lecture, "Wireless During the War" by Mr. Carpenter.

Friday, May 12th.

PHYSICAL SOCIETY.

5 *p.m.*—At the Imperial College of Science, South Kensington. "Experiments with Neon Gas Filled Lamps," demonstration by Mr. S. O. Pearson, B.Sc., and Mr. H. Anson.

WIRELESS SOCIETY OF HIGHGATE.

"The Action o the Valve in the Light of the Electron Theory," by Mr. D. H. Eade.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

"The Principles of Tuning," by Mr. H. F. Yardley.

Saturday, May 13th.

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

Afternoon.—Visit to Victoria Telephone Exchange.

Wednesday, May 17th.

NORTH MIDDLESEX WIRELESS CLUB.

8.30 *p.m.*—At Shaftesbury Hall, Bowes Park, "The Advantages of Sectional Wireless," by Mr. Edward McT. Reece.

Thursday, May 18th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "Electricity and Matter," by Prof. Sir Ernest Rutherford, K.B.E., F.R.S.

Friday, May 19th.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—"Valve Characteristics and the Practical Measurement of Valve Constants," by Mr. L. Grinstead.

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

7 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "The Elimination of Atmospherics in Radio Telegraphy," by Mr. A. H. Reeves.

Wireless Club Reports

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

The Wireless Society of London.

The Forty-seventh Ordinary General Meeting was held on Wednesday, April 26th, at the Institution of Electrical Engineers, at 6 p.m.

After the minutes of the previous meeting had been approved and signed, the **President** called upon Captain H. de A. Donisthorpe to open a discussion on the "Circuits of the Four-Electrode Valve." (For Report see next issue.)

At the close of the discussion the **President** announced that the following had been duly elected to membership of the Society: Rev. John Whately Pyddoke, Major J. J. F. O'Shaughnessy, H. A. Thomas, B.Sc., L. J. Hughes; and that the following Societies were accepted for affiliation: Dick Kerr Wireless Society, Preston; Nottingham and District Radio Experimental Association.

The meeting adjourned at 7.35 p.m.

North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 89th meeting of the Club was held at Headquarters on Wednesday, April 19th. There was a good attendance, and after the minutes had been read, the Chairman, Mr. G. Evans, called on Mr. R. Maxwell Savage, B.A., to lecture on "Electro-Chemistry."

Mr. R. Maxwell Savage commenced by relating how the early philosophers speculated on the constitution of matter, but beyond arguing about the subject, they made little progress. Later, Volta made some discoveries, and he and others experimented by passing currents through liquids, and noted some surprising results. Mr. Savage then described some of these effects, and illustrated them by some experiments. He described the latest theories on the composition of matter and the nature of the atom, explaining how the atom was composed of a nucleus surrounded by electrons. He told his audience that these electrons were, in fact, particles of electricity, and explained how, when some compounds were dissolved in certain liquids, they were broken up into two or more parts, and how the passing of a current caused the split components to behave in accordance with certain laws, and made possible the process of electro-plating.

The lecturer performed a number of experiments to illustrate his remarks, showing how different an element was from the ions to which it gave rise. A silver coin, immersed in a solution of elementary sulphur, was unattacked, whereas sulphur in the ionic state at once caused brown stains to appear.

Several members had questions to ask, which Mr. Savage answered, and a discussion ensued, largely centring round atoms and their nature. The lecturer explained how scientists calculated the mass of the atom, and dealt briefly with what is known as Mendeleeff's Periodic Table. A vote of thanks was moved from the Chair and seconded by Mr. Symons, and was carried with enthusiasm.

Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the Club Room at 7.45 p.m. on April 21st, Mr. W. C. Ramshaw in the Chair. Following the business of the meeting a very interesting lecture on "Aircraft and Wireless" was given by Mr. M. Eskdale, one of our most enthusiastic members. The lecture had special reference to D.F. work, which was very lucidly explained and illustrated by means of diagrams and lantern slides, which were loaned for the occasion by Messrs. Marconi's Wireless Telegraph Co., Ltd. The lecture was very much enjoyed by all present, and a hearty vote of thanks was accorded to Mr. Eskdale.

Birmingham Experimental Wireless Club.*

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

At a meeting held at Digbeth Institute on Friday, March 31st, an extremely interesting lecture was given by Mr. A. C. Chatwin on "Wireless in the Tropics."

Mr. Chatwin described certain different types of transmitting and receiving apparatus used in the Army and very ably enumerated their advantages for different purposes. He then described the joys of a voyage to East Africa in war-time, and told of the troubles and dangers which beset the British forces in that country during 1916 and after. Some interesting photographs were passed round, which illustrated the lecturer's remarks, and showed the types of apparatus used in the East for radio-communication.

The systems of wireless communication used by the troops in Mesopotamia and India were then described, with special reference to the geographical and geological conditions existing in these countries, and their bearing on radio-work.

The lecture was full of interesting anecdotes, and was much enjoyed.

The President (Mr. A. L. Lancaster) proposed a vote of thanks to Mr. Chatwin, which was carried unanimously.

Manchester Wireless Society.*

March 23rd. The last meeting of the winter session 1921-22 was held at The Albion Hotel, Piccadilly, Manchester, at 7.30 p.m. Mr. McKernan in the Chair.

Capt. Hollingworth (President) gave a very interesting and instructive lecture on the troubles experienced in wireless research. In introducing the subject, he confessed that what he had to say would be on the lines of unrestricted pessimism, and certainly the remarks that followed were enough to frighten the timid amateur when he realised that such pitfalls and stumbling-blocks were awaiting him in the course of his future experiments. Full of useful hints and surprising facts about the reception of wireless messages, the lecture proved very beneficial to those present, both amateur and advanced student.

A hearty vote of thanks was proposed by Mr. Evans and seconded by Mr. Reid. The members showing their appreciation with generous applause. The Chairman then declared the meeting closed.

April 3rd. A general meeting was held at Headquarters at 7.30 p.m., Mr. McKernan in the Chair.

The Hon. Secretary read the correspondence which had passed between the Society and the Postmaster-General, with regard to the issue of a special licence for the use of 1,000 watts transmitting power.

The application was made in January with a view to attempting a transmission across the Atlantic in March or April, but owing to the difficulty experienced by the Post Office authorities in obtaining the assent of other Government Departments, the reply had been delayed, so that it was now proposed to carry out the test as early as possible, as far as the erection of the station was concerned.

It is hoped that the station will be working by the end of May, and although atmospheric conditions will be much more unsuitable at that time of the year, the test will be made as arranged.

Further particulars will be issued later.

The meeting passed a resolution, authorising the opening of a subscription list, to which members were asked to contribute, in order to raise a fund to cover the expenses of the projected scheme.

A Committee was elected for the purpose of working out the approximate cost of the undertaking.

A working Committee of twelve members was also formed to deal with the constructional details.

The meeting was then declared closed.

All wireless enthusiasts and Societies interested in the proposed test, are invited to write to the Hon. Secretary, who will be pleased to answer any questions, approved of by the Committee.

A date will be announced, on which the station will be open to the public and a general invitation will be issued to the wireless fraternity.

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

April 19th. The Working Committee, who are concerned with the erection of the high power station of the Society, paid a visit to the proposed site at Baguley, near Manchester, and after a thorough inspection they decided that with the permission of the local authorities and the Altrincham Electrical Department, the spot was ideal for the occasion.

Accordingly arrangements were made for the necessary interviews to be applied for, and all accessories to meet the requirements of the site were carefully tabulated.

A list of the gentlemen and members who will be responsible for the final details will be made known in the course of the next few days.

Brighton Radio Society.*

At a meeting of the above Society, held at its Headquarters in Buckingham Road, on April 6th, an instructive lecture upon the construction of aerials was delivered by the President of the Society, Mr. W. E. Dingle, who described the various types of aerials in use in this country and on the continent. The lecturer furnished useful data for the information of members about to install wireless sets, stress being laid upon the importance of insulation throughout.

Lectures by prominent gentlemen have been arranged for forthcoming meetings whereby valuable assistance will be rendered to experimenters carrying out work during the present year.

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

Plymouth Wireless and Scientific Society.*

At the meeting held on Wednesday, April 12th, a lecture was given by Mr. L. J. Voss on "The World's High Power Wireless Stations." Starting with a description of the earliest equipment at Poldhu, the lecturer led us through the various developments of the spark system right up to the present timed-spark C.W. system installed at Carnarvon. The various C.W. systems were then dealt with, the Poulsen Arc, the H.F. alternator and the valve transmitter, including the latest mammoth valve set at Carnarvon, whose signals can be heard well in Australia. The recently opened New York Central Station and its remarkable aerial equipment were ably explained. Altogether the lecturer was a great success, being at the same time intensely interesting and highly instructive.

Full particulars of the Society may be obtained from the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

Wireless and Experimental Association.*

The last meeting of the Association was held on April 19th at the Central Hall, Peckham. In the absence of the Secretary, an Assistant Secretary was appointed to take over the duties. A most interesting discussion took place on several points in transmitter working with choke control modulation, especially as to the precise junction of the choke.

Until further notice, all enquiries and communications should be addressed to Assistant Secretary, Mr. W. J. Joughin, 21, Troughton Road, Charlton, S.E.7.

The Willesden Wireless Society.*

The Society met on April 11th to hear Mr. C. Dunham lecture upon the "Design of High Frequency Transformers," and, as Mr. Dunham deals with this system of reception in his daily work, some very useful and interesting hints were obtained. Mr. W. Corsham announced a rather remarkable transmission feat by his station, **2 UV**, in a test with Mr. R. D. Spence, of Huntley, Aberdeen. **2 UV**, using tonic train with only 0·09 in the aerial, was read by Mr. Spence, and this reflects great credit upon Mr. Spence's reception system.

The meeting on the 17th of April was opened by Mr. Corsham, the subject being "Low Frequency Reception," and a very interesting debate was the result, some members being for and some against, and the meeting closed with a vote of thanks to Mr. Corsham for opening the debate.

Assistant Hon. Secretary, Mr. W. E. E. Corsham, 104, Harlesden Gardens, London, N.W.10.

Radio Experimental Association (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A meeting of the above Association was held on Thursday, April 20th, at the Mechanics' Hall.

Mr. R. Pritchett, B.Sc., delivered a most interesting lecture entitled "Theory of the Valve." The lecturer, who treated the subject from a scientific

point of view, illustrated his lecture by means of characteristic curves and also lucidly explained the method of plotting various curves. Mr. Pritchett's effort to expound a truly difficult subject was greatly appreciated by those present. Later in the evening an amusing extract from an old copy of *The Wireless World* was read by Mr. Carpenter, whose remarks about the construction of valves, their uses, methods of testing same, and general hints on how to manage them caused great amusement.

The Hon. Secretary will be pleased to afford information re membership, etc., to those interested.

Croydon Wireless and Physical Society.

Hon. Secretary, Mr. B. Clapp, "Meadmoor," Brighton Road, Purley.

At a meeting of the Croydon Wireless and Physical Society, held at the Central Polytechnic, Croydon, on Saturday, April 1st, 1922, a most interesting lecture was given by Mr. B. Hesketh on "Various Methods of High Frequency Amplification." The lecture was accompanied by some very interesting experiments with a three valve set, using as the H.F. coupling, Reactance Capacity. Mr. Hesketh explained and demonstrated the great flexibility of this method over other methods.

At the lecturer's request, the lecture was freely interspersed with questions from the members.

A very hearty vote of thanks to Mr. Hesketh terminated a very enjoyable evening.

The Southend and District Wireless Club.

On March 24th a General Meeting was held at the Science Laboratory of the Technical Institute, Southend-on-Sea, when one of our Hon. Presidents, Mr. Finn, M.Sc., etc., gave a lecture and practical demonstration on X-rays and other interesting electrical experiments.

Spark effects in vacua at varying degrees of exhaustion were very fine, as also the floating ring experiment, etc.

Members were interested in an electrolytic rectifier for A.C., which was used in circuit with the induction coil for the X-ray experiments.

The following meeting was held at Club Headquarters, Argyle Institute, Westcliffe-on-Sea, on March 31st. Mr. Plaistowe took the chair, and after the reading of the minutes, called on Mr. Meyer to lecture on "Transmission and Reception of Short Waves."

After an extremely interesting discourse, a vote of thanks was accorded, and then a general discussion on the subject of the lecture took place and questions were answered by the lecturer.

Mr. Knipe then gave us a few practical hints on engraving of receiver panels, etc., which proved of interest to members.

On April 7th, at Headquarters, a lantern lecture was given, the subject being "Commercial Stations —Transmitting and Receiving."

Through the courtesy of Messrs. The Marconi Scientific Instrument Company, some very good slides were projected. Following this a buzzer practice for high speed readers took place, and then, after a general discussion, the meeting closed at 10 p.m.

We propose to meet fortnightly in future at the Club Room and on alternate weeks to hold field days, when apparata will be taken into the surrounding country.

Several members hold transmitting licences, so that there is always something worth listening to, especially on short waves.

Prospective members are invited to call at 300, London Road, Southend, or preferably, attend any general meeting.

Walthamstow Amateur Radio Club.

Meetings are held weekly on Wednesdays at the Y.M.C.A., Church Hill, at 7.30 p.m.

The meeting of April 19th was devoted to practical tests and experiments with members' apparatus and some very good results were obtained. Mr. Chas. C. Biggs has kindly offered to make and present to the Club an additional amplifier, an offer which is much appreciated.

It is regretted that owing to business obligations, Mr. K. Hardie has had to resign the secretaryship of the Club and Mr. Allan, of 23, Ardleigh Road, has been elected to fill the vacancy.

The Club does not adopt a standard too high for beginners, and those in the district who are desirous of taking up wireless may derive much help by becoming members. On the other hand, experts will find the meetings interesting, as the results of the practical experimenter, however elementary, are, as everyone knows, frequently full of brilliant, though sometimes revolutionary, ideas.

Falkirk and District Radio Society.

A meeting of those interested in wireless telegraphy was held in the Old High School, Falkirk, on Monday, 20th March, for the purpose of considering the formation of a Society. Mr. W. Milne presided and there was a large attendance. It was unanimously agreed to form a Society—to be known as the Falkirk and District Radio Society, and that endeavours be made to procure suitable rooms for the erection of an aerial, subject to the necessary licence being forthcoming. The following office-bearers were appointed: President, Mr. J. R. Laird; Vice-President, Mr. G. Walker; Secretary and Treasurer, Mr. M. B. Blackadder; Committee, Messrs. McFarlane, Grindlay, Milne and Collumbine. The Secretary's address is Glenmorag, Falkirk, and he will be pleased to hear from any intending members.

Leamington Spa and Warwick.

Mr. Frank Sleath will hold a meeting at his private address, 31, Archery Road, Leamington Spa, at 7 p.m., on Tuesday, May 9th, to discuss the possibilities of forming a local wireless society. It is hoped to start the proceedings by listening in to the Marconi concert. Will all persons interested please attend.

Section de T.S.F. du Club d'Aviation de Valenciennes (Nord).

The Aviation Club of Valenciennes has created a special section for the study of radio-telegraphy and telephony and meetings will be held weekly at the Lecture Hall of the Institution of Civil Engineers.

President, Monsieur G. Flayelle, 36, Rue de Mons, Valenciennes, France.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) Four questions is the maximum which will be accepted at a time.*

"S.R." (Darlington) *sends sketch of receiver and asks (1) For criticism. (2) Value for grid condenser. (3) Value of grid lead. (4) Wavelength range.*

(1) The circuit is not very good. The condenser C would be much better across the grid coil than across the plate. With a telephone transformer the telephones should be on the positive side of the H.T. battery.

(2) The value is not critical; it depends somewhat on the wavelength, increasing with increase of wavelength. For your set 0·0003 mfd. should be about right.

(3) About 3 megohms.

(4) Probably about 4,000 metres.

"A.W." (Harrogate).—(1) It is impossible to specify the windings for a set if you state neither the type of set nor the wavelength range required. However, if you propose to make a crystal set, put the larger coil, wound with No. 22, in your aerial and wind the other coil with No. 26 for the closed circuit.

(2) No. 25 S.S.C. will give you 105 turns to 2¼".

"D.H.C." (Haileybury) *submits a diagram of a receiever and asks (1) For criticism. (2) Why the set will not oscillate. (3) For information about H.F. transformers. (4) If red-leaded joints in an iron water-pipe would make it useless for an earth.*

(1) The circuit is quite good, except that we should prefer two tuning circuits, which would minimise reradiation. Your telephones should be shunted by a condenser, the absence of which probably explains failure to oscillate.

(2) This may also be due to too small a reaction coil, dampness of the coils, poorness of material in the formers.

(3) Turn about 8 grooves an eighth inch deep in a piece of ebonite 1" in diameter. Wind each groove with No. 44 wire all in the same direction and connect alternate sections into the grid and plate circuits. Adjust the amount of wire until the best results are obtained for the desired wavelength.

(4) No. The conductivity of the water and the capacity across the joints will probably prevent this.

"OC.S." (Horsham) *asks (1) The gauge of two samples of wire. (2) Whether they will be satisfactory for the high resistance winding of a telephone transformer.*

(1) The silk covered wire is No. 40 and the enamelled wire is the same.

(2) These wires are hardly thin enough for the purpose; but might be used if you wound on about 8,000 turns for the H.R. winding.

"A.L.C." (Bedford) *asks (1) How to make the simplest and most efficient inter-valve transformer. (2) Whether it is satisfactory to use H.R. telephones with a two-valve set.*

(1) The simplest method is to make a L.F. transformer, for which see reply to **"H.C." (Brighouse)**, recently. A more efficient method for a reasonable range of wavelengths is to use a H.F. transformer, a description of which will be found on pages 780 and 781, March 18th issue.

(2) This is quite possible, but L.T. telephones with a transformer are preferable in this case.

"L.P." (Thorpe Bay) *asks (1) For windings for a H.F. transformer for 1,000 metres. (2) Ditto for 700 metres. (3) Criticism of a two-valve circuit.*

(1) See pages 780 and 781, March 18th.

(2) As above, but reducing the wire until the desired value is obtained, or increasing the thickness of paper used to separate the windings.

(3) The circuit is correct, but we should recommend applying the grid potential to both valves. Separate filament resistances are not necessary if the valves are of the same type. A two-tuned circuit would be much more selective unless liable to give radiation trouble.

"STUMPED" (Witham) *asks for windings for a microphone transformer for use with an iron core 3½" long.*

We cannot give the windings exactly without knowing the resistance of the microphone to be used, which may be anywhere between 1 ohm and 100 ohms. The primary winding should be about the same resistance as the microphone. This resistance should be measured. If you find it very low, wind with about No. 26; if fairly high, about No. 32. The secondary winding should be of No. 44, and will probably require about 3 ozs. The core should not be less than ½" in diameter.

"R.W." (Nottingham) *asks (1) Whether a detector can be made from Rochelle salts. (2) Windings for a telephone transformer. (3) If a 2 mfd. condenser can be used with a variable condenser to increase the wavelength. (4) Material required for the manufacture of a grid condenser and leak.*

(1) We have no experience of the rectifying power of this substance. You might try and see.

(2) A telephone transformer is seldom efficient with H.R. telephones, but you should get fairly good results if you use a closed iron core with about 4 ozs. of No. 44 on each winding.

(3) No; capacity is much too big.

(4) Mica, tinfoil, a piece of slate, a lead pencil and a few terminals.

"E.B.C." (Birmingham) *submits a diagram and asks why he is unable to receive signals.*

The diagram shown should be quite satisfactory. We are unable to say why it will not work, except that there should be a condenser across the telephones. Possibly the reaction coil is reversed, the grid condenser or leak faulty or the valve defective.

"W.A.S." (Kilburn) *asks for a good four-valve circuit to comply with certain requirements.*

It is not efficient to spend a lot of money on a number of valves and at the same time to be content with the poor results which are unobtainable from a single circuit tuner. A good all-round set for use of wavelengths of above 700 metres is shown in the diagram (Fig. 1).

"S.B." (Blackburn) *asks for details of parts of a circuit sketched.*

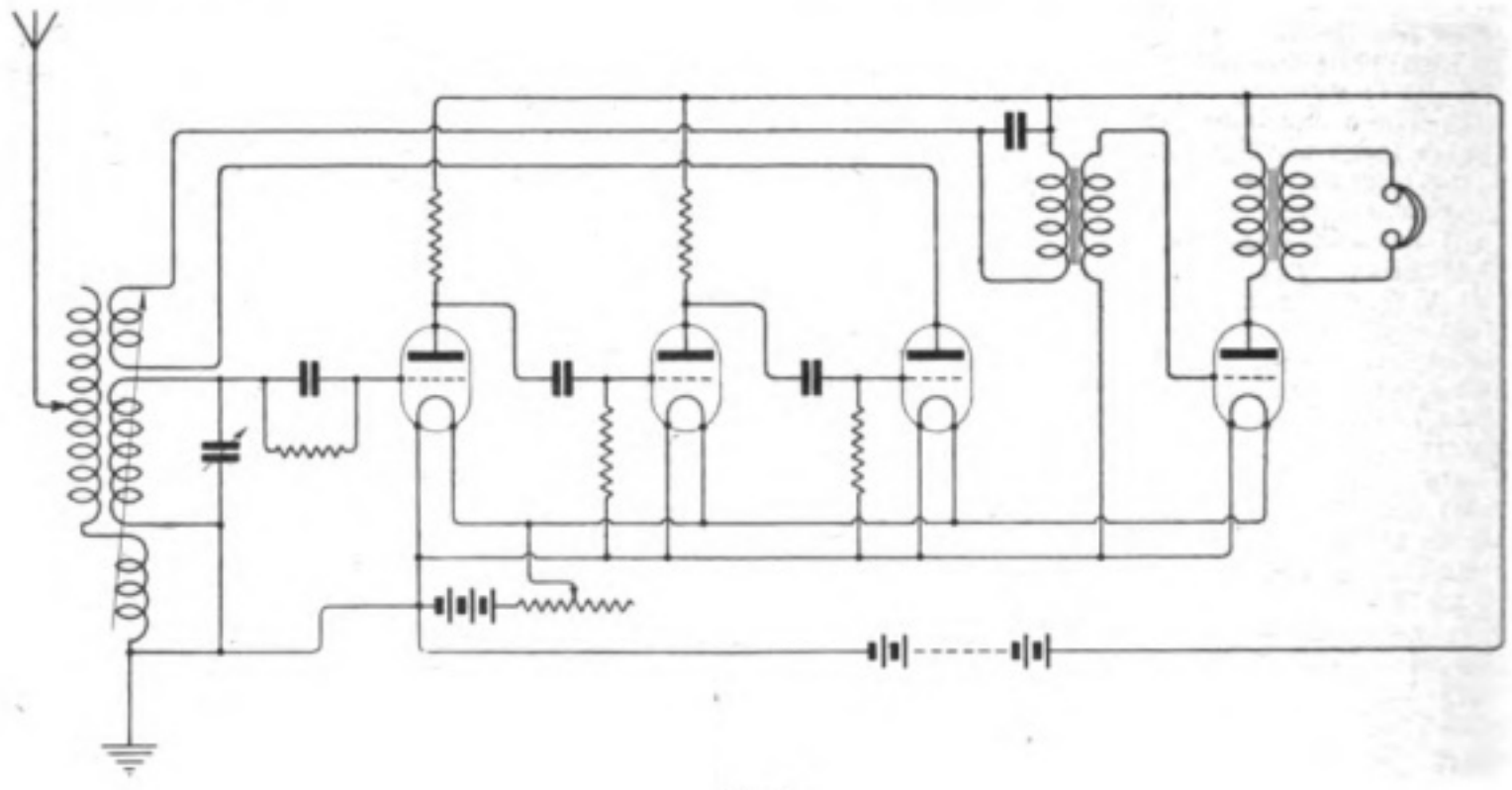


Fig. 1.

Coils S and T would depend on the wavelength required. Up to 5,000 metres S might be 8" × 5" of No. 26; T 5" × 3" of No. 30, with a few tappings. Anode resistances, 50,000 ohms; grid leaks about 2 megohms; telephones, 8,000 ohms or preferably 120 ohms with a transformer. Condenser P, 0·0008 mfd.; H.T. battery 80 volts, L.T. 6 volts; grid leak may be made by rubbing down pencil lead into a piece of slate, but on the whole it is better to buy one.

"C.A.C." (Hampstead) *submits a circuit and asks* (1) *Wavelength of the A.T.I.* (2) *If the reaction coil should have tappings.* (3) *If he should get* **PCGG.** (4) *If there is a Wireless Society in Hampstead.*

(1) Coils do not have wavelengths for any useful purpose. Inductance is about 30,000 mhys., which with a 0·001 mfd. condenser should tune to about 9,000 metres.

(2) Yes, about half-a-dozen, preferably with dead-end switches.

(3) This can be done with a set of this type, but you may have difficulty with coils for such long wavelengths.

(4) No.

"J.D.D.P." (Whitchurch) *asks* (1) *If an aerial 25′ high in a valley would give signals on a simple crystal set.* (2) *If the horizontal wire can be connected with downlead by twisting only, without soldering.* (3) *What is meant by screening.*

(1) Results will probably be rather poor.

(2) This is undesirable, as a twisted joint may work loose.

(3) The surrounding of part, or all, of the circuits with earthed metal sheets, generally for the purpose of reducing induction effects, or the absorption of signals in near-by conductors.

"G.A.W." (Stratford) *asks* re *the valve and crystal set of issue No.* 2, *Vol.* 8 (1) *If the set will receive telephony and* **PCGG.** (2) *If not, for additions necessary to do so.* (3) *If* 20′ *is high enough for the aerial.*

(1) The sets should receive telephony, including **PCGG**, if skilfully used.

(2) An additional note magnifying valve would improve results.

(3) Yes, for fair results, but a greater height is desirable.

"R.H.P." (King's Norton) *has a set which gives trouble with the carrier wave when receiving telephony, and asks* (1) *If a grid condenser and leak will improve matters.* (2) *What other addition to the circuit would help with the carrier wave.* (3) *Describes very poor results with* **2MT** *on February* 14*th, and asks if he can reasonably expect to get these concerts.* (4) *For any general advice on telephony reception.*

(1) No.

(2 and 4) Results probably due to too tight

reaction coupling. Also a condenser across the telephone transformer primary would probably help; capacity 0·001 mfd. The great point in receiving telephony is to use only sufficient reaction to approach the oscillating point without actually making the set oscillate.

(3) We believe that the modulation of **2MT's** transmission was very poor at about that date. It has since been considerably improved and you should now have no difficulty in getting the concert.

"D.G.L." (Southborough) *asks* (1) *Which of two circuits is the better for telephony.* (2) *Particulars of A.T.I. to tune* 5,000 *metres with a* 0·002 *mfd. variable condenser.* (3) *If this set will receive* PCGG *on a* 5′ *square frame mounted at about* 30′ *high.*

(1) Fig. 3, page 674, is somewhat the better.

(2) About 8″ × 5″ of No. 26.

(3) It might do so with careful handling. Very little is gained by raising the frame 30′ above the ground.

"E.A.F." (Stepney) *asks* re *the Marconi Type* 31*A Receiver* (1) *Wavelength range for each position of the jigger switch.* (2) *Whether single or balanced crystals have special advantages for certain wavelengths.* (3) *When to use E* 1 *instead of E, and why.* (4) *How to tell when the crystals are in a sensitive state.*

(1) Range 1 tunes to about 650 metres, range 2 to about 1,450 metres, range 3 about 3,000 metres.

(2) No. Balanced crystal working is useful when atmospherics are bad.

(3) Use E1 on very short wavelengths, as doing so introduces a small series condenser into the aerial circuit.

(4) Most easily by buzzing the aerial, and adjusting on these buzzer signals.

"S.O.S." (Birmingham) *wishes to add a valve to a Mk. III tuner, and asks for advice.*

This tuner was designed for short wave work and the addition of a valve will not greatly increase its efficiency. The valve can be used as a detector in place of the crystal by connecting the valve terminals to the grid and filament. It would be more useful, however, as an L.F. amplifier with the telephone terminals connected *via* a step-up transformer to the grid and filament of the valve. The addition of a loading coil will not allow the Dutch concert to be received. For an article on the conversion of this tuner, see March 5th and 19th, 1921, but it would probably be better to dismantle the set and use the parts.

"SHORT WAVE" (Devon) *asks* (1) *If permission is necessary to change from an outside to an indoor aerial.* (2) *Particulars of an indoor aerial.* (3) *If American amateurs are still transmitting on short wavelengths.* (4) *If it is possible to receive them with two valves.*

(1) Notification of any proposed change of this nature should be given to the P.M.G.

(2) Hang up several wires parallel to each other as long as possible and spaced a few feet apart. Connect them in parallel. Do not wind to and fro. We do not recommend this type of aerial.

(3) Normal transmission is going on on various short wavelengths, but no special attempt is being made to transmit across the Atlantic.

(4) No, highly improbable.

"A.J.C." (Crouch End) *asks* (1) *How to add a valve to an existing crystal set.* (2) *Which is the better use for a valve as amplifier or detector.*

(1) Connect the grid and negative side of the filament to the existing telephone terminals and connect the telephones in the plate circuit between the negative H.T. and the L.T. battery.

(2) If you have an efficient crystal set the valve will give best results as an H.F. amplifier.

"D.J.M." (Thornton Heath) *asks if a wire like the sample submitted could be used for telephone transformer for the frame aerial set of Vol.* 8.

The wire is No. 38 S.C.C. It could be used for the primary winding, but it is too fine for the telephone winding. For the primary wind on 10,000 turns.

"S.R." (Barcelona) *asks* (1) *Why a certain valve L.F. set does not magnify very well.* (2) *For the wave range of a basket coil tuner.*

(1) This set should certainly give more amplification than twice. Possibly the filament battery is reversed, or there is a disconnection in one of the windings.

(2) We cannot give you much assistance about this tuner as you do not state the size of the coils or the capacity of the condenser. However, thirty coils in the aerial will probably want more than three coils in the reaction. It is quite possible that the last few coils do not make much difference to the wavelength, so that the same stations will be heard on all of them.

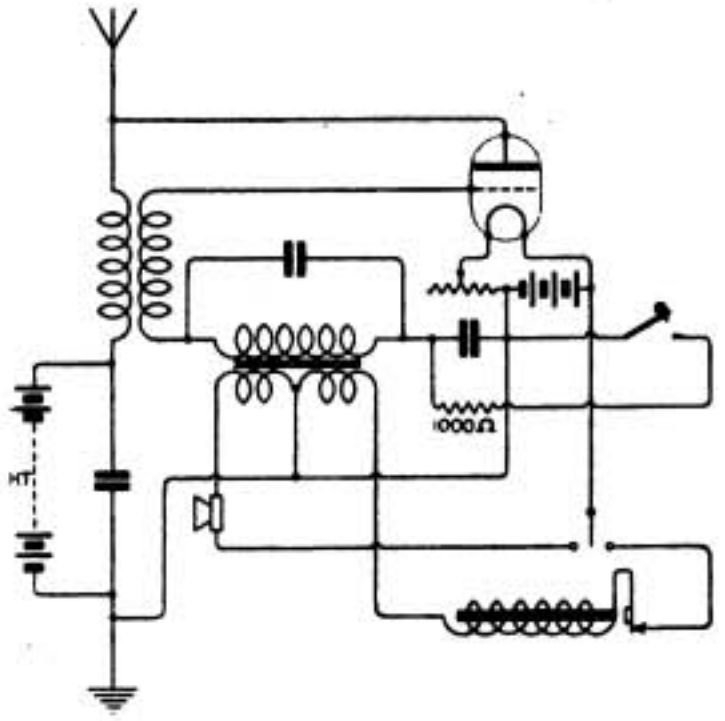


Fig. 2.

"DOT DASH" (Cape Town) *asks* (1) *For a one-valve circuit to use certain apparatus.* (2) *For a single valve transmitting circuit for C.W., telephony and tonic train.* (3) *Wavelength of a certain loose coupler set.*

(1) See Fig. 2, page 811, March 18th issue, and Fig. 4 of the same issue.

(2) See diagram. Fig. 2.

(3) With a 0·0005 mfd. condenser across the secondary both circuits will tune to 3,500 metres on a 100′ single wire aerial.

"J.W.M." (Bethnal Green) *asks* (1) *Wavelength of Pulham.* (2) *Wavelength of Southwold.* (3) *Whether loading coils should be connected in*

secondary when one is used in aerial circuit. (4) *The amount of H.T. required for more than one valve.*

(1) Telephony 900 metres C.W.

(2) No definite information.

(3) Not necessarily. The inductance of the secondary circuit may be high enough without this addition to tune the circuit to the same wavelength as the loaded aerial circuit.

(4) All the valves being in parallel across the H.T. battery, only the same voltage is required as for one, that is about 60 in your case.

"RADIO-LANTIC" (Newark) *asks if a certain station transmitting on* 7,850 *metres is Glace Bay.* (2) *Why different call signs are given for some stations in the Wireless World Supplement of January 2nd and in the "Wireless Pocket Book and Diary."* (3) *Names of stations of which certain calls are given.*

(1) Most probably.

(2) For duplex working it is necessary for the receiving station to be some distance away from the transmitting station, in which case each station generally has a call sign allotted to it. For instance, you quote **NFF** and **WII** for New Brunswick. **NFF** is the true call of New Brunswick and **WII** the call of its receiving station at Belmar, on which its traffic is usually handled.

(3) **BWQ** Queenstown, **GKR** Wick, **TIF** Tiflis, **TCHK** Tashkent, **WSEM** general call for Russian stations. Remainder of calls no information.

"C.M.McC." (Clapham) *asks if it is possible to increase the wavelength of a set from* 2,500 *to* 30,000 *metres by means of a loading coil.* (2) *Amount of wire and size of former.* (3) *Turns and gauge of wire for an intervalve L.F. transformer.*

(1) This might be done by a series of coils with appropriate increase of reaction coil. A single loading coil would hardly be efficient.

(2) We should recommend you to buy, or make, a series of slab coils, increasing in size to about 1,200 turns with a mean diameter of 3".

(3) See reply to "H.C." (Brighouse).

"E.A.W." (Bromley) *wishes to receive telephony and asks* (1) *If an aerial under the roof would be satisfactory.* (2) *How many wires to use.* (3) *Whether to use one or two valves.* (4) *If one valve sets are successful for Dutch concert.*

(1) Fairly, if well arranged.

(2) Four or five in parallel.

(3) Not less than three with an aerial of this sort.

(4) Single valve sets will pick up **PCGG** with a good aerial if skilfully used under favourable conditions, but do not give very strong signals. For enjoyable results more magnification is desirable, and this is almost essential with the poor type of aerial you propose to use.

"C.S." (s.s. "Collegian") *asks for winding of three variometer formers for wavelength from* 300 *to* 30,000 *metres.*

It is undesirable and difficult to obtain big ranges of wavelength of this nature by means of variometers, as the losses in these coils are very considerable when they are very big and have their windings opposed. It is seldom possible to make a variometer with maximum inductance of more than seven times its minimum inductance. For a range of 300 to 30,000 metres you will need at least five variometers. The determination of suitable sizes would be best obtained experimentally, but in view of their poor performance we do not think this would be worth while.

"KEEN" (Emsworth) *has a single valve set on which he can hear only ships and asks* (1) *For criticism.* (2) *For additions to increase the range to* 4,000 *metres.* (3) *If* 750 *ohms telephones need a transformer.*

(1) For wavelengths above that of ships a loading coil of No. 30 will introduce too much resistance into the aerial circuit. The coil should be made larger and wound with No. 24 or No. 26. As at present arranged the maximum wavelength is about 3,000 metres, so that **FL** should be heard.

(2) An additional inductance in the secondary circuit is all that is required to obtain the increased wavelength. We cannot say how much without more precise information about the condenser. A reaction coil coupling with the secondary will be a great improvement. Try a 3" former, wound for 6" with No. 36.

(3) No.

W.B.B. (Dublin) *asks* (1) *For information regarding the 52a Aircraft set.* (2) *If a three or four valve set would receive telephony concerts.*

(1) We are sorry that we have no information about this.

(2) Yes, with efficient intervalve coupling and carefully adjusted reaction.

"R.T.H." (North Devon) *asks* (1) *If a set shown will receive the Dutch concerts.* (2) *What is the use of a filament resistance.* (3) *The meaning of the Paris time signals.* (4) *The power required to transmit* 3 *miles.*

(1) Yes, if properly adjusted. Connect a 0·001 mfds. condenser across the winding of the L.F. transformer in series with the reaction coil.

(2) As you are only using a 4-volt filament battery no resistance is required. The majority of valves require at least 4·5 volts across the filament, in which case a 6-volt accumulator with a resistance is used.

(3) This is a time vernier sent on sidereal time. The dots are 49/50ths of the sidereal second. Eight figure groups give times of 1st and 300th dots in sidereal time and can only be used in conjunction with a sidereal clock.

(4) This distance could easily be covered by a 10-watt valve set. Five watts should be sufficient with an efficient set.

"DIELECTRIC" (Wimbledon) *asks what are the objections to the use of oil for a dielectric of variable condensers.*

There are no serious objections, but the chief to our mind is the messy nature of such a condenser, especially in the event of a leak in the container or overturning of the condenser. An oil condenser cannot conveniently be mounted on a panel with other apparatus. Electrically it is quite good.

"P.Y." (York).—Your crystal circuit is wrongly connected. See Fig. 5, page 642, January 7th issue, and connect up accordingly, either with or without condensers. Use 4,000 ohm telephones, or else 120 ohms with a transformer. You should hear ships and possibly **FL** if the A.T.I. has sufficient winding.

"P.J.D." (Dublin) *asks* (1) *Why no signals are received on a five-valve set.* (2) *For a suitable reaction coil for* 2,500 *metres.*

(1) The scheme of connections is correct, but it is quite possible that some of the component resistances

are defective. Partially disconnect the amplifier so that each part may be tested. Try the telephones in the first anode to begin with and test preferably with buzzer signals. When you have got this valve right add another, and so on. Eighty to 100 volts will be required for this set.

(2) Make a 3" former to slide into the primary and wind with 6" of No. 30.

"D.H.B." (Wisbech) *asks* (1) *For a diagram of a microphone amplifier with parts.* (2) *If 4,000 ohms telephones are suitable for a three-valve set.*

(1) We are sorry that we do not know of a suitable type to recommend. The only satisfactory type that we know is the Brown relay, which is described in many text books, but this instrument is not suitable for amateur construction.

(2) Yes, if there is no telephone transformer.

"A.S." (Coventry) *asks* (1) *How to arrange capacity reaction for a single valve set.* (2) *For the issue in which a single valve set was described.*

(1) Connect the reaction condenser between the grid and anode of the valve. A suitable condenser may be made of a ½" glass test tube, coated inside and out with tin or copper foil. One coating should be made a sliding fit to allow of the adjustment of the capacity of the condenser. Capacity reaction in a single valve circuit is liable to give very erratic results.

(2) February 5th and 19th, and March 19th, 1921, issues.

"R.B.R." (Streetly) *asks* (1) *If crystal set described will receive the Dutch concerts.* (2) *If it will be improved by the addition of a valve magnifier or a telephone transformer.* (3) *For an efficient set to make or buy with approximate cost.* (4) *Meaning of high tension.*

(1) The set is not sufficiently sensitive for this purpose. At least two valves will be required for weak speech.

(2) A note magnifying valve will increase signal strength and bring in the English concert.

(3) Try making a single-valve set as shown on Fig. 2, page 811, March 18th issue, or that shown in Fig. 4 of the same issue. It would cost £3 to £4 with valve and batteries.

(4) In wireless receiving the term is used to denote the anode or plate voltage of the valve. It is called high-tension, or voltage, because the potential of this battery is greater than that of any other battery used on the set.

"R.T.C." (Herne Hill) *asks* (1) *For a loose coupler for 3,000 metres for a crystal set.* (2) *If it can be used later for a valve set.*

(1) A.T.I., 6" × 10" of No. 24. If a 0·0005 mfd. secondary condenser is used the secondary may be 5" × 8" also of No. 24.

(2) Yes, it can still be used with the valve gear connected across the secondary condenser in place of the crystal and telephones.

"J.W.H.C." (Nuneaton) *asks for a non-technical description of a simple and inexpensive Morse writing apparatus for use with his set.*

Instructions for the construction of such apparatus will take more space than we can give. We may say, however, that for recording on the three-valve set you will need a good quality relay sensitive to about ½ milliamp. The construction of this piece of apparatus is beyond the power of any but a very exceptional amateur. A suitable relay of P.O. type will cost about £12. The relay should be used to work the inker by means of a local battery. The inker itself may be made by an amateur and consists essentially of a clock-work mechanism to draw paper tape in front of an ink wheel and a magnetic arrangement to force the ink wheel against the paper when the relay is operating.

"W.T." (Carnforth).—The jamming you complain of is surprisingly bad for a DC system and points to neglect of the machines at the generating station. We are afraid you can do little to cure it except removing your aerial as far as possible from the wires, putting it at right angles to them, and, if you still get induction with the aerial disconnected, screening all your instruments in large closed iron boxes.

"C.W." (Greenwich) *sends* (1) *A circuit for criticism, and asks* (2) *If a grid leak and condenser will improve the set.* (3) *If the set will give* PCGG. (4) *If the set shown on page 781, February 5th, 1921, should be connected as in his diagram.*

(1) and (4) The set is quite all right. The small differences you have made are quite immaterial. The grid condenser and leak (0·0003 mfd. and 2 megohms) might slightly increase the sensitiveness, but would necessitate the use of more H.T. volts.

"BOBBIN" (Walsall) *asks* (1) *The best form of radiator for a Wilson coil set.* (2) *Information about the efficiency of frame aerials.* (3) *Correct spacing between turns for a receiving frame.* (4) *If a narrower frame is better for direction finding.*

(1) Your results show that an open aerial gives best results. The artificial aerial condenser was not of large enough capacity. It should be quite possible to get the set to work satisfactorily on a closed circuit, but the radiation will be much poorer than on an open aerial. (2) The two-layer frame may be used provided its natural wavelength does not come out higher than the minimum wavelength to be received. (3) This varies with the size of frame, wavelength, etc., but as a rule it need not be greater than ½ inch. (4) In practice there is little to choose between them.

"C.G." (Coventry) *wishes to add three valves to a Mark III Tuner.*

There are many possible three-valve circuits, most of which have been given in these columns. Try any you fancy. Connect the valve terminals on the Mark III to the input terminals of the amplifier. A possible rearrangement of the Mark III circuits themselves for reaction purposes is given in the issue of June 25th.

"EXPERIMENTER" (Bourne End) *asks* (1) *A question about certain H.F. transformer formers.* (2) *If capacity reaction is as good as magnetic reaction.* (3) *Best ratio for L.F. transformers.* (4) *Best combination of three valves.*

(1) Not suitable for short waves or for wide wave ranges, but quite good for long waves. (2) Under the best conditions of each not a lot to choose between them, but as a rule capacity reaction is more difficult to handle and liable to be erratic. (3) This depends on a variety of circumstances. The best value usually lies between 1/1 and 1/3. (4) One H.F., one detector, and one L.F. for general purposes. Two H.F. and one detector is also very good for obtaining some results from very weak stations.

"C.F.W." (Nottingham) *asks* (1) *For criticism*

of a three-valve set. (2) *Best earth without using a water-pipe.* (3) *A book on telephony transmissions.*

(1) The set is O.K., but it will be better to connect the reaction coil to the anode of the second valve, with a 0·001 mfd. condenser across the intervalve transformer winding which is in that circuit. (2) Either a large metal plate should be buried in the ground, or a considerable length of wire netting laid along the ground. (3) We do not know of a book that will exactly suit your purpose.

"**H.W.H.**" **(Taunton)** *asks* (1) *For windings for the choke of an impedance amplifier for* 150 *to* 4,500 *metres.* (2) *For windings for a C.W. transmitter.* (3) *For the capacity of a condenser.*

(1) We do not think you will get at all satisfactory results with this amplifier at less than 1,000 metres. Above 1,000 metres you would probably find an ounce of No. 42 wound on a long iron core satisfactory. (2) You give no particulars of your aerial so we cannot give you exact windings, but about 50 turns of No. 20 on a 3" diameter former for the anode coil, and 3" of No. 30 on a 2½" former for the grid coil will probably be sufficient for short wave work. (3) You do not mark your diagram to show which condenser you refer to. The condenser across the H.T. may be about 0·005 mfds., and the condenser across the break may be 0·001 mfd.

"**SCOUT-PADD**" **(Maida Vale).**—It is not easy to give a reason without direct experiment. Try increasing the L.T. voltage to six, and also reaction between the grid and plate of the first valve only.

"**S.A.B.**" **(Wimbledon)** *refers to Fig.* 12, *page* 726, *February* 18*th issue and asks* (1) *If the telephones should be short-circuited as shown.* (2) *How many plates to use for a* 0·0001 *mfd. air condenser.* (3) *What anode resistance to use for "Ora" valves.* (4) *Wave range of a certain circuit.*

(1) No, this is a mistake. The lead which short circuits the telephones and blocking condenser should be omitted. (2) If the plates are 2" diameter, separated by $\frac{1}{16}$", you will require about 10 fixed plates and 9 moving. (3) 30,000 to 50,000 ohms. (4) It depends on the coils and the condensers used, about which you say nothing.

"**W.H.**" **(Salford)** *asks* (1) *Which is the better of two aerials.* (2) *If iron guttering under one end of an aerial will affect signals.* (3) *Times of transmission of Wakefield and Halifax.* (4) *If an indoor aerial would be effective with a one or two valve set.*

(1) The two wire aerial. (2) Not to any appreciable extent. (3) We have no information. (4) It will give fair results if the aerial is carefully arranged, but of course, signals from any but nearby stations will not be at all loud.

"**ANXIOUS**" **(Windsor)** *asks* (1) *If an earth lead need be insulated.* (2) *For a practical book on loud speakers.* (3) *Filament voltage for three "R" valves.*

(1) No. (2) We do not think there is such a book in existence, but a very useful article appeared in the issue for February 19th, 1921. (3) Connect the three valves in parallel and use a six-volts battery with a small series resistance.

"**R.A.F.**" **(Doncaster)** *asks* (1) *For winding for a former* 2½" *diameter for* **PCGG** *with a circuit of Fig.* 12, *page* 726. (2) *If circuit shown is suitable for* **PCGG.** (3) *Gauge and quantity of wire for H.F. transformer for* **PCGG** *on former* 1½" *diameter.* (4) *Ratio for L.F. and telephone transformers.*

(1) 10" long of No. 24, say, 4 ozs. (2) Yes, if a 0·001 mfd. is connected across the anode winding of the first L.F. transformer. Wind for 4" with No. 28. Inter-valve about 1/2 step-up, telephone 8/1 step-down.

"**H.G.P.**" **(Ramsgate)** *asks* (1) *How magnetic reaction is used with slab tuning coils.* (2) *How to make a reaction coil for the same.* (3) *How many ohms to a megohm.* (4) *If possible to hear* **PCGG** *distinctly on a two-valve set at Croydon.*

(1) and (2) One slab is used as a tuning coil and another placed on top of it, and connected in the anode circuit is used for the reaction. Reaction coupling is varied by separating the coils as desired. (3) One million ohms. (4) Yes, when Croydon air service station is not working.

"**H.A.K.**" **(Herne Hill).**—We are sorry that we have no information regarding the French crystal receiver. We should recommend you to write to the Société Française Radio-Electrique, 79, Boulevard Houssmann, Paris, for a two-valve set (*see* Fig. 3, page 812, March 18th issue). In place of the magnetic reaction a small variable condenser should be connected between the anode of the second valve and the grid of the first.

"**P.M.G.**" **(Coventry)** *asks* (1) *If a crystal set shown is suitable for* 2,800 *metre stations.* (2) *If Sullivan 'phones will work with Brown telephone transformers.* (3) *If an aerial described is satisfactory.* (4) *If a circuit shown for* 6,000 *metres will receive speech.*

(1) The diagram is quite correct for an elementary set. The wavelength range will depend on the size of the coil, which you do not describe. (2) and (3) Yes. (4) Circuit is not complete. A variable condenser is necessary across the secondary circuit. The only station we know of sufficiently near you to give telephony on a crystal set is the Birmingham air station.

Company Notes.

"The Directors of The Ever Ready Company (Great Britain), Limited, recommend the payment of a Final Dividend for year ended March 31st, 1922, of 5½ per cent. on the Preference Shares, making 9 per cent. for the year, and 9 per cent. on the Ordinary Shares; both payable on June 1st, 1922. Accounts will be issued on May 9th. General Meeting, May 31st."

SHARE MARKET REPORT

Prices as we go to press on April 28th, are :—

Marconi	Ordinary	£2	8	6
„	Preference	2	7	6
„	Inter. Marine	1	10	0
„	Canadian		11	0
Radio Corporation of America :—				
Ordinary	.. ..	1	5	0
Preference	.. ..		17	0

13th MAY, 1922. Engineering Library MAY 23 1922 PRICE 6D. NET.

THE WIRELESS WORLD AND RADIO REVIEW

VOL. X. No. 7 13th MAY, 1922. Registered at the G.P.O. as a Weekly Newspaper.

THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

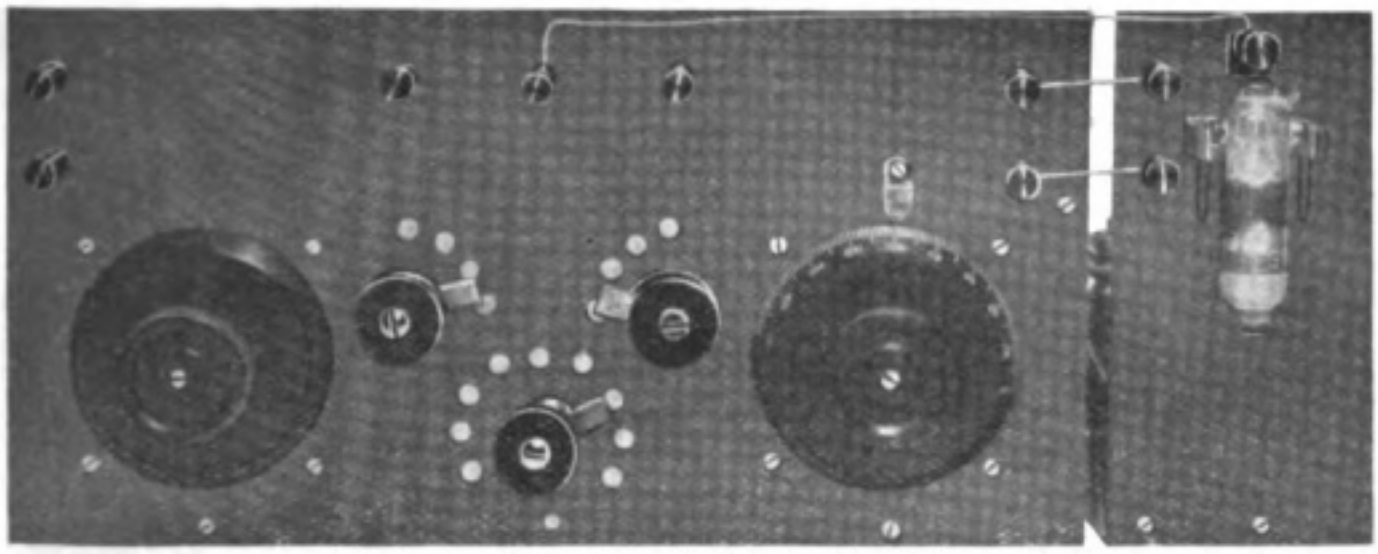
VOL. X. No. 7. MAY 13TH, 1922 WEEKLY

The Reinartz Tuner

A NEW IDEA IN SHORT WAVE RECEPTION

By PERCY W. HARRIS.

THE successful completion of the Trans-atlantic Amateur Tests has achieved two things. On the one hand, it has drawn attention to the high efficiency of transmission on short waves, and on the other it has emphasised the superiority of C.W. for this purpose. In America, where transmitting licences are much more freely granted, the latter point has aroused the greater interest, for there the efficiency of short waves was already well known.



A front view of the Reinartz Tuner with detector panel.

The wider adoption of C.W. for short wave transmission in the United States has been considerably hindered by the difficulty (only to be realised by those who have attempted it) of constructing and operating satisfactory C.W. tuners for the short waves. The "standard American regenerative receiver" which uses very loose aerial coupling, variometer or condenser grid tuning, and a tuned plate circuit (variometer tuned), has reached a high degree of efficiency, but is difficult to handle, owing to the need of simultaneously tuning of all three of the oscillating circuits. The difficulties met with in tuning to damped waves, for which these tuners were primarily designed, are, however, trivial compared with those encountered in tuning to C.W. signals, as will be understood when we consider that a variation of a twentieth of a metre in wavelength on a 200 metre adjustment is sufficient to change the frequency of the heterodyne note from 500 to 1,000.

In England this type of tuner, in which the plate circuit is tuned and coupled to the grid circuit by the internal capacity of the valve itself, has never been very popular, partly because short wave work has not been greatly developed here (the circuit functions best below 450 metres) and partly because most British amateurs have accustomed themselves to electro-magnetic reaction by means of a coil in the plate circuit coupled to a grid circuit preceding it. This latter arrangement, whilst convenient to handle on longer waves, and much simpler to tune than the American regenerative type, is often found difficult to handle on short waves, and in unskilled hands tends to burst into oscillation when critical reaction is aimed at.

With these considerations in view, the writer recently read with some interest the description published in the American wireless magazine, "QST" for June last, of a new C.W. and spark regenerative short-wave tuner for which the following advantages were claimed:—

(1) It would oscillate nicely at whatever wavelength the grid circuit were tuned to.

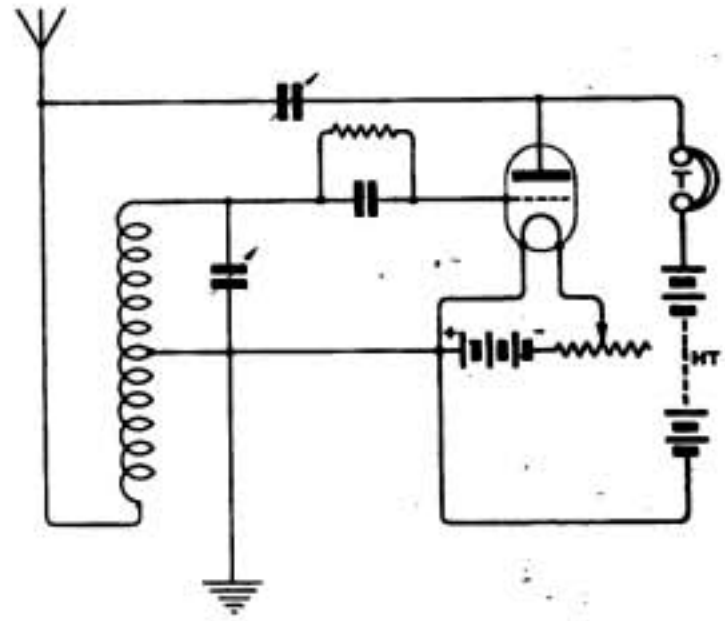
(2) No continual adjustment of coupling and no *aerial tuning* were needed.

(3) It was only necessary to set the tuner either to oscillate *or regenerate without oscillating*, whereupon the tuning could be carried out on *grid circuit tuning condenser alone*, without other adjustment.

(4) It was free from "capacity effects" due to the proximity of the hand.

This remarkable tuner was ascribed to Mr. John L. Reinartz, of South Manchester, Connecticut, and sufficient details were given to enable those who would to construct it.

In the March, 1922, issue of "QST," there appeared a further article entitled "The Improved Reinartz Tuner," wherein it was stated that since the publication of the previous article "hundreds of enthusiastic letters from individual readers of 'QST' report the construction of as many sets, which in every case are performing as well as, or better than we said, to the surprise and delight of their owners." The article showed several improvements which had been introduced by Mr. Reinartz and further constructional details were given. In view of these statements the writer decided to construct the tuner for himself so as to test the certainly remarkable claims made for it. The result of his tests convinces him that many other British amateurs will be glad of particulars and constructional details.



Circuit when using exterior coil.

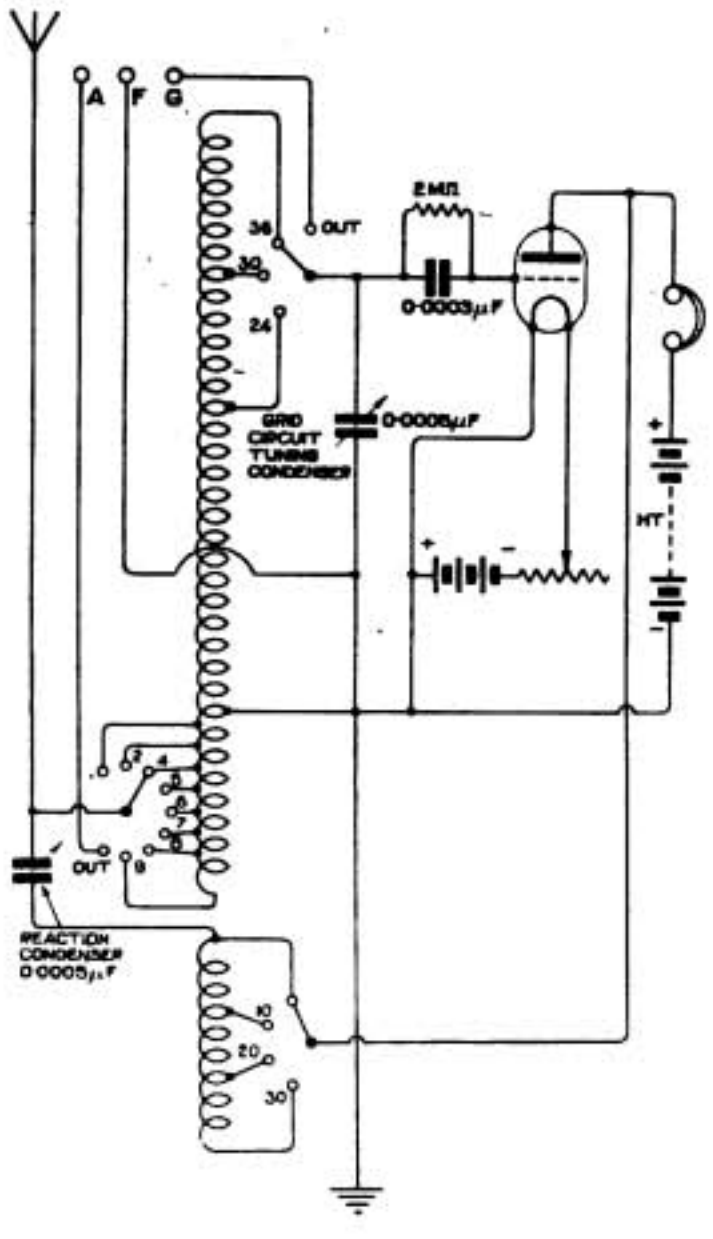
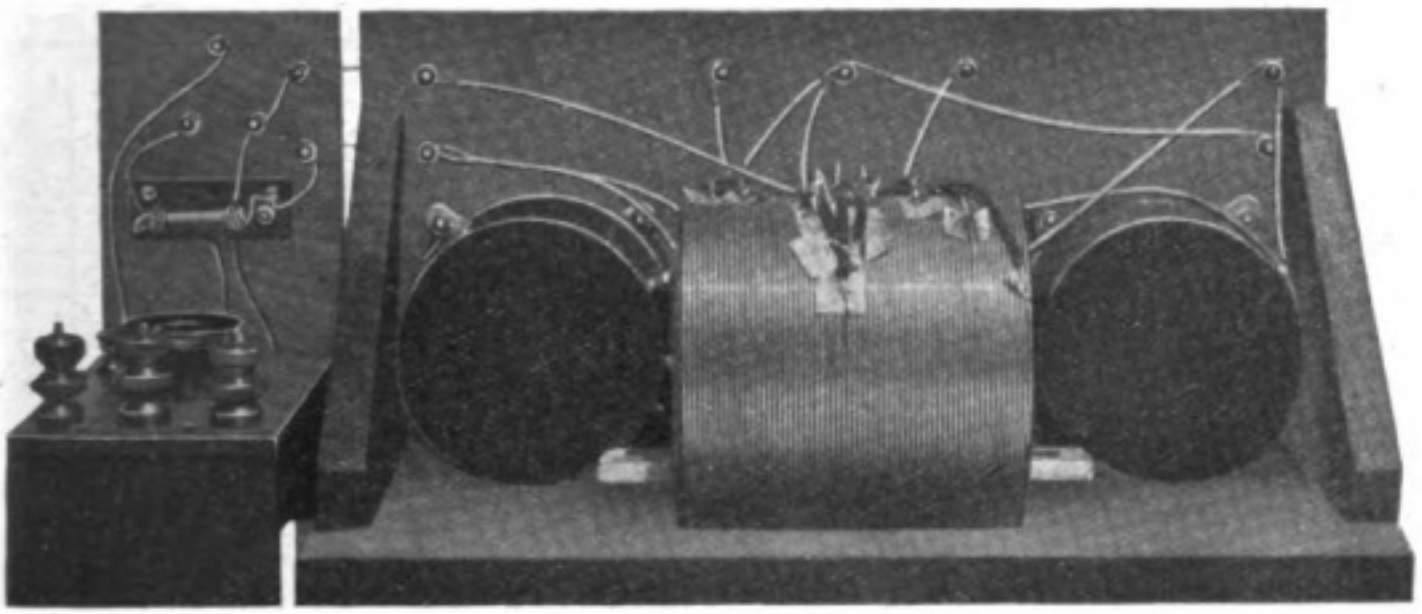


Diagram of connections.

The tuner is of great interest apart from the claims justly made for it. An inspection of the circuits on this page will show the reader that there are many points of novelty. Firstly, the aerial circuit, instead of being coupled in the usual way, functions aperiodically, and is left on one adjustment over a wide band of wavelengths. When readjustment is made it is not for tuning purposes, but rather to alter a coupling effect. The switch connected to the aerial should therefore be regarded differently from the usual aerial tuning inductance. The aerial circuit can easily be traced through the switch and the particular stud on which it is set to earth. Frequently, good results are obtained with *only one turn of wire in the aerial circuit*. The aerial coil is continuous with the grid coil, and is therfore very tightly coupled to it. The grid coil has tappings so that the best combination of capacity and inductance can be found for a particular wavelength range. These will be seen at the top of the coil.

Particular interest attaches to the method of obtaining reaction, by a combination of electrostatic and electromagnetic effects. It will be seen that the plate of the valve is connected through an inductance (wound on the same former, and variable in four steps) to a condenser connected to the aerial. According to the setting of the inductance and condenser, so will the set regenerate to the desired degree, without oscillating, or oscillate at a chosen intensity. This will be explained in detail later. Incidentally, on the proper setting, there is practically no "backlash."

It will also be noticed that this tuner utilises a parallel or shunt supply of its high tension. For this reason there must be no telephone condenser, or if a transformer is used, any condenser across its primary winding, otherwise the high frequency current will not take the right path. If high resistance telephones are used, it will generally be found that their impedance is high enough to prevent leakage, but if a note magnifier is attached, the impedance of the primary will probably be too low, and an iron-core winding of some sort (the writer uses the intact winding of an old army-type intervalve transformer) should be inserted in series. Two other points in connecting up should be noted. The filament connection from the tuner must be made to the *positive* low tension, and the negative high tension must be connected to the positive low tension also. This point, through the tuner, is earthed.



A back view of the tuner and detector panel.

As described by the inventor, the tuner is made with a basket coil, but the writer has found it more convenient, and, he believes, more efficient, to construct it with a single layer solenoid with spaced turns. Particulars are therefore given of this form, but obviously the flat coil can be used if desired.

Reference to the photograph of the front of the instrument shows seven terminals, two condensers and three switches with four, four and nine studs respectively. The two terminals on the left-hand side are connected to aerial and earth, the two on the right to *plate* and grid (not grid and filament as might be expected) while the centre terminal is connected to the positive filament terminal. Alternatively, the positive of the L.T. battery may be earthed instead. The remaining two terminals (to the left and right of the central terminal), are used for connecting an external coil for longer wavelengths, in a way presently to be explained.

Of the switches, the lower with nine studs is that for the aerial. The upper left-hand switch controls the plate windings and the upper right-hand switch the grid turns. The left is the reaction condenser and the right the grid circuit tuning condenser, which should preferably be about 0·0005 mfd. The reaction condenser is better a little larger than this, although the writer uses a pair of the smaller Mark III condensers, both about 0·0005 mfd. maximum. These are quite satisfactory.

There are really two coils, one for the plate circuit and the other for the aerial and grid circuits, as shown in the diagram. Both must be wound on the same former, in the same direction. It is therefore only necessary to wind one coil, the winding being cut when the required number of turns for the plate circuit have been wound on.

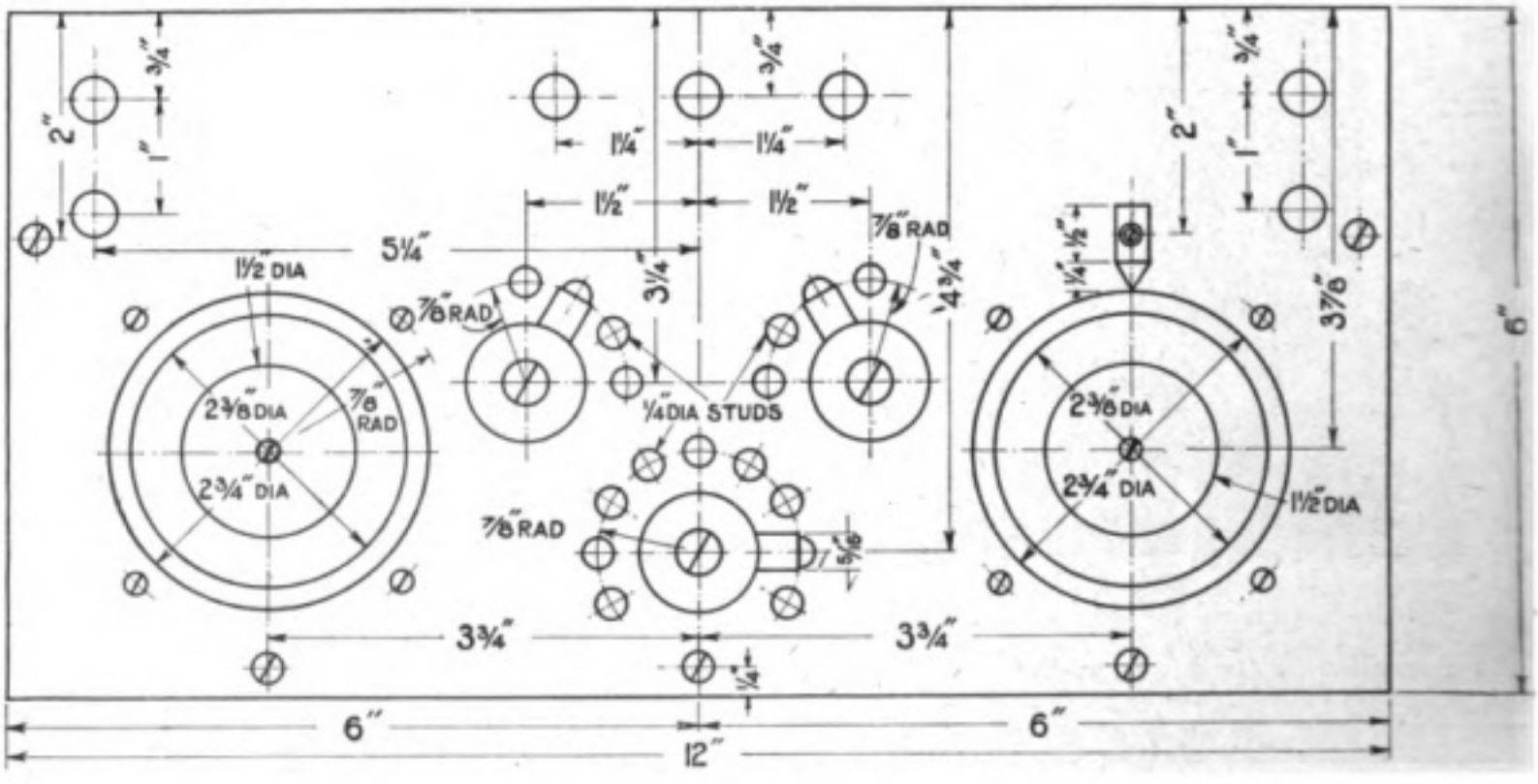
It will be found easy and convenient to use one of the empty formers from an old Mark III. tuner, as the groove cut on these formers enables the windings to be spaced well. With the tappings given later the tuner will then tune down below 130 metres and up to about 325 metres, and will give perfect control of oscillation and regeneration over the whole range. If longer waves need to be tuned in, a very simple arrangement enables a very wide range to be covered. For this the three top terminals come into play.

Referring once more to the diagram of connections, it will be seen that the aerial switch has one stud (the lowest) connected to the top terminal marked A. The grid switch also has a stud connected to a top terminal G. The central terminal is earthed as shown. When using exterior coils, the aerial and grid are placed on these studs and the plate switch on the top stud. The interior coils are then cut out entirely. For 600 metre work, Mr. Reinartz recommends a coil of 70 turns of No. 26 wire (DCC is best) on a former 2¾ ins. in diameter, tapped at 20 turns from one end. The extremities of this coil are connected to the A and G terminals, and the tapping to the terminal in the centre (F). The 20 turns should be between A and F, and the 50 between F and G. Tuning is then carried out solely on the grid condenser, the aerial being untouched. Reaction takes place on the reaction condenser alone, there being no plate coils in circuit. A diagram of the connections when using exterior coils is given in the right hand diagram on page 190. The writer has used a coil with about 40 turns in the aerial

circuit, and 85 in the grid on a former 3½ ins. in diameter, and this tunes from 550 metres to about 1,200. In general ⅓ of the coil should be between A and F, and ⅔ between F and G.

To the right of the tuner in the photograph will be seen a little detector panel designed by the writer to go with the Reinartz tuner. The terminals are arranged in a convenient way, and the panel carries behind it a combined condenser and grid leak (0·0003 and 2 megohms), a filament rheostat, the choke above referred to, and the necessary terminals for H.T., L.T., and output. All leads are made as short as possible and the connections are made as in the diagram. The valve used is a QX, which suits this work very well.

The operation of the tuner is a little peculiar at first, and "wants knowing." As a beginning it is well to practise with a wavemeter such as the



Constructional details for front panel.

Townsend, buzzing on various short wavelengths. The aerial switch should be tried at various positions, the grid switch set to include all the grid turns and the reaction condenser set about midway between maximum and zero. Before troubling to tune, try by tapping the grid terminal, whether the set is oscillating. If not, try various combinations of reaction condenser and plate turns until loud clicks, when the terminal is touched *and when the finger is removed*, show that the oscillatory stage has been reached. It will then be found that by varying the condenser one way or the other the set can be put just off oscillation, and, if the grid circuit is varied the signals from the wavemeter will be easily picked up. Readjustment of the reaction condenser and a few further trials will reveal a delightfully smooth and easy control of regeneration, with practically no backlash and perfect ease of adjustment for telephony. On 300 metres there will be found steady increase of regeneration up to the oscillating point over about 30 or 40 degrees of the reaction condenser. Even on 180 metres there is no difficulty in setting at a critical value just prior to oscillation. For damped waves there is no capacity effect worth mentioning from the presence of the hand, provided the rotary plates of the grid condenser are connected to earth and the rotary plates of the reaction condenser to the aerial.

For short-wave C.W. reception it is well to fit the grid condenser with a short extension handle (3 ins. is long enough), or the capacity effect of the hand will be felt. Testing with a separate heterodyne on the other side of the room, oscillating at 130 metres, it was found possible to pick up the signal and *stop on the note required*, final adjustment of the note being made on the reaction condenser, which also controls the degree of oscillation. It is a noteworthy point that the fineness of control of the oscillation effectively prevents excessive re-radiation, which in most autodyne shortwave receivers is a great nuisance. In this case the oscillation of the receiver is adjusted to be only strong enough to give good signals. Of course, a separate heterodyne should always be used where possible.

The photographs and diagrams will tell the experienced man how to construct the Reinartz tuner. The beginner is advised to buy a sheet of ebonite of the measurements given, and $\frac{5}{16}$ in. thick. Three switches, with in all 17 switchpoints will be needed, and seven terminals. The empty Mark III. former is also obtainable from dealers. The baseboard is 12 ins. long, 5 ins. broad, and ½ in. thick, and to this the panel is secured by two

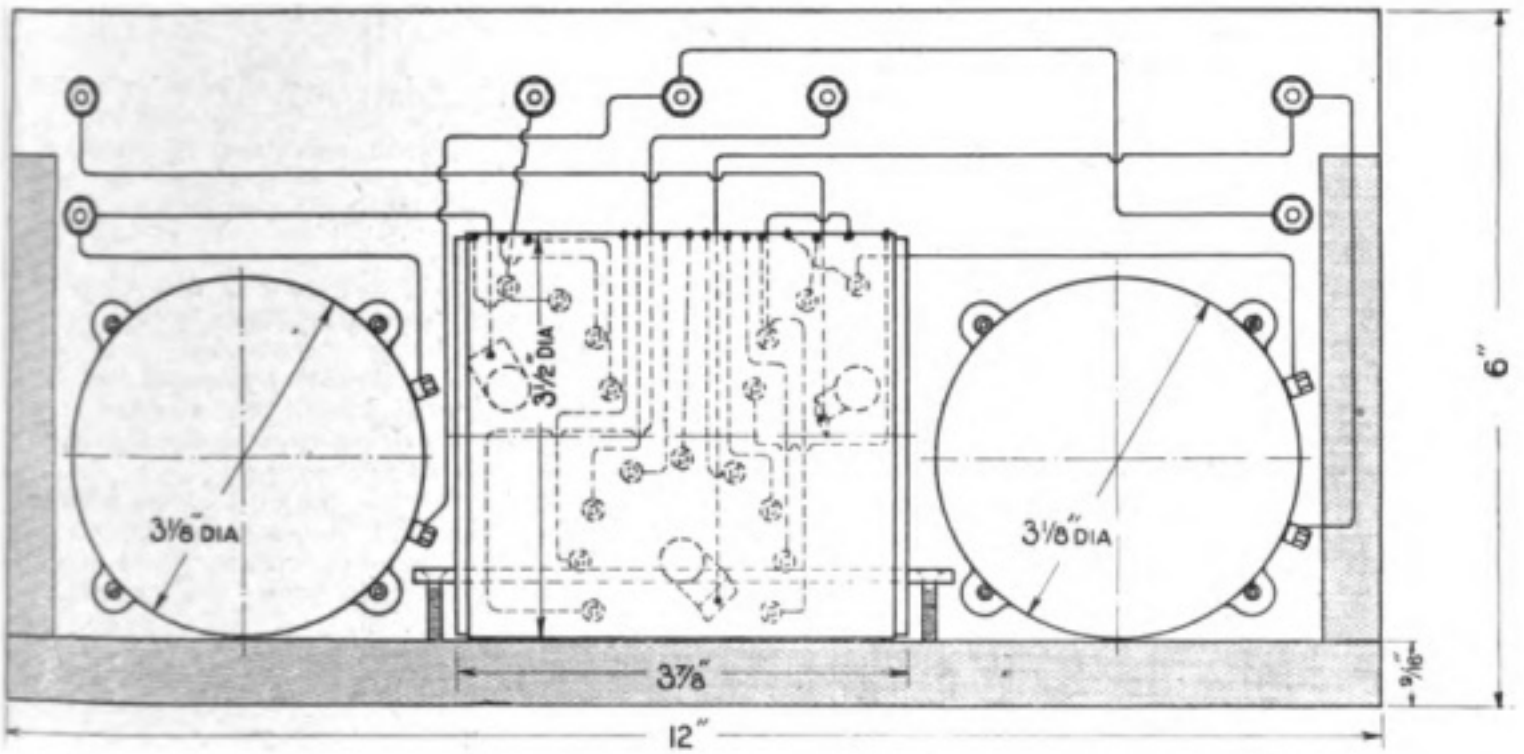
uprights, which may take any convenient shape. The condensers are the most expensive item, and should preferably be bought *for panel mounting.*

When the switches and their studs have been fitted and the terminals and condensers mounted in place, the panel should be secured to the uprights. Next, with the aid of insulating tubing, wire up those terminals and studs which are not connected with the coil. Then, to each of the terminals and studs which have to be connected to the coil, secure a separate length of about 9 ins. of insulated wire.

The coil should then be wound. At the extremity of the former drill a fine hole and pass the wire through it, allowing about an inch for connection. Then wind ten turns on the former and tap off. Continue for another ten turns and make a second tapping. A further ten turns are then

The coil should be placed in position with the final turns on the left-hand side. To wire up, take the wire from the bottom stud of the plate switch, bare its end and twist it round the wire protruding through the former at the beginning of the coil. Take the second stud and similarly connect it to the first tapping, and so on as shown in the diagram. The tenth turn is taken to the central filament terminal, which is earthed. The final turn comes to the second grid stud from the top, the first being connected to the grid terminal above it.

When all wires have been joined in this way the joints should be carefully soldered. It is preferable, before joining up, to slip lengths of insulating tubing over all wires, but this is not necessary if good insulated wiring is used. Bare wire may be used on the former, but if this is the case, care must be taken that the joints do not



Constructional details (back view.)

wound and the coil cut after allowing an inch or so for the connection at the beginning. This completes the plate coil.

Starting again, with sufficient wire for linking up, wind two turns, then tap; two more, tap again, and then tap at the fifth, sixth, seventh, eighth, ninth and tenth turns. This completes the aerial circuit. Taps are then taken from the 24th, 30th and last (36th) turns for the grid switch.

In the tuner constructed by the writer, the taps were made by baring a short length of the wire, looping it and twisting it on itself before continuing the winding. Thus every tapping is a slight protrusion from the coil. They should all come on the top of the coil when this is laid in place. A strip of wood an inch broad and 5 ins. long serves to secure the former in a horizontal position, by the aid of two brass screws which attach the projecting portions to the baseboard.

short-circuit the turns adjacent. Strips of empire cloth or other insulation will prevent this.

The tuner and its circuit would seem to open up wide possibilities for experimentation. There is no question as to its effectiveness for the work for which it is designed. The Editor will, I am sure, be very glad to publish experiences of other amateurs with this interesting invention.

This article, though based upon American practice, opens up a new field of research in methods of reception, particularly for short wave signals. The Editor will welcome for publication descriptions of other circuits or apparatus designed specially for short wave work, and would be glad to receive also accounts of the experiences of readers with this particular circuit.

On Heterodynes

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

(*Continued from p.* 163.)

OF the parts required to build up the instrument of which an outline was given in the first part of this article, the valve holder will first be considered. Although it is easily possible to build up an instrument of this type to operate with almost any type of valve, it is not always possible to obtain stable oscillations over the whole tuning range. The values here given are suitable for the average V 24 valve, so that a valve of this type should be used with them. To build up a holder for the valve, four clips will be required—one of them preferably being stiff, and the others thin and springy, so as to make good contact with the valve terminal caps. Suitable dimensions for the stiff or rigid contact are shown in Fig. 4. This should be bent up from 3/32 in. brass strip ½ in. wide. It may be fixed in the position shown in Fig. 2 (which is reprinted herewith for convenience in reference) by two 5 B.A. round-headed brass screws. The two side clips should be cut from thin springy phosphor-bronze strip, and are also ½ in. in width. Their dimensions are given in Fig. 5. The thickness of the bronze should not be more than about 1/64 in. The remaining end clip should also be ½ in. wide, and bent up from the same phosphor-bronze. Its dimensions are set out in Fig. 6. The larger hole shown at the left-hand end of the base strip of this clip is designed to be clamped under the LT – terminal of the instrument as was indicated on Fig. 2 in the first part of this article. The relative positions in which the four clips should be fixed can also be seen from that diagram, and from Fig. 7 which is a side elevation of the assembled valve holder.

The sockets for the coils should preferably be purchased ready made, and mounted on the instrument top in the positions set out in Fig. 2. By securing these plug sockets to the ebonite top by two screws into the brass portions, these screws can also serve for making the connections inside the instrument.

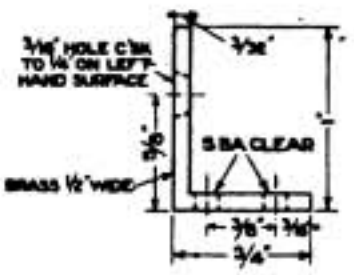


Fig. 4.

It should be pointed out that in this diagram, Fig. 2, the upper coil plug socket has been lettered "Main" and the lower "Reaction." If this lettering is adhered to, the connections to the plug sockets shown in Fig. 3 should be reversed, *i.e.*, the two leads joined to the lower socket should go to the upper one, and *vice versa*.

This rearrangement puts the coil socket labelled "Reaction" in Fig. 2 in series with the Anode circuit of the valve, and the "Main" coil in the grid circuit, in accordance with the schematic diagram in Fig. 1 (*see* p. 162).

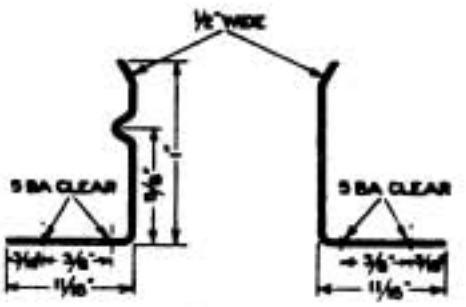


Fig. 5.

Any convenient form of switch can be used for the valve filament circuit. A miniature tumbler switch is shown on the plan of the instrument in Fig. 2, as a switch of this type is convenient for the purpose.

Unless a telephone transformer is fitted into the instrument, it is necessary to provide a link to short-circuit the terminals marked "Phones," when no telephones are required for use with the instrument. If a telephone transformer is fitted inside the case with the low-resistance winding joined to the "phone" terminals, such a link is not necessary when the telephones are removed. In case it is required, its dimensions are set out in

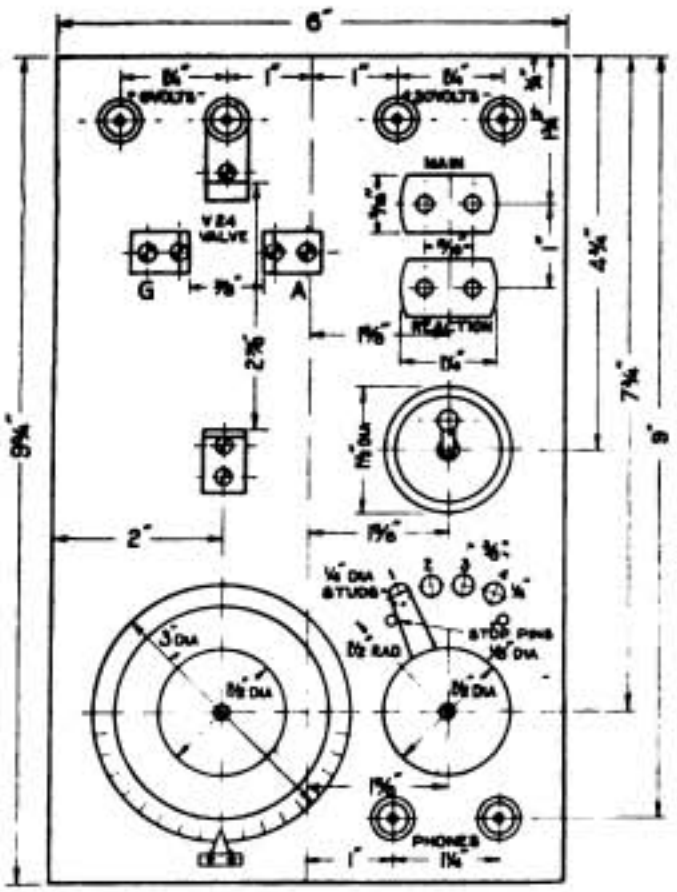


Fig. 2.

Fig. 8. It should be cut from brass strip, ¼ in. wide by 3/32 in. thick.

The essential dimensions of the 4-point range switch shown near the lower right-hand corner of Fig. 2, can be obtained from that diagram.

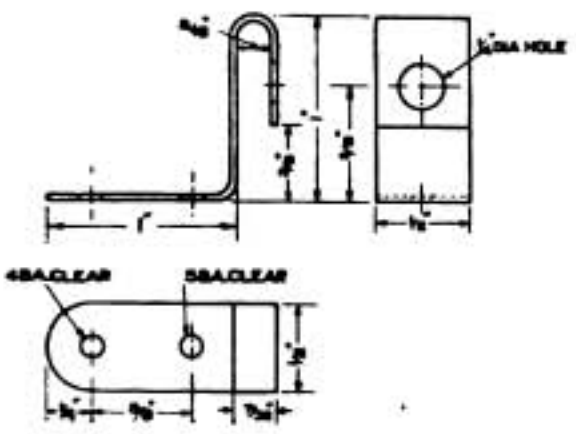


Fig. 6.

Both the switch arm—which should have three or four laminations—and the contact studs can be purchased ready for mounting, but if preferred they can be built up on the lines indicated in Fig. 9, and to the dimensions there given.

article, it will be noted that a condenser shunted by a resistance is shown in the connection to the grid terminal of the valve holder. While the valve is perfectly well able to oscillate without this

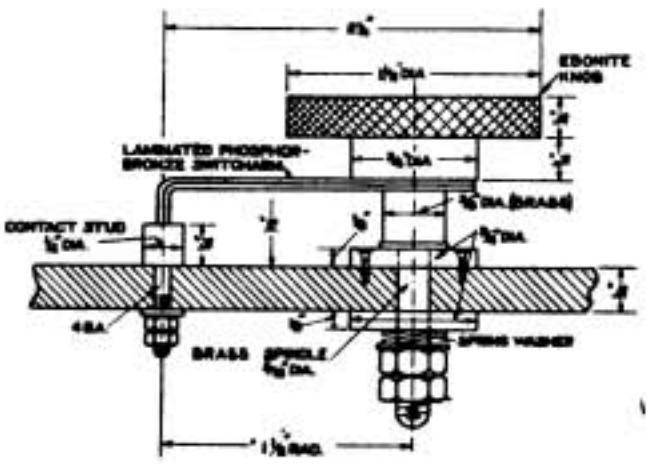


Fig. 9.

addition, its use is advantageous when using the instrument with telephones to indicate the approximate wavelength of an oscillating circuit, as it helps the valve to function better as a detector.

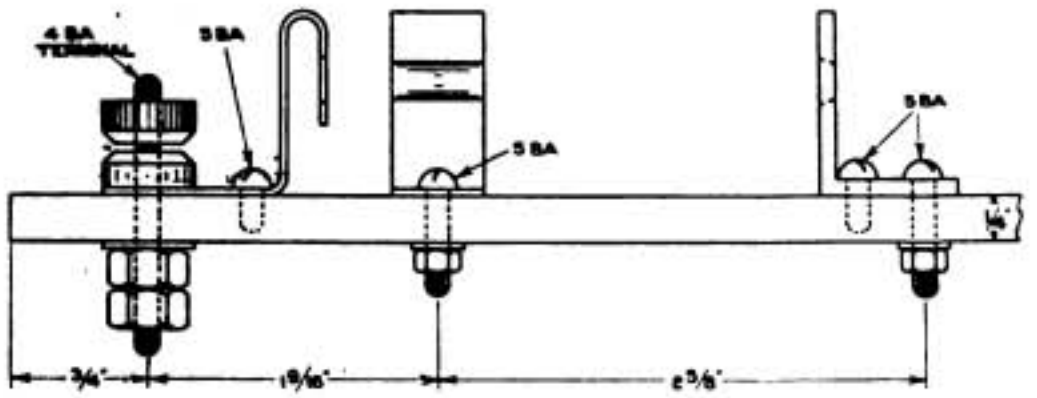


Fig. 7.

The variable tuning condenser shown near the lower left-hand corner of Fig. 2, should have a standard dial 3 ins. diameter, and should preferably be obtained ready made. Its maximum capacity should be about 0·0013 microfarads, and it should, of course, have air dielectric. Those who prefer to build their own condenser will find general instructions in earlier articles in these columns.

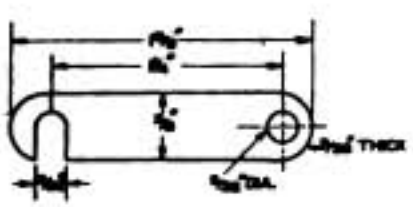


Fig. 8.

The pointer for the condenser scale can be cut from thin brass or bronze to the dimensions given in Fig. 10.

Referring again to Fig. 3 in the first part of this

The passage of the oscillating p.d.'s through this condenser also causes it to become charged and thus to make the grid potential more negative—a state in which the stability of the oscillations is often improved. It also exercises another effect—viz., to preserve a greater constancy of the frequency

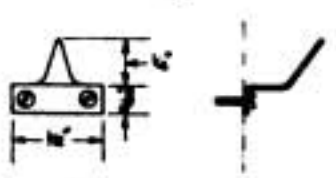


Fig. 10.

of the oscillations. It is well known that the apparent capacity of the grid electrode of the valve to the filament and plate is not quite independent of the filament temperature and plate potential, and that consequently any changes in these quantities will vary the effective capacity of the oscillation circuit—since the grid capacity is

additive to the circuit capacity—and consequently vary its frequency. When a condenser is joined in series with the grid circuit it partly obscures this change, and lessens the effect which a change of grid capacity will produce upon the oscillation frequency. The resistance is, of course, necessary, to provide a leakage path for the grid currents, after the usual manner of using a grid condenser and leak.

The effect of this series condenser in rendering more constant the oscillation frequency will be greater the smaller its capacity is made in proportion to the grid capacity of the valve itself, so that the value of this condenser should be kept down as much as possible consistent with not stopping the oscillations set up by the valve.

On the longer wavelength ranges using the larger values of tuning condenser, the effect of variations of the grid capacity upon the frequency of the oscillations becomes less important as these variations are then swamped by the large capacity with which they are in parallel.

In order to meet these somewhat conflicting requirements, the values of this series condenser and resistance may be made similar to the values ordinarily used for grid condensers and leaks, or say about 0·0002 μF and to 2 MΩ; although tests show that for most ordinary purposes this condenser and leak resistance may be omitted and the lead from the condensers taken direct to the grid terminal of the valve.

If exact constancy of oscillation frequency is not required—such as in ordinary heterodyne reception—this condenser and resistance can be omitted from the circuit. If they are used, they can conveniently be mounted on the underside of the instrument top, immediately beneath the valve holder so that they are in a convenient position for connection to the grid terminal.

Three fixed condensers are required in the instrument of values 0·00125, 0·0025, and 0·00375 microfarad respectively. Convenient units made up to the capacity desired can be obtained and mounted inside the instrument as near as possible to the 4-point switch to which they are connected, so as to keep the length of the connecting wires as short as possible.

If it is desired to use an ordinary French, or R valve with an instrument of this type in place of the V 24 valve, for which it is designed, a few modifications are necessary. Firstly, of course, an R valve holder must be fitted in place of the one described. This can be mounted in the place occupied by the V 24 valve holder in Fig. 2, or preferably, from the point of view of spacing between the parts, etc., in the position set out in Fig. 11, which also shows the plug sockets for the coils in a fresh position. The location of all the other parts remains as set out in Fig. 2. This arrangement, Fig. 11, should give ample clearance for any ordinary type of valve to be inserted in the valve holder.

Using an average R or R 4 B valve, with 30 volts in the plate circuit, good oscillations can be obtained with capacities up to about 0·0025 μF in the tuning circuits. This maximum value is most conveniently obtained in four stages, with a variable condenser having a maximum of 0·0005 μF (or rather more) and four fixed condensers of 0·0005, 0·0010, 0·0015, and 0·0020μF respectively, which can be connected successively in parallel with the variable condenser. For this purpose an extra stud will be required on the range switch, making a total of five in all. This addition is also shown in Fig. 11.

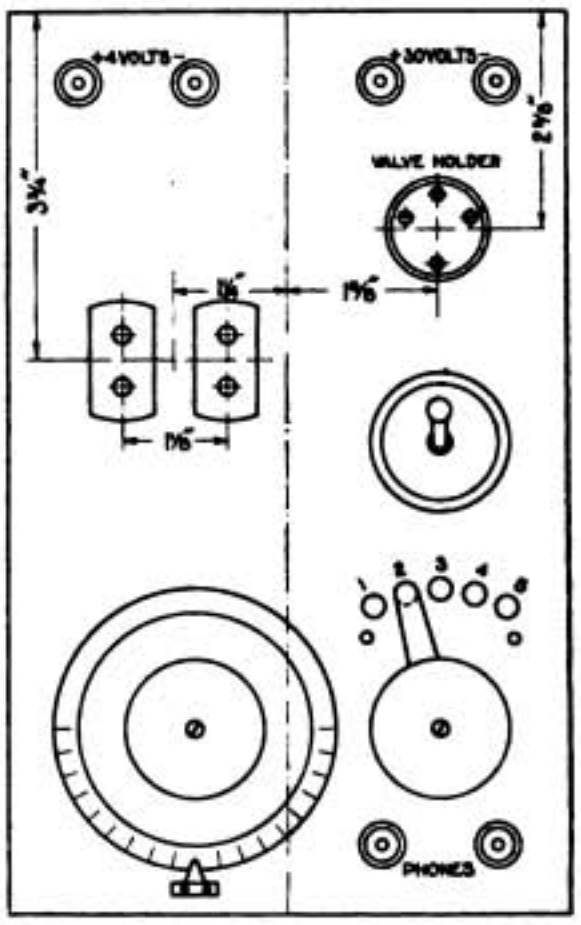


Fig. 11.

To cover the same range of wavelengths as was obtainable with the previously described arrangement, an alteration of the coil numbers required is necessary. To cover the same range of wavelengths with the above-mentioned maximum capacity it is necessary to use five coils instead of four. The combinations shown in Table III. give good results and stable oscillations over the required capacity range.

TABLE III.

Coil combinations for maximum capacity of 0·0025 μF.

Main Coil No.	Reaction Coil No.	Approximate Wavelength Range (metres).
50	150	250—1,100
200	150	1,000—4,400
400	200	2,000—9,200
1,000	400	6,000—30,000

As was mentioned in the first part of this article, a fixed filament resistance should be fitted inside the instrument. When the V 24 valve is fitted this resistance should have a value of 1 to 1½ ohms, so

as to give about 5 volts (or just over) on the terminals of the valve filament when a 6-volt accumulator is joined to the LT terminals. The necessary resistance can be obtained by winding a few inches of resistance wire on a former composed of slate pencil, or a flat strip of micanite about ½ in. to ¾ in. wide. If No. 30 S.W.G. Eureka resistance wire is used a length of from 6 to 8 ins. will be required. The resistance when completed should be mounted on the underside of the top of the instrument in any convenient position in the filament circuit, preferably supported so that the resistance wire is not in contact with ebonite top, or with other parts of the instrument.

With the instrument for the R valve, if a four-volt battery is used for the LT source in place of the 6-volt used with the V-24 valve, no filament resistance will be required. The LT terminals should in this case be engraved "4 volts," as indicated in the plan (Fig. 11).

The variable condenser in this case, although of smaller maximum value (0·00055 μF), can be of the same type as the larger one in the first-described instrument, and should be fitted with a 3 in. dial. Variable condensers of the type used in various patterns of wireless instruments used in the Services can be employed in both instruments.

(To be continued.)

A Vernier Condenser

HERE is a method for making a very satisfactory fine tuning condenser. A cylindrical lamp glass is required of the type used for surrounding a vertical gas mantle. A rectangular sheet of tin foil is fixed by means of shellac varnish to the outside of the glass leaving about 1 in. spare at each end and extending half way round. The lamp glass acts as the dielectric and at the same time serves as a bearing for an internal revolving wooden cylinder which carries the inner plate. The cylinder is made of hard wood and is

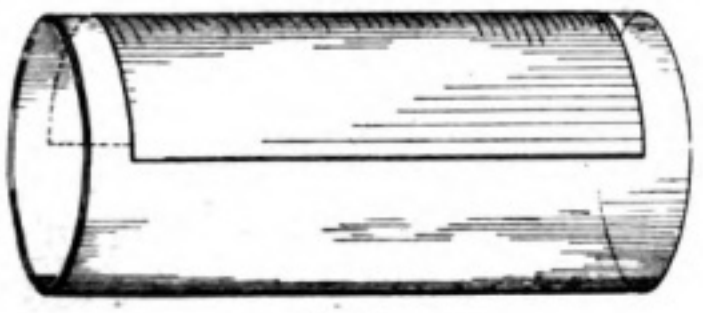


Fig. 1.

an easy fit in the glass. It is covered on nearly half its circumference with very thin copper or aluminium foil, or if this is not available, tin foil may be used. The cylinder is given several coats of shellac varnish and thoroughly dried out before fixing the metal foil, and it will then be found that if a good deposit of shellac has been obtained that the foil can be fixed in position quite easily with a further coat of varnish. This inner plate of the condenser is not made exactly rectangular, but one on the longer edges is cut away to the shape shown in Fig. 2. This is necessary in order that the condenser may give a steady increase in value when operated near its minimum position. If it is not intended to calibrate the condenser when finished, and the revolving cylinder is a good sliding fit in the lamp glass, there is no need to provide bearings and an ebonite knob fixed on to one end will serve for making adjustment. If a pointer and scale are required it is then better to arrange bearings by carefully plugging the ends of the glass with wooden discs having holes in their centres to carry the brass spindle that passes through the centre of the cylinder as shown in the diagram. Owing to the risk of breaking the glass when plugging the ends an alternative method is to fix the cylinder down to a base board by means of two thin brass straps passing over it and setting up external bearings made out of small pieces of

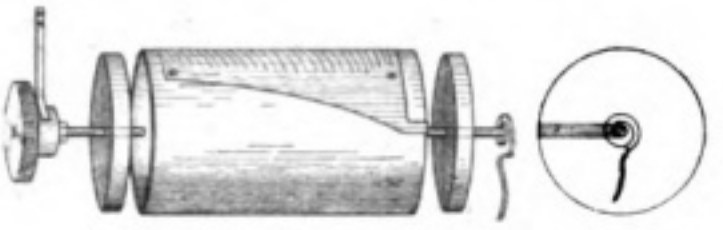


Fig. 2.

sheet ebonite. Contact to the outer plate can be made by a piece of wire tied round at one end. When the brass strap is used a terminal can be adopted for holding down one end of the strap. Connection is made to the inner plate through one end of the spindle, and a strip of foil between spindle and inner plate establishes contact.

Such a condenser as well as being easy and cheap to make, possesses in its design, the great advantage of having perfect insulation, and so readily lends itself to fine adjustment when moving from zero.

The photograph shows a neat amateur station erected by Mr. A. W. Ford of the Birmingham Experimental Wireless Club.

Four-Electrode Valves and Their Circuits*

By Capt. H. DE A. DONISTHORPE.

Capt. H. de A. Donisthorpe.

FIRST of all I must apologise for my inability to attend this Society last month, when I was to have delivered my lecture on the "Harnessing of Electrons," but owing to pressing business, I was unavoidably absent from town.

In view of the fact that the discourse so ably given by my colleague, Mr. Blake, covered a large amount of the ground which I had intended to traverse, it is my intention this evening to talk to you on the last subject dealt with in my aforementioned lecture, and to open a discussion on four-electrode valves and their circuits.

In that lecture I dealt with the evolution of the thermionic valve from the first principles of the electron theory, illustrating in each of the various cases, and leading up finally to the four-electrode valve where a more or less complex control of electrons is brought about. Perhaps it would not be out of place at this stage to suggest the name of "Quadrode" for the four-electrode valve, in order to avoid the cumbersome expression at present in use.

From time to time we have listened to many interesting papers given before this Society, wherein the thermionic triode, or three-electrode valve, has played a prominent part; but, with the exception of that valued paper given by Prof. Fleming on December 10th, 1920, we have heard very little about the quadrode and its attendant circuits. I will therefore briefly deal with the various forms of such valves, and their corresponding circuits, and trust that those members who have had experience in this direction will contribute to the discussion, by giving their experiences, as I see we have one or two members here to-night who are intimate with their action and circuits.

To the absolute amateur, this discussion may not be of immediate interest, but it is hoped that he will be able to gain a certain amount of knowledge, so that, when these valves become a more marketable and cheaper article, he will have some groundwork to work on, in their manipulation.

The classification of the different types of quadrodes now in existence is not an easy matter, as each individual valve may be said to have been evolved for some particular purpose, that is to say, some are utilised for the purpose of rectification only, and others for magnification of radio signals, while others are designed for the reception of continuous waves. Roughly, they may be classified into three different types:—

Type I.—Those having two grids in addition to the usual filament and anode.

Type II.—Those having two anodes in addition to the usual filament and grid.

Type III.—Those having three anodes in addition to the usual filament.

In each of the above-mentioned classes it may be taken as a general rule that there are two controlling elements. These may be either two grids or two anodes, as we know them with regard to triodes; the electrodes of quadrodes having at the present moment no standardised nomenclature.

It will be noted that this classification only relegates these quadrodes into different groups according to the electrodes actually employed, and therefore no useful purpose will be served by dealing with them according to this classification. I will, therefore, as far as possible, deal with the subject from a chronological point of view.

The establishment of a thermionic current between the hot cathode and the anode of a triode is now a well-known fact, and the electrons in this instance may be said to be controlled by means of a static charge impressed on a grid inserted in their path. In the case of quadrodes, however, the electrons do not experience such a quiet journey in the functioning of the valve; and, in the different types of such valves, the electrons are affected in different ways, by reason of the additional electrode. In some cases there is a diversion of electrons from one main anode to an additional one, and in others the electrons are made to overstep their mark on reaching a highly positive grid, with the result that they pass through it to the further electrode, the resulting additional work so evolved being beneficially employed. Or, again, the electrons may be buffeted about between two electrodes during their journey to the anode.

Perhaps the original quadrode was that due to Majorana, which was patented in 1912. The circuit in which this was used, and the general arrangement of the electrodes of the valve, are shown in Fig. 1. This valve was designed for the purpose of rectifying

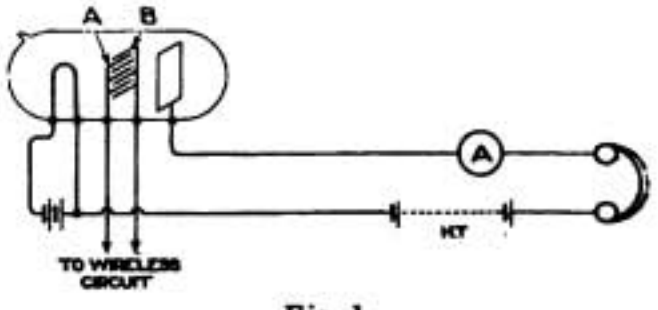


Fig. 1.

radio signals, but the results obtained therefrom can only be compared as equal to that produced by ordinary crystal rectification. From the figure it will be seen that the grid is split up into two separate and insulated portions, A and B, which may be compared to two separate grids, and the P.D. to be detected is connected across these two portions. In this connection it should be pointed out that the potentials on these two grids should be equally above and below that of the filament. Now, when an alternating P.D. is applied to these two halves, the electrons may be said to be buffeted about.

* A Discussion before the Wireless Society of London, opened by Captain H. de A. Donisthorpe, on Wednesday, April 26th, 1922.

with a resulting reduction in anode current, and a corresponding variation of current in the anode or telephone circuit; so that incoming radio signals applied to these two grids are consequently rectified.

In view of the fact that this is a potential-operated device, it will be seen that it is necessary to use a large inductance across the two grids, in order to obtain the maximum sensitiveness, and, consequently, it is more sensitive when employed for the reception of long waves.

Prof. Fleming perhaps made the next step, in the introduction of his type of four-electrode valve, and, as mentioned before, a full description was given by him before this Society, so that I will not do more than briefly describe the valve and circuit he uses.

The action of this valve is very similar to that aforementioned, due to Majorana, and the valve consists of four plates, which are curved along their axes, so that their convex surfaces are towards the filament, the filament being a short straight vertical one, made of tungsten, and situated in the middle of the four plates. One pair of diametrically opposite plates is connected together, and forms the anode or collecting plate. The other two are the two control elements, and may be compared to the two grids in the Majorana valve. Prof. Fleming has called these plates the potential plates. The circuit in which this is employed is shown in Fig. 2, where it will again be seen that the two controlling elements are connected directly across the receiving circuit.

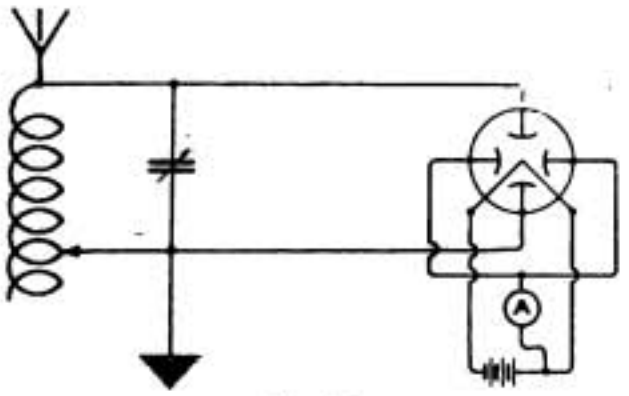


Fig. 2.

When the valve is in action the usual anode-filament current is established, and an incoming signal, induced from the aerial into the secondary circuit A, produces a difference of potential across the ends of the inductance of that circuit, with a consequent P.D. between the plates A_2 and A_4, with the result that there is a decrease in the anode-filament current. The characteristic curve, illustrating the action of this valve, is shown in Fig. 3, from which it will be seen that a potential difference on the potential plates produces a fall in the thermionic current from the filament to the collecting plates. It will be clearly seen that the extent of this decrease is determined by the potential difference applied to the plates, so that the results obtained are proportionate to the amplitude of the radio signals taking place in the wireless circuit.

It will be noticed in the above two cases that there is one very marked difference, and that is that the former type embodies the two controlling electrodes directly in the electronic stream whilst in the latter this is not so. This is shown in the two diagrams on the board (*one a sketch of Dr. Fleming's four-electrode valve and the other with filament, two grids and plate in succession*).

There are two other similar forms of quadrodes, due to Mr. Hesketh and Mr. Scott-Taggart respectively. The latter uses an identical circuit to that employed by Prof. Fleming, but employs a grid leak to allow the negative charges to leak away from the control elements or potential plates.

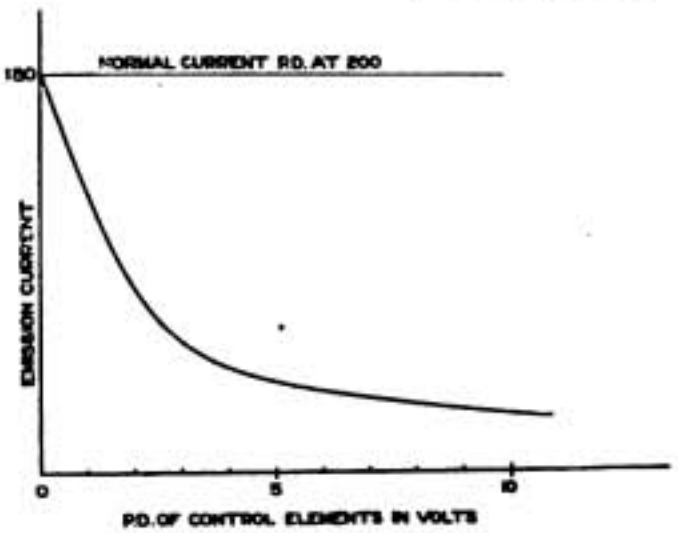


Fig. 3.

The above-mentioned forms are of interest from an historic point of view, in that they mark another step in the progress of the thermionic valve practice in radiotelegraphy and radiotelephony, but cannot be said to be instruments of great practical value, in view of the fact that their uses and sensitiveness are not superior to those of existing methods of rectifying and amplifying.

The next types which I intend to describe, however, are of interest from the fact that they are a considerable improvement over existing types of triodes, inasmuch as they function in such a manner that one of these valves will do the work of two or three triodes, or will allow C.W. reception other than by the existing known methods.

There are several well-known types of quadrodes, the first being known as the Marconi Four-Electrode Valve, the next two being due to Mr. Scott-Taggart, and the last a German pattern which I have drawn up on the board here (*filament, grids and plate in succession*). This is the usual Telefunken bulb, and a glass support which holds the outer electrode and the two grids and the filament and the connections coming through. Germans are very good glassworkers and make a satisfactory job of this type of valve.

The three first mentioned are now commercial articles, and are used in the Marine Radiotelegraphic Service. In view of the fact that Mr. Scott-Taggart is here, and will I hope give us a description of his valves and circuits, I will not dwell on these two forms but will now describe the Marconi quadrode and its attendant circuits, whereby may be obtained, with one valve, a one-stage H.F. amplification, rectification, and a one-stage L.F. amplification.

In appearance this valve is very similar to the familiar "Q" type, but slightly larger in external dimensions, and possesses, in addition to the usual mesh grid, an additional grid of a spiral form.

The electrodes are known as the "first grid," "second grid," and "outer electrode," and connections are made by means of metal pips on the outside of the glass.

Fig. 4 shows you roughly the general construction of these valves, showing the spiral grid and the mesh grid, and the outer electrode.

The next illustration (Fig. 5) shows a simplified

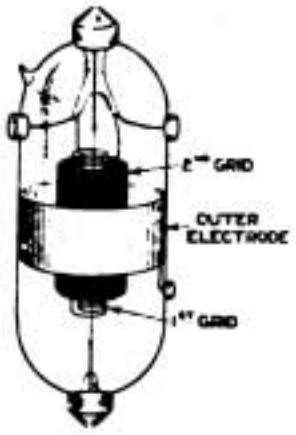


Fig. 4.

diagram of connections, when using this quadrode for the purpose of rectification. It will be seen that the connections of the second grid, are similar to those of the anode circuit for a triode arrangement, the high-tension battery being connected in this circuit for the purpose of attracting the negative electrons given off from the filament.

This second grid, in fact, functions similarly to that of an anode of a triode, but since it has the construction of a grid, the electrons on reaching it pass through due to the velocity they have attained on their journey from the filament.

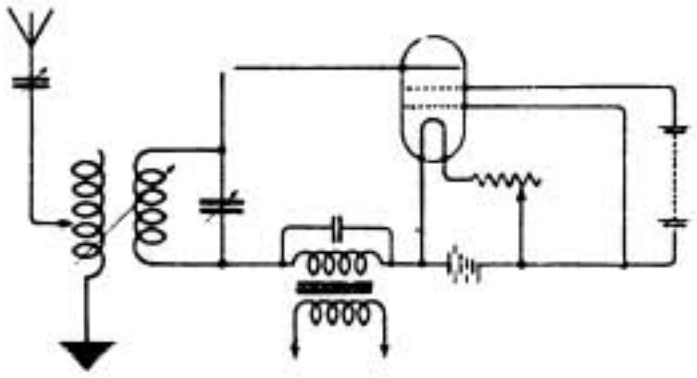


Fig. 5.

Now the outer electrode is connected to the negative end of the filament, consequently, the electrons on passing through the second grid, come under the influence of a negative charge and are retarded.

A drop in volts across the second grid and outer plate results, which, it will readily be seen, is equal to the rise in volts between the filament and first grid, therefore the speed of the electron at the outer plate will be equal to its speed at the filament, which is zero.

If an alternating E.M.F., due to induced oscillations from radio signals in the wireless circuit is applied across the outer electrode and negative end of the filament, as shown in the diagram, the positive halves of the oscillations will cause the electrons to be attracted, and during the negative halves repelled. A rectified current will therefore flow in the outer electrode circuit in series with which is a telephone transformer.

The foregoing illustrates the manner in which the quadrode can be made to operate as a rectifier, but with the aid of the circuit shown in Fig. 6, a one-step high-frequency amplification is obtained in addition.

Referring back once again to the action of the triode, it is well known that by carefully adjusting the potential of the grid relative to the filament, a current can be produced in the anode circuit of greater magnitude than that of the induced current of the radio signals flowing in the grid circuit.

It has already been pointed out that the second grid of the quadrode takes the place of the anode in the triode, so that the magnified current due to the radio signals in the wireless circuit is produced in the circuit of the second grid. In this circuit a primary winding A of a high-frequency type of transformer is connected, the secondary B of which is in the outer electrode circuit.

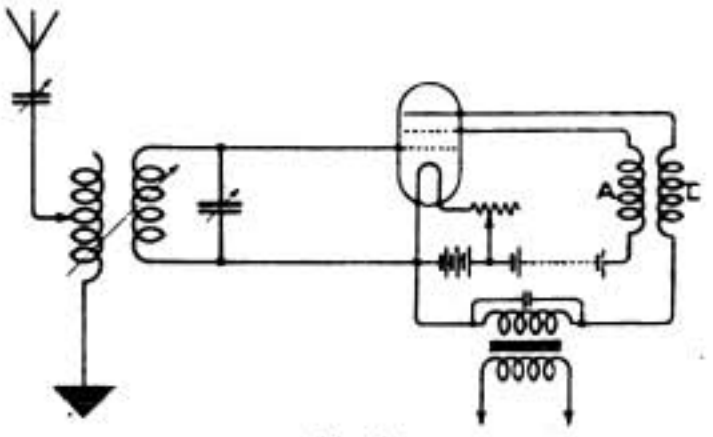


Fig. 6.

It follows that the oscillations of this magnified current in the second grid circuit produces an alternating E.M.F. across the secondary B. This secondary is connected across the outer electrode and negative end of the filament, consequently the magnified current is duly rectified, and thus a one-step high-frequency amplifier and rectifier is satisfactorily obtained.

A still further stage can be accomplished by means of one of these quadrodes, whereby the low-frequency oscillations obtained in the outer grid circuit of the previous arrangement can themselves be amplified. The circuit for attaining these results is shown in Fig. 7. Here the rectified signals are impressed back on to the first grid by means of an iron core transformer, whose ratio of windings is 1/1, and a simple low-frequency triode arrangement follows, the low-frequency amplification being produced in the second grid circuit in the usual manner, in which circuit the telephone transformer is connected.

These two transformers, are shunted by two small blocking condensers in order to allow the high-frequency currents flowing in those circuits to pass freely. Thus a one-step high-frequency magnification, rectification, and a low-frequency magnification is successfully obtained with the use of one valve.

Another use of this instrument is the elimination of jamming. By means of the potentiometer the plate potential may be varied over the whole range

of the characteristic curve, so that any point on this curve may be selected at will.

Rectification occurs at either of the bends A or

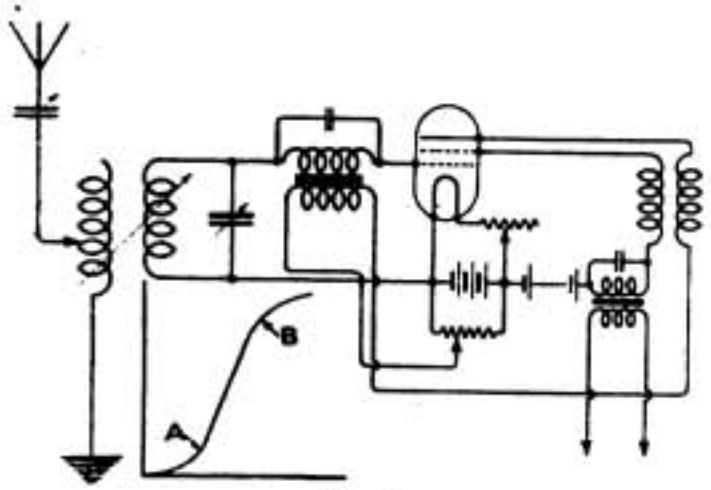


Fig. 7.

B, but as the two effects are in opposition there will be a point, near the centre of the straight part of the curve, at which the resultant rectification is zero and the signal becomes inaudible. The position of the vanishing point so obtained will be found to differ according to the quality and strength of the received signal, hence it is possible, in most cases, to so adjust the potentiometer that a jamming station is entirely cut out, while the required signals remain audible.

I have here on the table an instrument which I have just been speaking about. This is the quadrode amplifier, the potentiometer, filament resistance and a switch for varying the high frequency transformer windings. It will be seen that the last-named arrangement provides for a variation of the number of turns in the transformer so that it is possible to obtain windings corresponding to a wavelength of 300, 600 or 800 metres. Unfortunately, the tuner I am using in conjunction with this amplifier will not go down to 600 metres, in view of the long aerial we have got here, so that I am unable to demonstrate this amplifier very satisfactorily. I thought when I came here the aerial was an ordinary "Postmaster-General's" amateur type of aerial, but it is considerably longer. However, if any of you like to come up afterwards you can test the apparatus for yourself.

The question of inserting further electrodes into the bulb of a thermionic valve, in addition to those of the quadrode, has already been considered. In this connection, however, it should be borne in mind that with each additional electrode the construction of the valve becomes more difficult. A circuit devised by Capt. Round, wherein a valve containing three grids, G_1, G_2, and G_3, and one plate, P, is employed, is shown on the board (Fig. 8). Here the incoming high frequency oscillations in the circuit A are impressed by means of the usual high frequency type of transformer T, between G_1 and the filament. Magnified current will flow in the circuit of the second grid, G_2, this grid serving as an anode. By means of the transformer T_1, magnified P.D. is impressed between the third grid, G_3, and the filament, so that a second magnification takes place in the actual plate circuit. The signals so obtained in the circuit S, by means of the H.F. transformer T_2, can then be suitably rectified.

There are numerous other ways of dealing with these additional electrodes, which I have not got time to go into now.

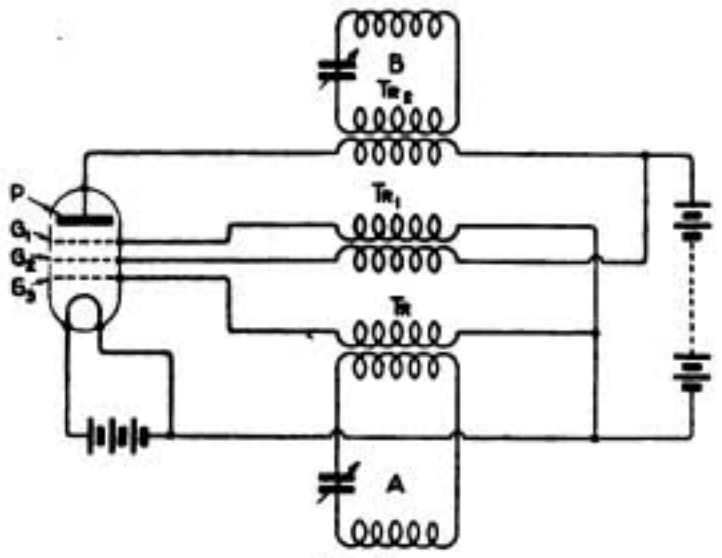


Fig. 8.

In conclusion, I would like to state that I personally have had experience only with the Marconi Four-Electrode type, and that the remainder of my paper must be taken as a collection of data, which I trust will have proved interesting; and I now hope that we shall have the pleasure of hearing some of our other members' experiences in connection with quadrodes.

(To be continued.)

New Amateur Wavelength.

In a speech in the House of Commons on Thursday, May 4th, Sir Henry Norman made special reference to the position of the amateur wireless experimenter in this country. He said there was a large and enthusiastic body of scientific workers in this country who were keenly interested in amateur wireless. He estimated that there were at least 10,000 at the present time and that before long this number would probably reach 100,000. The decision of the Committee which the Postmaster-General had appointed, had now removed some of the restrictions on their operations. A new wavelength of 440 metres had been sanctioned for transmission and the wireless amateur was to be exempt from inspection of his receiving station and would no longer be restricted as to the length of receiving aerials.

Sir Henry Norman paid a tribute to the work of the amateurs and expressed the opinion that they deserved all the encouragement they could get. He referred to their services given during the war and emphasised the importance of this body in the event of any future crisis. It was also pointed out that there should not exist amongst amateur wireless workers any feeling that the public services were unsympathetic towards them. On the contrary the desire existed to give them all the freedom which was compatible with public interest.

Sir Henry Norman acted as Chairman of the Sub-Committee of the Imperial Communications Committee, which considered the question of wireless telephone broadcasting, and whose report formed the basis for the Postmaster-General's scheme.

A Change-Over Switch

By CYRIL J. MORLEY.

IN common with most amateur experimenters in Wireless Reception I have long realised the need of a quick and easy method of changing from one set of coils to another, and while trying various means of doing this was faced with the difficulty of obviating the dead end effects of the unused coils. To eliminate these effects this switch has been designed.

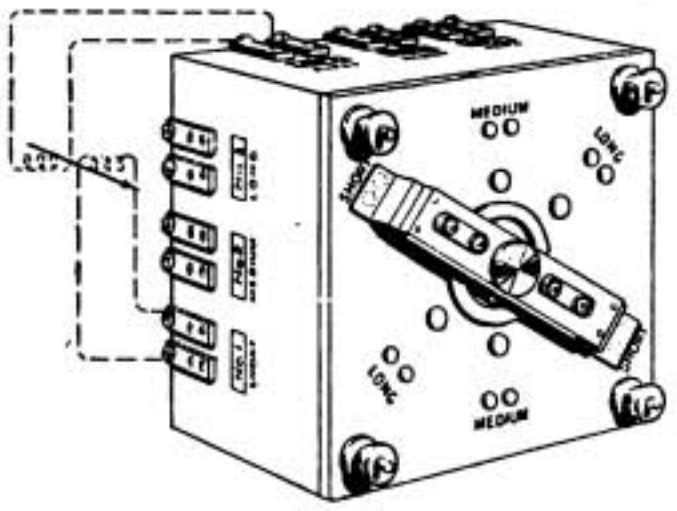


Fig. 1.

Being a user of the three types of coil—cylindrical, honeycomb, and basket wound—it was extremely desirable for purposes of comparison to be able to instantly change from one set to another without the undoing of terminals, etc., whereby valuable time is lost and comparison rendered impossible.

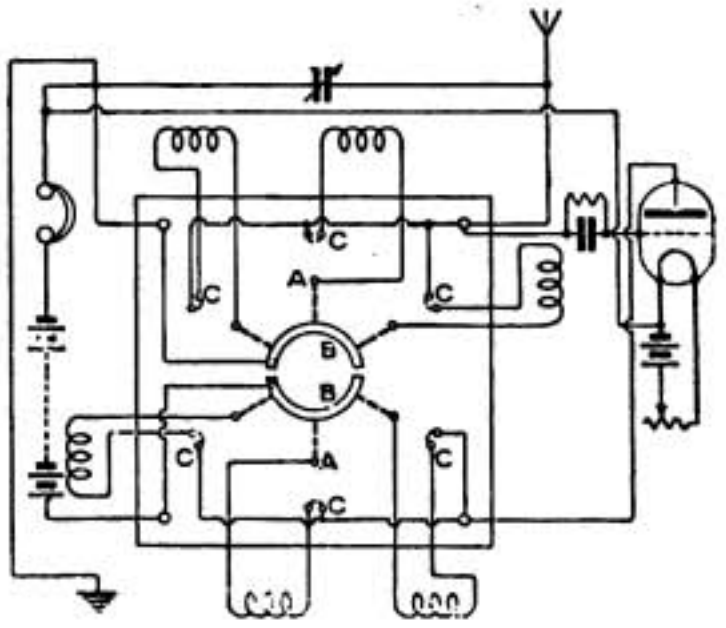


Fig. 3.

For variation of circuit I use a valve panel, described in *The Wireless World* and, in addition, the switch illustrated in Fig. 1 enables me to

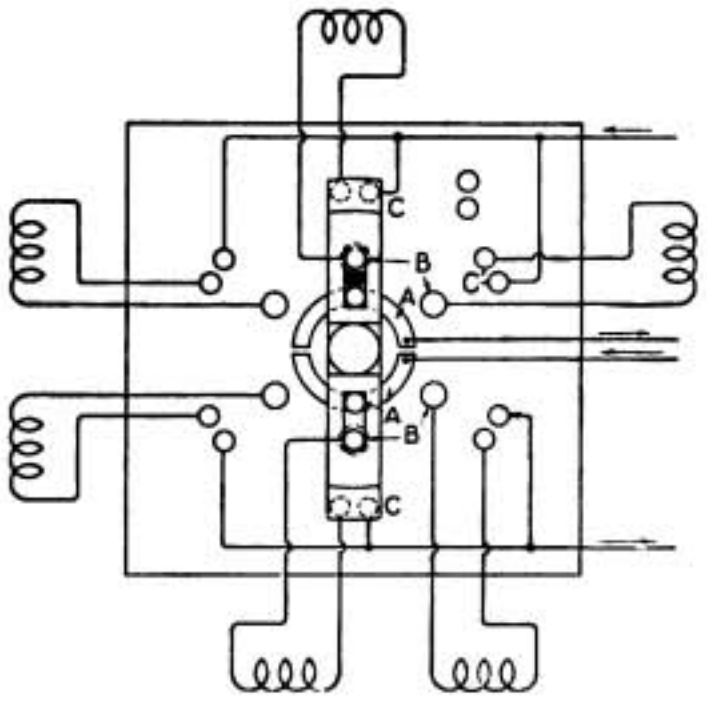


Fig. 2.

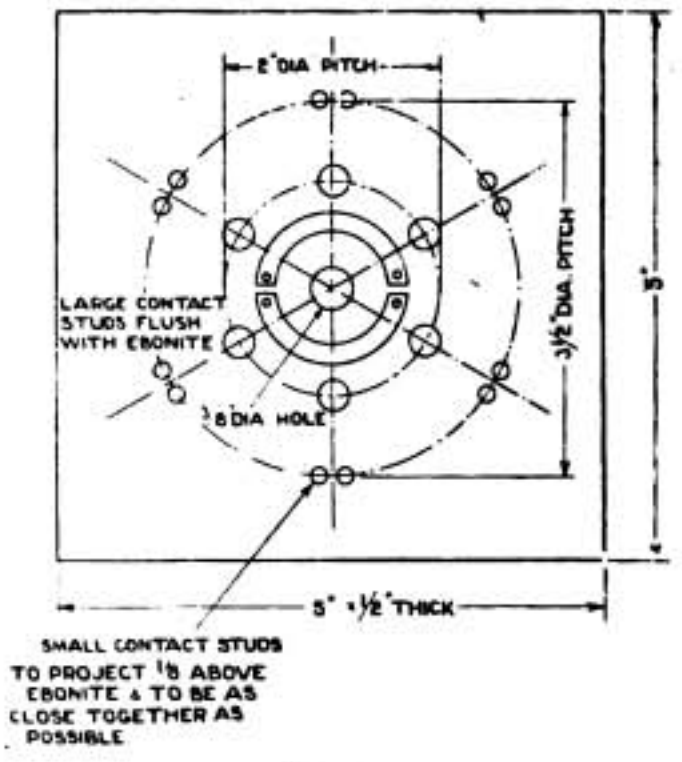


Fig. 4.

compare the results of various coils on the same wavelength.

It will be seen that with one movement of the

switch arm any one of the three sets of coils can be brought into use instantly without having recourse to altering connections, and it is to be understood that this switch is not limited to three sets of coils but is suitable for any number, and should be of great use to the average amateur for, say, a long wave set, short wave set, and medium wave set, any of which can be brought into use immediately without having any dead end effect from the two sets not in use, or the switch may be used for comparison of different coils for same wavelength.

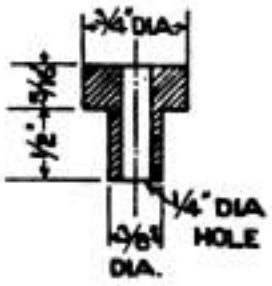


Fig. 5.

A diagram of the connections is given in Fig. 2, and on reference it will be seen that the switch comprises two circles of studs and two collector rings, contacts being made at A and B by spring contacts taken out of lamp holders, and at C by a piece of springy brass which short circuits two adjacent studs and completes the circuit for the particular coil in use. The switch arm is made of ebonite.

In Fig. 3 is given diagram of connections for ordinary reaction circuit using one valve only. The connections made by the switch arm are shown by the dotted lines, *i.e.*, from ring B to stud A, and from stud C to C, thus completing the circuit. The reaction coil circuit is completed in the same manner.

Full diagram of connections is given in Fig. 2, and it will be noticed that every coil is absolutely independent until connected by switch arm.

Fig. 6.

Full details for component parts are given herewith :—

1 Switch arm,
1 Centre bush,
1 Switch arm pivot,
18 Contact studs,
2 Collector rings,
1 Ebonite base.

Into the ebonite switch arm are screwed four spring contacts, A.A., these being connected at the top as shown at B. The contact for the outer ring of studs is made of 1/64" German silver, chosen because of its springiness.

To construct this switch, first get a panel of ebonite 5" × 5" × ¼" (Fig. 4). From the centre of this panel scribe a 3½" diameter circle and mark off the centre lines at every 60°. From the same centre scribe a 2" diameter circle. Drill a ⅜" hole in centre and drive in centre bush (Fig. 5). Next fix the collector rings (Fig. 6), and fix contact studs on 2" circle. These must be countersunk in until they are flush with the ebonite. Then fix the outer ring of contact studs and face them all up level. This completes the Switch Panel.

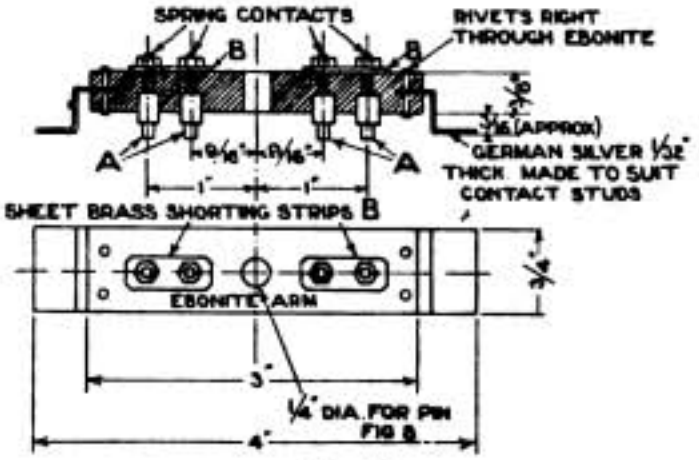


Fig. 7.

To make the Switch Arm, Fig. 7, take a piece of ebonite or fibre 3" long, ¾" wide, ⅜" thick, drill a ¼" hole in the centre. Drive in the Switch Arm Pivot (Fig. 8), and then at 1" from the centre each way counterbore for and fix the spring contact A.

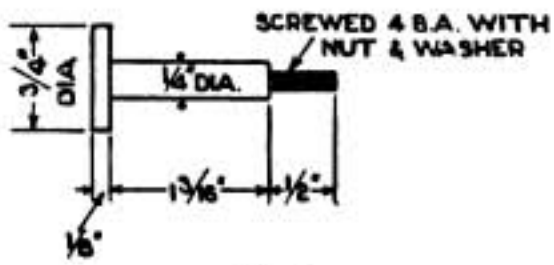


Fig. 8.

Then at 9/16" from the centre each way fix the spring contact B. The German silver contacts must now be fixed. Saw cut the ends of ebonite arm as shown, bend the German silver down until it makes a good contact and shorts the adjacent outer studs.

Fig. 1 is merely a suggested method of finishing the Switch.

A PRIZE WINNING CIRCUIT.

The prize award offered by MESSRS. B. HESKETH for the best circuit used in the reception of the Transatlantic Tests, has been awarded after very careful investigation, to MR. H. H. WHITFIELD, who was also the winner of the second prize for reception of American signals.

A description of the circuit and apparatus used by Mr. Whitfield appeared on pp. 681-684 of the issue of *The Wireless World* for February 4th, 1922.

The Radiotelephone Broadcasting

THE announcement which has been so eagerly awaited regarding the facilities to be given for Radio Telephone Broadcasting has now been made by the Postmaster-General. In the House of Commons on Thursday afternoon, May 4th, Mr. Kellaway announced that the recommendations of the Wireless Sub-Committee of the Imperial Communications Committee, which had been appointed to consider the question of broadcasting, had been accepted, and the Postmaster-General then outlined the system which he had sanctioned.

This country is to be divided into areas and broadcasting stations will be located in each area, the following towns forming the centres :—London, Plymouth, Manchester, Glasgow or Edinburgh, Cardiff, Birmingham, Newcastle, and Aberdeen. One or more broadcasting stations will be allowed in each area.

Permission to conduct the broadcasting service will be given to British firms who are *bona fide* manufacturers of wireless apparatus and the Postmaster-General is calling together the representatives of the firms who have made application for this permission, in order that some system can be worked out which will be satisfactory to all concerned.

The limit of power for each broadcasting station is fixed at 1½ kW, and the wavelength is to be such that no interference will be caused with other services and transmissions in each particular area.

Times of broadcasting are fixed for 5 p.m. until 11 p.m. on weekdays with no restrictions as to time on Sundays.

A licence to install a wireless receiving set will cost 10s. and these licences will be obtainable through any Post Office.

So opens in this country a new field of communication, the ultimate future of which it is not yet possible to appreciate. We may, however, look forward to the time when it will be imperative, if one wishes to keep abreast of the times, to install a wireless receiving station at home, and those who do not take advantage of the facilities not offered will be depriving themselves, not only of the enjoyment which may be obtained in the home from listening to musical selections, concerts and so forth, but also any items of general information which may be broadcasted, including lectures and possibly sermons on Sundays. The exact character and classes of news which it will be permitted to transmit has not yet been decided upon by the Postmaster-General.

No doubt full consideration has been given by the authorities to the possibility of serious interference if the wireless telephone receiving sets supplied to the general public are of such a nature as to permit of radiation. This point is still more important when we consider that the vast majority of those who will be installing wireless telephone receivers in the near future will be ignorant of the most elementary points of wireless theory, and will operate their sets entirely by rule of thumb. It would seem desirable that in issuing permits for the reception of telephony, that the Postmaster-General should make a very marked distinction between permits for experimental wireless and permits for the installation of a set where the user merely desires to avail himself of the broadcasting service.

At the present time, when application is made for a licence to conduct experiments in wireless telegraphy, the applicant is required to satisfy the Postmaster-General as to his ability to handle the apparatus without causing interference by radiation.

It would seem necessary for the proper regulation of wireless in this country that the types of sets to be used in the reception of the broadcasted transmissions should be approved by the Post Office Authorities before being supplied to holders of licences. If these sets were "registered" as it were, at the Post Office, a sample set being submitted by the wireless firm supplying, the position of the *bona fide* experimenter would then be clearly defined and his liberty would not be interfered with. Perhaps, by making this distinction the Postmaster-General might see his way to giving even greater facilities to the *bona fide* experimenter than is the case at present.

In approving applications for permits to conduct the broadcasting service, the Postmaster-General has obviously a difficult task before him. It is essential that no firm should undertake lightly such a service, as the expense of maintaining the service will doubtless be considerable. The financial gain to the firms who undertake the broadcasting service will depend upon the number of receiving sets which they are able to sell. Obviously then it would be grossly unfair for any firm to undertake broadcasting, without giving full guarantees not only of their ability to maintain the service without interruption, and efficiently from a technical point of view, but also that the nature of the transmissions given would be maintained at a reasonable standard.

In his statement Mr. Kellaway made reference to what was being done in the United States in the matter of supplying Radio Telephony Broadcasting Services, and the point was mentioned that the United States Government had found it necessary to reconsider the whole question with a view to controlling the use of wireless, particularly in respect to amateur transmitting stations. As Mr. Kellaway added, "we in this country have been able to profit by the experience of the authorities in the United States and are in a position to legislate in such a way as to prevent any such state of chaos as was threatened in the United States." There, as is generally known, there are no restrictions as to the installation of receiving stations and transmitting licences have been very easily given in the past. Perhaps we might suggest that here again the experience of the United States authorities only serves to emphasise the necessity of distinguishing carefully between the *bona fide* experimenter and the general public.

No doubt there is a very great future for wireless in this country and to use the words of the Postmaster-General in his concluding remarks on the subject in the House of Commons, "the possibilities of this service are almost unlimited. In the United States of America it was suggested that some arrangement might be made by which speeches of

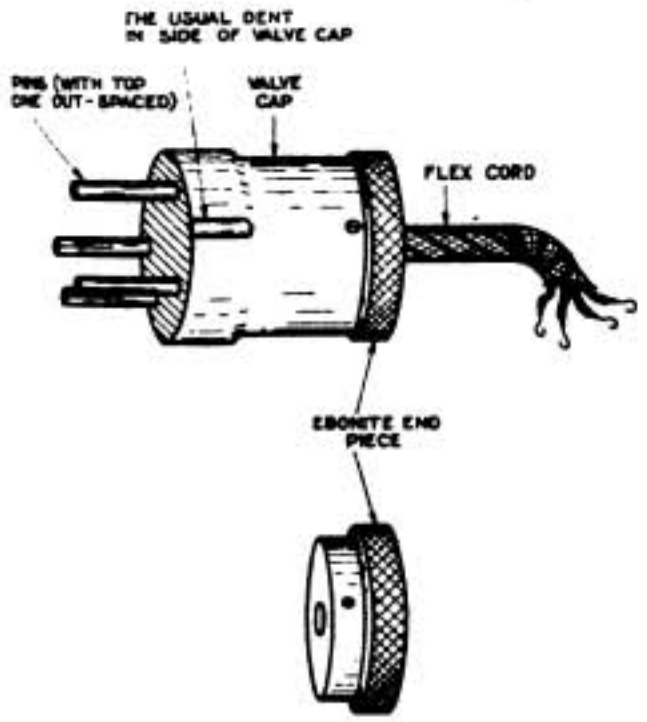
members of Congress might be radiated, and I can foresee a time when perhaps on this table a receiver will be properly concealed so as not to jar the æsthetic sense of members, and their eloquence will be transmitted to those of their constituents who are prepared to pay the cost."

The Broadcasting Service cannot but serve to foster still further the national spirit of our Island Kingdom, and will undoubtedly extend in the near future to all parts of the Empire.

A Four-Way Plug

By V. D. BROOKER.

NO doubt everyone dealing with up-to-date "wireless" apparatus on which valves are employed, has at some time or other experienced the misfortune of either breaking a valve or of having it burnt out. The result being that the old broken valve is usually thrown away as being of no further use, and following is given a description where the same could be used in the making of an efficient non-reversible four-way plug. All that is required of the valve is the plug portion, therefore, first of all, the glass bulb and interior must be removed. When this has been done it will be noticed that left behind, is what might be termed a copper cup with an insulated base, in which are fixed the four pins of the valve. By the side or through the pins are four holes, where the wires from the plate, grid and filament of the valve were previously threaded through the insulated base, and soldered on to the pins. Next



is required two lengths of town main flexible twin wire, these being long enough to suit the requirements. The eight ends of this wire are then each bared for a distance of about ½ inch and four of them are threaded through the holes in the old valve base and soldered to the four pins. On reaching this stage it has been found that melted sealing-wax, poured into the copper cup, will hold the four wires perfectly tight and also serve as an excellent insulator. Where several plugs might be required, different coloured sealing-wax could be used in each case, in order that the plugs may be distinguished one from the other and so avoid confusion. Where a little more elaborate finish might be required, these copper valve bases need not be filled right full with wax, but about ¼ of an inch from the top be allowed in order that an ebonite or wooden top may be fitted and secured through the sides by three screws (Fig. 1). When the sealing-wax is cold, the two lengths of flexible wire can be twisted together and the end bound, which will make a very neat four-way cord. The remaining four bared ends for connecting to the apparatus may be finished off with any form of wire grip or connection according to whichever is claimed to be the most suitable. On the receiver or other apparatus, as the case may be, an "R" valve socket can be fixed, and by means of this cheap home-made plug, any tuner, transformer (H.T. and L.T. together), and other apparatus can be connected quickly and without any fear of them becoming reversed.

One of these plugs has been constantly in use for twelve months and is now working well.

Notes

Death of Captain Carus-Wilson, M.C.

Captain Louis Charles Carus-Wilson, M.C., Assistant Experimental Officer at the S.E.E., Woolwich, has died at Brighton from illness contracted whilst on service in the near East.

In 1919 Captain Carus-Wilson was selected by the War Office to be the representative British officer at the Ecole Supérieure d'Electricité of Paris. There he won the diploma in radiotelegraphy, and was first on the list of foreign officers who completed the course. He was appointed to represent the War Office during the installation of the Cairo station.

Short Wave Directional Wireless.

Important research has been carried on in connection with directional transmission on very short wavelengths and in a paper given before the Institution of Electrical Engineers on Wednesday, May 3rd, Mr. C. S. Franklin, an experimental engineer of Marconi's Wireless Telegraph Company, disclosed some hitherto unpublished information on this subject.

Employing a wavelength of only fifteen metres, duplex wireless telephony has been carried on between London and Birmingham, which has been audible only at the specially designed stations carrying on the experiments.

Another result of this research has been the evolution of a "wireless lighthouse," which may mean much for the safety of navigation. A wireless beam, radiated by a revolving transmitter, can be made to indicate to a ship its exact position with respect to the "wireless lighthouse."

The apparatus concerned was demonstrated with a transmitter using a wavelength of only one metre.

The Dutch Concerts and Interference.

In our issue of April 8th, on page 52, reference was made to complaints of jamming of the Dutch Concerts by local amateur transmissions. Since the publication of this note we have received letters of strong protest from the Secretary of the Halifax Wireless Club and from Mr. H. H. T. Burbury

These gentlemen rightly point out that with suitably selective tuning of receiving sets, interference should not be experienced from local experimental transmission on 1,000 metres, when the wavelength of the Dutch Concerts is 1,070 metres. The Secretary of the Halifax Wireless Club, who, by the bye, does not transmit, states that he listens regularly to the Dutch Concerts without any interference from local amateurs transmitting at the same time and located all round him.

A Wireless Demonstration.

Probably for the first time in history a wireless aerial was installed at a place of worship in this country on April 27th. This was done by permission of the Postmaster-General, to the Guildhouse, in Eccleston Square, S.W., for the purpose of demonstrations which accompanied a lecture on Wireless Telegraphy and Telephony, given there by Mr. A. O. Gibbon, of the Engineer-in-Chief's Office, G.P.O., in aid of the funds for the League of Arts.

Loud-speaking telephones and a new method of amplification being employed, the audience were enabled to hear various items of news, music and spoken verse transmitted from the various stations around London—a typical demonstration of "broadcasting," proposals for which are now approved by the authorities. During the evening a relayed telephone "radio" message was received from Hot Springs, Arkansas, U.S.A., and successfully received by the Burnham station at Chiswick and transmitted from thence to the audience at the Guildhouse—a message of greeting to the Chairman (Mr. Pomeroy Cragg) from Miss Maud Roydon. This was received with tremendous applause.

Mr. Harry Lauder then sang two songs, which were received with astonishing clearness.

The apparatus on view and in use included specimens of the G.P.O. instruments, Western Electric, Burndept Co., Ltd., S. G. Brown, Ltd., and others.

For a most successful evening thanks are due to Mr. A. O. Gibbon, Engineer, G.P.O., and Mr. E. J. N. Winstone, Chief Inspector, G.P.O., for the excellent manner in which everything was worked and explained.

Broadcasting Wavelengths.

Sir Henry Norman announces that the authorities have allotted the band of wavelengths from 350 to 425 metres for Broadcasting.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Whilst listening-in to-night at about 8.20 p.m. on a three-valve set, we picked up strong telephony on 800 metres. He was calling "ABC de XYZ," and gave us (*a*) a recitation of humorous poetry; (*b*) a song; (*c*) a gramophone record; (*d*) another record—"Swanee"; (*e*) another song. He then called "CQ" and promised further concerts on Tuesday evening, April 25th, at 8.30 p.m., and Friday evening, April 28th, at 8 p.m. on 800 ms.

If you can find space for this, readers who have not yet heard this may be glad to listen-in and perhaps someone can tell us who "XYZ" is. Perhaps XYZ himself would oblige. The signal strength here at Wolverhampton was considerably louder than **2MT**, but jamming from a harmonic of a French automatic C.W. station was appalling.

T. W. HIGGS.
A. C. H. BASSANO.

Dunstall House,
Wolverhampton.
April 20th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The Committee of the Wireless Society of London has wisely recommended that the general use by amateurs of 1,000 metres should cease.

Pending the adoption of this recommendation, may I, as one of the many listeners to the Dutch concerts on Sunday afternoons implore the amateurs who have telephonic transmitting licences to moderate their exuberance at such times and, as they are strong, to be merciful.

Croydon, of course, is a recognised necessity and his official conversations with Lympne and various aeroplanes are always brief, terse and to the point, but even Croydon has occasionally to raise his stentorian voice to request silence on the part of some amateur who is jamming intercommunication with an aeroplane.

I hoped that Croydon's request last Sunday afternoon for cessation of transmission was addressed to an unknown individual in my neighbourhood who was carrying on an interminable conversation about nothing in particular with another experimenter whom he addressed as "er . . . old chap." Unfortunately for me it was some other transmitter who was interrupting Croydon.

My unknown neighbour complains frequently to "er . . . old chap" of the jamming of other amateurs in his locality but confesses that he keeps his P.O. telephone number secret, presumably to avoid complaints about his own transmission.

It is more than exasperating when listening to the Hague concert to have a fine rendering of "A Lover in Damascus" overpowered by a blatant cornet solo or chippy rag-time as performed on my unknown neighbour's gramophone.

I find it impossible to tune him out, and therefore infer that he must either be very near me or else abnormally strong.

Chiswick W.4. W. H. MERRIMAN.
April 24*th*, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to the tests carried out by **2AW** and **2QK**, which I consider are very good, perhaps my experiences may interest them. Up to recently, about two weeks ago, I never used more than 0·01 amp. in the aerial on 1,000 λ, although I could use more. I was received O.K. about eight weeks ago in Manchester, about 90 miles, on 5 valves, and also by Mr. Ward, about 70-80 miles, easily, so I was informed by **2KQ** I might add that I have been heard fairly well at 5 miles, on about 20 volts H.T., all above, of course, are speech. Station call **2NA** has obtained similar results also. Finally, I may add that my aerial ammeter is quite O.K.

2 H.F.

Birmingham.
April 20*th*, 1922.

Book Reviews

THE "PRACTICAL ENGINEER" ELECTRICAL POCKET BOOK AND DIARY, 1922. (London: *The Technical Publishing Company, Ltd.* Twenty-third edition. Pp. 610 + cxxxiv. $3\frac{1}{4}" \times 5\frac{1}{2}"$. Price, cloth 2s., leather 2s. 6d. net.)

This is the new annual edition of a handy reference book well known to most practical electrical engineers. It is mainly a note book of condensed information under 35 different headings. All the usual tables dealing with wire gauges, carrying capacities, cable constants, specific resistances, screw gauges, Whitworth's standards, are included, and have evidently been brought well up to date. Short articles are included on testing, instruments, transformers, motors, lamps, welding, etc., and, in short, a very great deal of information is compressed into a relatively small space. It is a pity that the Wiring Tables of the I.E.E., shown on page 95, *et seq.*, have the gauge expressed in S.W.G., whereas wires are now always referred to by their diameter in decimals of an inch (*i.e.*, 7/·064, instead of 7/16, etc.).

The whole subject of wireless has been allotted ten pages only, five of which are devoted to spark transmission and reception with the old Marconi 31A crystal receiver. Valve reception is dealt with in one page and transmission in another; finally, the whole subject of wireless telephony is allocated just over half a page of text plus two diagrams. A choke control transmitter is illustrated but the illustration omits to show any iron core to the choke in the H.T. supply!

While the book is of no value to the wireless amateur from the point of view of information on wireless practice, it is distinctly valuable as a handy pocket collection of data regarding general electrical engineering. The diary gives one week to each page. Finally, a short dictionary of technical terms is given in French, Spanish and Russian: the Spanish portion is somewhat academic in its translations, witness "*Gomas Para Ruedas de Locomotoras*" for "*Tyres for locomotives*"; we hardly think that rubber tyres have as yet become usual for even Spanish locomotives! F. P.

MARINE WIRELESS POCKET BOOK. By W. H. Marchant. (London: *Sir Isaac Pitman & Sons, Ltd.* 1922. Pp. 180. $4" \times 6\frac{1}{2}"$. Price 6s. net.)

As is stated in the preface, this little book is very evidently intended for the guidance of the sea-going wireless operator, as comparatively few pages are devoted to *general* technical information. What information of that nature *is* given is set out very concisely and clearly, and is very much to the point. Some 70 pages are devoted to a description of the standard ship transmitters and receivers (spark) of the Marconi Company, Radio Communication Company and Telefunken Company, and there is little information in those pages of any interest to the amateur. Some 12 pages are devoted to the description of several types of Marconi valve receivers, but nothing new or of much interest is described. It is a pity that a book published so recently for the sea-going operator does not even mention the Marconi Standard Marine Receiver, using a single four-electrode valve to perform simultaneously the functions of H.F. amplifier, detector and L.F. amplifier. We understand that this instrument is being supplied to large numbers of ships, and is regarded as the standard valve receiver for ship work.

The book concludes with a few pages of regulations affecting ships and land stations, abbreviations, codes, time signals, weather reports, and a particularly concise and well-illustrated glossary.

In conclusion, while this book should prove of real use to operators and to those training as operators, it is of no utility to the average amateur. F. P.

Calendar of Current Events

Saturday, May 13th.

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

Afternoon.—Visit to Victoria Telephone Exchange.

Sunday, May 14th.

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

Tuesday, May 16th.

Transmission of Telephony at 7 to 7.25 p.m. on 700 metres, followed by C.W. calibration signals on 1,000 metres, by **2 MT**, Writtle, near Chelmsford.

Wednesday, May 17th.

NORTH MIDDLESEX WIRELESS CLUB.

8.30 *p.m.*—At Shaftesbury Hall, Bowes Park, "The Advantages of Sectional Wireless," by Mr. Edward McT. Reece.

Thursday, May 18th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "Electricity and Matter," by Prof. Sir Ernest Rutherford, K.B.E., F.R.S.

Friday, May 19th.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—"Valve Characteristics and the Practical Measurement of Valve Constants," by Mr. L. Grinstead.

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

7 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "The Elimination of Atmospherics in Radio Telegraphy," by Mr. A. H. Reeves.

BIRMINGHAM EXPERIMENTAL WIRELESS CLUB.

7.30 *p.m.*—At the Digbeth Institute, "Elementary Wireless Telegraphy" (illustrated by lantern slides), by Mr. Frank S. Adams.

Tuesday, May 23rd.

WOLVERHAMPTON AND DISTRICT WIRELESS SOCIETY.

8 *p.m.*—At 26, King Street, Wolverhampton, "The Electronic Theory," by Mr. Blakemore.

Wednesday, May 24th.

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Lecture by Dr. Richardson.

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (tea 5.30 *p.m.*).—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, "Some Effects of Capacity on Mutual Induction with special reference to their Application to the Elimination of Jamming," by Mr. J. H. Reeves.

Friday, May 26th.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—"The Amateur Set," by Mr. T. Brown Thomson.

Wireless Club Reports

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

Edinburgh and District Radio Society.*

Hon. Secretary, Mr. W. Winkler, 9, Ettrick Road, Edinburgh.

The Society has been honoured by Sir J. Alfred Ewing (Principal of Edinburgh University), who has accepted the Hon. Presidency, and Mr. J. S. Smith (of G.P.O., Edinburgh), who becomes Chairman and Vice-President.

Other Vice-Presidents are :—Mr. G. D. Crichton and Mr. H. W. Clark.

Among other resolutions passed at the Annual Meeting of the 5th inst., the following are of general interest.

(1) Members in future must have attained the age of 18 years. Candidates under this age may become "Associate" members, and shall pay the reduced annual subscription of 5s. (in place of 12s. 6d.).

(2) The Council shall in future consist of six members, exclusive of the three V.P's., but including the Hon. Treasurer and Hon. Secretary., i.e., nine members in all.

A sale of apparatus will take place on Wednesday, May 11th, when the next General Meeting will be held.

Before the conclusion of the meeting a very hearty vote of thanks was accorded to Mr. Crichton for the admirable way in which he had filled the Chair during the past session, to the great benefit of the Society.

Mr. Crichton replied by thanking the Council for the enthusiastic manner in which they had assisted him.

Members are reminded that their subscriptions are now due, and will be gladly received by Mr. Crombie.

The close of our second year shows a very satisfactory position generally. Our balance-sheet shows a "cash in hand" balance of over £18. Our membership has passed 60, 50 per cent. of this number having receiving licences of their own.

During the next few weeks we hope to be established in our new Headquarters, c/o The Royal Scottish Society of Arts, at 117, George Street, which will be to our advantage in more ways than one.

Cardiff and South Wales Wireless Society.*

On Thursday, April 6th, 1922, a joint meeting of the above Society and the Permanent Way Institution was held at Headquarters, Mr. N. M. Drysdale, presiding. Mr. A. W. M. Dyke gave a lecture entitled "Elementary Principles of Telephony." The lecture was highly interesting and instructive, the lecturer illustrating the many points dealt with by means of practical experiments. The Chairman, in proposing a hearty vote of thanks to the lecturer, remarked upon the great trouble which Mr. Dyke must have gone to in bringing such a large selection of apparatus from Neath.

Mr. W. Cleaver, Engineer, Port Talbot Docks, President of the P.W.I., thanked the Society for arranging the joint meeting, and stated that he would let the Secretary know when the P.W.I. meetings were being held at Cardiff, inviting our members to attend. Mr. G. Towers, Vice-President, Birmingham Wireless Society, who was on a visit to Cardiff, was introduced to the meeting. Mr. Towers expressed his delight at seeing such a flourishing Society at Cardiff.

A General Meeting was held at Headquarters on Thursday, April 20th, 1922. Mr. N. M. Drysdale occupied the Chair, when a discussion took place on "Methods of Coupling Valves." The Chairman, in his opening remarks, extended a hearty welcome to Mr. E. Ogden, P.O. Engineer, who, it was explained, is a very keen radio experimenter.

Mr. H. C. Linck in opening the discussion gave his experiences of (1) Resistance Coupling, (2) Reactance Capacity, (3) Transformer Coupling.

Mr. H. F. A. Sanderson detailed the difficulties met with in High Frequency working, and explained what steps he had taken in order to overcome these difficulties. Mr. H. Russell Jones related many of the experiments that he had carried out, the choke coil method being particularly good. Mr. E. Ogden in touching on the resistance capacity method said, that in view of the difficulty experienced in utilising this system for short-wave working, and the fact that the Amateur wavelength is likely to be altered to 400 metres, some other method suitable for short-wave reception would have to be devised. Messrs. H. W. Dowle, H. J. Price and Alex Lawrence also contributed valuable points of interest. Unfortunately, the evening passed all too quickly, the Chairman having to remind the meeting that time would not permit the discussion to be carried further that evening. A most hearty vote of thanks was accorded to all who had assisted in making the evening such a great success.

All gentlemen in the district interested in wireless are invited to communicate with the Hon. Secretary, Mr. P. O'Sullivan, 16, Adamsdown Square, Cardiff.

Borough of Tynemouth (Y.M.C.A.) Radio and Scientific Society.*

Hon. Secretary, Mr. L. L. Sims, "Eynesbury," Cleveland Road, North Shields.

In connection with the above Society an exhibition of films was given recently dealing with Direction Finding on one of the principal air routes.

One of the members of the Society being connected with a local picture theatre, kindly arranged for the private projection, and the exhibition was thoroughly enjoyed by the splendid number of members and friends present.

The thanks of the Society are due to Messrs. Marconi's Wireless Telegraph Company for kindly loaning us the films.

After the show, the company had the opportunity of inspecting the operating and generating rooms

of the theatre, the plant being one of the most up to date in the district.

On Monday, April 24th, the winter session of the Society was concluded under most enjoyable circumstances, a dinner having been arranged.

The President, Mr. J. E. Burnett, F.R.Met.S., presiding over a splendid attendance, amongst those present being Mr. Summers Hunter, C.B.E., Mr. Stanley Todd, Dr. Jas. A. Hislop and Mr. Rowland Lishman, J.P.

After the toast "The King" was honoured, the President proposed the health of the guests coupled with the name of Mr. Summers Hunter, C.B.E.

Mr. Hunter, who is a notable personality in engineering circles on the N.E. coast, gave an encouraging and inspiring address and related many incidents of his association with scientific men including the late Lord Kelvin.

The toast of the "Society" was proposed by Mr. Stanley Todd, Dr. Jas A. Hislop ably responding.

After the toast to the President, a welcome was given to the Secretaries of Newcastle and Sunderland Societies, who were present.

At intervals Mr. J. W. Yeates rendered amusing monologues.

The function was such an unqualified success that it has been decided to hold the dinner annually.

The first "field day" of the Society was held on Saturday, May 6th.

Leicestershire Radio and Scientific Society.*

A highly successful dance was held at the Vaughan College on April 22nd.

The arrangements were admirably carried out by the Committee. The President, Mr. C. T. Atkinson, called for a hearty vote of thanks to Mr. G. Bennett for his excellent management of the lighting and colour effects and for providing an excellent jazz orchestra, and for the general success of the evening.

Thanks are also due to Mrs. Atkinson, Pratt, Wilkins, Messrs. Atkinson, Rudkin, Wilkins, and others for their help with the refreshments, and to the M.C's., Messrs. L. Dunkley and L. Pratt, pianist, Mrs. Eld, A.L.C.M.; violinist, Miss C. Blockley.

As will be seen from above, this Society has now taken up a more extended field of operation, and the first lecture under the new regime took place on April 24th, the title being "X-Rays," and the lecturer, Mr. A. E. Ball.

A brief history of the earlier work of Prof. J. J. Thomson and Sir William Crookes was followed by a display of Vacuum Tubes and so on, step by step, up to modern times, slides being used to illustrate practical apparatus and applications.

A welcome innovation was caused by the discovery that the Society had among its members present one of the earliest workers in the science under discussion, and at the invitation of the lecturer this gentleman, Mr. E. E. Brooks, B.Sc., augmented the description by some of his reminiscences. Home-made tubes were also shown by him, and a number of radiographs taken by their aid.

Most of the members present were allowed to view the bones of their hands, and sundry other objects, by the aid of the lecturer's apparatus, a most successful evening being spent.

In conclusion, the President of the Society, Cyril T. Atkinson, Esq., proposed a very hearty vote of thanks to the lecturer, Mr. Brooks, and the lanternist, this being seconded by Mr. Pallett, and heartily endorsed by the whole company.

All communications regarding the Society should be addressed to the Hon. Secretary, Mr. J. R. Crawley, 269, Mere Road, Leicester.

The West London Wireless and Experimental Association.*

Club Rooms: Belmont Road Schools, Chiswick, W.4.

Meeting held Thursday, April 20th.—Morse practice was given by Mr. H. Wilson. "Listening in" on short wavelengths was also carried out, the results not being up to expectation.

Mr. J. F. Bruce gave a very interesting address on the "Phillips" circuit, and fully explained his experiences and experiments carried out on same, many interesting and useful hints were given in connection therewith. Afterwards a debate was opened on the following subject, and as it will probably interest wireless amateurs as a body, I give the question here, and shall be pleased to hear from any wireless enthusiasts as to their experience: "Can a condenser in series with aerial be used on short wavelengths, say 200 metres, if an A.C. supply is in the locality? If not, what is the explanation?"

Hon. Secretary, Mr. Horace W. Cotton 19, Bushey Road, Harlington, Middlesex.

Newcastle and District Amateur Wireless Association.*

Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

On Monday, April 17th, the members of the above Association listened to a very interesting lecture by Capt. Stevens on "Wireless During the War."

The lecturer, who was engaged during the war in connection with signalling arrangements, related some very interesting experiences of early trials and difficulties in France, and touched upon power buzzer work and listening sets.

The Association expect to have the pleasure of hearing Capt. Stevens again in the near future.

Liverpool Wireless Association.*

Hon. Secretary, Mr. James K. Wilkie, Junr., "Avondale," Knowsley Road, Cressington Park, Liverpool.

A meeting of the Liverpool Wireless Society was held at the Royal Institution, Colquit Street, on Thursday, April 27th. A paper was read, in the absence of Mr. Haggard (from whom the Secretary would like to hear) by Mr. James K. Wilkie (Hon. Secretary), on "Accumulators: How Made, Used and Abused." Mr. Wilkie passed round numerous exhibits of abused accumulators, and gave numerous notes on what to look out for when buying accumulators. Mr. Grindrod, who was in the chair, proposed a vote of thanks, which was seconded by Mr. Lamb and carried with applause.

It was decided to send a resolution to the Wireless Society of London, suggesting that they should send to all Members of Parliament a letter or pamphlet containing suitable data on the liberties of American amateurs and other points of interest

to the wireless amateur this side, as the report recently published in *The Wireless World and Radio Review*, page 20, vol. X, No. 1, showed that the Hon. Members were evidently not in possession of the full facts.

The Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A General Meeting was held at the Leeds University on Friday, April 28th, Mr. A. M. Bage (Vice-President) taking the chair at 8 p.m. The Chairman called upon Mr. A. F. Carter, A.M.I.E.E., to deliver a lecture entitled "The Troubles and Trials of an Amateur."

Mr. Carter commenced his lecture with an explanation of how the amateur can become a very usual person if need be. He is extremely usual at any time, and the lecturer reminded us what the pre-war amateur did for us during the war. Mr. Carter interested his audience by relating some of his early efforts at the commencement of the war, when he was still mastering the mysteries of a piece of carborundum. Getting on to more modern questions, such as crop up nowadays, he paid particular attention to the difficulties that beset an amateur who plunges for a multi-valve set, using perhaps up to five stages of H.F. amplification and to work on the widest wavelength range. The lecturer then described various H.F. transformers he had used, and with the aid of blackboard sketches and diagrams showed how they could be made to function over a wide range of wavelengths. Proceeding, he explained the 7-valve set he had on view, comprising four stages of H.F. amplification, transformer coupled; the rectifier stage and two L.F. magnifications. He described the complicated-looking switchgear, and convinced the meeting that it was much more simple than it appeared. Many other constructional details were gone into very thoroughly, and the lecturer concluded his lecture after mentioning some results he had obtained with the set.

As is usually the case at the meetings of this society, the discussion was prolonged, but exceptionally interesting. A demonstration of the set in action was then given, using the lecturer's frame aerial. **LCM, POZ, HB** and unlimited 600-metre noise came in and was made audible to the meeting by use of a loud speaking telephone.

A hearty vote of thanks was accorded to Mr. Carter. Thanks are also due to the British Wireless Supply Company for providing the essential filament current. The proceedings terminated at 10.40 p.m.

The Hon. Secretary will be only too pleased to forward particulars of the Society to amateurs in Leeds and district. Annual subscriptions, 5s.; meetings twice monthly, no associate membership; number of members, between seventy and eighty.

The Wallasey Wireless and Experimental Society.*

At the Fourteenth Meeting of the Society, held on April 27th, at 106, Albion Street, New Brighton, Mr. Mills lectured the members on "Home Instrument Making." The lecturer dealt first with the tools and materials needed; he explained that it was no use trying to do good work with poor tools and bad materials. He then explained the making of instrument cases and the polishing and finishing of the same. He then described the making of a short wave set, giving dimensions and complete directions for making each part. Mr. Mills' lecture was most instructive and entertaining. On its termination a vote of thanks to the lecturer was passed.

It has been decided to start a library of technical books for the use of the members; a small charge will be made, the proceeds going to the instrument fund. Several new members were admitted, bringing the total number of members up to thirty-six.

The Society still has room for a few members, and interested friends should write to the Hon. Secretary, 106, Albion Street, New Brighton, who will be pleased to give full particulars. Visitors will always be welcomed at the meetings each Thursday at 8 p.m. Membership cards are now available and can be obtained on application to the Secretary.

Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

At a meeting of the above Society held on Wednesday last, April 19th, at the Kingsland Assembly Rooms, a good attendance was recorded. New members still continue to flow in and the Society is getting a large membership. Arrangements are being made for the first camp, which is to be held in the New Forest in June, and some interesting experiments will be carried out. Quite a large amount of names have been given in to the Secretary for the week camp, which shows how keen the amateurs of Southampton are getting.

The buzzer practice which is given every week for 30 minutes to the members is showing good results, and it is a pleasure to state that practically every young member of this Society can read the Morse. The Society intends to continue its weekly meetings all through the summer.

A Meeting was held at the Kingsland Assembly Rooms on Wednesday April 26th. After the business of the evening, Mr. Freeman, Chairman, continued his lectures on "Single Valve Circuits," with a brief explanation of the terms rectification, H.F. amplification, and L.F. magnification, with the aid of rough blackboard characteristic curves, showing how it was possible to work the valve accordingly. The Chairman explained that H.F. amplification is by no means as straightforward a procedure as L.F. magnification. He concluded his lecture after the answering of various questions, and a demonstration was then given to the Press. Mr. Wansbrough was placed in charge of a three-valve receiver, and exceptionally good signals were recorded. With thanks to the Chairman and the Press, an enjoyable evening was brought to a close.

Any information required by any amateur in Southampton and district will be gladly given on application to the Hon. Secretary.

Ilford and District Radio Society.

At a meeting of the Society held on Thursday, April 20th, Mr. E. McT. Reece, representing Messrs. H. D. Butler & Co., lectured on "A Few Useful Circuits."

Developing his subject in a most interesting manner, Mr. Reece emphasised the necessity for having the aerial circuit in resonance by balancing inductance and capacity. This process must be repeated when using coupled circuits so that both circuits are in tune, and although any amateur worth his salt did this in the old days when crystals were universally used, modern amateurs are prone to regard single circuit working as sufficient and merely adopt the idea that an additional valve will overcome any losses. In view of the fact that, in proportion to the energy expended, a crystal is far more efficient than a valve, the best method of using a single valve is by adding it to a crystal circuit, preferably in front as a high frequency amplifier. The additional advantage of a potentiometer for adjusting the grid charge must not be lost sight of, and a demonstration proved that a considerable increase of signal strength could be gained by critical adjustment. Mr. Reece then explained a novel panel of his own construction, where, by means of plugs and switches, practically any known circuit can be quickly connected and additional steps of amplification, either H.F. or L.F., by merely lengthening the base board. Many different circuits were tried and criticised, and the simplicity with which alterations were made aroused the envy of many of us.

After the lecturer had illustrated a useful method of calibrating a set from tables published by the Admiralty, questions were asked by members and dealt with by Mr. Reece in such volume that our Chairman—Mr. H. Lassman—had eventually to close the meeting or Mr. Reece would never have got home.

On Thursday, April 27th, a concert and demonstration of radio telephony was held at the Society's Headquarters for the purpose of arousing local interest in our movements, and at the same time assisting club funds.

Much hard work had been put into the affair by our members, none of whom have had any previous experience in organising such public functions, and a packed hall was the extremely gratifying result. Several well-known artists, including Mr. Frederick Lennard and Bert Sinclair's Royal Concert Party, gave us music and humour, but the star turn of the evening to our uninitiated audience was the radio reception conducted by our Vice-President, Mr. J. E. Nickless, A.M.I.E.E. (**2 KT**). Speech and music transmitted from **2 ON** at Walthamstow and **2 JX** at Ilford were rendered audible all over the hall and a considerable distance outside by the distribution of three loud speakers. That mysterious person **QRN** was kind to us, and the clarity of the intense volume of sound was greatly appreciated. Many people could hardly credit at first that it was genuine. There is, however, no truth in the report spread by a doorkeeper that traffic was held up while tram and bus drivers stopped to listen.

When the transmission was over many members of the audience invaded the platform at the invitation of Mr. Nickless and inspected the apparatus, incidentally asking questions about the functions of the different parts. Naturally we had the dear old lady who wanted to know why we needed extra lamps when the lighting of the hall was so good.

It is believed that this most successful evening will considerably strengthen our members, while a cursory examination shows the financial aspect quite up to our expectations.

We still have plenty of room for new radio enthusiasts in the Society, and full particulars can be obtained from the Secretary, Mr. L. Vizard, 12, Seymour Gardens, Ilford.

Dundee and District Amateur Wireless Association.

At a meeting of the above Association held at the Club Rooms, Morgan Academy, on February 21st last, Mr. A. Macleod lectured on "Telephony," and together with diagrams and blackboard sketches gave a most interesting lecture.

Mr. J. Grimes lectured on "Einstein's Theory of Relativity" on February 28th, and along with blackboard sketches made clear to members present several details in this most interesting theory.

At a General Meeting on March 21st the following members were elected office-bearers for the ensuing year.

President, Mr. A. Macleod; Treasurer, Mr. R. L. D. Kennedy; Chairman and Secretary, Mr. R. H. B. Candow; Committee, Messrs. A. Cram, J. Pellow, J. Ellis, R. Brown; Librarian, Mr. W. Bullians.

Mr. A. Macleod was then instructed to draw up plans for a single valve telephone transmitter.

On April 11th, Mr. Bruce, of Edinburgh University, lectured on the subject of X-rays before a large attendance of members, and in a very able manner described the various parts of apparatus, etc.

The attendance previous to Mr. Bruce's lecture has not been altogether satisfactory, and it is hoped that in future members will appreciate these lectures more than they have done in the past.

The annual subscription of 10s. is now due, and the Treasurer would be much obliged to receive subscriptions at an early date.

Particulars as to membership can be obtained from the Secretary, Mr. R. H. B. Candow, 33, Cowgate, Dundee, or by calling at the Club Rooms, Morgan Academy, Dundee, any Tuesday evening between 7.15 and 9.15 p.m

Bolton Wireless Society.

A new aerial has now been fixed at Headquarters, and some very loud signals have been received. Good signals can be obtained from the usual American stations **WII, WQK, WSO,** etc. A two-valve H.F. amplifier is being constructed to go before the Society's A Mark IV three-valve set, and it is then hoped to get in the telephony stations.

Meetings of the Society from now will be held every Tuesday night, when, after the **2 MT** concert, morse practice will be held, after which, the meetings will be open for discussions, *impromptu* lectures, questions, and anything of general interest. Outings and visits will also be arranged and announced in due course.

There are several persons interested in wireless in this district who have not yet attached themselves to any society. To those an urgent appeal is made to add their weight to the movement by joining the Society. The Hon. Secretary, Mr. H. Chadwick, 9, Raimond Street, Bolton, will be pleased to forward particulars to any prospective member, or to see them personally at the Headquarters, Bradford Buildings, Mawdsley Street, (opposite the Technical School), any Tuesday evening.

The Wolverhampton and District Wireless Society.

The above Society made its first public appearance on Thursday evening, April 27th, when a Concert and Radio Telephony Demonstration was held in the A.J.S. Motor Works Assembly Rooms. Mr. Harry Stevens presided, and there was a large attendance. There was a most enjoyable musical programme, and the artists were Miss Maud Morgan, Miss Ethel Davis, Miss Elsie Turton, Mr, Arnold Devey, Mr. Stanley Eaton, and Mr. John Bourne.

During the interval a wireless demonstration was given on a frame aerial in the building. Songs and speeches by some of the artists in a distant part of the works were distinctly heard, and loudly applauded by the audience. The concert and demonstration were a decided success, and it is hoped to repeat it at a future date.

The next meetings will be held on May 23rd and June 6th, at 8 o'clock, when a series of discourses on the Electronic Theory will be given by a Mr. Blakemore, who is a science lecturer, and will be illustrated by special models. Prior to the meeting there will be buzzer practice commencing at 7 o'clock, at Headquarters, 26, King Street, Wolverhampton.

Hon. Secretary, Mr. Geo. W. Jones, 8, Rosebery Street, Wolverhampton.

Radio Experimental Association (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A general Meeting of the above Association was held on Thursday, April 27th, 1922, Room 74, Mechanics Hall, 7.30 p.m., when the members had the pleasure of listening to an interesting discourse upon the reception of very short waves. The lecturer, Mr. Allan, is to be complimented on the masterly way in which he dealt with the subject. We were also very interested in the piece of apparatus exhibited by Mr. Allan. The subject which always creates a wide field for discussion, did not fail to do so on this occasion, and from the views that were forthcoming it was evident that the members are very enthusiastic on this important branch of radio science. The meeting closed with a hearty vote of thanks to the lecturer for his magnificent effort.

The Paddington Wireless and Scientific Society.

At an informal meeting, held in the Paddington Institute on Saturday, April 1st, it was decided to re-form the pre-war Paddington Scientific Society and incorporate a section for the study and practice of radio telephony and telegraphy. A committee of three was appointed, consisting of Messrs. A. L. Beak, G. Turton and A. Hoban, with Mr. L. Bland Flagg as Secretary. The organising Committee met on Monday, April 3rd and formed the propositions, which, if passed by the first General Meeting of the Society, would constitute its rules.

The first General Meeting was held on Thursday, April 27th, and was well supported. The items on the agenda included the enrolment of members, the passing of rules and the election of officers. Sixteen members were enrolled and these will be augmented during the coming weeks. The suggested rules were passed unanimously. The following officers were elected, and will hold office for one year: President, Mr. A. G. Cook, M.A., A.M.I.E.E.; Vice-President, Dr. J. H. Vincent, M.A., D.S.C., M.I.E.E.; Chairman, Mr. A. Hoban; Committee, Messrs. A. L. Beak (Librarian), G. Turton (Apparatus Steward), L. Bland Flagg (Hon. Secretary), and V. W. Venables.

The Society has at its disposal well-equipped laboratories for the research and experimental work in all branches of science, and a well-equipped workshop, where apparatus can be made to the personal requirements of members. The Society is applying for affiliation to the Wireless Society of London and is applying also for a receiving licence, and as soon as circumstances will permit it is intended to apply for a transmitting licence. A programme for the coming year is being arranged, which will include the reading and discussion of papers on scientific subjects, Morse, buzzer practice and demonstrations will be arranged from time to time.

The Hon. Secretary of the Paddington Wireless and Scientific Society, Paddington Technical Institute, Saltram Crescent, W.9, will be pleased to furnish particulars to any interested persons within the area of the Society. Subscriptions have been fixed at 2s. 6d. entrance fee and 5s. annually for full membership, and 2s. 6d. for associate membership.

The North Essex Wireless Society.

Hon. Secretary, Mr. F. T. Smith: Headquarters, 15, Rayne Road, Braintree.

On Wednesday, April 26th, a very clear fundamental lecture was given for beginners by Mr. A. Jesceleyne, who explained how to make a cheap crystal receiver. Mr. Jesceleyne was thanked heartily for his excellent lecture, and he will be pleased to help any junior members who contemplate making the receiver he described.

South Hackney.

Mr. E. R. Walker, of 48 Dagmar Road, South Hackney, E.9, would be glad to get into touch with any amateurs in the districts of Hackney, Clapton, Stamford Hill, Dalston and Victoria Park, with a view to forming a Society in that area.

Radio Club Argentino.

A club has been formed in Buenos Ayres for the promotion of the study of wireless telegraphy and to bring together those interested in the science. The President is Señor Capitan de Fragata Luis F. Otlandini and the Secretary Señor Rafael A. Mastropaolo, Calle Belgrano 1732, Buenos Ayres. The Club has among its officers and members many gentlemen who are influentially associated with the development of wireless telegraphy in the Argentine.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

"T.A.M." (London) *asks for help with a crystal set which is giving very disappointing results.*

The circuit is correct, and if the makers' instructions are followed you should hear ships and stations such as FL and Poldhu. You should also hear Croydon telephony easily. Try various adjustments of the crystal, and if this is unsatisfactory, try other crystals. Make sure that there is no short circuit to earth on your aerial.

"D.T." (Merthyr Tydvil) *refers to Fig.* 10 *and Fig.* 11, *page* 726, *and asks for a diagram for the combined circuits using common batteries.*

In the diagram shown, Fig. 1, the circuits are combined and improved in general arrangement.

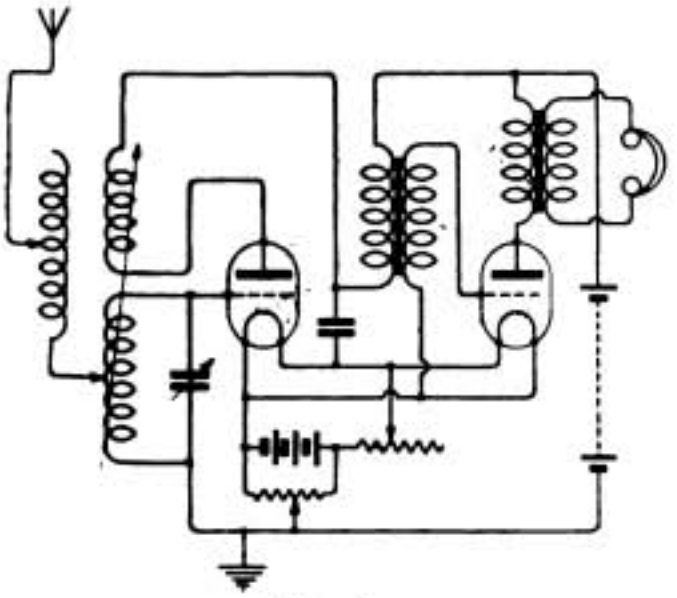


Fig. 1.

"A.M." (Campbeltown) *asks* (1) *For diagram of connections for two-valve resistance amplifier.* (2) *Diagram of a good set for general purposes.* (3) *For capacity for condenser.* (4) *Which of two aerials is the better to use.* (5) *Why his last questions were not answered within two or three issues of his writing.*

(1) See diagram, Fig. 2. (2) The circuit of Fig. 3, page 398, September 17th issue, is one of many quite suitable for your purpose. Please note that these columns are intended for the assistance of readers with specific difficulties, and not for the detailed design of sets for more or less freak requirements. (3) We cannot say, as you do not give enough information for us to obtain the thickness of the di-electric between the plates. (4) We prefer the single wire. (5) We cannot answer questions in less than about a month, owing to the time taken to put a technical magazine of this nature in print. Replies are dealt with as far as possible in rotation, and with the large number

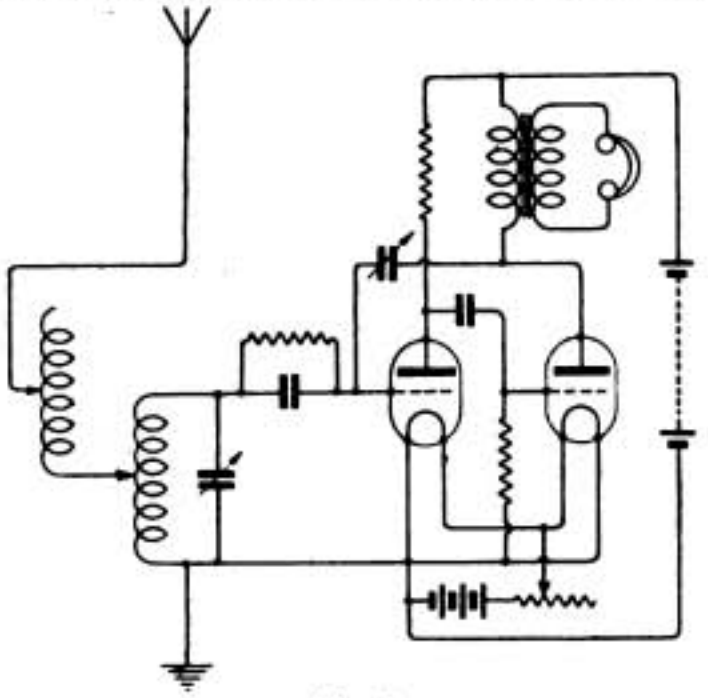


Fig. 2.

received a delay of more than a month has been unavoidable in every case. It is hoped, however, now that this journal is issued weekly, to reduce the delay in the insertion of replies.

"B.C.G." (Kenilworth) *asks* (1) *The inductance of a coil* 8" *in diameter, wound with* 20 *turns of No.* 7/36 *Litz.* (2) *Inductance of a variometer wound with similar wire.* (3) *Inductance of a variometer wound with* 27/40. (4) *Where to get a long range wavemeter calibrated.*

(1) 1,600 mhys. (2) and (3) Neither of these variometers admit of exact calculation, but the maximum in either case should be about 130,000 mhys., with a minimum of about 80,000 mhys. (4) We do not know of any concern specialising in this sort of work, but think that most of the larger makers of wireless apparatus would undertake the job for you.

"E.R." (Brussels) *asks* (1) *For criticism of a set.* (2) *For information about the tuning of H.F. transformers.* (3) *The relative resistances of the internal and external parts of an anode circuit.* (4) *For the effect of loose coupling with autodyne sets.*

(1) Do not use resistance capacity coupling at

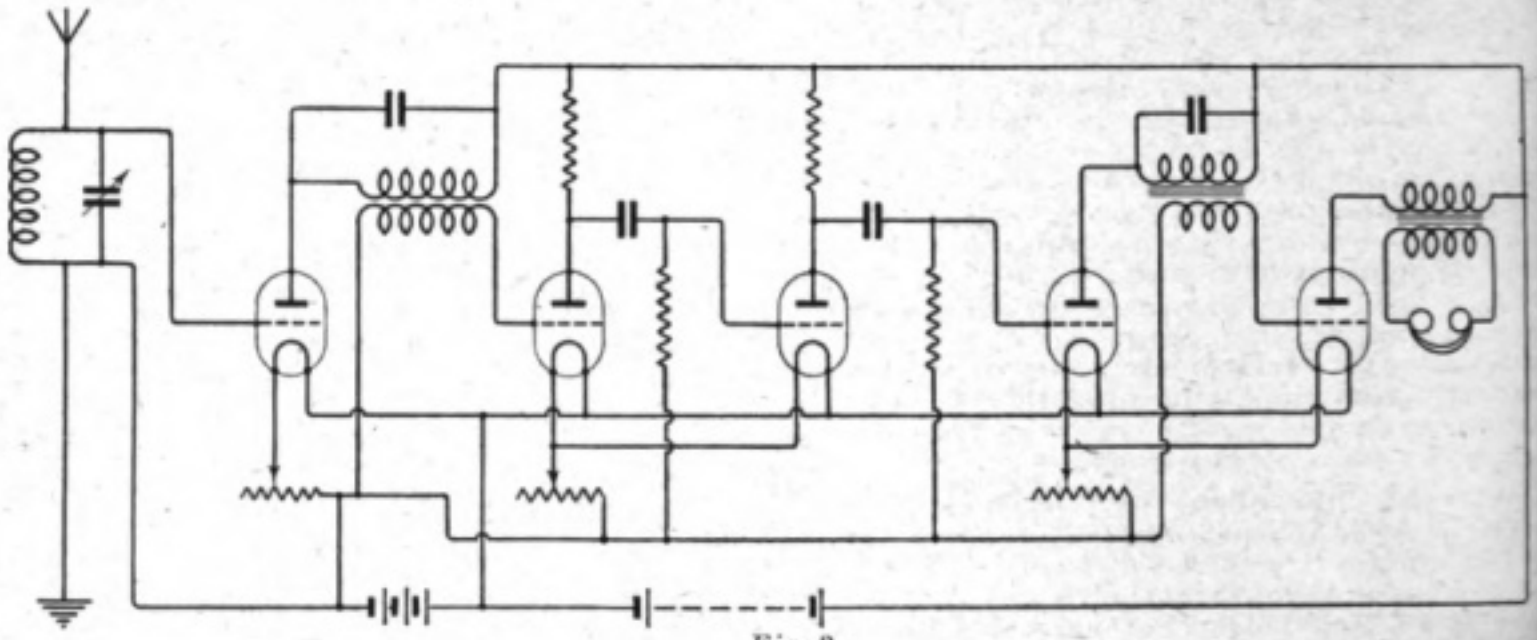


Fig. 3.

short wavelengths. Reaction should be in the anode of the rectifier. If the separate heterodyne is strong, couple it to the grid of the rectifier. If weaker, couple to one of the earlier valves. A common battery arrangement is shown in the diagram, Fig 3. (2) Only one winding should be tuned by a condenser, the tight coupling between the windings then gives the effect of tuning both circuits. (3) The condition of equality of internal and external resistance only holds in the case of resistance amplifiers, not in the case of resonance transformers. (4) The effect is probably due to the set having two distinct possible periods of oscillation, one governed by the constants of the closed circuit, and the other by those of the combined closed and aerial circuits. Tightening of the coupling causes a rapid change over from one state of oscillation to the other.

"D.P." (Anfield) *asks how to connect up a condenser, a valve panel, and a coil holder—the external connections of which he sends, but the internal wiring of which he knows nothing about.*

As we are unacquainted with the wiring of the panel, we can only suggest a wiring which will suit its most probable arrangement (Fig 4). The set may, of course, not work if the panel happens to be differently arranged. The leads to the terminals marked "Tune" may need interchanging.

"I.D.A." (Wellington) *asks* (1) *If plug-in transformers are suitable for an H.F. amplifier given in a back number.* (2) *Number of turns and gauge of wire for* 1,100 *metres on a* 1" *diameter transformer.* (3) *Diagram of a two-valve set to work in conjunction with an existing set.* (4) *If* **PCGG** *will be heard in Cheshire on two H.F., one detector and two L.F. valves.*

(1) Yes. (2) Each winding should be about 3" long, of No. 40 wire. A small variable condenser will probably be necessary across one winding. (3) See diagram (Fig. 5). (4) Yes.

"W.E.J.D." (Newbury) *asks* (1) *Where to obtain French valves.* (2) *If a single valve circuit shown will work satisfactorily.*

(1) The "R" valves, listed by many of our advertisers, with prices of 10s. upwards, are examples of the type known as "French." (2) Yes, provided the inductances are correctly pro-

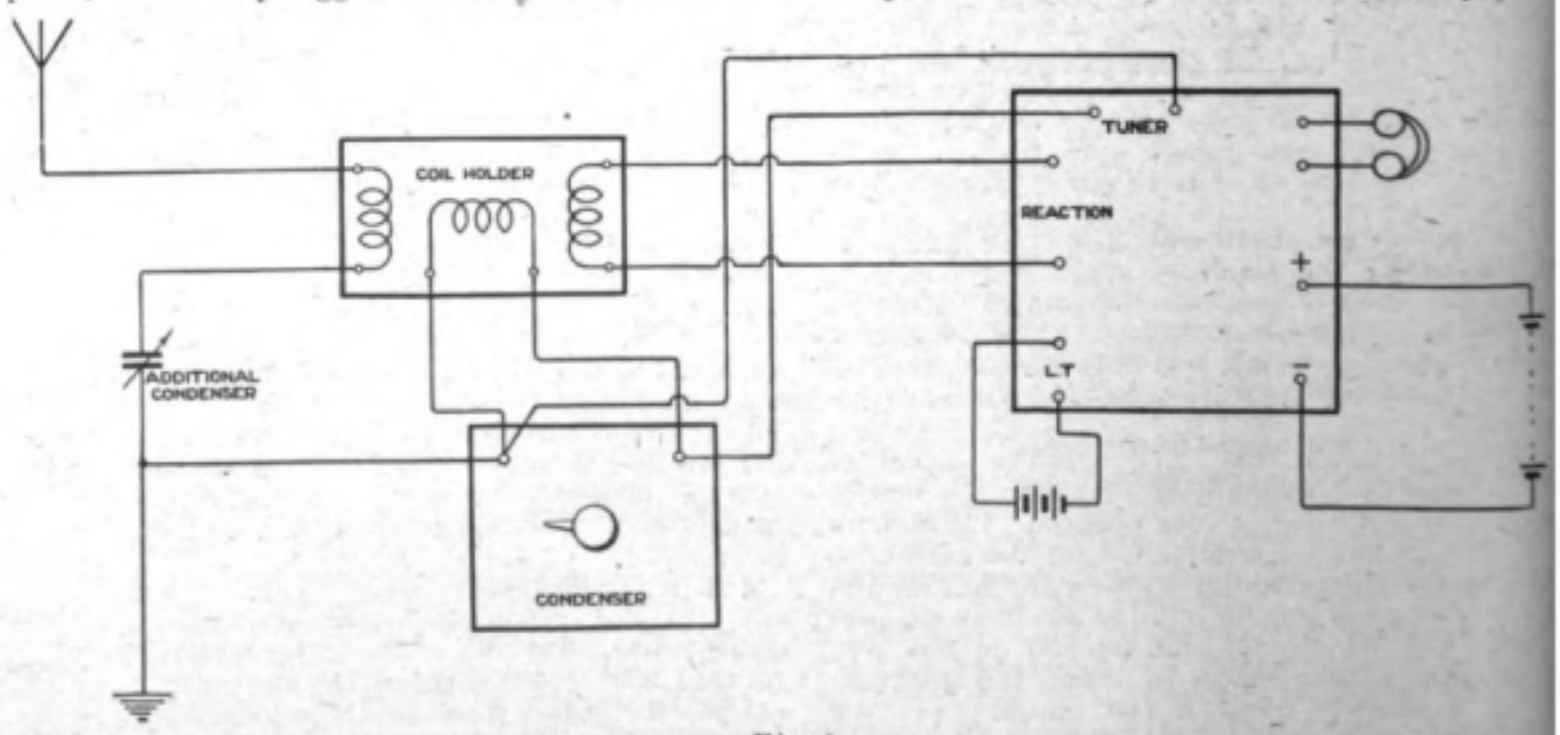


Fig. 4.

portioned and a 0·001 mfd. condenser is connected across the telephones.

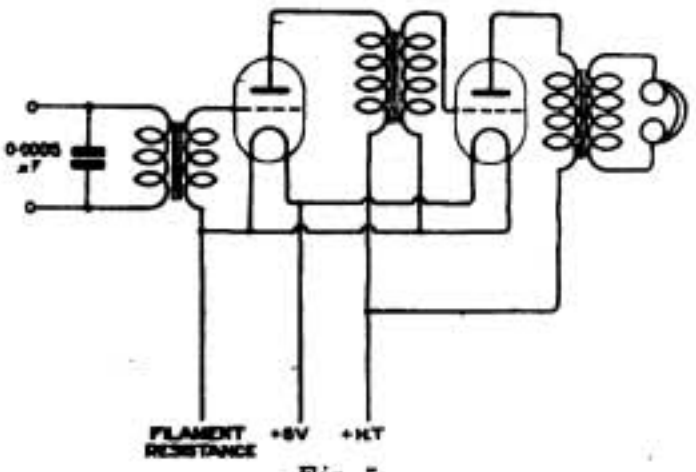


Fig. 5.

"S.A.P." (Copenhagen).—Your theory of the action of grid condenser is fairly correct as far as it goes, but it neglects various subsidiary effects, which in practice considerably modify the action. We have not space to go into the matter fully here, but may point out that some sets work better with the leak connected to the negative side of the filament and some with it connected to the positive. In any given case find which is best by experiment. We are more than a little sceptical of your statement that the grid charge in a certain instance raised the potential of the battery sufficiently to burn the valve out. (2) Try about an ounce of No. 40 wire wound in a few layers along an iron core ½" diameter and, say, 8" ong.

"MICROHENRY" (Barnet) *asks* (1) *Gauge and material of a sample of wire.* (2) *How to calculate the natural wavelength of an aerial.*

(1) No. 20 phosphor bronze. (2) The natural wavelength is between 4 and 4·5 times the length of the aerial, including the down-lead. In a "T" aerial only half the length of a horizontal part should be counted.

"MIDGE" (Chelmsford) *asks* (1) *If possible to receive* **2 MT** *telephony on a crystal set at* 18 *miles.* (2) *Gauge of a sample of wire.* (3) *If the same could be used for a transformer in a single valve set to put the rectified signals back on to the grid for L.F. amplification.* (4) *If a transformer will affect the wavelength of the set.*

(1) Yes. (2) No. 38, S.S.C. (3) Yes. Transformer should have a 1/1 ratio with about 5,000 turns on each winding. (4) No. Provided there is a condenser of 0·001 mfd. across the winding in the grid circuit. There should also be a similar condenser across the telephones.

"AMATEUR" (Walsall).—(1) The arrangement suggested is rather cumbersome, with very little indeed to recommend it. We think you would find the circuit of Fig. 4, page 32, April 1st issue, will meet your requirements. We do not advise any more complicated switching stunts. (2) Yes, if properly proportioned. (3) We are unable to calculate the inductance of the coils, as you do not state the diameter.

"W.A.R." (Heywood) *asks* (1) *For a diagram of a set with three valves and a crystal.* (2) *If this would receive* **PCGG.** (3) *Windings for* 1,200 *metres H.F. transformer.*

(1) A crystal is hardly necessary in combination with so many valves, but see diagram (Fig. 6). (2) It should do so. (3) See reply to **"I.D.A." (Wellington),** above.

"P.O.P." (Stratford-on-Avon).—The crystal diagram is not quite correct. The blocking condenser should be across the telephones. The battery should be applied to the crystal through a potentiometer. *See* Fig. 4, page 813, March 4th issue. The information regarding the single valve set will be found in the same issue, Fig. 2, page 811. For 6,000 metres the A.T.I. may be 10" × 6" of No. 26. To increase the range another 2,000 metres add an additional coil of 8" × 6" of No. 26.

"C.G." (Cardiff) *refers to magnetic detectors and asks if the same can be used with valve amplification for receiving C.W. and spark.* (2) *Failing combination with valve set, what tuning inductance and condensers should be used for receiving short wave signals.*

(1) A valve might be used for magnification after

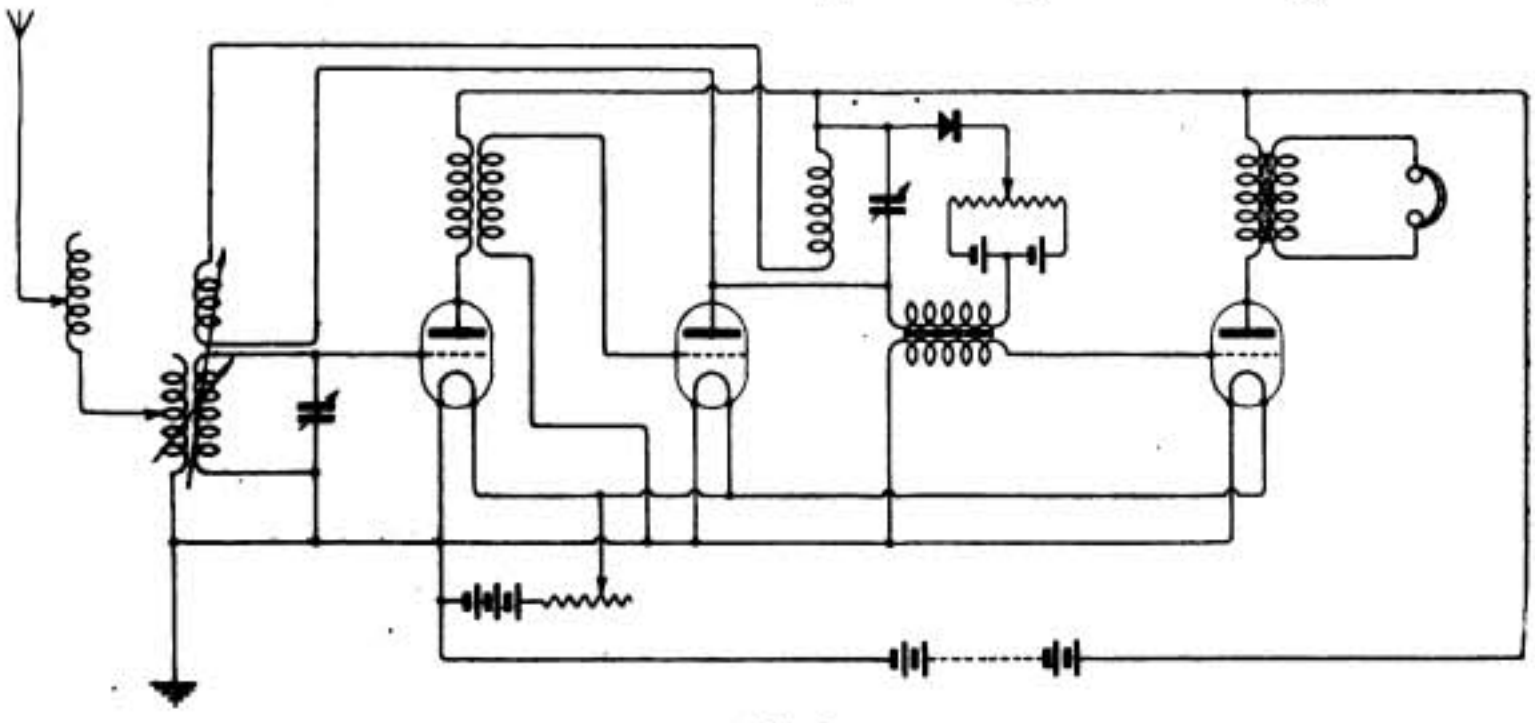


Fig. 6.

magnetic detector for spark stations. For C.W. the magnetic detector could be used after a valve autodyne H.F. amplifier, but this arrangement would be most inefficient. (2) The magnetic detector is highly inefficient on small amateur aerials, and we should very strongly advise you to use a valve or crystal as detector. Tuning circuits for a magnetic detector are the same, except that a much bigger ratio of capacity to inductance is required, and the magnetic may be introduced direct into the aerial circuit.

"L.R.G." (Cheshire) *asks* (1) *How to improve his set.* (2) *If suitable for telephony.* (3) *If L.R. telephones and transformer will be more efficient than* 2,000 *ohm. telephones.* (4) *How to increase sharpness of tuning.*

(1) Circuit is incorrectly arranged, see diagram (Fig. 7). (2) This is not the most efficient way of using three valves, but you should certainly hear **FL.** (3) There will not be a great difference in strength, but the transformer arrangement is distinctly preferable on other grounds. (4) This will follow from the suggested rearrangemnt of the circuit.

so large a range. (2) A suitable arrangement is shown in Fig. 4, April 1st issue.

"AMATEUR" (Norway) *is making a three-valve set with tuned anode circuits, grid condensers and leaks, and asks* (1) *Best values for coupling condensers and leaks.* (2) *If anode tuning coils should have same number of turns as the primary of an H.F. transformer.* (3) *If the amplifier will be as good as transformer amplifier.* (4) *If Weston moving coil relay may be used with the above set for recording.*

(1) About 0·0005 mfd. and 2 megohms. (2) Not necessarily. The coils should be of the size which will tune to the required wavelength with the condenser C.3 and C.4. (3) The amplification should be better than with a transformer coupled set, but it may be somewhat difficult to stop the set from oscillating. (4) Yes.

"J.H.B." (Partick) *asks* (1) *How to construct a frame aerial.* (2) *If* 100′ *wire run round the walls of a house on insulated hooks would be any good.* (3) *If P.O. licence would be necessary for the above arrangements and if they should give* **2 MT.**

(1) A good article on this subject appeared in

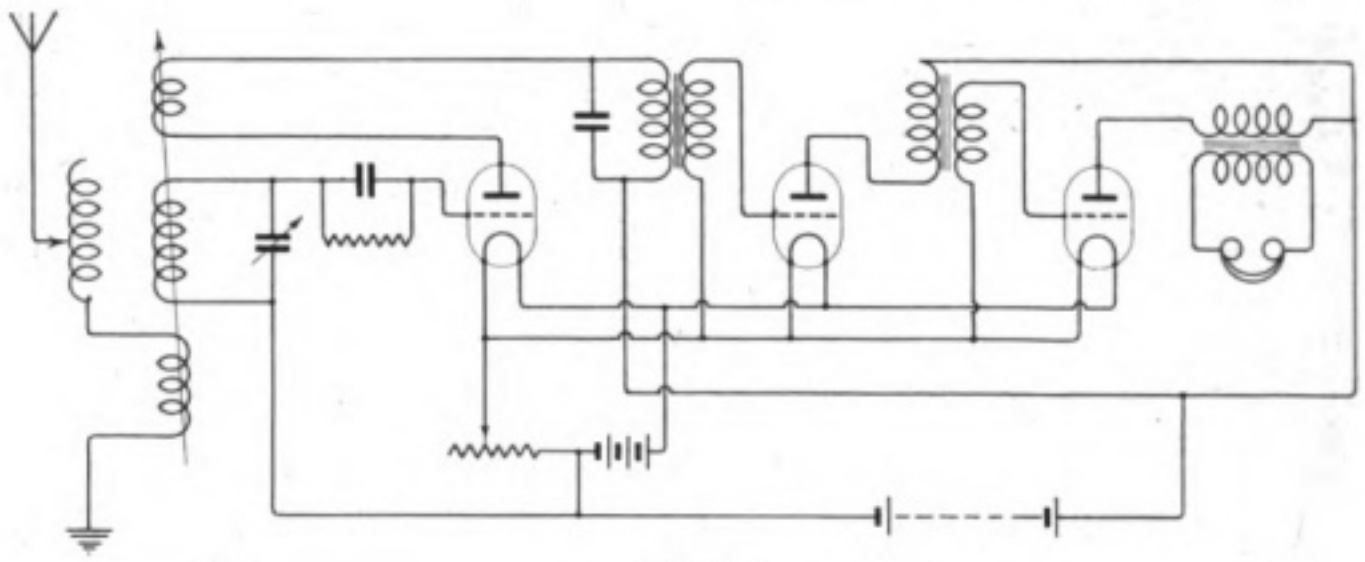


Fig. 7.

"T.R.J." (Birmingham).—(1) Circuit is correct as shown. (2) It is better to connect the reaction coil in the anode of the rectifier. (3) No. The S.I.C. of glass varies between about 3 and 10 with different variations in the composition without much change in specific gravity. Glass for condenser plates generally has a value of about 6. (4) In your case there must be sufficient inductance in each so that the circuits are tuned to the same wavelength with their respective condensers. There is no constant proportion : for instance, if a loading coil is used in the aerial circuit the primary of the loose coupler may be many times smaller than the secondary.

"D.A.C." (Walthamstow) *asks* (1) *If circuit of Fig.* 3, *page* 617, *December* 24*th issue, will work with duolateral coils with suitably tapped H.F. transformers for* 300 *to* 30,000 *metres.* (2) *For diagram to cut out switching arrangement of H.F. or L.F. valve.*

(1) Yes, or a single tuned circuit receiver may be used for the longer wavelength. It has often been pointed out in these columns that it is not possible to construct an efficient H.F. transformer to cover the issue of June 12th, 1920, which can still be obtained from the publishers. We have not space to treat the matter adequately here. (2) This will not be very satisfactory, partly owing to all the wires being horizontal and partly to their being near bad di-electric material in the walls, which will lead to serious losses. (3) Yes. (4) Unlikely, without more than two valves.

"X" (Malton).—(1) We prefer 3 H.F. to 3 L.F. (2*a*) We cannot give the reason for loss of strength in this case without fuller particulars of the circuit. In case (*b*) result is evidently due to poorness in the design or construction of the telephone transformer ; but in any case the use of 1/1 transformer, which can obviously never be perfectly efficient, is bound to give some weakening of signals. This is often worth while, on account of the better working of the set obtained. (3) A suitable switching arrangement for adding a L.F. valve is shown in Fig. 4, page 706, February 4th issue.

"SIRIUS" (Brighton) *asks how to add an H.F. valve to a single valve set, shown.*

See diagram (Fig. 8).

"A.J.G." (Peckham).—(1) The set referred to should be satisfactory. (2) Yes. (3) There is no risk in using H.R. telephones without a transformer, unless exceptionally high voltage valves are used. (4) Two "Ora" valves may be used. It is generally a mistake to mix different sorts of valves except for specific purposes.

"G.E.B." (Birmingham).—(1) The formula you quote is applicable to the parallel arrangement fairly accurately, provided that the C of the formula is the sum of the added capacity and the capacity of the aerial. The formula does not hold for the series case, and is never strictly true, owing to the

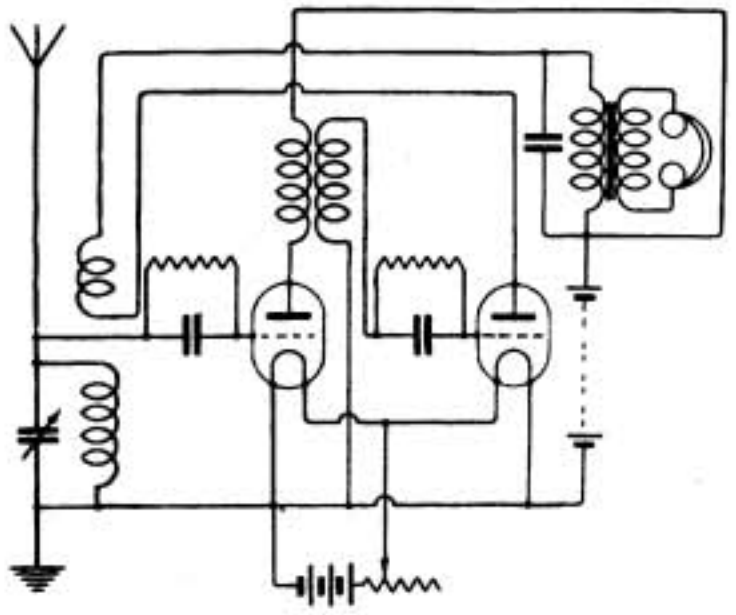


Fig. 8.

distributing inductance and capacity of the aerial. (2) The suggested scheme should be quite satisfactory. (3) The No. 1 coil might have about 500 turns. No. 2: 1,000 and No. 3 1,500 turns, winding width being about 1" in each case. For reaction use the size next smaller than the tuning coil. (4) These valves should be quite satisfactory and would take about ¼ ampere each.

"A.G.J." (Braintree) *asks for windings of the circuit of Fig. 1, page 560, December 10th issue. (2) If Mark III coupling coils would be suitable for the coupling in this circuit or in that of page 65, April 13th, 1920. (3) If this coupler could be used on a set loaded up to 3,500 metres for telephony. (4) If L.F. reaction could be introduced into either of the circuits named.*

(1) We have no practical experience of the working of this circuit, but its underlying principles appear to us of questionable utility. We much prefer later circuits in this article, such as, for instance, No. 2. If you try the circuit of Fig. 1 we should give the two coupled circuit inductances the normal tuning values and wind the secondary of the coupler on the same former as the primary, separated from it with Empire cloth, and of about No. 36 wire. (2) Not for the circuit of Fig. 1, but it could be used for the circuit of page 65. (3) Coupler might be used on this wavelength if rewound with about No. 34 wire. (4) We do not recommend the use of true L.F. reaction, which is very liable to produce unmanageable "howls." Low-frequency back coupling for the purpose of re-amplification may, however, be used, as, for instance, in the circuit of Fig. 2, page 561.

"W.T.E." (Listowel).—(1) Circuit is correct, except that the condenser should be in parallel with A.T.I. for 7,000 metres. For short waves it is better on the aerial than the earth side of the A.T.I. (2) Condenser 0·001 mfd. A.T.I. 8" × 5" of No. 26. Reaction coil 6" × 4" of No. 28. (3) 120 ohm telephones with a transformer. If used, put the transformer on the positive side of the H.T. battery. (4) Arrange the reaction coil to slide inside the A.T.I.

"A.C.T." (Hemel Hempstead).—(1) A circuit might be on the lines of that shown in Fig. 3, page 398, September 17th issue, though we do not think that the 1:25 transformers will be of much use. (2) We cannot say the wavelength without more information about the condensers, but probably the maximum will be 2,000 to 3,000 metres. (3) Yes. The correct polarity should be found by experiment. (4) We prefer the twin aerial.

---------- **(Oundle).**—(1) The suggested type of amplifier could be used, but only with the addition of an anode resistance or impedance for each valve, and also a coupling condenser. The circuit would then closely resemble the normal resistance capacity circuit. Common H.T. can then be used. (2) We are afraid the scheme is of little practical utility. (3) About 0·00045 mfd. (4) The most obvious improvement is the addition of a reaction coil. The next is the substitution of two loosely coupled circuits for the single circuit shown, also the connections of all the plate circuits in the diagram are wrong. After attending to these points high-frequency amplification can be added if desired.

"H.F." (Woking) *asks (1) If a circuit is correct. (2) If it will receive* **2 MT.** *(3) If 1,000 ohm telephones are suitable. (4) For the meaning of reaction.*

(1) The circuit is correct as far as it goes, but it would be greatly improved by a tuning condenser across the anode coil. (2) Yes, particularly if altered as suggested. (3) These will be fairly satisfactory. (4) An adequate explanation of this matter would take more space than we can afford. Consult Bangay's "Oscillation Valves," or other elementary textbook.

"D.B.F." (Mayfield) *only gets* **PCGG** *weakly on a one-valve set, and asks (1) If adding a resistance capacity amplifying valve would improve it. (2) If so, how to connect it. (3) If rectifying with a crystal would give better results. (4) A sketch, showing how to do this.*

(1) and (2) Yes. A suitable circuit is shown in Fig. 3, page 812, March 18th issue. The anode resistance may be 50,000 ohms. (3) and (4) This will not be as good as two valves, but would be better than the single valve set. For circuit, *see* Fig. 4, page 61, April 8th issue.

"G.A.H." (Farnborough) *asks (1) How many yards of No. 40 wire will have a resistance of 50 ohms. (2) For the gauge of two samples of wire.*

(1) Approximately 40 yards. (2) A is No. 42 and B is No. 40.

"R.B.W." (Gillingham) *has a set as Fig. 3, page 812, which has worked well until recently. He now gets scratching noises in the telephones, and asks why. (2) If it might be due to the telephones burning out. (3) If he can use No. 38 wire for a reaction coil. (4) If not, what gauge to use.*

(1) and (2) This may be due to a partial burn-out

of the telephones, breakdown of the grid condenser, defective battery (probably H.T.), defective valve, or a bad connection somewhere in the circuit. (3) and (4) This may be used, but we should prefer about 4″ × 3″ of No. 32 or No. 34.

"A.H.C." (Streatham) *asks if it would be possible for two sets on one aerial to receive C.W. on different wavelengths simultaneously. (2) If two 100′ single wire aerials, lying at right angles to each other from one point, would be as liable to interfere as two 50′ aerials running parallel to each other, 100′ apart.*

(1) This can be done, particularly if the wavelengths to be received are well separated and so that no harmonic of either lies very close to the other fundamental. It could be most easily done by using separate heterodynes for each set, instead of allowing the sets themselves to oscillate. (2) There would probably not be much to choose between these arrangements. In neither case will interference be very bad, unless you use re-radiating circuits.

"C.H.K." (London).—To receive **PCGG** it will be necessary for you to alter the windings of the Mark III tuner as described in the articles in the issues of March 5th and 19th. You could then arrange the C Mark III panel for H.F. amplification, transformer coupled, and rectification, using the "Tb." amplifier for note amplification if desired. The section marked "long" should consist of several 1·5 volt cells connected in series, and that marked "short" should be a single 1·5 volt cell. The size of the cells used is unimportant.

"J.V.T." (Bermondsey) *asks (1) For necessary apparatus to adapt a crystal set for C.W. reception. (2) For suitable circuits if his are unsatisfactory. (3) If the revised set will receive telephony.*

(1) A valve, 6-volt accumulator, filament resistance, H.T. battery, a potentiometer, reaction coil and valve holder. The circuit will then be on the lines of Fig. 6, page 775, March 4th issue, but with the telephones in this case on the earth side of the H.T. battery. With somewhat more gear a valve and crystal set as Fig. 4, page 813, could be used. (2) Your circuit should be satisfactory. Reaction coil may be 5″ × 3″ of No. 32. (3) Yes.

"SPARKS" (Wolverhampton) *asks* re *the pocket set in March 4th issue. (1) For information about the aerial tuning condenser. (2) How to make the grid leak. (3) If the wavelength range can be increased efficiently.*

(1) We have no further information, but from the description, which is not very clear, we imagine the moving plate should be pivoted at the left-hand bottom corner and rotated by the handle. We should recommend covering the tinfoil on both sides of each plate with mica. (2) By rubbing down pencil lead on a small piece of roughened ebonite or slate. (3) The wave range could no doubt be extended by increasing the size of the coils, but this would involve increasing the size of the set. We should not recommend any considerable increase.

"J.A.C." (Forfar) *is troubled with jamming on a single circuit receiver, and asks if that of Fig. 3, page 705, will give as loud signals and greater selectivity. (2) For the value of the reaction condenser. (3) If magnetic reaction might be used.*

(1) Certainly. Keep the coupling between the A.T.I. and the closed circuit very weak. (2) Probably somewhat less than 0·0001 mfd. It might be found better to put it between second plate and the first grid. (3) Yes, we prefer this. Introduce it in the last plate circuit and couple with the closed inductance only.

"C.L.P." (Birmingham) *has a slab coil tuner which gives very critical tuning for telephony. He asks (1) If the use of solenoid coils would improve this. (2) Dimensions and windings for 1,200 metres. (3) Which is the better for telephony, H.F. or L.F. amplification.*

(1) The type of coil used will not make much difference. Tuning is nearly always critical with telephony, particularly with good coils. It is not to be regarded as a drawback unless floppiness of reaction is also present. You could get easier tuning with a small capacity Vernier condenser in parallel with your main condenser. (2) A.T.I. may be 7″ × 5″ of No. 22, reaction coil 5″ × 4″ of No. 28. (3) For general purposes we prefer the H.F.

"NOVICE" (Swinton).—(1) You will probably not get serious interference with the telephone wires with your aerial arranged as shown, which appears to be the best that you can do. You may, however, find difficulty in obtaining permission to place your wires so close to the telephone lines. If this is the case, you will have almost no alternative but to use a frame aerial with, say, a three-valve set.

"DUBIUM EST" (Monkseaton) *asks (1) For help with a resistance amplifier which gives poor results on 1,000 metres. (2) Whether the reaction coil should be in the H.F. amplifier or in the detecting anode. (3) Why a different set of stations are heard by reversing the side of the reaction coil. (4) If jamming by GCC could be kept out by introducing a variometer tuned to 600 metres in the grid lead to the valve.*

(1) Resistance amplification is never very good at 1,000 metres, but it should be much better than you suggest. A capacity of 0·001 mfd. is too big for this wavelength: try nearer 0·00005 mfd., and try various values of grid leak. (2) Reaction from the rectifying valve is the better because of the larger currents flowing in that anode circuit. (3) We regret that we cannot explain this somewhat unusual phenomenon. (4) This would have some rejector effect, but it would be better to put an ordinary tuned circuit in place of the variometer, which is probably only tuned by its own self-capacity. The results of this experiment are, however, not likely to be very good, at any rate until you use a two, or better, three-circuit, receiver, with the circuits very loosely coupled.

SHARE MARKET REPORT

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

Marconi Ordinary	£2	8	6
" Preference	2	6	3
" Inter. Marine	1	9	6
" Canadian		10	6
Radio Corporation of America:—			
Ordinary	1	1	3
Preference		14	0

20th MAY, 1922. THE PRICE 6D

WIRELESS WORLD AND RADIO REVIEW

VOL. X. No. 8 20th MAY, 1922. Registered at as a Weekly

THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 8. MAY 20TH, 1922. WEEKLY

Short-Wave Directional Wireless Telegraphy*

By C. S. FRANKLIN.

DIRECTIONAL wireless telegraphy is as old as the art itself, for Hertz made use of reflectors at the transmitting as well as the receiving ends in order to augment the effects, and to prove that the electric waves which he had discovered, obeyed, to a considerable degree, the ordinary optical laws of reflection. Senatore Marconi in his earliest endeavours to develop a telegraph system using electric waves, also employed reflectors to increase the range and get directional working.

The discovery by Marconi of the great increase of range obtained by the use of longer waves, and the earthed vertical aerial, practically stopped development on directional lines for the time being. The demand of the time was for increased ranges; and as the first practical application of wireless telegraphy, namely, working to and between ships, required "all round" working there was very little call for directional systems.

To-day the range has arrived at the maximum possible on the earth, and the wavelength has increased to such an extent that the frequencies proposed are within or near to the limits of audibility. The possible gamut of wavelengths is becoming very fully occupied, and although the development, during the past four years, of nearly pure continuous-wave transmitters, and of receivers with vastly improved selective powers has eased the problem, the time will soon arrive when practically the only way of increasing the number of possible services will be by employing systems having good directional characteristics.

There are, broadly, two general classes of directional aerial systems:

A. Those having the general characteristic that their directional power or polar curves are nearly independent of their dimensions. The directional result is obtained by opposing the effects of a number of aerials, or parts of an aerial with suitable phasing adjustments; the degree of opposition being a function of the direction. Systems of this class may be made small compared with the wavelength employed; for the purposes of position finding, and as receiving systems enabling interference to be eliminated from several directions, they have already been developed to a considerable degree. The simplest example of this class is the well-known frame aerial. By employing a sufficient number of aerials the system may, theoretically, be given any desired sharpness of directional power without making the dimensions large; this can, however, only be done with a large sacrifice of receiving or radiating power.

B. Those having the general characteristic that their directional power or polar curves depend on their dimensions relative to the wavelength employed. In this class the directional result is obtained by adding the effect of a number of aerials, or parts of an aerial, when working in the required direction. The underlying principle is that the effects, for the required direction, are integrated over a wide front in proportion to the wavelength. Such systems can, therefore, only have small dimensions when using short waves, and this fact makes their development difficult.

As examples of such systems may be mentioned—

(1) Reflector systems in general.
(2) Systems composed of lines of aerials, at right angles to the working direction, correctly adjusted as regards phase. In this may be included the Alexanderson long aerial with its feeders.
(3) The Beverage long, horizontal receiving aerials. This aerial and equivalent arrangements form a class by themselves, but have the characteristic that the directional power is a function of the dimensions.

The reflector system was the first one that was tried for wireless telegraphy; it has been considered by several investigators, but very little research work on such systems has yet been published. Useful research work on these lines is not easy; the use of reflectors of reasonable dimensions implies very short waves of the order of a few metres. The very high attenuation of such waves over land or sea, and the difficulty of getting much power

*Abstract of a paper read before the Wireless Section of the Institution of Electrical Engineers on Wednesday, May 3rd, 1922.

into them, tended to make early attempts very discouraging.

In this paper it is proposed to give some results of investigations made with reflectors and wavelengths below 20 metres. It is also hoped to be able to give a demonstration with a continuous-wave valve transmitter furnishing approximately a 1-metre wave, and a reflector having a 2 wavelength aperture, so that some idea can be got of the order of the directional effect, or " beam " obtained.

The investigation was commenced by Senatore Marconi in Italy in 1916, with the idea of developing the use of very short waves, combined with reflectors, for certain war purposes. The author assisted him there, and it was very interesting work, as it was like being back in the very early days of wireless when one had a perfectly clear field.

The waves used were 2 metres and 3 metres. The only interference experienced with such waves is from motor boats and motor cars. These machines apparently emit waves from near 0 up to 40 metres in length, and the day may come when they will have to have their ignition systems screened, as on some aeroplanes, or carry a Post Office licence for transmitting. Incidentally, if some of the motorists were to listen to the irregularity of their ignition, they would have a fit. At Senatore Marconi's suggestion a coupled-circuit spark transmitter was developed, the primary having an air condenser and spark in compressed air. By this means a moderate amount of energy was obtained, and the small spark-gap in compressed air proved to have very low resistance. The decrement of the waves emitted was judged to be of the order of 0·03.

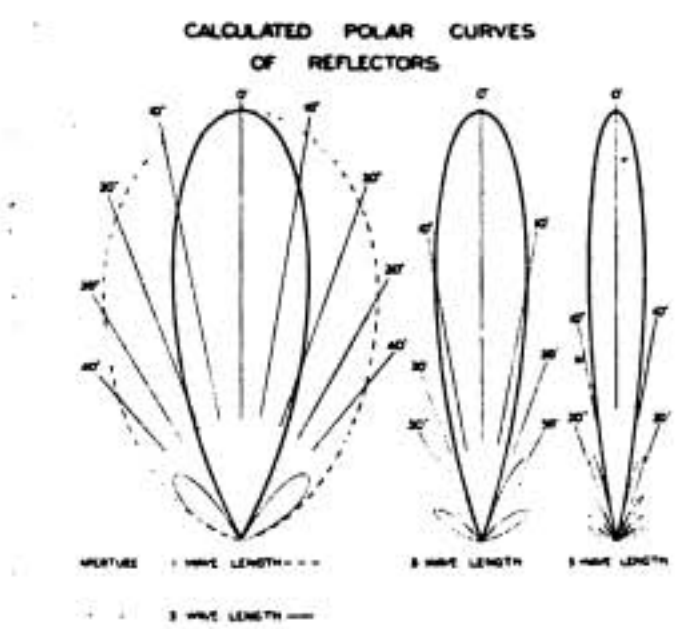


Fig. 1.

The receiver used was a carefully picked crystal, while the reflectors employed were made of a number of strips or wires tuned to the wave, arranged on a cylindrical parabola with the aerial at the focus. The transmitting system was arranged so that it could be revolved and the effects studied at the receiver.

Assuming that the waves leave the reflector as plane waves of uniform intensity, having a width equal to the aperture of the reflector, it is not difficult to calculate the polar curve of radiation in the horizontal plane, which should be obtained from reflectors of various apertures. In Fig. 1, are shown the calculated curves for apertures of 1, 2, 3 and 5 wavelengths.

The method of measurement at the receiver was the well-known " slide back " method with a rectifier; this method if calibrated against an adjustable local generator is quite reliable to a few per cent., and has given very consistent results.

Reflectors having apertures up to 3½ wavelengths were tested, and the measured polar curves agreed very well indeed with the theoretical curves. The use of two reflectors with apertures of 3½ wavelengths, one at the transmitter and one at the receiver, increased the working range about 3 times.

These Italian experiments showed that good directional working could be obtained with reflectors properly proportioned with respect to the wavelength. The attenuation over sea for the wavelength used was found to be very high, and with the apparatus available the maximum range obtained was 6 miles.

The experiments were continued at Carnarvon in 1917. With an improved compressed-air spark transmitter, a 3-metre wave and a reflector having an aperture of 2 wavelengths, and a height of 1·5 wavelengths, a range of over 20 miles was obtained to a receiver without a receiving reflector. The experiments at Carnarvon brought into prominence a property of wave propagation which, the author thinks, is not generally known, and the extent of which is not realised. This is the very rapid increase in the strength of the electric field with height above the ground. The rate of increase appears to be a function of the height divided by wavelength, and while not very noticeable with waves of several hundred metres, is very marked with waves of a few metres, length. The order of the effect may be gathered from the following experimental results.

It has been mentioned that the range attained at Carnarvon with a 3-metre wave was over 20 miles. The transmitter was at a height of 600 ft. and the receiver 300 ft., there being a clear air line between them. To the shores of Carnarvon Bay, 7 miles from the transmitter, there is also a perfectly clear air line, yet the signals at sea level were much weaker than at 20 miles with the receiver 300 ft. up. It was not possible to ascribe the weakness of signals to any screening or reflections from trees or other objects. Tests were made at different levels on a hill situated at this point, and it was found that signals steadily increased in strength with height. Accurate measurements were not possible with the portable receiver, but the increase of strength of the field at a height of 10 wavelengths was estimated to be 6 or 7 times. Further tests on this effect have shown that the increase of strength with height is not always uniform.

Subsequently when this reflector and transmitter used at Carnarvon were brought down to sea level, it was found that the limiting range to the same receiver at sea level and over sea was 4 miles. When both transmitter and receiver are at a low level the range is very dependent on the nature of the intervening country, and is very restricted even over sea; when, however, both stations are many wavelengths above the intervening country its nature is of far less importance, and the range is increased many times.

These experiments showed that very considerable ranges were possible with very short waves.

In 1919 experiments were commenced at Carnarvon with valve transmitters, with the idea of producing a directional telephone system. Mr. R. H. White and Mr. E. Green, and, later, Mr. A. W. Hall, assisted the author in this work. A wave of 15 metres was selected, which while well within the capacity of the power valves available, allowed a simple reflector to be used without too large a structure. After some trials a single valve transmitter was arrived at taking about 200 watts with a 15-metre wave, and giving 1 ampere in the centre of a half-wave aerial. A heterodyne receiver with supersonic beat-note was employed.

After gaining some experience, and solving many small practical difficulties, very strong speech was obtained at Holyhead, 20 miles away. The strength was such that shadows produced by small hills and buildings were hardly noticeable, unless the stations were close behind them.

The next point was to test the maximum range, and particularly to find whether such waves would carry over the horizon, and whether there would then be a rapid falling off of strength. Permission was kindly given for a test to be made on the Dublin Steam Packet Company's boats running from Holyhead to Kingston, and this was done in June, 1920. During this test, speech was received right into Kingstown Harbour, 70 nautical miles from Carnarvon, and the point was proved that there was no rapid diminution of strength after passing the horizon line from Carnarvon.

As a result of these experiments it was decided to test the range of a short-wave reflector system wholly over land. A site was chosen at Hendon, and a reflector and transmitter for 15-metre waves erected with the reflector pointing towards Birmingham. Tests were commenced in February, 1921, from Hendon to a portable receiver on a motor car. Very good speech was received up to 66 miles, and fair speech in the neighbourhood of Birmingham. A reflector station was then erected at Frankley, near Birmingham, 97 miles from Hendon, and tests were started there in August, 1921. The following are some particulars of the Hendon and Birmingham plant :—

Fig. 2 shows a photograph of transmitter and receiver.

The transmitter consists of two medium-size power valves working in parallel. The power to the valves is usually 700 watts (4,000 volts, 175 mA). The aerial is rather longer than half a wavelength, and has a radiation resistance of the order of 90 ohms. The efficiency, input to valves to aerial power, is between 50 and 60 per cent., and about 300 watts are actually radiated. With the reflectors up at both ends speech is strong, and of very good quality. It is usually strong enough to be just audible with a $\frac{1}{4}$ to $\frac{1}{2}$ ohm shunt across a 60-ohm telephone.

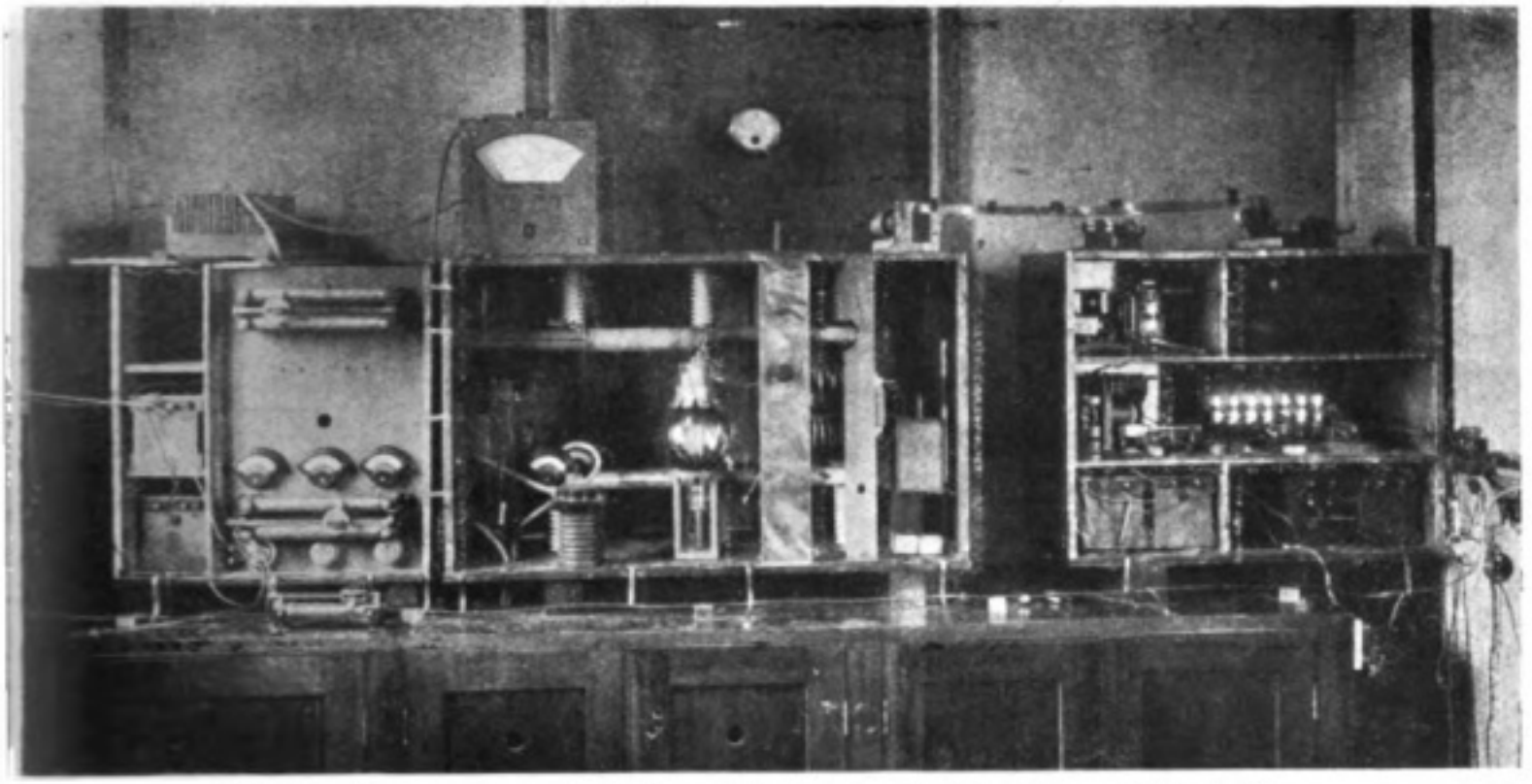


Fig. 2. Transmitter and Receiver of the type used at Hendon and Birmingham.

With both reflectors down the speech is usually only just audible with no shunt. Average measurements indicate that the energy received when both reflectors are up is about 200 times the energy received when not using the reflectors. Thus to get the same strength without reflectors as with them a 140-kW valve transmitter of the same efficiency would be required. Local measurements of the polar curves taken round the station show that the electric field in front of the station is increased approximately 4 times by the use of the reflector, and that the same order of increase is obtained during reception; the increase of energy received due to the use of the two reflectors should therefore be $4^2 \times 4^2$ 256 times.

Fig. 3 shows a measured polar curve of the electric field of Hendon station taken locally. It

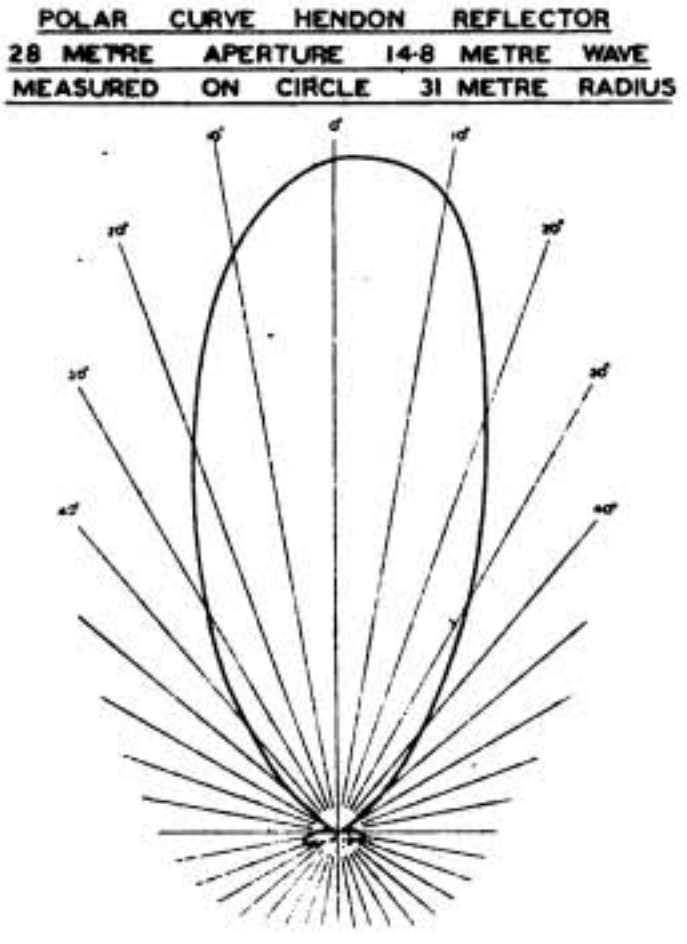


Fig. 3.

is rather unsymmetrical owing, it is thought, to the ground being on a slope, and perhaps to local reflections from trees and wires.

It has been suggested that a polar curve taken locally round the station is not the same as the polar curve at a distance, and that the directional effect is soon lost. The author does not agree with this. It has therefore been planned to measure the range of Hendon and Birmingham in different directions, but this has not yet been done. The fact that by using reflectors the energy received at these stations is increased some 200 times, is, the author considers, a proof that the directional effect does persist. It is, however, essential that the stations should be in situations free from obstacles which might cause powerful local reflections and distort the field. Experiments made with revolving reflectors, where it is comparatively easy to make measurements at any distance, also prove that the polar curve is practically constant at all ranges.

The production of waves of the order of about 12 metres and upwards is quite practicable up to several kilowatts by large power valves, and it is also practicable to operate valves in parallel. With such high frequencies very large currents pass into the grid and anode; the seals through the glass must, therefore, be large. The production of a reliable transmitting valve entailed a large amount of work, and the great dissimilarity of results from apparently similar valves was very puzzling for some time. In a new batch of valves the efficiency at 15-metre wave would vary from about 60 per

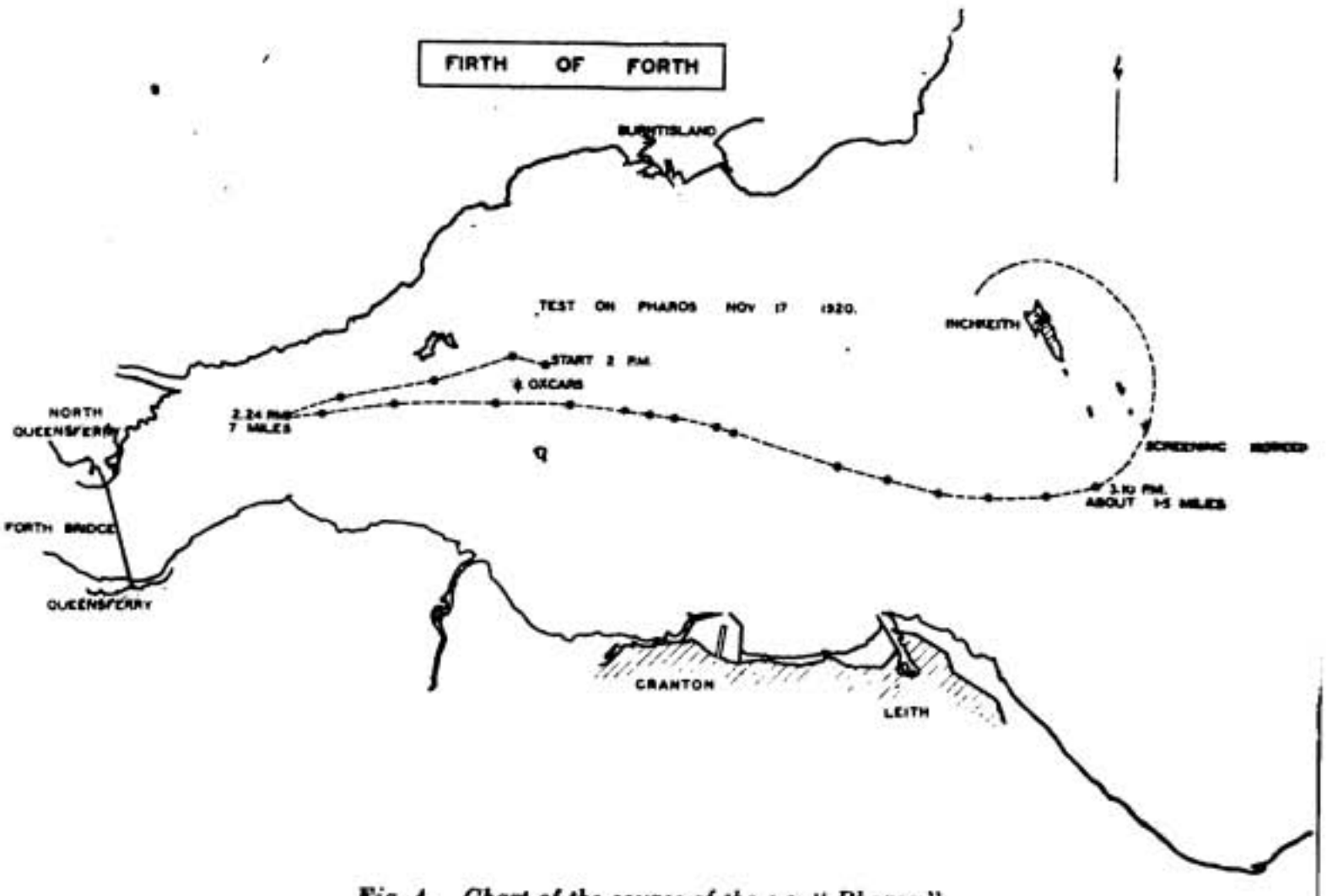


Fig. 4. *Chart of the course of the s.s.* "*Pharos.*"

cent. down to 5 per cent., and if any attempt was made to push up the power on a bad valve the glass would promptly melt at some spot. The cause of the trouble has been found to be due to losses in the deposits on the glass, owing to high-frequency currents induced. Such deposits are always produced in valves during exhaustion, and vary considerably.

If a number of valves are laid successively between the plates of a small air condenser in a very high-frequency field of the order of 20,000,000 per sec. (without making any connections to the valves), the results are quite remarkable. Some

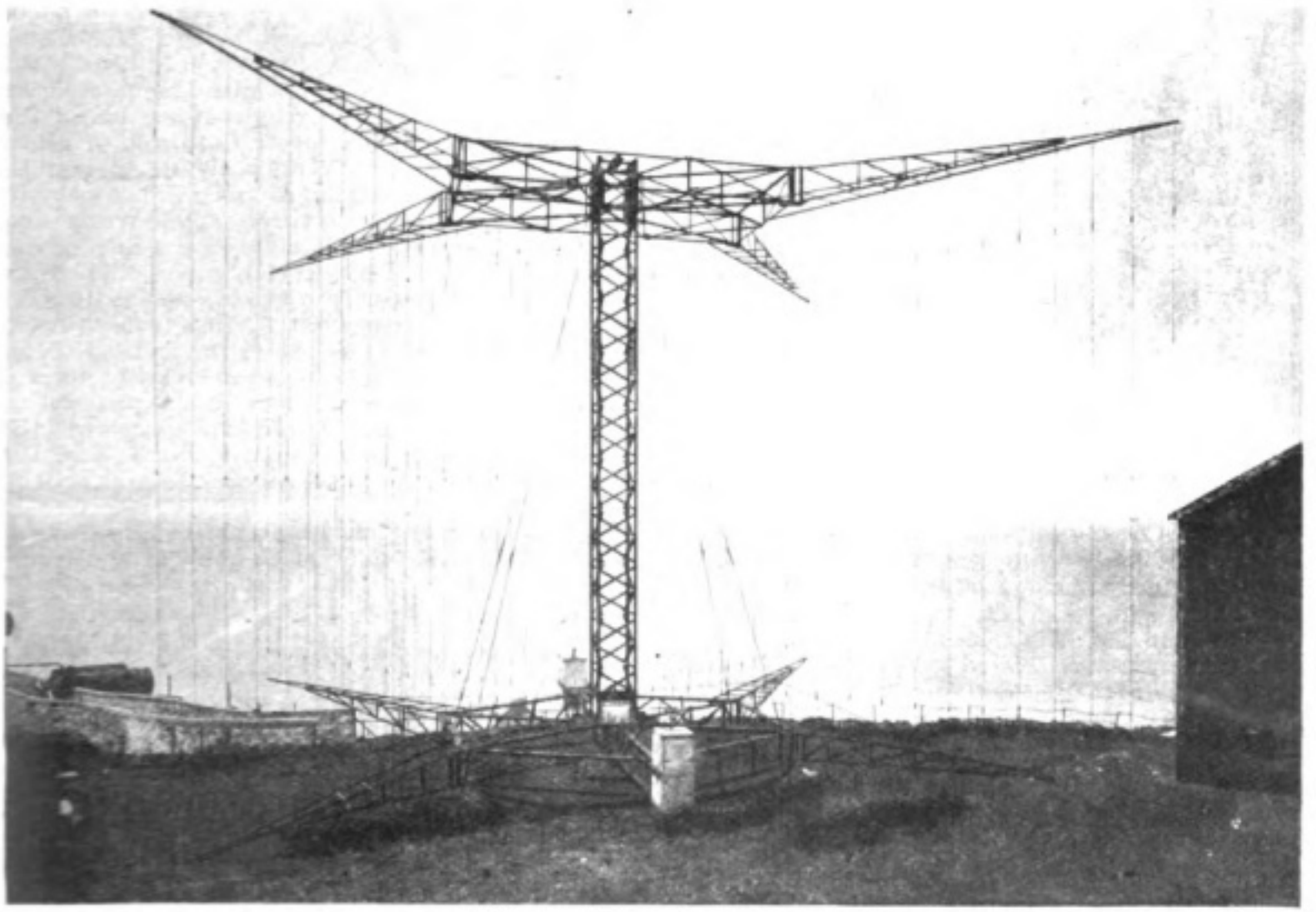


Fig. 5. The Reflector at Inchkeith.

produce no appreciable effect, while others at once put a big lead on the circuit, and if 200 to 200 watts of high-frequency energy are available, the glass gets hot and will quickly melt at some spot. One of my assistants, Mr. E. Green, made a useful discovery which overcomes this difficulty and it is now therefore possible to use what are practically standard valves, and their life appears to be about the same as for lower frequencies.

During the continuous-wave tests at Carnarvon it was found that reception was quite possible on the transmitting aerial while the transmitter was operating. This has been used successfully for duplexing between Hendon and Birmingham, and eliminates all switching.

The heterodyne may be either the transmitter, or an independent small heterodyne in the receiver. Both the transmission and the reception utilise the same aerial and reflector, and the transmitter is left going and can be operated while receiving.

There is no reduction in strength while the transmitter is on, but a practical trouble has appeared. Owing to the comparatively large power, strong currents are induced in all conducting structures and circuits close to the reflector and transmitter, such as the supporting towers and buildings, and every variable contact produces a noise. The elimination of all variable contacts in the neighbourhood of the transmitter has proved a work of some magnitude.

Reflectors besides giving directional working, and economising power, are showing another unexpected advantage, which is probably common to all sharply directional systems. It has been noted that practically no distortion of speech occurs, such as is sometimes found with non-directional transmitters and receivers.

Although the results between Hendon and Birmingham constitute a record for telephony for

the wavelength—for such results were believed to be impossible two years ago—they are only a first attempt and do not represent the best that can now be done after the experience gained. Birmingham, it is interesting to note, is 10,400 wavelengths from Hendon.

It has thus been demonstrated that wavelengths of the order of 20 metres are quite capable of providing point-to-point directional commercial service over very considerable ranges. Such services will be comparatively secret as compared with the usual non-directional type of transmission.

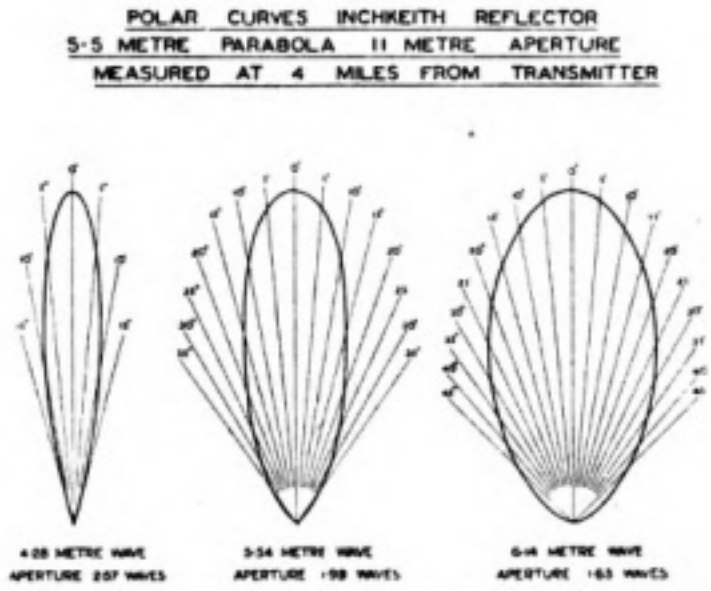


Fig. 6.

The directional effect obtained with reflectors which are large compared with the wavelength, is so good that it was suggested that it would prove very useful for position finding for ships near dangerous points. Through the courtesy of Messrs. D. & C. Stevenson, Consulting Engineers to the Northern Lights, and the Commissioners of the Northern Lights, trials are being made with a revolving reflector erected on Inchkeith Island. Credit is due to the author's assistant, Mr. N. Wells, who has been superintending this work on the island—very often under strenuous conditions.

The general idea is that a transmitter and reflector revolving will act as a kind of wireless lighthouse. It is not intended at present for long ranges, but rather that revolving reflectors should be erected in position, similar to those at present occupied by fog signals, and be capable of similar ranges, so as to give the position to ships during fog when within about 10 miles of the danger point.

An experimental revolving reflector was erected on Inchkeith, and tests were made to s.s. "Pharos," the lighthouse tender of the Northern Lights Commissioners, during the autumn of 1920. With a 4-metre wave, spark transmitter, a reflector of 8 metres' aperture, and a single valve receiver on the ship, a working range of 7 nautical miles was obtained. The reflector made a complete revolution once every two minutes, and a distinctive signal was sent every half-point of the compass. It was found that this enabled the bearing of the transmitter to be determined within ¼ point of the compass, or within 2·8 degrees. Fig. 4 shows a chart of the course of the s.s. "Pharos."

These results were good, but it was desired to know the effect of putting the transmitter lower down at the point of the island where ships would pass quite near. A new and larger reflector was designed, and erection has just been completed.

Fig. 5 is a photograph of the reflector at Inchkeith.

Fig. 6 shows polar curves taken with reflector.

This latter figure gives measured polar curves taken recently with the new reflector, and illustrates very well how the beam sharpens up with large ratio of reflector aperture to wavelength. The curves were measured at a distance of 4 miles.

The best method of giving the direction to a ship by means of such a revolving beam requires consideration. The method being adopted is, the author thinks, the most practical one. When listening in a receiver to a moderately sharp revolving beam the signals are heard only for a very short time. Taking the case of such a beam shown in Fig. 6 as produced by the 4·28-metre wave: supposing it makes a complete revolution in one minute, then at 4 miles with the receiver at maximum sensitiveness signals will be heard for 7 seconds every minute. Near the limit of range signals will be heard for only about 4 seconds. The exact time of maximum signals is not easy to determine by ear, but the times of starting and vanishing are easy to determine, as the rate of rise and fall of the signals is extremely rapid. The time half-way between these two times gives with great exactness the moment when the beam is pointing to the ship.

It would be quite possible to arrange to send a general broadcast signal when the beam passes through true north; then by arranging for the beam to revolve at a perfectly uniform rate, the bearing on the ship could easily be determined by means of a stop-watch. This method is probably the most accurate, but has some disadvantages. It entails accurate timing mechanism at the trans-

Fig. 7.

One of the two short-wave receivers.

mitter; the use of two waves; and three, or perhaps four receivers on the ship, as well as the use of a stop-watch.

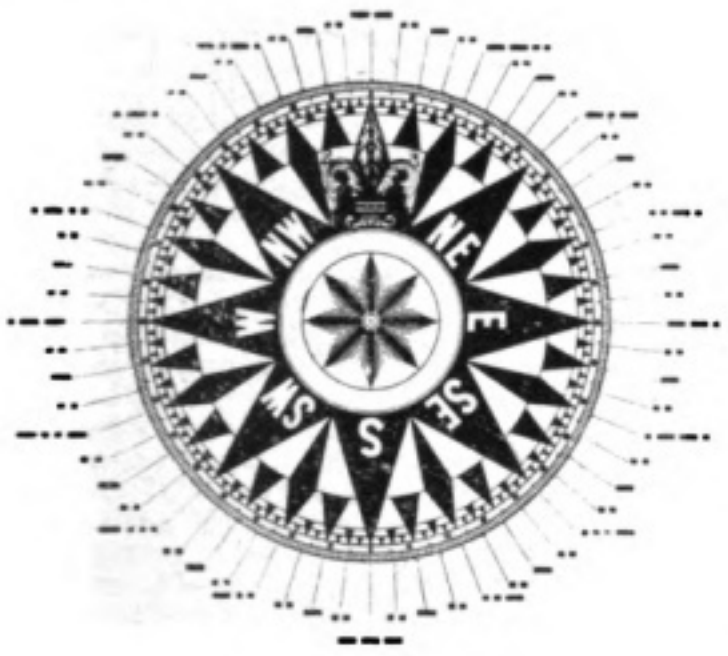


Fig. 8.

For the short wave two receivers are required, one at each end of the bridge, or one fore and one aft. One of these is shown in Fig. 7. This is necessary to avoid screening by the ship itself. If the broadcast wave for giving the time when the beam passes true north is another short wave, then two more receivers would be required.

The method provisionally adopted avoids accurate timing mechanism at the transmitter and the use of a broadcast wave, also the use of additional receivers and a stop-watch. On the base of the revolving reflector contact-segments are arranged so that a definite signal is transmitted every half or quarter-point of the compass. A distinctive letter is sent every two points and short signs mark the intermediate points and half-points. When listening-in at the receiver a few short signs are heard and one or two letters. The letters and signs used are shown on the card (Fig. 8). If the letters *t* (—) *i* (– –) *o* (— — —) *i* (– –) *t* (—) *i* (– –) are heard:

By reference to the card shown in Fig. 8, the half-way position is between South and S. ½ West and the bearing to the transmitter will be S. ¼ W.

The apparatus proposed is of a very reliable nature. The spark transmitters are very robust, and last for years without attention. The receivers are simple valve rectifiers with fixed adjustments except for a "backing off" potentiometer for dealing with powerful signals at close range. The attenuation of these waves over sea is so strong that a little experience enables distance to be judged by strength of signals, and this can be measured by means of the potentiometer. The only qualification necessary for a person determining the bearing, is the ability to read a few Morse signs.

In conclusion, it is thought that enough has been done to show that short-wave directional wireless telegraphy is likely to be very useful in the future, and the results just described should lead the way to more extended researches.

The names of some of those who have been directly associated with these experiments have already been mentioned, and the author has to acknowledge the large amount of help and assistance derived from the advice and researches of many others.

Wireless Telephone Broadcasting in America

UNITED STATES GOVERNMENT REGULATIONS FOR CONTROL

THE final report of a Radio Telephonic Committee appointed in connection with the recent Department of Commerce Conference on Radio Telephony, in Washington, has now been made public. The committee recommended that an advisory committee to the Secretary of Commerce be appointed, to consist of not more than twelve members, six in the Government and six from outside.

Recommendations were made as to wavelength allocation by classes, giving the amateur the band between 150 and 275 metres, and suggesting the assignment of specific wavelengths to each broadcasting station, except those operated by the Government, within the bands designated for such use. Experiencing great difficulty in providing even part of the general service demanded, the conference disapproved of the introduction of direct advertising at the expense of essential communication.

In connection with technical methods intended to prevent and reduce interference, authority to prevent unnecessary interference was sought, and it was suggested that the Bureau of Standards should make a special study of operating difficulties, ranges, width of wave bands, etc.

With the report in its final form, a legal subcommittee is now preparing a bill intended to give the Government authority to establish and enforce regulations, which will shortly be introduced in both houses of Congress, and, it is hoped, rushed through. The Committee, headed by Dr. S. W. Stratton, Director of the Bureau of Standards, and including members of Army, Naval, scientific, commercial, and amateur communication and radio interests, recommend that the Secretary of Commerce be vested with authority to control the establishment of all radio transmitting stations except amateur, experimental and Government stations, and the operation of non-Government

transmitting stations, all receiving stations being excepted. The Committee also passed a resolution to the effect that the types of radio apparatus found most effective in reducing interference be made available to the public without restriction.

ALLOCATION OF WAVE BANDS.

The assignment of 22 wave bands for radio telephony was made as follows: Transoceanic experiments, non-exclusive, 5,000-6,000 metres; Fixed service, 2,850-3,300; Mobile service, non-exclusive, 2,500-2,650; Government broadcasting, non-exclusive, 1,850-2,050; Fixed station, non-exclusive, 1,550-1,650; Aircraft radio telephony and telegraphy, exclusive, 1,500-1,550; Government and public broadcasting, non-exclusive, 1,050-1,500; Radio beacons, exclusive, 950-1,050; Aircraft radio telephony and telegraphy, exclusive, 850-950; Radio compass service, exclusive, 750-850; Government and public broadcasting, 200 miles or more from the seacoast, exclusive, 700-750; Government and public broadcasting, 400 miles or more from the seacoast, exclusive, 650-700; Marine radio telephony, non-exclusive, 650-750; Marine telegraphy, exclusive, 525-650; Aircraft radio telephony and telegraphy, exclusive, 500-525; Government and public broadcasting, exclusive, 484-495; Private and toll broadcasting, 285-485; Restricted, special amateur radio telegraphy, to overcome barriers, non-exclusive, 310; City and State public safety broadcasting, exclusive, 275-285; Technical and training schools (shared with amateur), 200-275; Amateur telegraphy and telephony (exclusive, 150-200 metres) (shared with technical and training schools, 200-275 metres), 150-275; Private and toll broadcasting, exclusive, 100-150; Reserved, all below 100.

WHAT IS BROADCASTING?

To clear up certain difficulties due to lack of definitions, the Committee defined Government broadcasting as that done by departments of the Government; Public broadcasting, that carried on by public institutions, universities, and such stations as are licensed to disseminate information and educational service; Private broadcasting, signifying broadcasting without charge, by a station owner, communication company, store, newspaper, organization or individual licensed to disseminate news, entertainment and other service; and Toll broadcasting, where a charge is made for the use of the transmitting station.

Private detective agencies desiring to operate radio telephone broadcasting stations, it was recommended, should be required to co-operate with municipal or state services in the use of the wave band 275-285.

In view of public demand for broadcasting, it was not deemed desirable to send messages over wide areas for point-to-point communication, except where communication could not be effected by other means. It was recommended that for this purpose other means should be used. An immediate study of geographical distribution of broadcasting stations was urged to secure the best service with minimum interference. Where congestion of radio broadcasting existed, it was recommended that the Secretary of Commerce should assign suitable hours of operation to stations. When conflict of transmissions occurs, consideration for the public not otherwise reached was recommended, and the priority of stations was established as Government, Public, Private and Toll.

NO ADVERTISING.

Direct advertising by radio broadcasting was prohibited and indirect advertising limited to the statement of the station's call letters and the name of the concern responsible for the matter broadcasted.

Recommendations that the transmission of signals tending deliberately to interfere with the reception of official time signals, constitute grounds for the suspension or revocation of a license were advocated in the report. Licenses for operators of radio telephone transmitting stations, should also require a knowledge of receiving and transmitting apparatus and the International Morse Code sufficient to receive at a rate of not less than ten words per minute.

It was agreed that the operation of Government stations be conducted in such a manner as not to interfere with the commercial traffic and broadcasting, and that whenever Government-owned stations were used for the transmission of commercial traffic and broadcasting, they should conform to the regulations established by the Secretary of Commerce.

RECOMMENDATIONS RELATIVE TO AMATEURS.

The final report recommended that the status of the amateur be established by law and that the limits of the wave band allotted to the amateur as given above (150-275 metres) be specified in the law, and that the amateur continue to be under the jurisdiction of the Department of Commerce.

For the purpose of self-policing among the amateurs, the creation of amateur Deputy Radio Inspectors, elected from their number in each locality, was approved; that upon receipt of notice of such election the Radio Inspector in charge of the district appoint the person chosen a Deputy Radio Inspector, serving without compensation or for the sum of one dollar per year; that the duty of such amateur Deputy Inspector should be to endeavour to the best of his ability to accomplish, under the direction of the District Radio Inspector, observance of the Radio Communication Laws and the Regulations of the United States and the observance of such local co-operative measures as are agreed to in each community for the minimization of interference between the various groups of the public interested in radio; that such Amateur Deputy Inspectors be clothed with whatever authority might be necessary in the opinion of the District Radio Inspector.

It was also recommended that the waves assigned to amateurs, between 150-275 metres, be divided into bands according to the method of transmission; damped wave stations being assigned the band of lowest wavelengths, interrupted or modulated continuous wave radio telegraph stations the next band; radio telephone stations the next band, and finally unmodulated, continuous wave radio telegraph stations the band of highest wavelengths. That amateurs be permitted to carry on broadcasting within the wavelength band assigned by

the Secretary of Commerce to amateur radio telephony, was recommended.

NEARLY 19,000 TRANSMITTING STATIONS.

Within a few days the Department of Commerce will have issued its 19,000th transmitting license. To-day there are 18,894 stations of various classes entitled to transmit radio signals.

On April 28th, the number of amateurs licensed and listed in their nine districts was 15,061, but as these reports come in only monthly, the number has probably already passed 16,000. A survey of all broadcasting licenses gives a total of 212, the number of which is increasing daily.

The balance of the stations are, of course, commercial, ship and special stations, which do not increase as fast as the amateur and the popular broadcasting stations.

Between April 23rd and 27th, twenty licenses were issued, among them there were three universities, two newspapers, a church and a police department.

Listening In

By J. E. WILKES.

NOWADAYS one can read *ad infinitum* about valve circuits, high and low frequency amplification and valves of all types; but one rarely sees an account of actual results. I propose, therefore, to write a little of what I actually get on my apparatus in the hope that others will be prompted to do the same; it is best to compare results and in that way to select the most suitable apparatus for one's particular requirements.

At the outset, I will detail the sets I have in use at the present time.

The basis of most of my work is a C Mark III amplifier. At first this must sound strange; but the amplifier is fitted with a panel just in the space occupied of old by the H.T. battery; on the panel I have fitted a separate rectifying valve, but above all a perikon detector mounted inside a rubber tube. Alongside I keep a separate heterodyning valve.

The coils to supply all sets are of the honeycomb type for all wavelengths above 600 metres; for and below that, I use spider webs.

With the foregoing apparatus I can read all ordinary spark and C.W. stations. For example: Supposing I want to check my chronometer by the 1655 G.M.T. time signals from Annapolis, as I do each evening. First I switch in my largest coils; then I plug in my crystal set and switch on the separate heterodyne; following this, I put all of the 4-volt current through the filament of the amplifier, but only 15 volts on the plates; in this way Annapolis comes in quieter and far more clearly than by using any valve as a detector.

A further example may serve to show the convenience of this apparatus. Let us assume that we want to get the ships on 600; all the change necessary is to switch off the separate heterodyne; switch in the spider coils; increase the plate current to 60 volts and reduce the filament current; then the ships come rattling in.

The above set gives me the following interesting items: On C.W. I get all big stations from Panama to Cairo; the most interesting are Sayville press; Annapolis time; occassional American news despatches; Rome press; Hanover-American news despatches; Bordeaux press; Helsingfors press; sometimes, but never unless hard pressed, I read the Leafield press; this usually brings on refreshing sleep.

Several of the foregoing stations are usually read on crystal only, with the aid, of course, of a separate heterodyning valve; there is no more certain way.

On the spark I get Moscow, Coltano, Malta, Nauen and hosts of ship and shore stations.

In telephony I get with ease Croydon, Paris and one or two more, but the set fails singularly to bring in our dear old friend, the Dutch Concert, or any of the land stations or planes on the London-Paris air route, excepting Croydon.

For the latter class of work, and for all other kinds of delicate work, I use a six-valve high frequency set. This has interchangeable transformers, and of course, a separate heterodyne. The switching arrangements are such as to enable any number of valves to be put in use. In fact, a single valve can be used, self-heterodyned.

For very delicate long distance work, this set is used as follows: First of all the station is tuned in to oscillate with reaction; coil reaction oscillation is then stopped by loosening the coupling; next the set is made to oscillate with the separate heterodyne and tuned to the exact note obtained originally. Now the reaction coil is brought back very gingerly to nearly its original position. The most careful adjustment will produce extraordinarily clear loud signals and no other method of work will give the same selectivity. The one drawback is the length of time required to get everything in perfect tune, and to keep it there with ever-changing currents.

For telephony, of course, the six valve set is *it*, *par excellence*. For instance, if only three valves are used, and the result sent to a loud speaker *via* the C Mark III amplifier, the Dutch Concert can be heard easily 50 yards away. I regret to say that some of our people insisted on dancing to the music last Sunday afternoon.

The distortion caused by the loud speaker is very bad, however, and it is far preferable to use the telephones, especially for speech.

Wireless to me is literature, music, society, and, as before hinted, occasionally narcotic. I have tried to sketch the means by which I have "got there" after several years of experiment. I know others do better. Will they be so good as to tell us of their methods and what they get too?

B

The Mechanical Design of Switches for Inductances

By J. R. HOULT.

Member of the Manchester Wireless Society.

IN designing switches for use with Inductances there are several requirements which must be taken into account, namely, robust construction, lengthy service, freedom from capacity effects and smooth working.

The necessity for robust construction will, of course, be obvious, and with robust construction lengthy service is closely allied. It does not follow that a strong switch will always give lengthy service; it may grind itself to pieces with constant wear, or again, it may be so strong that the blades tend to jam when passing successive contacts.

Freedom from capacity effects is more a matter of carefully considering the circuit in which the switch is to be used. In a plain inductance circuit, as Fig. 1, it will be found that the switch should

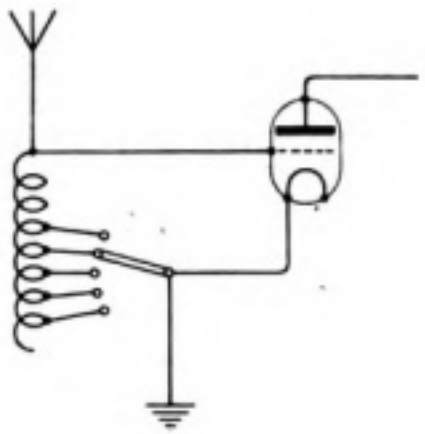


Fig. 1.

be placed in the earth lead as shown; if this is done the capacity effect of the hand when making adjustments will be found to be at a minimum. There are, however, circuits in which the switch would be desirable at the grid end of the inductance, and here we have to make allowance in the design of the switch. In the switch to be described the writer has arranged a fairly small knob at a good distance from the front of the panel, an arrangement which gives good service in practice.

Smooth working of a switch is, generally speaking, the result of careful "bedding" of the blades and a consideration of the ratio of the diameter of the contacts to the distance between them.

In the photos Figs. 2 and 3, the type of switch favoured by the writer is seen attached to an inductance former of shellaced cardboard. It will be noticed that the stop pins are used to support the inductance former; this allows the whole inductance and switch, as a unit, to be removed from its case. This type of construction, which is becoming widely recognised as a standard arrangement, is strongly recommended by the writer, since any adjustments are easily carried out, and in the case of inductances like that shown, it will be seen that the length of the wire required for tappings is reduced to an absolute minimum. This is not only desirable from the cost point of view, but also from the more important one of capacity effect, as it will be seen that if the former was independent of the switch and fixed in a case with the switch base as a sort of lid, its tappings would have to be much longer in order that there would have to be sufficient room to solder up the connections. When the "lid" was put on, the tappings would be twisted and crumpled between the

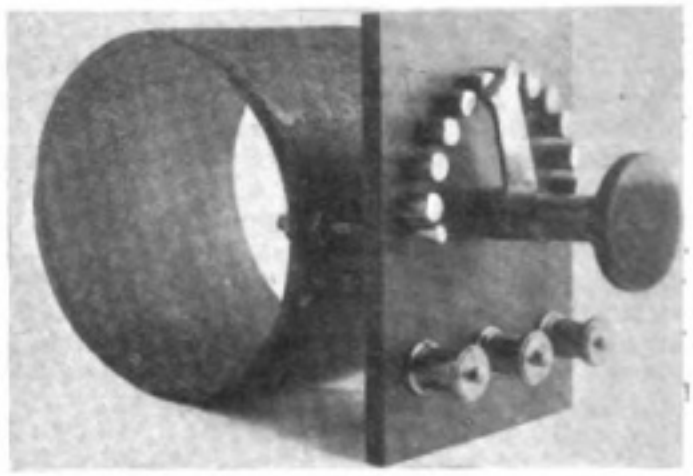


Fig. 2.

former and the switch base, and the resulting path for the H.F. currents would be anything but straight.

The dimensions of the switch are given in Figs. 4, 5 and 6. The dimensions of the base should be made to suit the cabinet or box in which the switch will be fitted.

It will be seen that the switch consists of a spindle A with a milled knob, carrying the blades C and a bush B for the ebonite base.

The threaded part of the bush, which is shown

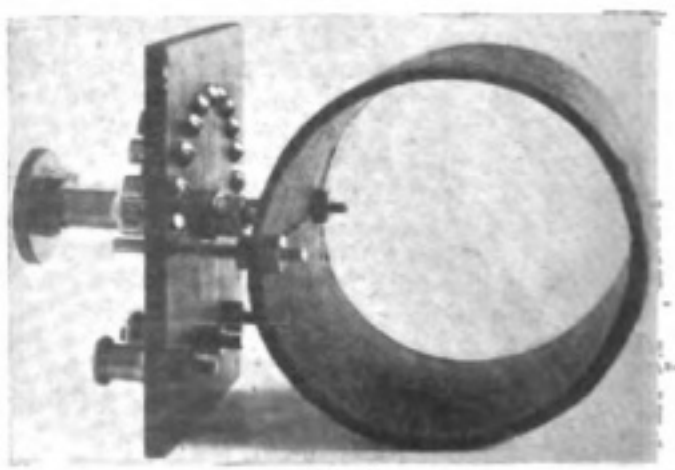


Fig. 3.

as 7/16 of an inch long and having 26 threads per inch, is one of the important points to notice. This length decides the maximum thickness of

base on which the switch can be used. In future switches the writer will increase this length to 9/16 of an inch (with a corresponding increase in the length of spindle "A") in order to accommodate bases up to ¾ of an inch thick. If a thinner base is used the bush is not cut down, as the extra part sticking through does not interfere with the working of the switch. The method of attaching the blades to the spindle is shown at D. The hole in the blades is a tight fit over the spindle, and the two blades are pushed up tight to the shoulder and two small holes drilled. Small brass wire pegs are then hammered in and filed off flush with the underside of the blades. The method of fastening the spindle in the bush so that the nut will not work loose is shown at E. A 6 B.A. hole is

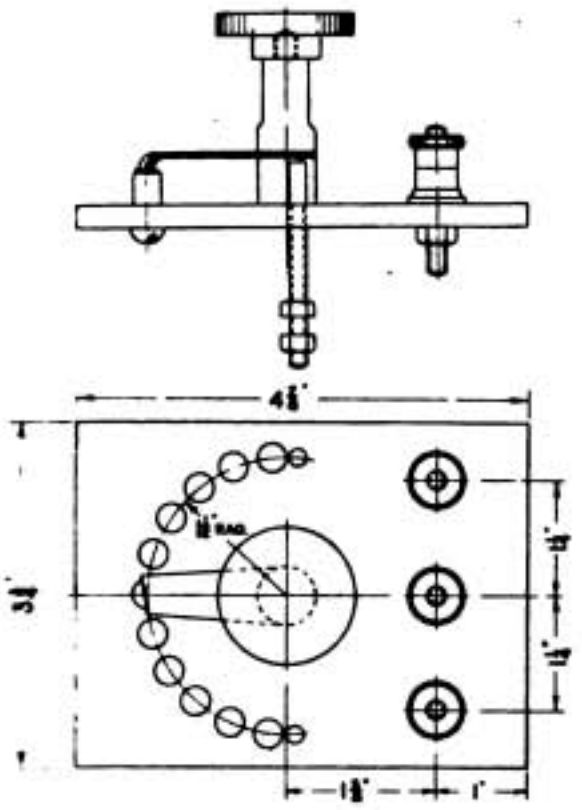


Fig. 4.

tapped into the spindle (in the part marked 3/16 of an inch Whit in sketch A), and a screw and washer is placed over the nut as shown to keep the nut from working loose. A spring washer is placed under the same nut to keep the blades hard down on the contacts.

The whole switch is made of brass with phosphor bronze blades and ebonite knob and base.

The stop pins are shown at F (Fig. 6), and require no explanation except that the base is tapped to receive them, as there is not room for a nut at the back.

The contacts themselves are a decided advantage over the commercial type where the stem is turned down from the contact diameter as they cost considerably less and they can be used for *any* thickness of base, the varying factor being the round-headed screw which can be bought in almost any length. The tappings are soldered on to the heads of the screw by the writer, but in temporary switches they can be placed directly under the screw head and tightened up.

With regard to assembly and bedding. The contacts are first mounted and well tightened. A file should be placed over as many contacts as possible and well rubbed to ensure that all contacts are the same height; this process should

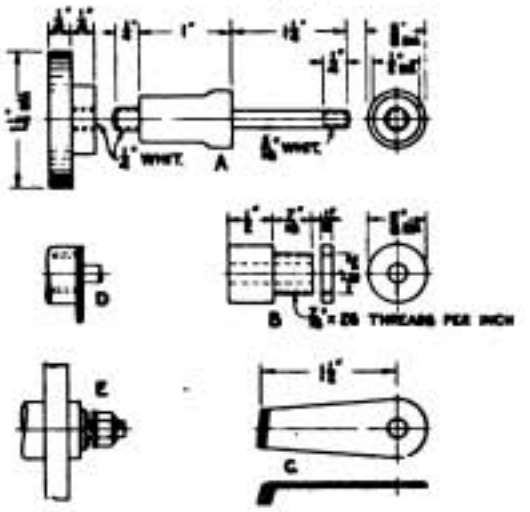


Fig. 5.

be repeated with a piece of emery cloth over the file to give a smooth surface. Next place the bush in position, and, finally, the switch. When the switch is tightened up and the 6 B.A. screw got into position a piece of emery cloth should be placed face *up* over a few contacts and the switch arm run over it; rub the switch to and fro several times to bed the blades parallel to the contact faces. The edges of the blades then need carefully rounding.

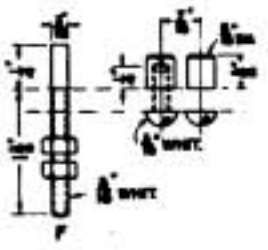


Fig. 6.

It will be noticed that the blades are not bent over squarely, but at a slight angle. This is an important factor to the successful working of the switch as it makes the contacts self-cleaning and greatly assists the smooth working of the switch. It will be seen that a slight scraping action takes place, and to assist this a trace of oil should be rubbed over the surface of the contacts.

In conclusion it might be mentioned that the writer has had several of these switches in constant use for a period of three years, no adjustments of any kind having been found necessary.

The Reinartz Tuner.

Mr. Harris points out to us that in the diagrams of his article on the Reinartz Tuner there are two slight errors. In the diagram of connections on page 190 the aerial tappings are numbered 2, 4, 5, 6, 7, 8 and 9. Actually they should be numbered 10, 8, 6, 5, 4, 3, 2 and 1. In the constructional drawing on page 193 the tenth tapping of the aerial circuit should be connected to the central filament terminal. Both of these points were made clear in the text.

Four-Electrode Valves and their Circuits

By CAPT. H. DE A. DONISTHORPE.

(*Continued from p. 201.*)

The President

I believe Mr. Scott-Taggart wishes to speak; I will ask him to continue the discussion.

Mr. J. Scott-Taggart.

Before describing one or two special kinds of valve which I have designed myself, I would like to make a few comments on the paper which we have just heard.

Personally, I am not a great enthusiast where special kinds of valves are concerned. The valve which has been described to-night is a complicated structure containing a filament, two grids and an anode, and this valve is intended to enable us to obtain high frequency amplification, with a stage of rectification and a stage of low frequency amplification. We have noted from the diagram that we have seen to-night that the different elements used, such as inductances and transformers, are of the kind used in an ordinary receiving set, and it seems to me that very little is gained by making a complicated valve having a plurality of electrodes instead of using the ordinary collection of two or three standard three-electrode valves. We do not benefit by having fewer component parts. The only way in which we derive any benefit is that we can use a single valve instead of, say, two or three three-electrode valves, and all those who have had any experience in the construction of thermionic valves will, I think, agree with me when I say that to make the four-electrode valve that has been described to-night, necessitates as much time and trouble as two or three standard types of valve which are made in very large quantities, so that it always seems to me that with these special types of valves (freak valves, we may call them), unless they produce some entirely new effect, we are complicating the problem of receiving wireless signals. We are trying to produce a compact set in a roundabout way which gives neither improved results nor cheaper manufacture. The disadvantage, moreover, of trying to combine everything into a single valve is that the circuit tends to oscillate much more readily, and adjustments are more critical than in the simple case with two or three valve receivers. I have not dealt with the question of saving in valves. I doubt very much whether anything at all is saved on it, because three-electrode valves are made in thousands and can be made fairly cheaply, whereas a special valve with two grids complicates the construction very greatly and is an expensive proposition. Then again, in the construction of these valves there is a tendency to a greater loss due to non-uniformity, the different swings. It is bad enough to construct uniformly two or three-electrode valves, so that when we make an addition to it we complicate the problem still further.

Then again, turning to the question of the amount of amplification we get by a valve of this kind. It has been said that you get an amplification equivalent to three ordinary valves, but I am doubtful whether that is so, because in the first place it is a well accepted fact that a valve cannot carry out all three functions at the same time to the best effect; it is better to allow a valve to amplify high frequency or low frequency at a single stage, and to use different valves for the different subsequent stages, so that once you begin to do all these things with a single valve, you are liable to produce complications which are disadvantageous. To use the valve as shown us, you get a stage of high frequency amplification, and you get a stage of rectification which is inefficient. What you are doing is to use a Fleming valve as a rectifier and a Fleming valve is really no better than a crystal detector; then you take the rectified currents from this Fleming valve rectifier and amplify them at low frequency, so what you are doing is equivalent to a stage of high frequency amplification, followed by a crystal detector and a stage of low frequency amplification. When you are using three three-electrode valves, you get a stage of high frequency amplification, a stage rectification which may be three or more times as sensitive as a two-electrode valve and then a three-electrode valve is used as an amplifier. And you can use all these valves to the best advantage whether it be as rectifier, high frequency or low frequency amplifier.

There is another point which I wish to mention in connection with the circuit. I noticed in Fig. 7 two points; one was that the transformer which passes back the low frequency current for low amplification is connected at the grid end of the inductance. I would be very pleased if the author of this paper could explain the reason for putting the transformer at the grid end instead of at the filament end, because generally speaking it is good practice, and the best practice, to place a piece of apparatus such as a transformer or battery at a point of earth potential and not at a point in the circuit which is at high frequency potential to earth. There is also, I notice, no grid condenser connected across the grid winding of the low frequency transformer.

Coming to the valves which I have designed myself, possibly the same objections might be raised against them. It is questionable whether any of these freak valves have any merit over the ordinary three-electrode valve. Of course, you are open to get a certain advantage over the single three-electrode valve, but I think in general it is preferable to keep to a pair or three ordinary three-electrode tubes instead of trying to complicate matters by putting all the electrodes into one tube. Of course, if you get some entirely new scheme which cannot be resolved into three-electrode tubes, well and good; something new is produced. But if you are going to produce the old effect in a more complicated manner, it is better to stick to the ordinary methods of reception.

I have brought along a few slides which I have

sketched out, and I hope they will come out sufficiently clearly to be seen.

Fig. 9 illustrates a four-electrode valve of a kind already described by Mr. Donisthorpe. Two grids, G_1 and G_2 are used and these grids both apply high frequency potentials which vary the electronic current flowing from the filament to the anode A. The incoming signals set up oscillations in L_1 and C_1, and these oscillations are applied to G_1 and produce amplified oscillations in the anode circuit of the valve. We have the anode A, a tuned oscillatory circuit L_2 C_2, the telephones T, and the

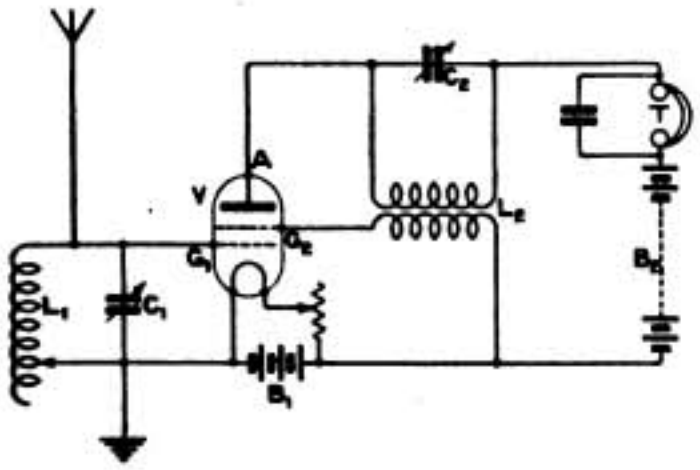


Fig. 9.

anode battery which is below. Now, if we examine that circuit to start with, we will see that when signals are being received, the oscillations are amplified by the valve, and produce amplified currents in L_2 and C_2, and these amplified currents are now rectified by the valve, and also amplified, and I do that by connecting the grid coil L_2 across the grid G_2 and couple it to the coil L_1. Now, when we are receiving wireless signals, we get the magnified oscillations in L_2 C_2 passed on to the grid coil L_1, and applied to the second grid G_2 where they are rectified. This can be done either by putting a leaky grid condenser in the G_2 grid circuit, or simply by relying on grid damping to lessen the positive half-cycles, and so produce a rectification effect. Now these oscillations applied by L_1 to the grid will give a rectified current in the anode circuit, and we therefore get in the anode circuit not only magnified high-frequency oscillations which are passed through L_2 C_2, but also rectified low frequency currents, which pass through the telephones T. The advantage of the circuit is that we can get reaction effects and also high frequency amplification and detection, the detection being accompanied by low frequency amplification, although no transformer is shown in the particular example I have shown. The coupling between the coils at L_2 is such that there is a reaction effect between these two coils, and if the coils are coupled sufficiently tightly, continuous oscillations will be set up in the circuit L_2 C_2 and by tuning L_2 C_2 to a frequency slightly different to the frequency of incoming continuous wave signals, beats will be produced in the circuit, and these beats will be rectified by the valve and will produce signals in the telephones.

The advantage of this circuit is obtained chiefly when receiving continuous waves, and an additional advantage is that the oscillations are not produced actually in the aerial circuit as in the usual form of continuous wave receiver, but in a circuit to the right of the valve, so that the valve really acts as a trap which allows incoming continuous wave signals to be applied to the grid, but does not allow the local oscillations to get back to the aerial circuit. It is difficult to prevent a certain amount getting back, but the amount would be very small and negligible in comparison with the amount which gets back in the case of the usual self-heterodyne circuit.

The second type of valve is one which is becoming important commercially, and is fitted to a large number of steamers including the new Cunard vessel "Berengaria," and it is called the "Negatron." Some of you may have read about it in the *Radio Review*. It is a form of valve having four electrodes, but working on a different principle to any of the other kinds of valves which have been shown here. I have two anodes which take the form of flat plates, and which are marked A and B one on each side of the filament, a grid being placed between the filament and anode B (Fig. 10). This grid is usually in the form of an ordinary piece of wire not in the form of a mesh, and the circuit which is used in connection with it for demonstrating the action of the tube is given in Fig. 11. The object of this valve is essentially to produce a negative resistance effect. You all know the nature of a negative resistance characteristic and that the current curve slopes down, and that as we increase the voltage applied to a conductor the current decreases, and it is also a well-known fact that any negative resistance device, if applied to a circuit having ordinary resistance, will neutralise the resistance, and if we connect an oscillatory circuit in a negative resistance device we can produce continuous oscillations, which may be used for transmission or for any other purpose, so that negative resistance devices are very important. In Fig. 11 we have two anodes A and B, as shown in Fig. 10. In the A circuit we have a battery about 60 volts and a milliammeter M. The anode is connected to the grid through a battery B_4, which is put there to give the grid G a voltage about zero, otherwise it would have a high positive potential. The anode B is connected to a high tension battery B_3, also of about 60 volts. The action of the arrangement is briefly this:—By adjusting the filament current, I arrange that the

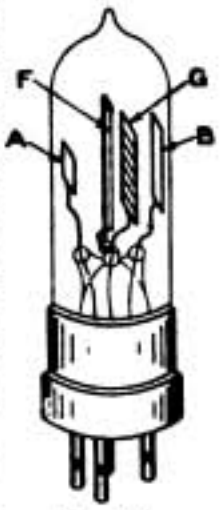


Fig. 10.

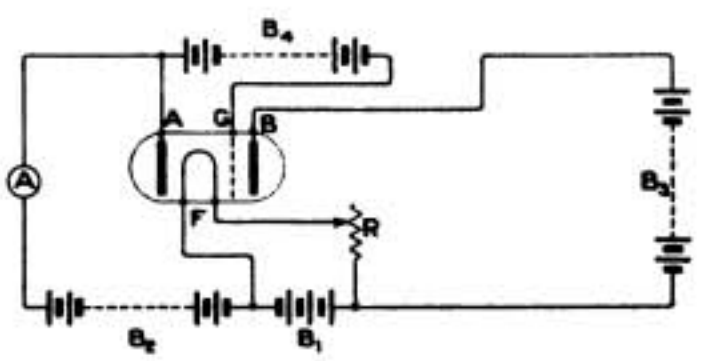
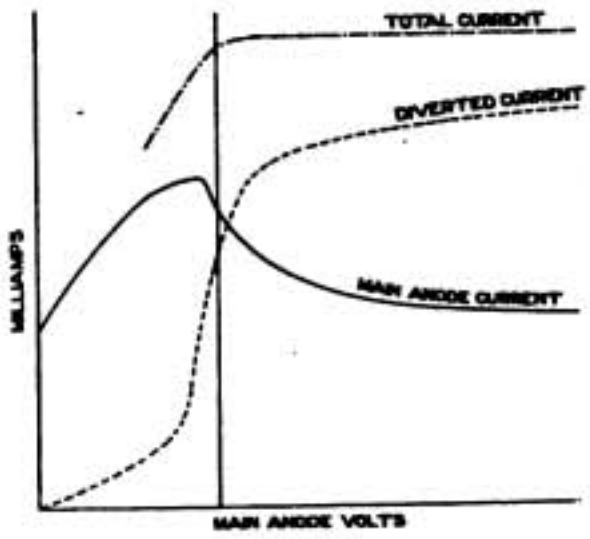


Fig. 11.

electrons from the filament all go to one or other of the two anodes. Now, when such are the conditions, if we increase the number of electrons passing to one anode, we must take away electrons which are going on to the other anode, because there is only a limited supply; if one anode takes more the other must take less. Now, if we suppose that the voltage of B_2 is increased, the voltage of the anode A is increased. In the ordinary course we would expect the anode current A to increase, but the grid G is made more positive, and this extra potential on the grid G increases the number of electrons flowing to the anode B, the total number being still distributed between the two anodes. The current to B increases, and the extra electrons must come from those which would have gone to the A anode. The grid, therefore, acts as a means of diverting current from one anode to the other. By supplying an extra positive potential to the anode A, the tendency is to increase the current. At the same time we are increasing the number of electrons flowing to B, and therefore decreasing the number flowing to A, so that the result is that the number of electrons flowing to A decreases and therefore the A anode circuit has negative resistance; if we include in it a circuit having positive resistance such as an oscillatory circuit, continuous oscillations may be produced.



Fig, 12.

The theory which was worked out long before the actual valve was constructed, has proved to be correct by characteristic curves taken of the valve. Some actual characteristic curves are shown here (Fig. 12). We have the main anode current characteristic curve which is shown by the thick line. That represents the amount of current flowing to the left-hand anode, the anode marked A in the previous figure. The vertical line represents some steady voltage which is normally on the anode, say 60 volts. Now, if we increase that 60 volts to 70, we notice from that characteristic curve that the current in milliamps. decreases, and that decreasing effect is obtained from the top of the curve right down to the right-hand side, so that over that range of voltage the valve acts as a negative resistance. If the normal voltage i too small, the effect is longer obtained because the valve is no longer saturated. As we are increasing the voltage on the main anode marked on the bottom scale, we are making the grid more positive and increasing the current to B, and the dotted line shows the diverted current. If we compare the main anode current and diverted current we see where the electrons are going to.

As the B anode current increases, the A anode current decreases, and the total current is shown by the top curve. If we measure that value it will always remain the same. It is simply a question of two anodes dividing up the electrons between them. If one takes more, the other must take less. If we add the two together their currents will always be the same.

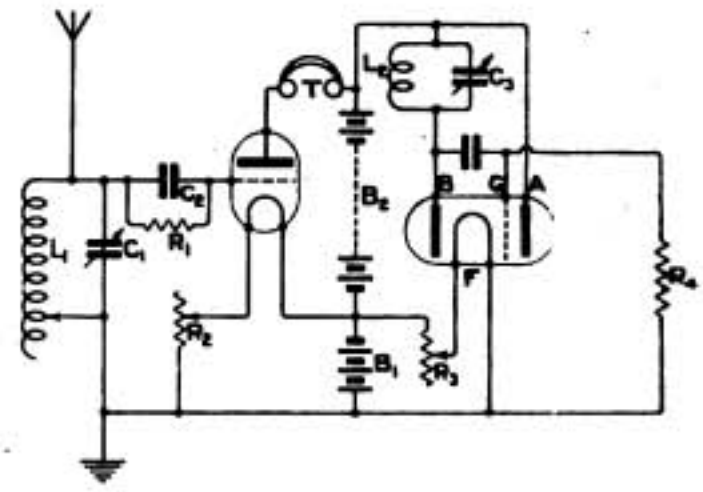


Fig. 13.

Fig. 13 shows a practical example of the way in which the Negatron is used as an oscillator for the reception of continuous waves. The right-hand portion, to the right of the battery B_2, is a simple receiving circuit using a leaky condenser, C_2 R_1, as the means of obtaining the rectification effect. That portion is simply the usual receiving circuit, but the left-hand portion is the negative resistance oscillator, which is the external heterodyne. It produces beats in the aerial circuit, and the oscillator is really the same as the previous illustration, except that we have got one or two practical details incorporated. For example, instead of having two batteries we have only got one B_2. Then instead of having a battery to prevent the grid being given a high positive potential we have a little condenser which is shown above the letter G, and this condenser is an insulating condenser, a resistance R_4 being provided to keep the grid from accumulating large quantities of electrons. It is not the ordinary grid condenser used for the purpose of rectification. We connect the oscillatory circuit L_2 C_3 in the B anode circuit, and the moment that it is connected up and the filament rheostat R_2 adjusted to a suitable value to produce saturation in the valve, the circuit L_2 C_3 will oscillate.

Fig. 14 shows another use of the Negatron in a self-heterodyne circuit. Instead of using it as a separate oscillator for external heterodyne reception, I am now using it as a self-heterodyne. We have the receiving circuit L C_1, which forms the aerial circuit also included in the main anode circuit, so that oscillations may be set up in it, and all we have to do is to connect the telephones T in the position shown, or we can preferably connect the telephones in the other anode circuit. It makes little difference in which circuit you connect the telephones. Oscillations are set up by adjusting the filament resistance R_2.

An interesting effect may be obtained with a circuit of this kind and that is the damping of the aerial circuit may be reduced, not quite to produce self-oscillation but sufficiently to produce a decrease of damping. It was proposed a long time ago, long before the three-electrode valve came into prominence, to use negative resistance devices of different kinds in this country to reduce the damping of circuits and so get stronger signals, and any negative resistance device, of no matter what type,

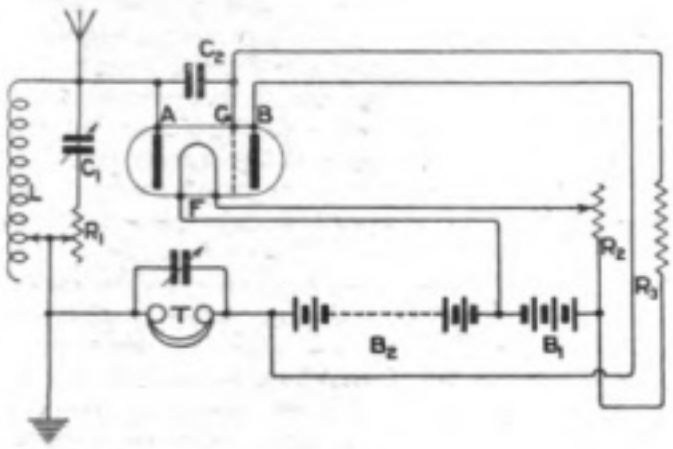


Fig. 14.

may be applied for this purpose. Where this is done, we can connect a resistance R_1 of about 30 ohms in LC_1, and, by adjusting the resistance of R_1, we can alter the damping of the aerial circuit just to the point preceding self-oscillation, and under those conditions we get very strong amplification of signals.

The last slide (Fig. 15) goes back again to a form of circuit in which two grid valves are used. In this case I have, instead of using a single grid to amplify low and high frequency signals, kept a separate grid for each particular process. One grid is reserved for high frequency amplification, and the other is kept for low frequency amplification. For example, in the first valve V_1, the incoming signals are applied to the top grid, the high frequency oscillations in the first valve passing through the primary of L_2, which passes on the high frequency oscillations to the top grid of the second valve. This also amplifies the high frequency oscillations which are passed on by means of the transformer L_3 to the three-electrode valve V_3. The rectified currents are communicated by the low frequency transformer T_1 back to the second grid of the first valve, the amplified low frequency currents being applied by the intermediary transformer T_2 to the lower grid of the second valve. They are again amplified and finally signals appear in the telephones T.

Mr. C. F. Phillips.

With regard to Capt. Donisthorpe's remarks, I should be glad if he would explain, if it is convenient to do so, exactly how the circuit he showed on the screen as Fig. 7 is made to generate oscillations. I saw, I think, two ways in which it may possibly generate, but it struck me when I heard the telephones humming on the table that it was generating at audio frequency. I take it that if this is so there may be some difficulty in varying the note, and as the amplifier in the form in which it stands is intended, I believe, to receive continuous waves without a separate heterodyne, I am not quite sure whether generation at audio frequency, without any ability to vary that frequency, would be very successful in the reception of continuous waves. I think that is the only remark that I have to make except to say that I very much agree with Mr. Scott-Taggart that the valve which Capt. Donisthorpe has called the "quadrode," but which I believe Dr. Eccles called the "tetrode," is in no way better than several three-electrode valves. The only saving that I can see is a saving of filaments, and filaments are not very expensive things, and I daresay that the particular filament of the type of valve we are looking at, would take a current probably of the order of 0·5 to 1· ampere, or something of that sort, whereas if we use three three-electrode valves of the type which are known as low temperature emitters we might get three valves and run three filaments at perhaps a third of an ampere, and so save in battery power. I am

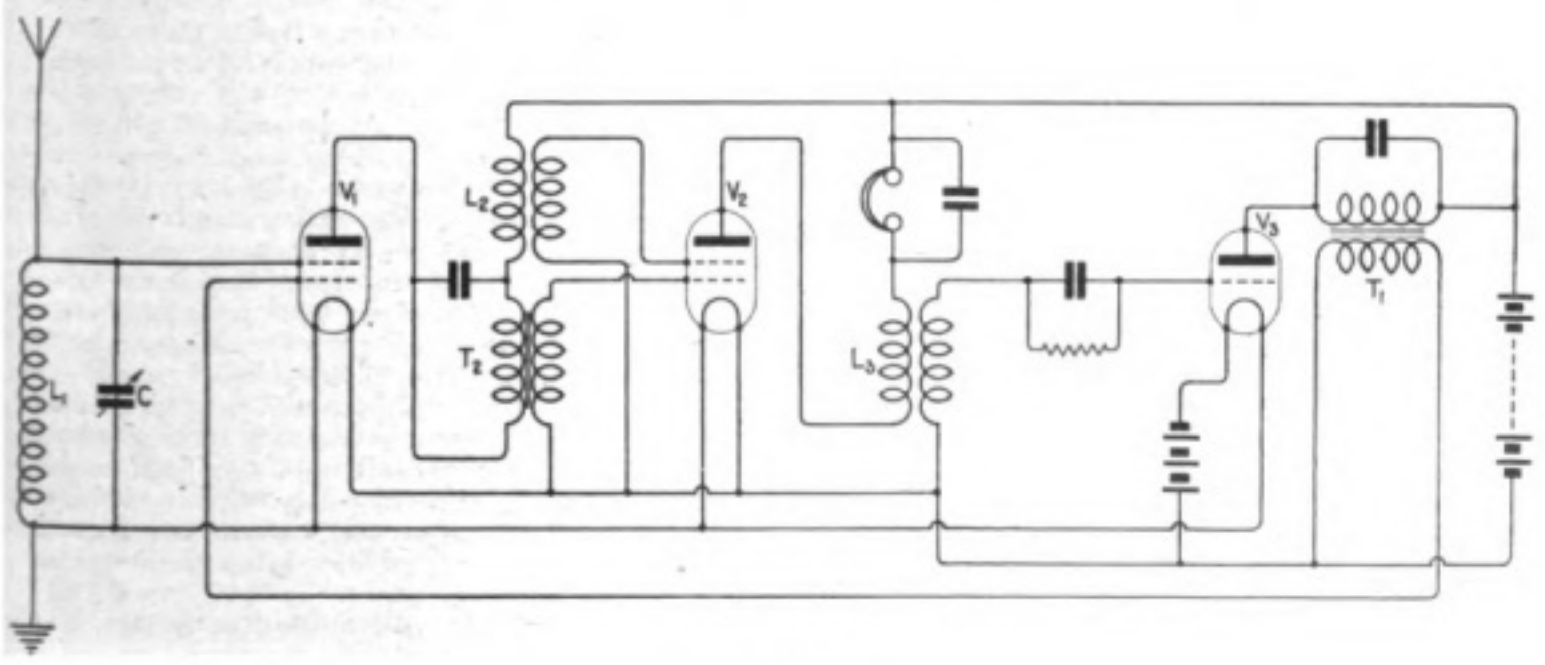


Fig. 15.

not at all sure that three low temperature emitters in the future will cost very much more than one four-electrode valve. I say in the future.

Mr. R. E. H. Carpenter.

There are one or two questions which I should like to ask Mr. Scott-Taggart. First of all, I must express my appreciation of the extremely lucid way in which he explained the action of the "Negatron," device. In connection with that circuit I would like to know whether, when an oscillating circuit is connected in series with the "Negatron," the frequency of the oscillations bears a close agreement with the calculated $\sqrt{LC}$ value. It is difficult in the case of the ordinary triode arrangement to calculate your frequency, nor can it be given by any circuit arrangement, owing to the necessity of coupling the retroaction coil to the main inductance. I notice that the curves which he gives for the "Negatron" are curves in the ordinary sense in that they are not particularly flat at any point. I wonder whether such a circuit is particularly rich in harmonics.

I was interested in Mr. Scott-Taggart's remarks that it had been proposed long before the advent of the valve to use negative resistance devices to reduce the decrement of aerial circuits, and one would be interested to know what device other than the valve existed or whether that was merely the expression of a higher scope for the future.

Mr. J. Scott-Taggart.

With regard to the question of harmonics, I do not think any more harmonics are likely to be produced with a "Negatron" than with an ordinary valve system, because with that you have got a point of saturation, and, of course, the "Negatron" generates comparatively feeble oscillations, depending on the size of the valve and unless the negative resistance portion of the characteristic curve is employed the valve will not generate oscillations for the simple reason that the curve is not sloping down. With regard to the calculated frequency, that is nearly always the same as the actual frequency obtained, and the "Negatron" in that respect resembles a single circuit oscillator in which you have a single oscillation circuit without any reaction coil and connect the filament to the middle point on the inductance, and the two ends of the coil to the grid and anode of the three-electrode valve. Of course, the various effects which control the frequency bear on matter, for example, the anode filament current. With regard to the lessening of impedance, I did not say that a negative resistance device had been used to reduce aerial resistance to a critical value, but that it had been used generally, and applied to different kinds of circuits, especially with respect to telephone circuits. Dudell, for example, used one of his first arcs for the purpose of lessening the impedance of the telephone lines, and telephone apparatus, and he got a very marked increase in sensitiveness. The effect is really equivalent to the ordinary reaction effect obtained with the three-electrode valve. The two phenomena are identical in their results. He also proposed to use, instead of the ordinary arc, which is not suitable, a vapour lamp, and Cooper Hewitt a few years later in 1904 developed the idea considerably, and used the Cooper Hewitt lamp to reduce the damping in telephones, so that it was not a very great step to apply the principle to ordinary wireless signal circuits.

Mr. Oswald J. Carpenter.

I may have misunderstood Mr. Scott-Taggart, but I believe he stated that note frequency amplification is obtained, using the four-electrode valve he described. If this is correct, and the potential of the outer grid is varied at note frequency, it seems to me that any attempt to secure a condition for autodyne reception will result in generation of audio frequent oscillations. This is the case with the Marconi device which, however, employs a heterodyne unit for undamped wave reception, in accordance with the usual commercial practice.

In connection with this type of valve I should like to mention a possible field for experiment which may be of interest.

The single-valve telephony transmitter utilising "grid control" is becoming very popular with amateurs, particularly in view of the extended employment of short wavelengths. Unfortunately, you cannot obtain a very high percentage of modulation with the standard arrangement, since when the amplitude of the generated waves is varied very considerably the valve will momentarily cease to oscillate, and therefore the speech formation will become broken and very distorted. In Fig. 16

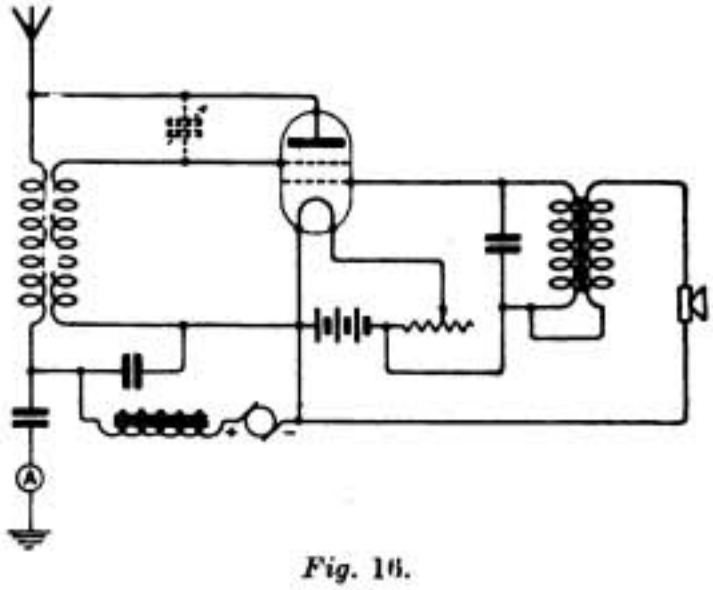


Fig. 16.

I give a circuit which is not new but which is not generally known. It will be seen that the microphonic control circuit is connected to the inner grid of a four-electrode valve. As this grid is nearer the filament than is the main grid, it is able to effect an equivalent control of the electron stream with smaller potentials. The utility of this is evident when handling outputs necessitating high grid potentials. The microphonic currents are, of course, no longer superposed on the oscillatory currents, which now traverse the outer grid circuit, and substantial modulation of the high-frequency energy may be secured with improved stability. The anode and outer grid circuits are sometimes coupled through a variable capacity, as indicated by dotted lines.

I should like to mention another matter, that is, the attempt to deprecate the need for four-electrode valves. One point which seems to have been overlooked is that if you have one valve doing the

work of three, you have but one replacement charge in place of three. Also, you have a more robust filament, yet one taking considerably less current than three and having a considerably longer life — that is an interesting point regarding maintenance. As for construction, I do not think the difficulties are as great as has been suggested. Captain Donisthorpe has brought a specimen and from this it will be seen that, unlike the low-temperature emitters mentioned, the electrodes are not of a micrometrical nature, and that they are well spaced.

Mr. M. Child.

I should like to ask Capt. Donisthorpe whether he has received satisfactory telephony with one of these four-electrode valves. I think that must be a point of interest to a great number of us here, because we are interested in transmission and we are certainly interested in the reception of telephony, and I think if we could have a little information on how this valve behaves in actual practice in the reception of speech it would be probably useful.

A good deal has been said to-night on the question of negative resistance. I believe that it is of great utility in eliminating atmospheric disturbances. When we get strong X's, by the use of some such apparatus as Mr. Scott-Taggart has described in his "Negatron" circuit, and put into the aerial circuit a large artificial resistance in order to damp that circuit very considerably, so that it is very insensitive to the atmospheric currents which may be passing, we can yet wipe out from our signal currents the effect of that resistance completely. I believe that is, theoretically, at any rate, quite a useful proposition.

The President.

It appears to me that the four-electrode valve will prove very useful and find its level like the three-electrode valve. It is a case of the survival of the fittest. It is a pity we have no one here who can give us data as to the life of the valve and its robustness, but we do not seem to have anybody here who is experienced in using it for reception. I do not know whether the life of the valve is effected by having to perform several operations. There is no doubt that there is a great deal to be said for the low temperature valves. The small dimensions of the valve are not a thing to be despised.

I will ask Mr. Scott-Taggart to reply.

Mr. J. Scott-Taggart.

There is only the question of oscillating and low frequency. In order to get that low frequency oscillation you must have—(I think the reference is to the double grid valve)—you must have some form of tight coupling which in the particular circuit that I gave did not exist. There is no back coupling at all; I couple no anode circuit to another grid circuit. In the single valve circuit there is just a pair of telephones. There is no telephone transformer with a winding going back on to one grid, so that the arrangement could not produce low frequency oscillations. There is also a point raised on the life of the filament. I do not think that these valves last any longer than the ordinary valves. The filaments are of the same size, and if you assume the valve costs 45s., and three ordinary valves cost 45s., when one of these particular type burns out 45s. has gone, whereas in the case of the three-electrode you may have two left out of the three!

(To be concluded.)

Potentiometer Control of H.F. Amplifiers

By S. O. PEARSON, B.Sc., A.M.I.E.E.

SINCE the advent of Mr. Campbell Swinton's "plug-in" type of high-frequency transformer* for intervalve coupling, a great many amateurs have adopted tuned high-frequency amplifying circuits using these transformers. One of the chief difficulties to be met with in this type of circuit is the tendency for continuous oscillations to be set up and maintained, and some means must be provided for their control. Various methods are available, but it is intended here to discuss in particular the potentiometer method of control, and an attempt is made to explain why an amplifier controlled in this way is liable to be noisy, especially when receiving telephony. This fact has been noted and mentioned in *The Wireless World* of February 4th last, by Mr. H. H. Whitfield, who won the Second Prize in receiving the American Amateur Transatlantic Signals last December.

When both the grid and plate circuits of a three-electrode valve are tuned to approximately the same wavelength, self-oscillation usually occurs, regenerative action taking place through stray coupling between the two tuned circuits, and, in the case of speech reception, must be stopped. Greatest amplification and sharpest tuning are obtained when self-oscillation is just on the point of occurring. Speech cannot be received satisfactorily with the valves oscillating.

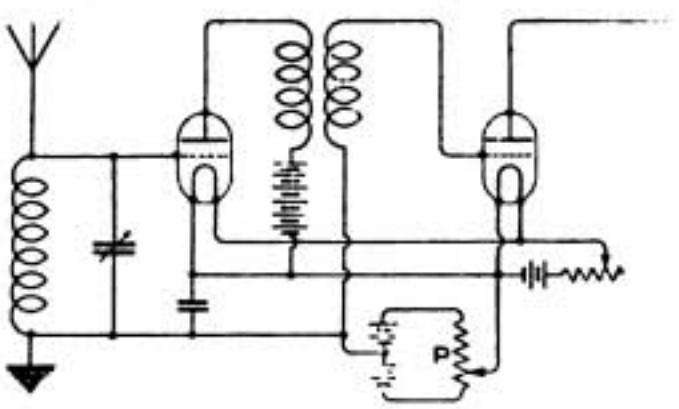


Fig. 1.

A very common method of preventing this oscillation is provided by the use of a potentiometer operating on the grid potential of either the first or all of the high-frequency valves. Fig. 1 represents such an arrangement, the first two valves and one high-frequency transformer being shown. P is the potentiometer for varying the normal grid voltage.

* See *The Wireless World*, June 25th, 1921.

The self-oscillation may be stopped either by raising the normal grid potential above that of the filament so that a grid current flows, thus increasing the damping of the tuned grid circuit, or by lowering the grid potential until the valve operates on

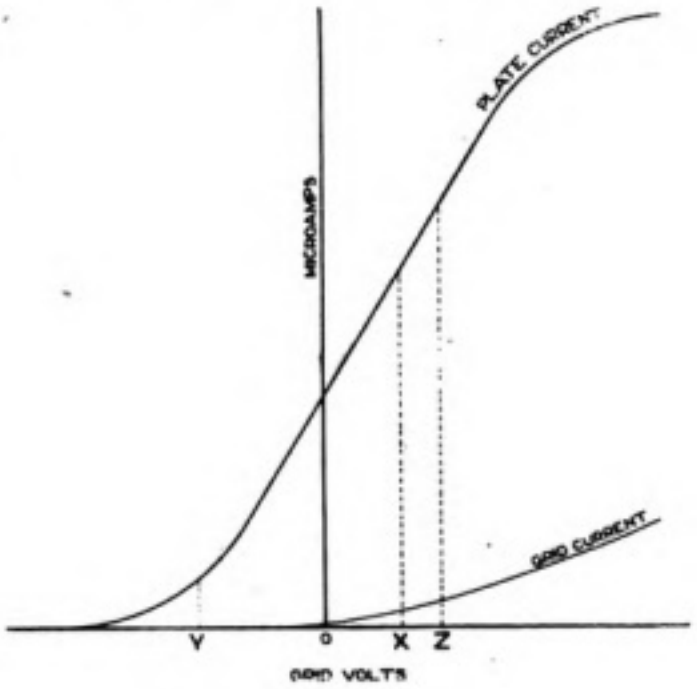


Fig. 2.

or near the lower bend in the characteristic curve, in which case oscillations will cease on account of the reduced steepness of the characteristic curve at the point of operation.

In Fig. 2 is shown a typical characteristic curve of a three-electrode valve. Suppose that X and Y are the upper and lower values respectively, at which oscillations just cease; at both of these points there is still a considerable amount of retro-active effect between the two tuned circuits of the first valve, and telephonic signals will be heard at their loudest. If now the grid potential is raised above X or lowered below Y it will be found that signals become very much weaker or even inaudible; that is, the regenerative effect varies with the grid potential, or, in other words, the damping of the circuit is dependent upon the value of the grid potential. It is this fact which accounts for the noisiness when receiving the *carrier wave* of a telephonic transmission, even though the carrier wave emitted by the transmitting station be pure.

Suppose that the normal grid potential of the first valve is set at some such value as Z (Fig. 2) and that a small continuous oscillation of constant amplitude, such as that due to a non-modulated carrier wave, is applied to the grid circuit; the plate current will then have a steady oscillating component in direct proportion. If now the normal or average potential of the grid is lowered slightly, but not sufficiently to allow self-oscillation to occur, the amplitude of the oscillatory component of the plate current will be increased, since the retro-active effect has been increased. In addition, the mean value of the plate current will be reduced, since the average value of the grid potential has been lowered. These effects are shown clearly by the curves of Fig. 3.

The curve A represents the impressed oscillation in the grid circuit; at P the normal value of the grid potential is suddenly lowered. The corresponding plate current is shown by curve B. It will be observed that at the point Q, corresponding to the point P of curve A, the mean value of the plate current is suddenly lowered, *but the amplitude of the oscillation has increased.* The dotted lines represent the mean values of the curves.

We see from the above that the oscillations in the plate circuit vary in amplitude as the grid potential is varied. Well, now suppose that the normal grid potential is varied at an *audio frequency*, whilst the carrier wave of a telephonic transmission is

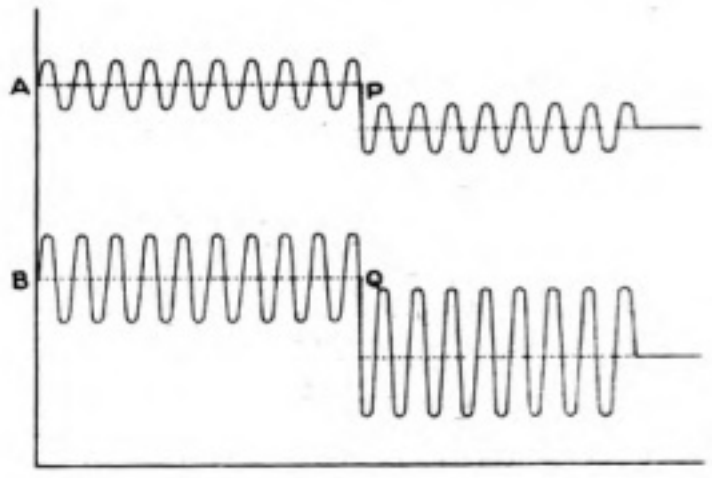


Fig. 3.

being received. The resulting oscillating component of the plate current will vary *in amplitude* at the audio frequency; in other words, the received carrier wave is being modulated locally and an audible note will be heard in the telephones. This effect is shown graphically by the curves of Fig. 4. As before, the curve A represents the received carrier wave; B is the low-frequency impressed voltage on the grid. The actual potential impressed on the grid is the resultant of curves A and B, and is given by the curve C. For the reasons given previously, the oscillating component of the plate current will be somewhat as shown by the curve D.

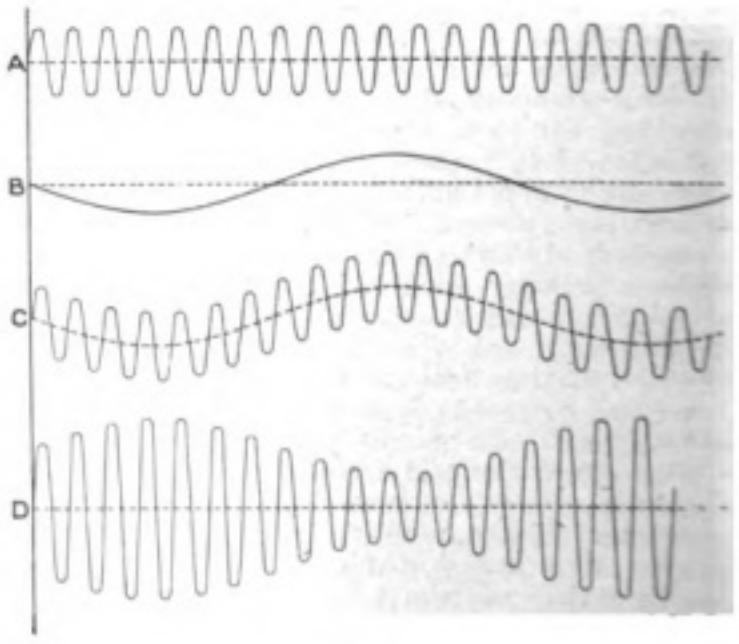


Fig. 4.

Actually, of course, the mean value of the plate current will vary at the low frequency, but this is unimportant, and has been omitted for the sake of clearness; the tuned intervalve transformer offers a very low impedance to the audio frequency component, which is therefore not passed on to the next valve. But the modulated high-frequency component is amplified by the succeeding valves and is rectified at the detector, giving an audible note in the telephones. It must be borne in mind that the curves A of both Fig. 3 and Fig. 4 represent the induced voltage in the aerial or grid circuits, and not the actual voltage variation of the grid itself. When working on the straight portion of the characteristic the grid voltage curve will be an exact reproduction of the plate current curve to a different scale. When the damping is zero the oscillating grid voltage will be exactly equal to the induced oscillations, but if there is any damping at all the grid voltage becomes less.

If the carrier wave ceases whilst the audio-frequency oscillation is being applied to the grid of the first valve, no sound is heard in the telephones, since low-frequency oscillations are not passed on by the transformers.

In practice there are many low-frequency disturbances, such as those due to electric light mains, electric railways, etc., and under the above conditions such disturbances will modulate the received carrier wave of a telephone station, resulting in a great deal of noise in the telephone receivers; atmospherics also seem to be aggravated by this type of circuit.

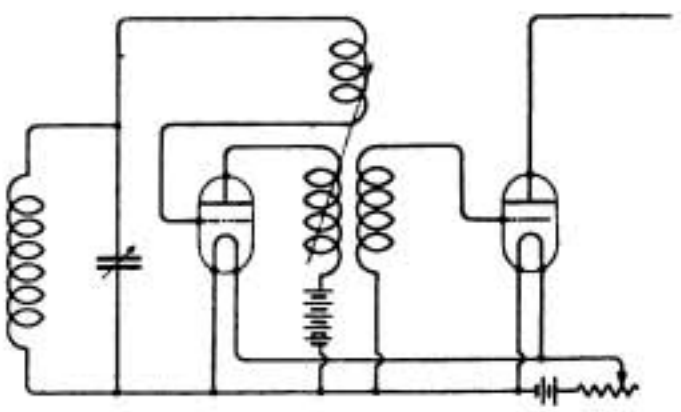


Fig. 5.

It will be found that the amplifier will work much more silently if the oscillations are controlled by means of "negative reaction," that is, by magnetic coupling between the input and output circuits so directed as to neutralise the stray coupling between the circuits. When employing two or three stages of high-frequency amplification the author has found that by coupling the grid circuit of the first valve to the first high-frequency transformer, the self-oscillation of the whole amplifier is brought under control. The coupling coil is connected in series with the grid lead of the first valve and mounted above the first H.F. transformer in such a manner that the coupling can be varied by sliding the coil or otherwise. Fig. 5 shows a diagram of connections for such an arrangement. One coupling coil will work satisfactorily over a very wide band of wavelengths.

Notes

A Foretaste of the Broadcasting Service.

Those who in this country are fortunate enough to possess receiving stations had a foretaste on Thursday evening, May 11th, of what, with the new broadcasting schemes, may be a matter of every-day occurrence. By arrangement between the *Daily Mail* and the Marconi Company the progress of the Great Fight between Carpentier and Lewis at the Albert Hall was broadcasted by wireless telephony from Marconi House. The result was listened to all over the country, and by many wireless enthusiasts in France as well. As one amateur, who spoke on his wireless telephone set shortly after the conclusion of the fight, expressed it, the only regret was that the fight was over so quickly that the transmission that he had enjoyed was all too brief.

The time is soon coming when news items of this kind will be distributed regularly, and will be taken advantage of by all who avail themselves of the Postmaster-General's new concession for the installation of receiving sets.

2MT : Changes in the Transmission from Writtle.

We are advised that, commencing on Tuesday, May 30th, the transmission by Writtle will commence at 8 p.m. instead of 7 p.m., on a wavelength of 400 metres instead of 700.

In view of this change in wavelength and the fact that all broadcasting will be conducted on wavelengths of this order, it will be necessary to get busy in the design and construction of suitable receiving sets. This is a subject well worthy of careful experiment, as many new problems are met with in designing receivers for short-wave reception.

Irish Wireless Station Destroyed by Fire.

The Admiralty Wireless Station at Bunbeg, Donegal, was attacked by Irish Republicans on Wednesday, May 10th, and after the entire furniture and other effects had been publicly sold, including the private property of the evicted personnel, the station was set on fire and burnt to the ground. The damage is estimated at more than £20,000.

The Institution of Electrical Engineers.

The Annual General Meeting of the Institution of Electrical Engineers (Corporate Members and Associates only) will be held on Thursday, May 25th, 1922, at 6 p.m., at the Institution Building, Savoy Place, Victoria Embankment, W.C.2, to receive and consider the Accounts for the year ended December 31st, 1921, and the Annual Report of the Council, and to elect Auditors.

Copies of the Accounts and Report (which will in due course be published in the Journal) can be obtained from the Secretary.

The Annual Conversazione will be held on Thursday, June 29th, 1922, 8.30 to 11 p.m., at the Natural History Museum, South Kensington, S.W.

Invitation cards will be issued in due course.

Hourly Weather Messages: Additions.

The following changes took place with effect from May 1st, 1922:—

(i) An additional Hourly Route Weather Message, giving observations for 0400 G.M.T., is transmitted by Air Ministry, call sign GFA, wavelength 1,680 metres, at 0435 G.M.T. daily.

(ii) An additional Hourly Route Weather Message, giving observation for 0400 G.M.T., is also transmitted by Le Bourget, call sign *ZM*, wavelength 1,680 metres, at 0428 G.M.T. daily.

Personal.

Among those called to the Bar at the Middle Temple last week appears the name of Mr. John J. Honan, A.M.I.E.E. Mr. Honan served as a Wireless Officer in the R.F.C. and R.A.F. and was for some time an Assistant Instructor in the Wireless Telegraphy Direction-finding School at Farnborough.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With regard to the letter of Messrs. T. W. Higgs and A. C. H. Bassano in the issue of May 13th, I am glad to be able to furnish a reply to their query. The station whose telephony they heard was the Signals Experimental Establishment, Woolwich Common, Woolwich, London. I heard the telephony myself, but this is scarcely surprising, as I am but a couple of hundred yards away. The establishment is under Government control and does not make a regular habit of these *impromptu* concerts, and, moreover, *XYZ* is not the proper call for this station.

E. H. RAWED.

Royal Arsenal, Woolwich.
May 12th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I want to thank you for publishing on page 146 my letter of April 16th. It brought a reply from **2CV**.

Referring to the details you give about my station on the same page, I would like to point out that my wavelength is now 360 metres instead of 525 and that I listen on all waves between 180 and 400 metres..

May I remark that by his letter appearing on page 178, Mr. G. W. G. Benzie seems to have wrongly interpreted my message of April 17th. That message read: "CQ, British Amateurs de 8AB = Pse tell **2CV** last night QRK," by which I meant to ask all British Amateurs to inform **2CV** that the night before I had received him well,

I hope you will publish the above and with anticipated thanks I renew all good wishes to your magazine.

LÉON DELOY,
French "8AB."

Tuesday, May 9th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Referring further to your issue of April 22nd, I was very interested in Mr. J. Bever's low power transmission.

To-day I was working **2 KQ** Wolverhampton, using rectified A.C., 600 volts, 16 milliamps., 9·6 watts. Aerial radiation, 0·3 amps. He reported my speech excellent and asked me to reduce power. I gradually brought this down, **2 KQ** reporting still perfect speech. The final power used was as follows: H.T., 70 volts, plate circuit 4 milliamps., aerial reading not readable, power input 0·28 watts. **2 KQ** reported speech weak but still readable.

I think this is a record. The distance between Sheffield and Wolverhampton being 84 miles.

During the whole of the test **2 GJ** Sheffield was listening-in and will confirm this statement.

I should like to hear if any of your readers have transmitted speech this distance on such small power.

W. A. WARD,
Working **2 IQ**.

Sheffield.
April 30th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I was very interested in the correspondence pointing out some of the nonsensical matter published in our daily and weekly press.

The following extracts from *The News of the World* of December 4th last are no doubt interesting. The amazing bits of information occur in a serial called "The Death Message," by Lawrence Clark:

He took up the telephone head-piece, clamped it over his ears and put out his sallow hand to a pointer on the left side of the table. "I am waiting for the Poldhu call," he exclaimed, "it is due about now. We get our English news from them." Suddenly bright blue crackle and viciously vital sparks leapt into being in the spark gap. The groping swing of the pointer in his left hand stopped; his right shot out and gripped a slip of paper headed "News Message." "This is Poldhu speaking now," he exclaimed. The spark continued to crackle, and his right hand slipped over the foolscap, taking down the news sent out broadcast from the Cornish station, two thousand miles away. A little later on the operator gave the pointer a swing to the right, and suddenly a higher pitched note began to sound in the little cabin and the spark gap grew into blue flashing life. "This is the 'Imperator' speaking," he exclaimed.

Miss Morris, in the dead of night, apparently slipped into the wireless room, and for five minutes she occupied herself, and then cautiously stepped out, but evidently her evil work was thoroughly done.

The operator, however, being trained from early youth, soon discovered she had tampered with the machine, and for two days no message was received or sent on board the steamer.

The operator was utterly baffled by the machine's mysterious failure, for try as he would it was impossible for him to send a message. What in God's name had she done? He had examined everything—the leading-in wire, the magneto, the detonator. What had she done? With infinite care he went over every section of

his instrument, and apparently nothing was out of order, yet it was impossible for him to send or receive a message.

A little later, however, his eyes were resting full on his magneto, and as he looked a sudden thrill went through him. He recalled something he had said to Miss Morris five days before, something about the details of the magneto. In a flash his fingers were busy with the screws. In fifty seconds the magneto was in his hands. He held it, scrutinised it, turned it, and screwed it into place again. Then his fingers flew to the sending key, but almost before he touched it he knew that the instrument was in order.

Miss Morris, acting on his own gossiping information, had merely reversed the poles of the magneto. A brilliant trick most difficult to discover. And he, like a fool, had been two days finding it out.

I think the last remark about his being a fool is the only true thing mentioned in the whole paragraph.

RENÉ H. KLEIN.

Book Review

HANDBUCH DER DRAHTLOSEN TELEGRAPHIE UND TELEPHONIE. Eugen Nesper. 2 Vols. 10" × 7", xlviii + 708 + 545 pp. 1,321 Figs. Price 390 marks + 25 per cent. (*Julius Springer*, Berlin, 1921.)

The publication of this work will be welcomed by every radio engineer and student of the subject who can read German. It is, in our opinion, one of the best books of its class yet written on the subject. Generally speaking, it is descriptive and non-mathematical, although the results of mathematical investigations are given and full references to original papers where further details can be found. The subject is covered very thoroughly; the book is well printed, very well illustrated and bound and produced in the style which one associates with the name of Springer. The last hundred pages are devoted to compilations of radio literature, both articles and patent specifications classified under subjects and alphabetically under authors' names. Although English titles have sometimes proved too much for the German compositor, this part of the book will prove very valuable for purposes of reference.

A surprising feature of the book is the war atmosphere that seems to pervade the author's review of the subject. The opening sentence of the book may be translated as follows: "Radiotelegraphy obtained its baptism of fire in the Russo-Japanese War in 1904, and proved itself already then to be reliable in military service, not only at Port Arthur but especially for the *Times* News Service between Wei-hai-wei and Chemulpo. It was also used for espionage purposes. . ."

We must say, however, that although, as one would expect, the apparatus described and illustrated is preponderantly German, the author has evidently endeavoured to be scrupulously fair in describing the development of the art and in apportioning credit for invention and discovery. We were struck by the entire absence of that pronounced national bias which usually pervades German books dealing with this aspect of the subject.

Some errors are bound to creep into a work of this magnitude, especially when an author attempts to discuss the wireless projects of other countries. One is surprised, for instance, to see Corfu in a list of British Colonies and stated to have a radio station forming part of the British system in the Mediterranean. In the same paragraph we have "St. Jones" (Newfoundland). We also notice that the velocity of electromagnetic waves is stated to be $1{\cdot}96.\ 10^{10}$, instead of $2{\cdot}96.10^{10}$, and several other errors of a minor nature. These detract little from the value of the book, which should certainly be found in every library of serious radiotelegraphic literature. G. W. O. H.

Calendar of Current Events

Sunday, May 21st.

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by PCGG, The Hague, Holland.

Tuesday, May 23rd.

Transmission of Telephony at 7 to 7.25 p.m. on 700 metres, followed by C.W. calibration signals on 1,000 metres by **2MT**, Writtle, near Chelmsford.

WOLVERHAMPTON AND DISTRICT WIRELESS SOCIETY.

8 *p.m.*—At 26, King Street, Wolverhampton. "The Electronic Theory," by Mr. Blakemore.

Wednesday, May 24th.

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (Tea, 5.30 p.m.).—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C., "Some Effects of Capacity on Mutual Induction with Special Reference to their Application to the Elimination of Jamming," by Mr. J. H. Reeves.

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Lecture by Dr. Richardson.

PORTSMOUTH AND DISTRICT WIRELESS ASSOCIATION.

"Thermionic Valves," by Mr. Barratt.

Friday, May 26th.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—"The Amateur Set," by Mr. T. Brown Thompson.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—Informal Meeting.

WOOLWICH RADIO SOCIETY.

8 *p.m.*—At the Woolwich Polytechnic: An Exhibition of Home-made Amateur Wireless Apparatus.

Saturday, May 27th.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

Field Day.

Thursday, June 1st.

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Open Night and Soirée.

Friday, June 2nd.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—Lecture by Mr. F. L. Hogg.

BRADFORD WIRELESS SOCIETY.

Lecture by Mr. H. F. Yardley.

Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.—[ED.]

Wireless Club Reports

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

North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 90th meeting of the Club was held on Wednesday, May 3rd, at Shaftesbury Hall, Bowes Park. The chair was taken by Mr. G. Evans and, after the usual formal business, he announced that the lecture for the evening was entitled "A Few Notes on Wireless Direction Finding at Sea," by Mr. G. E. Dockree.

Mr. Dockree apologised at the commencement, saying that he had had very short notice and had consequently been unable to prepare his notes as thoroughly as he would have wished. He then outlined the principles involved in direction finding, explaining that there were two methods in use. First, that known as the unilateral method, and secondly, the bi-lateral. The essential part of the apparatus was a frame aerial, which was capable of being turned through 360 degrees. This was known as the compass coil. This, used in conjunction with a suitable receiver, enabled the bearings of the transmitting station to be ascertained, but gave two readings, 180 degrees apart. The unilateral method consisted in coupling the compass coil to the aerial so that the current in the aerial had the effect of either decreasing the current induced in the compass coil or increasing it, thus showing on which side of the receiving station the transmitting station lay.

The lecturer explained how, by using two shore stations in communication with each other, the position of the transmitting station could be found. He went on to explain the possible sources of error, which might arise from several causes and give rise to inaccurate results. Chief among these causes were unskilled operating, bad design of instruments, leaky insulation and errors due to configuration of the land. The question of insulation was very important, as a leak which was of small account in ordinary message work was sufficient to affect seriously the results in direction finding.

After questions had been asked by several members, and answered by Mr. Dockree, the meeting closed with a vote of thanks to him for a very interesting lecture.

Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the club-room at 7.45 p.m. on May 5th, with Mr. A. Bever in the Chair. After the business of the meeting, the Chairman called upon Mr. T. Brown Thompson to give his lecture on "The Automatic Recording of Wireless Signals and the Turner Trigger Relay." The lecturer, in a very able manner, reviewed the various methods of recording, and then passed on to the Turner relay, which he described. By the courtesy of Mr. A. M. Bage, of the Leeds Society, who loaned the apparatus, Mr. Thompson was able to demonstrate to some extent the working of the relay and tape machine, in conjunction with one of Messrs. Burnham's single-valve sets. Unfortunately, owing to slight damage to the recorder in transit, the demonstration was not as successful as it might have been, but nevertheless it was very much enjoyed, and at the conclusion a very hearty vote of thanks was accorded the lecturer.

A competition for members has been arranged as per particulars below, and it is hoped that all who possibly can will give it their support :—

Rules for Competition.

(1) Prizes (*a*) Valve value, 15s.;
(*b*) Vernier Condenser, value 7s. 6d.:
(*c*) Free Membership of Society for One Year.
(2) The above prizes will be awarded for the most efficient Single Valve Receiving Set for wavelengths of 600 metres and below.
(3) All Inductance Coils, Switches, Filament Resistances, Condensers (variable and fixed), Grid Leaks, etc., to be made entirely by the competitor. Condenser plates for variable condensers may, however, be purchased.
(4) Ebonite Knobs, Inductance Formers (if any) and other turned articles may be purchased, if desired.
(5) The general finish, design, compactness, will be taken into account.
(6) The competitor may choose the "Unit" method, viz., detector panel, tuner, condenser, or the complete set in one case.
(7) The Judges will be Mr. J. Bever, Mr. A. Barber and an independent judge appointed by the members, but who should preferably be a good telegraphist.
(8) Arrangements for tests to be made by the judges and announced later.
(9) Competitors' names to be handed in to the Organising Secretary.
(10) Closing date for entries, May 19th.
(11) Judging to take place at the club-room on Thursday, July 13th.
(12) Complete instruments, marked with competitors' name, to be handed in not later than 7.30 p.m. on July 12th. Any competitor not complying with the above conditions will be at once disqualified.

(*Signed*) N. WHITELEY,
W. G. A. DANIELS.
On behalf of the Committee.

The Wireless and Experimental Association.*

At the meeting held by the Association at the

Central Hall, Peckham, on April 26th, much interesting matter was brought forward for discussion. The difference between hard and soft vacuum valves was fully explained, together with the main points experienced in the use of each type. Several theories were put forward for explaining the reception of spark signals on the ordinary telephone system, one being that the high-frequency currents were by-passed to the microphone and there rectified. Much interest followed a description of an application of the dual amplification circuit, whereby an ordinary low-frequency amplifier could easily be converted by merely putting a plug connected to the new instrument in the place of the valve. Further discussion was raised on the action of the choke control or constant current system of modulation for telephony transmission. One member having hurried down from the meeting of the Wireless Society of London was able to illustrate several four-electrode valve circuits, but the large number of inductances used was more than many would care to manipulate.

On May 3rd, after the usual business had been conducted, a discussion was raised regarding the relative efficiencies of cylinder coils against basket coils of similar tuning ranges. The conclusion arrived at was that basket coils were the better on short waves, owing to lower self-capacity, although due to the lesser extent of the magnetic field, closer coupling was necessary. A paper was then read by one of the members on the determination and plotting of characteristic curves of two and three-electrode valves. This brought a very interesting evening to a close.

Full particulars for membership may be obtained from the Assistant Secretary (Mr. W. J. Joughin), 21, Troughton Road, Charlton, S.E.7.

Radio Scientific Society, Manchester.*

The last meeting of the above Society for the winter session 1921-2, took the form of a Social Evening and Smoking Concert, held on Wednesday, April 26th, at 16, Todd Street, Manchester, under the able direction of the Society's Chairman, Mr. G. G. Boullen.

A most enjoyable time was spent, due in no small part to the efforts of the members and their friends.

It is proposed to hold a series of outdoor excursions during the summer, details of which will be available shortly.

The Secretary, Mr. H. D. Whitehouse, will be pleased to answer all enquiries addressed to him at 16, Todd Street, Manchester.

Southport Wireless Society.*

Hon. Secretary, Mr. W. E. Otter, 5, Tower Buildings, Leicester Street, Southport.

A General Meeting was held on Tuesday, May 2nd, a large muster being present at the Queen's Hotel, Promenade, the Chair being taken at 8 p.m. by Mr. A. F. Stock. The Chairman called upon Mr. A. B. Brown to deliver a paper on the subject of "Accumulators."

The lecturer very clearly described the reason why every care should be taken of accumulators, and how, when a little care is practised, the life of a cell is prolonged. With the aid of internal parts of a cell he showed the results of neglect, such as short circuiting the terminals with files, or any conductor of electricity, overcharging, failing to keep covered with electrolyte and also permitting cells to discharge under 1150, the test being taken with a hydrometer.

It was a splendid lecture, being thoroughly enjoyed by all present. Mr. Brown volunteered to give another lecture in the near future and clear up any points he may have missed.

A hearty vote of thanks was accorded Mr. Brown at the close of the meeting.

The Willesden Wireless Society.*

Applications to Mr. F. A. Tuck, 87, Mayo Road, N.W.10.

The Society are still going ahead; new members are turning up at every meeting, and we are holding a special elementary class under Mr. A. Arnoll on Friday evenings at 8 p.m., at headquarters, 25, Station Road, Willesden Junction. The lecture on May 2nd was given by Mr. Wyatt, who dealt with the theory and practical working of a single valve receiver, particularly emphasising the correct adjustment of filament and plate potential, a thing usually overlooked by most members. A very interesting and instructive meeting was the result, and the lecturer was accorded a hearty vote of thanks.

South London Wireless and Scientific Club.*

Although silent as regards reports of our work in South London in connection with the extension of wireless telephony and telegraphy, and also our research of various matters appertaining thereto, we have by no means been silent in action.

Our meetings since our last report in January have been so enormously successful that South London seems to talk of nothing else, and of course we are busy catering for the "boom" which is the outcome of the co-operation of the members of the Club and of which we feel naturally proud.

It would be practically an impossibility to record in full the details of lectures, discussions, demonstrations, etc., which take place twice a week regularly, but nothing seems to have been so overwhelmingly successful as the lecture and open discussion which was given by our Secretary (Mr. Allen), and words could not adequately express the manner in which this was received. He began with a very lucid description of simple tuning, and later turned to the more advanced stages, yet constantly keeping to analogies to explain to those of our younger members the intricacies—how to stop howling whilst a set is oscillating, to the higher stages of tuned high frequency amplification. The questions evolved were so numerous that the discussion will be extended to another evening to enable all the members to express their views.

This is only one of our many interesting items, and only one of the many ways in which we assist the amateur in South London. Our Secretary (Mr. Allen), 9, Newington Causeway, will be pleased to give full particulars to anyone interested in a live society devoted to matters appertaining to wireless in all its branches.

Dartford and District Wireless Society.*

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

At the usual meeting of the Society, held at

Dartford Grammar School on Friday, April 21st, 1922, a most interesting and instructive evening was spent. Owing to a priority engagement our Vice-President (Mr. J. R. Smith, A.M.I.E.E.) was unable to be present.

The Hon. Secretary read the minutes of the last meeting, which were approved by those present. The Society's valve receiving set was used and tested for the first time and gave satisfactory results.

The question of a transmitting licence was fully discussed, and it was agreed a portable transmitting set would be very beneficial for experimental work.

Mr. Prangnell, Assistant Secretary, brought along another valve for trial, and a very instructive evening terminated at 10.30 p.m.

Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The April monthly meeting of the above Society, held at the Woolwich Polytechnic on Friday, April 28th, at 8 p.m., took the novel form of a concert entirely by wireless. From 8 o'clock to 9.45 p.m. the ether was filled with music and speech, and by means of a 7-valve receiving set and loud speaker (kindly loaned by the S.E.E.) this was rendered loudly and clearly audible to the audience. Promptly at 8 o'clock, directly after our Chairman (Mr. McPherson, B.Sc.) had opened the meeting, the voice of Captain Hughes, of the S.E.E., came ringing through the loud speaker, announcing the first item, which was a gramophone item. From that time till 9.10 p.m. we were regaled by fine music, including solos by Miss W. Beeson and Captain Hughes, violin solos by Mr. D. Young, interspersed with gramophone pieces. All were loudly and distinctly rendered.

Directly the S.E.E. had finished we heard the well-known voice of **2FQ** calling us from Blackheath. For twenty minutes we had more delightful music: we envied **2FQ** his selection of beautiful gramophone records. The moment he had finished we heard **2ON** from Walthamstow call us up, and for another quarter of an hour we listened to more delightful music.

Unfortunately we had to close down at 9.45, owing to Polytechnic rules, and so had to forego hearing **2OM**, who also promised to come on.

The West London Wireless and Experimental Association.*

Club-rooms, Belmont Road Schools, Chiswick, W.4. Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

Meeting held Thursday evening, April 27th, a fairly good attendance made. The larger part of the evening set aside for the purpose of receiving the special transmission by Mr. Read, Member I.R.E. (**2MO**) to the League of Arts, at Victoria, on the occasion of a lecture by Mr. Gibbon, of the Engineer's Chief Office, G.P.O., where a large audience listened to a demonstration of general broadcasting composed of music, speech and weather reports, etc.

Mr. Read, of Messrs. Burnham's, will in the near future—probably during June—give a demonstration and lecture on their Ultra IIII set.

Streatham Radio Society.

Messrs. A. G. Wood and J. S. Newton were responsible for calling an inaugural meeting of the wireless enthusiasts of Streatham, which was held on Wednesday evening, May 3rd, at "Compton," Pendennis Road, Streatham, S.W.

Among the company present were Messrs. H. J. Swift, J. S. Newton, S. C. Anstee, A. G. King, S. W. Johnson; K. M. Quilter, J. Stone, C. F. Leleu, A. G. Wood, G. P. B. Hassel and S. C. Newton.

The usual formalities were gone through, and Mr. A. G. King was elected Hon. Treasurer. Mr. S. C. Newton promised to act as Secretary *pro tem.*

It was unanimously agreed that the Society should immediately start to function under the above title, and the nucleus of a Committee was elected, consisting of Messrs. J. Stone, A. G. Wood and S. W. Johnson.

It was proposed, seconded and carried that the Society should, as soon as possible, endeavour to become affiliated with the Wireless Society of London, and that a public room should be secured for holding the meetings, the members present offering to assist in finding suitable accommodation.

The first Committee meeting will be held on May 17th, when the details in connection with the formation of the Society will be dealt with.

Applications for membership and any wireless matters interesting to members, should be forwarded to Mr. S. C. Newton, A.M.I.E.E., Hon. Secretary, "Compton," Pendennis Road, Streatham, S.W.

Southampton and District Wireless Society.*

A meeting of the above Society was held on Wednesday, May 3rd. Although the attendance was not so large as usual, owing to the weather, a fair number "Braved the Storm." A good evening's buzzer practice was given for the benefit of new members. Several new members were made. Mr. Bateman's lecture was held over till the following week, when it is hoped a large attendance will be present. As the membership is increasing so rapidly, all those interested in wireless in Southampton and district would be well advised to make early application for membership, as there are likely to be some drastic alterations in rules. *re* entrance fee, etc. For full particulars apply to the Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

Wireless Society for Ilkley and District.

It has been proposed that a Wireless Society be formed for Ilkley and District. Will all those who are interested communicate with Mr. E. S. Dobson at "Lorne House," Richmond Place, Ilkley, in order that a preliminary meeting may be arranged.

Slough, Windsor and District.

Will those interested in the formation of a Wireless Society for Slough, Windsor and District, please communicate with Mr. Thomas W. Price, Caversham House, Dolphin Road, Slough.

Fife and District.

Mr. Arthur C. Peterson, is anxious to form a Wireless Society in his district, and will be glad to hear from any others interested at Walkers Buildings, Dunbeath, Methil, Fife.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

"BEGINNER" (Walthamstow) *asks (1) For the wiring for a panel. (2) What wire to put on his coils. (3) For capacity of primary condenser.*

(1) *See* diagram (Fig. 1). (2) The two coils mentioned may be wound with No. 26, the 5" coil being used as tuner primary and the 4" loading coil. Tuner secondary may be a reaction coil, 6" × 4" of No. 30. (3) 0·001 mfd.

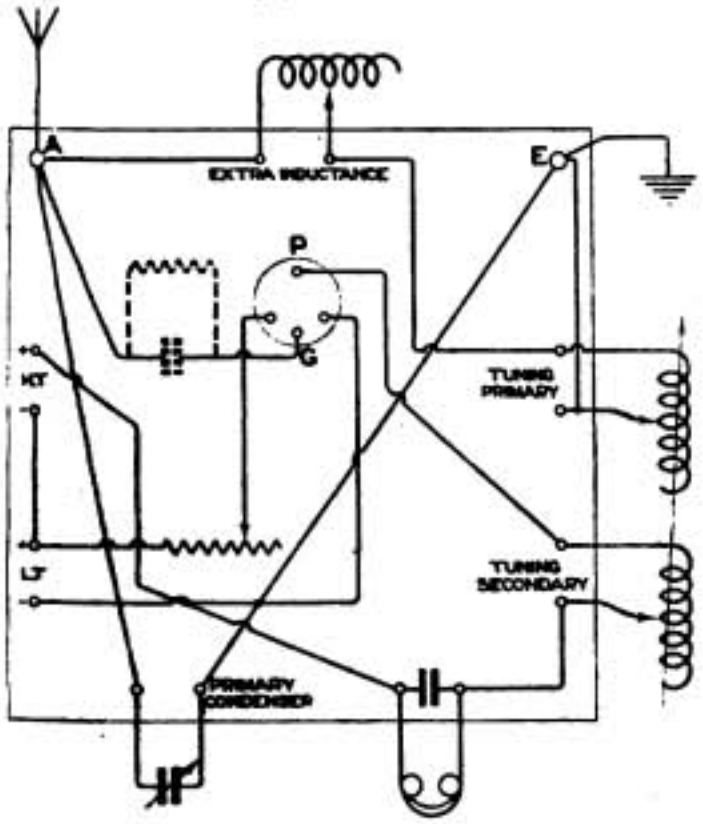


Fig. 1.

"G.A.B." (Harlesden) *asks if No. 16 gauge copper wire is suitable for a twin aerial. (2) For dimensions of a loose coupler to tune from 400 to 4,000 metres.*

(1) Yes. (2) Primary 10" × 7" of No. 24, secondary 8" × 5" of No. 26.

"A.C.McA." (King's Heath) *asks (1) How to add an H.F. valve to a single valve circuit shown. (2) If this is the best way to add another valve. (3) Any alterations to make his single valve set more efficient.*

(1) *See* Fig. 3, page 812, March 18th issue. The series-parallel switch may be omitted if desired. It is, of course, an improvement. (2) Yes for a large range of wavelengths (3) Add a reaction coil, as shown in the circuit referred to.

"E.B.U." (Birmingham) *refers to Fig. 8, page 778, March 4th issue, and asks (1) If 2,000 ohm telephones could be used. (2) If condenser across telephones is necessary, and, if so, what value. (3) If 60 volts H.T. is O.K. (4) If a 0·00005 mfd condenser could be used.*

(1) Yes. (2) Yes. 0·001 mfds fixed. (3) Yes. (4) This might be used for a grid leak for short wavelengths.

"W.K." (Johnstone) *refers to Fig. 12, page 726, February 18th issue, and asks (1) If no reaction coil is required. (2) How to tune the aerial circuit. (3) If "Ora" valves would work on this set.*

(1) No. Capacity reaction is employed by means of the condenser C.1. The A.T.I. should have a slider as in your diagram. (3) Yes.

"D.V.D." (Edinburgh).—You should use a frame aerial about 4' in diameter with 20 turns. You will require three or four valves for **PCGG.** The circuit may be as Fig. 4, page 32, April 1st issue, with the substitution of your frame for the A.T.I., the earth and aerial connections, of course, not being needed. An additional H.F. valve may be added exactly as the first valve shown.

"A.S.B." (Rotherhithe) *asks (1) For criticism of a two-valve set. (2) If the set would receive Dutch concert loud enough for a loud speaker. (3) Windings for H.F. transformer to cover 300 to 1,500 metres. (4) For suitable valves.*

(1) Circuit is O.K. 0·01 mfd. is too high for a telephone condenser; make it 0·001 mfd. (2) Signals should be fairly strong, but will be hardly good enough for a loud speaker. (3) To cover the range properly three transformers should be used. However, you might try formers 1½" diameter, 3" long, wound with No. 40 for a commencement, winding other transformers to complete the range when you have found what the one suggested gives. (4) R.4b, V.24, R, or similar type of valve.

"BEGINNER" (Herne Hill) *asks (1) If correct that we do not recommend crystal sets on account of the small number of spark stations working. (2) If it is possible to commence with a loose coupled crystal set and later to use the coupler with a valve set.*

(1) Crystal sets are still useful, especially for a beginner, as they give an insight into the principles of wireless in a simple and inexpensive way. They will give spark stations of which there are still numbers of ships, as well as stations such as **FL,** and telephony at short distances. So many people

are dissatisfied with the results, which are, of course, not so good as those given by the valve that we find it necessary to warn them of the limitations of a crystal. (2) Certainly in many different ways.

"H.F." (Blackpool) *asks* (1) *Cost of receiving licence.* (2) *If the reaction coil may be omitted from the circuit shown in Fig. 8, March 4th issue, Q. & A. columns.* (3) *For criticism of an aerial.*

(1) 10s. a year. (2) This will greatly decrease the efficiency of the set. The wavelength range will depend on the size coil and condenser used. A range up to 4,000 metres can easily be obtained with single layer coils. (3) The aerial will not be efficient if one part bends back on the other as shown in the diagram. It would be better to use only one 20' length.

"HARD VACUUM" (Renfrewshire) *asks* (1) *Is it worth while buying an old 1" spark coil for the wire on it to be used for winding telephones and transformer.* (2) *What is counted as "lead in" in measuring the length of an aerial.* (3) *If a three winding transformer may be used with H.R. telephones and a Brown 100 ohm loud speaker are used together.* (4) *If there is any advantage in spacing aerials more than 100' apart.*

(1) Possibly, if you can buy the coil cheaply, but you would have some trouble in using the wire again as it is probably bedded in wax. (2) We do not know the official ruling, but think it probably measured from the horizontal part to the part where the lead enters the house. (3) Yes, but the three winding transformer is not necessary. Connect the H.R. telephones in series or in parallel with the H.R. winding of an ordinary telephone transformer, using the L.R. winding for a loud speaker. (4) No.

"NEMO" (Teneriffe) *wishes to add an H.F. valve to his set and asks* (1) *If best to connect secondary inductance to negative of the battery or through a potentiometer.* (2) *If connections across both windings of the H.F. transformer would increase efficiency.* (3) *If reaction coil connected in rectifier anode would give better results than if in anode circuit of first valve.* (4) *If possible to relay telephony without distortion by means of a moving coil relay.*

(1) Potentiometer would somewhat improve results. (2) A condenser across one winding only would be sufficient. (3) Yes. (4) The ordinary moving coil relay is quite unsuitable. The Johnsen-Rahbek loud speaker, described in May 6th issue, is suitable for your purpose.

"E.J.L." (Liverpool).—(1) and (4) Maximum wavelength of the aerial circuit would be 2,600 metres, and to tune the secondary to this value a capacity of 0·0008 mfd. would be required. This is rather high for a crystal set and it would be better to rewind the secondary with No. 30 for use with a 0·0005 mfd. condenser. (2) If the earth lead is of good thick wire we would recommend its use rather than shortening it and the aerial as well. (3) Very little difference, but for a crystal set we advise the use of H.R. telephones.

"A.A.B." (Barnesbury) *asks* (1) *For a suitable single-valve set for 300 to 30,000 metres with slab coils.* (2) *Values of component parts for such a set.*

(1) A suitable circuit is shown in Fig. 2, page 811, March 18th issue, together with suitable values for the parts. The chief reason we do not recommend slab coil sets for short wave work is that suitable proportioning of A.T.I. and reaction coils is not very easily carried out for short waves with the coils.

"NEW READER" (Regent's Park) *asks* (1) *For criticism of a single-valve set.* (2) *What stations he should receive.* (3) *Wavelength range of set.* (4) *For improvements to the circuit.*

(1) Very fair, but see 4. (1) Paris, Poldhu and Nauen, also ship and coast stations on 600 metres; also Croydon telephony on 900 metres. (3) 400 to 4,000 metres. (4) Add a reaction coil between the positive H.T. and the anode of the valve, coupling this with the A.T.I. The coil may be 6" by 4" of No. 28. Put a 0·001 mfd. condenser across the H.R. winding of the telephone transformer.

"F.V.K." (Willingham) *refers to Fig. 3, page 555, November 26th issue, and asks* (1) *If the telephone transformer may be left out if 2,000 ohm telephones are used.* (2) *Suitable windings for L.F. intervalve transformers.* (3) *Why only 6 volt H.T. is shown.* (4) *If grid condenser and leak are advisable.*

(1) Yes. (2) Primary half an ounce and secondary 1½ ounces of No. 44 wire wound on a soft iron core ½" diameter and 2½" long. (3) This is only a diagrammatical representation of the position of the H.T. and not intended to represent the actual value. (4) This will probably improve rectification.

"L.E.K." (East Kilbride) *proposes to use a single-valve set on a small indoor aerial or frame and asks* (1) *For criticism of circuit.* (2) *Wave range of a certain coil.* (3) *Particulars of frame.* (4) *For what alterations to set to use 120 ohm telephones.*

(1) The circuit is correct but it will be useless on either of the aerials you suggest. Use either an outside aerial or three or four valves indoors. (2) With a small outside aerial the actual wave-range will be 4,500 metres. (3) With a frame aerial at least three valves should be used, and the frame may then have about 40 turns, about 4' in diameter. (4) The only alteration necessary is the inclusion of a telephone transformer as in many sets recently given.

"V.C.G." (Richmond).—(1) Your circuit would probably work slightly better than the one referred to. A good circuit is shown in Fig. 4, page 61, April 8th issue. (2) This circuit will not receive C.W., but will be suitable for spark and telephony, although the results will not be so good as those given by the circuit referred to in question 1. (3) A valve and crystal set should give better results than a single-valve set if a good crystal is used.

"L.R.F." (London, E.C.) *asks for a telephony circuit using one H.F. valve with a crystal rectifier.*

A suitable circuit is shown in Fig. 4, page 61, April 8th issue. The grid condenser and leak shown in it should be omitted. A carborundum crystal would be quite suitable.

"NEBULA" (Southampton) *asks* (1) *For information about* FL *time signals at* 9.25 *a.m.* (2) *If, in erecting an aerial, any advantage would be obtained in spacing the strands of cable through a 1" diameter ring.*

(1) See page 572, December 10th, 1921 issue. (2) The capacity of the aerial would be very slightly

decreased, but no observable improvement in reception would be obtained.

"S.E.P." (Fulham) *asks why his single-valve set, with tuned reaction, and crystal detector, will not oscillate below 300 metres, and what alterations to make to go down to 100 metres.*

You do not tell us the size of your coils which probably limit the oscillation point. At the lowest wavelength it would probably be necessary to couple the coils very tightly together as each coil would be very small. You might try the addition of a very small condenser across the grid and plate.

"R.H.M." (Shepherd's Bush) *asks (1) If an enclosed three-valve circuit is correct. (2) If suitable for one H.F. detector and L.F. magnification. (3) Whether a "Q" valve should be used as rectifier and "V.24's" as magnifiers. (4) Where to connect reaction coil.*

(1) Arrange one filament resistance to control the two magnifying valves and the other the rectifier. Connect the 0·001 mfd. condenser across the anode winding the L.F. transformer. (2) Yes. (3) Use a "Q" or preferably "QX," or "R.4 b" as rectifier, with "V.24" magnifiers. (4) Connect reaction coil in rectifier anode circuit.

"VARMER GILES" (Exeter) *asks (1) If a single crystal set is O.K. (2) How the polished surface can be removed from ebonite. (3) Why a compass needle turns to the magnetic north. (4) Wavelength of a circuit.*

(1) Yes, but preferably add a small block condenser across the telephones. (2) By rubbing with very fine emery paper. (3) Consult an elementary text-book on electricity or apply to the Editor of *Conquest*. (4) On a standard P.M.G. aerial, circuit would tune to 2,800 metres.

"R.W." (Nottingham) *asks (1) Why cracklings and whistlings are heard when the aerial is cut out. (2) Why no signals besides Paris and Moscow are received. (3) Windings for a small ship tuner.*

(1) and (2) In the absence of any information it is impossible to answer these questions. The first may be due to defective batteries, bad connections and many other causes. The second is very likely due to the use of too large coils which will not tune down to ship wavelengths. (3) The loose coupled tuner with a 0·0003 mfd. secondary condenser, windings may be—primary 4" × 6" No. 24, and secondary 3" × 6" of the same wire.

"S.P." (Barrow-in-Furness) *asks (1) For circuit diagram to add a crystal rectifier to a single-valve circuit. (2) If any use could be made of a potentiometer. (3) If a local concert should be received.*

(1) and (2) A suitable circuit is shown on page 61, April 8th issue. The grid condenser and leak should be omitted from the circuit. The potentiometer shown should be used in conjunction with the crystal. (3) This will depend entirely on your tuner windings for the wavelength of telephony. As you tell us neither your windings nor the wavelengths of the telephony, we cannot assist you.

"H.E.W." (Islington) *asks (1) For a good five valve telephony receiving circuit. (2) Why any circuit used on his aerial "howls," and if this is due to a near-by power station.*

(1) A good circuit for this purpose is shown in Fig. 3, page 31, April 1st issue. (2) This may possibly, but not very probably, be due to interference from the power station. It is more likely to be due to a circuit fault, such as the presence of two L.F. transformers near to each other, or to grid and plate leads being run too close together. As you give us no information about your set, we cannot assist you much.

"A.L.S." (Louvain) *asks (1) Meaning of the abbreviations "A.T.I." and "A.T.C." (2) For diameter of certain gauges of wire in Continental form. (3) If honeycomb or basket coils may be wound with No. 39 wire, if several wires in parallel are used. (4) For criticism of proposed circuit.*

(1) "Aerial Tuning Inductance" and "Aerial Tuning Condenser. (2)

No. 20	S.W.G.	corresponds	with	·91 millimetres.
No. 22	,,	,,	,,	·71 ,,
No. 26	,,	,,	,,	·46 ,,
No. 28	,,	,,	,,	·38 ,,
No. 30	,,	,,	,,	·32 ,,
No. 36	,,	,,	,,	·19 ,,
No. 40	,,	,,	,,	·12 ,,
No. 44	,,	,,	,,	·08 ,,

(3) Yes, but it would be somewhat difficult to do as you will have to twist up five or seven of the wires in sufficient quantity for the coil before starting to wind it. (4) A two-valve circuit should be quite satisfactory. The anode resistance of 70,000 ohms is suitable for French valve. For winding information, see Figs. 4 and 5, pages 38 and 39, April 8th issue, in which coil numbers refer to number of turns. Wind on a 5 cm. former, 2 cm. wide.

"E.H.S." (Princetown) *refers to Fig. 3, page 640, January 7th issue, and asks (1) Capacity of the blocking condenser, and if it is necessary to use this condenser if his telephone transformer has a condenser built into it. (2) Voltage of the H.T. battery. (3) If this set is as efficient as certain other combinations of valves. (4) If "R" valves should be used throughout.*

(1) About 0·002 mfd. (2) About 80 volts if "R" valves are used. (3) The special merits of this set are that it gives uniformly good H.F. amplification on all wavelengths above about 800 metres. It is, however, unsuitable for short wavelengths. The combination one H.F., one rectifier and one L.F. is better on short waves, but is not capable of working over large ranges of wavelengths with any one H.F. transformer. (4) Yes.

"J.A.C.B." (Dinting) *asks (1) The approximate range of an A.T.I. with 11" × 5½" of No. 28. (2) The capacity of a condenser consisting of two tubes of glass 6" × ¾" and 6" × ½", sliding one inside the other. (3) If 2,000 ohm telephones can be used with a valve. (4) If FL can be received on an indoor aerial.*

(1) This will tune a P.M.G. aerial to about 4,500 metres. (2) 0·00002 mfd. This is too small to be useful with the above coil. (3) Yes. (4) Possibly with one valve. Almost certainly with two.

"G.A.G." (Colchester).—The suggested method should be quite correct. The basket coils may be about 1½" internal diameter wound with about 100 turns of the Litz wire equivalent to No. 21. The arrangement you suggest will be about the best you can do at the price.

"BEGINNER" (Reading) *asks* (1) *For criticism of a circuit.* (2) *For data of inter-valve transformer to use certain materials.* (3) *If a frame aerial can be used with an indoor aerial on his circuit.* (4) *If he should get* **PCGG** *with a 20' indoor aerial and frame coils.*

(1 and 3) Do not use an indoor aerial as well as a frame. Your circuit will be satisfactory if your frames are replaced by tuning coils and also if your crystal arrangements are modified to be as Fig. 5, page 92, April 15th. (2) Use one ounce of the No. 40 for a primary, and two ounces for a secondary. (4) With a careful adjustment this circuit should give **PCGG.** Only four questions, please.

"INTERESTED" (Cumberland) *asks* (1) *If an aerial with a right-angle bend in the middle has the same natural wavelength and is as efficient as a straight wire aerial.* (2) *If a long lead-in inside the house is detrimental to the strength of signals.* (3) *Referring to Fig.* 10, *page* 726, *February* 18*th issue, asks what would be the approximate cost of the set less telephones and aerial.* (4) *If it would give Continental Spark and C.W. stations, and if a similar set is on the market.*

(1) Approximately the same natural wavelength, but probably about two-thirds the efficiency. (2) A long lead-in is undesirable as it is almost sure to run near bad conductors and bad dielectrics which will lead to loss and inefficiency. (3) Omitting the anode variable condenser, which is not required, a set of this type could be made for about £4, including batteries. (4) Yes. Most single valve sets on the market approximate very closely to this type.

"W.B." (Bradford).—The probable reason for your weak signals is the use of an indoor aerial with a single valve. Either put up a good outdoor aerial or add two more valves. With these alterations, both telephony and Paris time signals should be heard. **PCGG** will then be audible, but the provision of extra coils will not help you to get this station without the more important alterations we have suggested above.

"C.S.S." (ss. "Collegian").—(1) The grid leak may be about 3 meghoms. (2) These inductances may be wound with about No. 40 wire, and may have considerable self-capacity without serious inefficiency. They need not be accurately tuned to the wavelength. (3) Capacity reaction may be used for both spark and C.W. (4) With this set about 60 volts should be sufficient.

"SPARKS" (Capetown) *asks* (1) *What instruments are necessary to add six valves to a crystal set with a separate rheostat to each valve.* (2) *The approximate cost and diagram.* (3) *The voltage for the batteries for "V. 24" valves, and if separate batteries to each valve are necessary.* (4) *Which is better,* 100' *single wire aerial or* 70' *twin.*

(1 and 2) There are literally scores of ways in which six valves can be combined, but we strongly recommend you not to use more than two or three until you have sufficient experience to decide what type you prefer. Your crystal circuit is of very poor type, and it would be much better to improve this rather than to add a number of valves in a circuit which you will not understand and will therefore find unmanageable. Separate resistances for each valve are quite unnecessary. The cost of a six-valve set would be £20 to £30. (3) Six volts and 30 volts. Separate batteries are not necessary for each valve. (4) There is little to choose between these.

"BELL RINGER" (Walsall) *asks* (1) *Correct H.T. for an "R" valve.* (2) *Criticism of a circuit.* (3) *If it will receive telephony.* (4) *If an aerial with four wires* 20' *long, placed* 2' *apart would be suitable.*

(1) About 60 volts. (2) Rearrange the circuit as in Fig. 2, page 140, April 29th issue. (3) Yes. (4) Aerial is very poor for a single valve set. A greater length should be used if at all possible.

"A.T.N." (Thornton Heath).—The circuit you refer to is a very poor type and we would advise you to modify it on the lines of Fig. 3, page 812, March 18th issue. Also, for a set of this type at least 80 volts is desirable with "R" type valves.

"H.R." (Jersey) *asks how to connect up certain gear and if capacity reaction can be employed.*

The Fleming valve which you possess is a rectifier only. We should, however, recommend you to purchase a three-electrode valve, which will enable you to receive C.W. as well as giving much stronger signals. If you retain the Fleming valve, connections should be as in diagram (Fig. 2). Reaction cannot be used with these valves.

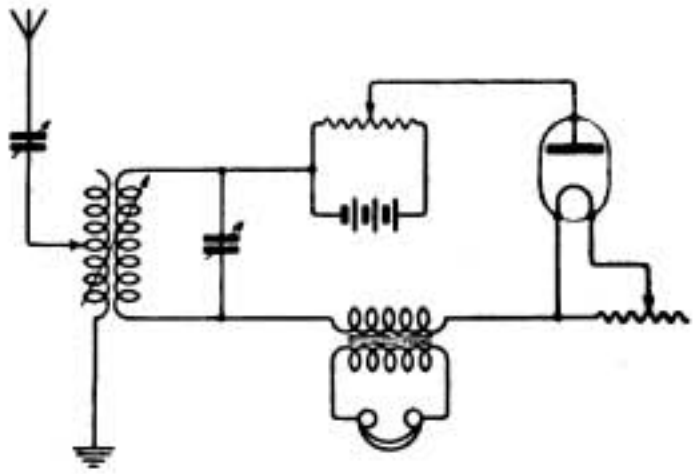


Fig. 2.

"PUZZLED DUTCHMAN" (Hinckley).—As you do not give the size of your aerial we cannot give the windings exactly, but for a maximum of 1,100 metres the A.T.I. may have about 150 turns on a former 4" diameter, with a slider for tuning, and the reaction coil 100 turns on a diameter of 3". These coils would then give you 700 metres as well.

"A.J.S." (Darwen) *asks the capacity of a condenser of* 2 *mils mica,* ½" *wide and* 2" *long.* (2) *If the H.T. arrangement of* **"F.L." (Grimsby),** *on page* 642 *can be used for a French or Mullard valve.* (3) *If not, how to make it do.*

(1) 0·0005 mfd. for each active sheet of mica. (2 and 3) For French valves the arrangement will be suitable, but for Mullard valves which require less anode voltage, use four 50 volt lamps in series and tap off one nearest to negative of supply.

"ELECTRON" (Broomsgrove) *refers to pocket set, March 4th issue, and asks* (1) *How much No.* 36 *wire to obtain for A.T.I.* (2) *If tappings should be taken at equal lengths or equal number*

of turns. (3) *Weight of wire for the reaction coil No. 26.* (4) *If an "Ora" valve will be suitable.*

(1) About 2 ounces. (2) Tappings at equal numbers of turns. (3) About 2 ounces. (4) The article in question states that best results were obtained with a French "H" soft valve. It will not be so good with an "Ora" or other make of hard valve, though perhaps much more stable and easier to manipulate.

"J.B.W." (Greenock) *asks* (1) *How many turns of No. 44 will be required on a 2" diameter by ¼" former for 2,600 and 1,050 metres H.F. transformers.* (2) *Advice regarding reception of* PCGG. (3) *If sufficient protection from lightning is obtained by shorting aerial and earth terminals.*

(1) The term "2" by ¼"" is very vague. It has been found that a 1½" diameter former with two windings each 4" No. 40 D.W.S. is a good transformer for 1,050 metres, from which you will see that your former appears to be too small for an efficient transformer. (2) On a single or two-valve set this station will be rather difficult to tune in at your distance. The best method is to carefully tune up set beforehand by using a buzzing wavemeter set tuned to 1,050 metres. (3) On a small aerial installation this is quite sufficient.

"FAWLEY" (Hants) *asks if certain windings are correct for a loose coupler; also for reaction coil for same.*

The inductance of primary is 17,500 mhys., and secondary 12,600 mhys. Primary will tune standard aerial to about 3,500 metres. This wavelength will require a 0·0003 mfd. condenser across secondary. A suitable reaction coil might be 3" diameter, wound with 7" of No. 30.

"THERMIO" (Coventry) *asks* (1) *For a 3 valve diagram with switching arrangements.* (2) *Connections for changing from a plain aerial to a coupled circuit reaction tuner.* (3) *For a modification of a circuit previously given in these columns without stating in which issue it was published in.* (4) *For formula for calculating capacity of variable and blocking condensers.*

(1) The diagram given on page 3, April 1st issue, appears to meet with all your requirements with the exception of separate filament resistances, which you can add yourself. (2) The circuit should be connected to a four-pole two-way switch as shown in the diagram (Fig. 3). It will be seen that the

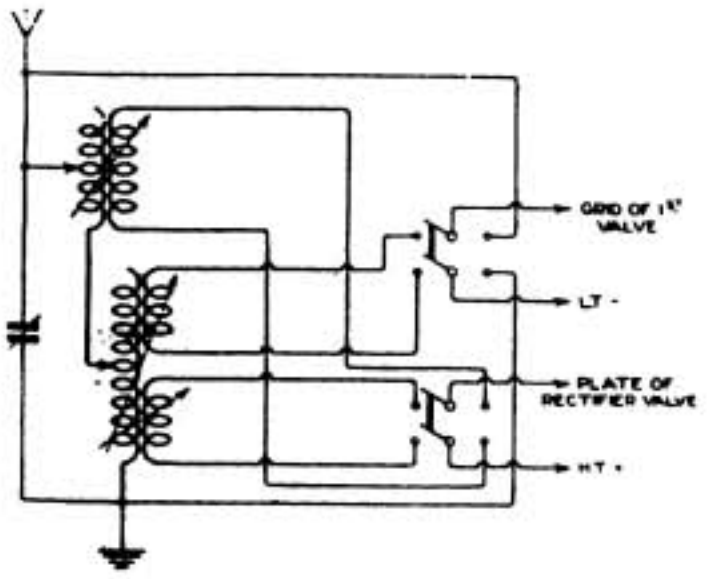


Fig. 3.

one variable condenser may be used for both circuits, because for the long wave tuner—plain aerial—the condenser will require to be in parallel with the A.T.I. (4) Variable and blocking condenser capacities may be calculated by the use of formula given under **"GRATEFUL," (Lytham),** page 60, April 8th issue.

"R.F.F." (Sidcup) *asks how many yards of wire are required to make a coil to receive on* 1,050 *metres.*

A 3" diameter former, 7" long, wound full of No. 24 wire—about 3 ounces—will tune a standard P.M.G. aerial to about this wavelength, but a reaction coil, tuning condenser and two or three valve amplifiers will be required to receive the Dutch concert at all strongly.

"T.E." (Walthamstow) *has trouble from "crackling noises."*

These noises are probably caused by induction from the telegraph and telephone wires which appear to surround you. The two-valve L.F. magnifier will make matters worse because the currents in the wires are at low frequencies. Connect a 0·001 mfd. condenser and telephones across the terminals of your single valve panel and listen to signals to see if noises are reduced by cutting out the L.F. magnifier. At the same time test each valve on this panel as it may possibly be due to a defective valve.

"WIRELESS" (Wood Green) *asks* (1) *If necessary to space turns when winding coils with enamelled wire.* (2) *If three sliders would be more useful than two.* (3) *If essential to have telephone transformer for* 8,000 *ohm telephones in a valve set.* (4) *Size of coils recommended for single-valve set.*

(1) No. (2) No. (3) H.R. telephones may be used in valve sets, but there is the danger of breakdown of insulation due to anode voltage. A 1:1 ratio transformer might be used, but the efficiency of the set would be decreased. (4) For a wave-range of 3,000 metres the A.T.I. should be 6" diameter, wound with 10" of No. 24, and the reaction coil 5" diameter, 8" long wound full of No. 28 wire.

"W. McN." (Dublin) *asks* (1) *If legal to make a magnetic detector.* (2) *The inductance of a 3" by 8" tube wound with No. 23 enamelled wire.* (3) *Receiving range of set, consisting of above inductance, a 0·0005 mfd. condenser and a magnetic detector.*

(1) For small aerials they are not worth making. (2) About 2,200 mhys. (3) Your diagram is incorrect; the A.T.I. condenser, and magnetic detector should all be in series to earth. You might possibly hear ships, but that is about all. The maximum wavelength will be 1,200 metres. You should be able to buy a piece of carborundum very cheaply, and could mount it in a clip made of clock spring. It will be more satisfactory than a magnetic detector.

"F.S." (Wealdstone) *asks* (1) *Size of wire for a 12" by 2½" former to tune to Paris and Madrid.* (2) *Size of a sample of wire.* (3) *If suitable for rewinding telephones.* (4) *If telephone condenser is correctly connected in his diagram.*

(1) For these stations a 6" diameter former wound with 10" of No. 24 enamelled wire will be required. For this purpose about 1 lb. of wire is necessary. As you have no tuning condenser you should provide a sliding contact in place of tappings. (2) It is

regretted that the specimen must have gone astray. (3) Wind the bobbins full of No. 44 wire, for which about half an ounce will be required. (4) Condenser is correctly placed. The range of set cannot be definitely stated. It depends considerably on the skill of the operator.

"A.M." (Smethwick) *asks for a diagram showing various combinations of three valves in a receiver circuit.*

A suitable diagram is given in the issue of April 8th, page 62. Additional switches for the filaments may be inserted if desired.

"ANMAIR" (Liverpool) *asks questions regarding a recording set.*

The current charge working the relay will be quite small, probably about 100 microamps. A suitable indicating instrument to use will be a Weston student's galvanometer, which has a centre zero and gives a full scale deflection with about 750 microamps. This instrument should be connected in series with the relay coils. There is no reason why the set should not record ships provided the circuit can be properly tuned to their wavelengths, and that the amplifier is suitable.

"J.E.A." (Derby) *refers to "Receiving Circuits" article, February 18th issue, and asks* (1) *For suitable winding for Fig.* 5. (2) *Winding for Fig.* 10 (3) *Details of coils M & S, Fig.* 7.

(1) This is not a good circuit for you to use. (2) For a maximum range of 3,000 metres make the aerial coil 6" diameter by 10" long and wind it full of No. 24 wire. The secondary condenser should be 0·0005 mfd. and its winding 8" of No. 24 on a 5" diameter former. For this wave-range the aerial condenser should be connected in series with A.T.I. and not parallel as shown. This circuit will be suitable for telephony. (3) The coils given in previous reply will be quite suitable.

"R.G.N." (St. Annes-on-Sea) *asks* (1) *If "Ora" valves may be used for L.F. amplification.* (2) *If choke coils may be used in H.F. amplification in place of transformer and for diagram of two-valve circuit.* (3) *If advantage is gained by use of separate H.T. to each valve.* (4) *Times of* FL *telephony and number of valves required.*

(1) Yes. (2) It is possible to use suitably designed choke coils, but they are not efficient for short wave sets. The circuit should be arranged as shown in Fig. 3, page 812, March 18th issue, with the choke coil in place of the resistance in the plate circuit of the first valve. (3) No. There is no advantage in a circuit of the above type. (4) No definite programme is yet arranged. It should be heard with two valves.

"S.S." (Staffs) *has constructed an "Amateur Mechanic" crystal set and also a "Work" single valve panel on neither of which are any results obtained.*

If the instructions regarding these sets have been correctly followed out, they should both give satisfactory results. Are you sure that your aerial is not earthed directly instead of through the apparatus? Make certain of this and also try another pair of telephones.

"G.B.W." (Frimley Green) *asks if it is possible to increase the range of Mk. III tuner by substituting slab or basket coils in place of existing windings; also what other alterations to make.*

This should make quite a useful alteration. Make the A.T.I. of basket coils of No. 24 and the secondary of No. 30 wire. Arrange for the A.T.C. to switch either in parallel or series with the A.T.I

"H.G.G." (London, N.1) *asks* (1) *For criticism of two-valve diagram.* (2) *Would above set receive Dutch concert.* (3) *Number of plates of certain size for a* 0·002 *mfd. condenser.* (4) *Whether to connect a Vernier condenser in series or in parallel with A.T.C.*

(1) The connections of this set are wrong. A correct diagram is shown in Fig. 3, page 12, March 18th issue. (2) Not as at present arranged, but when correctly connected and carefully adjusted it should do so. (3) With 1/16" between fixed plates, 36 fixed and 35 moving plates, will be required for 0·002 mfd. Owing to the small spacing and the number of plates required, the building up of this condenser will be found difficult. (4) This should be connected in parallel with the A.T.C.

"AERO" (Liverpool) *asks* (1) *If circuit shown for adding additional H.F. valve to existing valve set is correct.* (2) *If* PCGG *would be received on above with additional two valves for L.F. magnification.* (3) *Gauge of wire to use for earth lead.* (4) *The best point from which to take down lead from aerial.*

(1) This is incorrect. There is no H.T. to the first valve. Connect up as Fig. 3, page 812, March 18th issue. (2) Yes. (3) This should be of fairly stout wire—No 18 or 20 copper or of lighting flex. (4) The down-lead should be taken from a point which allows it to drop at right angles to the horizontal part of the aerial, which is usually at the end nearest to the house.

"S.E.H.R." (Birmingham) *sends crystal circuit diagram and asks* (1) *What additional apparatus is required for a single-valve set.* (2) *For diagram showing arrangement.*

(1) On page 90, April 15th issue, are two single-valve circuits, either of which will give good results. The following apparatus will be required: one valve; one 6-volt 30 amp. hour accumulator; one 30 to 50 volt H.T. battery; one 3 ohm filament resistance; one 0·0003 mfd. grid condenser; one 2 megohm grid leak; also additional coils.

"BEGINNER" (Sowerby Bridge) *asks* (1) *For diagram of set using three valves and a crystal* (2) *If the same will receive Dutch Concert.* (3) *Working range.*

(1) The most useful arrangement of three valves with crystal detector is shown in reply reply given to **"W.A.R." (Heywood)** in the issue of May 13th. (2) Yes, if the H.F. transformer between first and second valves is suitable for 1,000 metres. (3) This should receive most European stations within the wavelength range.

SHARE MARKET REPORT

Prices as we go to press on May 13th, are :—

Marconi Ordinary	£2	14	6
,, Preference	2	12	0
,, Inter. Marine	1	10	0
,, Canadian		12	6
Radio Corporation of America :—			
Ordinary	1	2	0
Preference		15	0

27th MAY, 1922. THE PRICE 6D NET

WIRELESS WORLD AND RADIO REVIEW

VOL. X. No. 9 27th MAY, 1922. Registered at the G.P.O. as a Weekly Newspaper.

THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 9. MAY 27TH, 1922 WEEKLY

Simultaneous H.F. and L.F. Amplification

SOME FURTHER OBSERVATIONS

By P. G. A. H. VOIGT.

(*Member of the Wireless and Experimental Association.*)

IN a previous article on this subject, published in *The Wireless World*, of December 10th, 1921, I described several circuits by which valves could be used for "dual" amplification.

In this article I wish to give improvements which eliminate most of the troubles experienced when working those circuits, and to give constructional details.

The first improvement is to decrease the number of adjustments by substituting for the tuned H.F. transformers special aperiodic H.F. couplings, which, though less efficient, are much more convenient to use.

This coupling is of the choke capacity choke type and functions in the same way as the resistance capacity resistance coupling. It has, however, the advantages that with this coupling it is not necessary to use extra H.T. as in the resistance coupling, and also a strong signal cannot paralyse the circuit. The difference is that both anode resistance and grid leak are replaced by air core H.F. chokes of comparatively low ohmic resistance, so as not to diminish the L.F. transformer efficiency. To increase the H.F. efficiency the two chokes are closely coupled. This electro-magnetic coupling alone would be sufficient to transfer the H.F. voltages from the plate to the next grid or crystal in the case of the longer waves, but for short waves the coupling condenser is required. This condenser need not exceed ·00005 μF. and when so small, will not decrease the L.F. transformer efficiency. The chokes themselves are slab or basket coils with an inside diameter of about 4 cms. and an outside diameter of about 9 cms. About 800 to 1,000 turns of 42 S. S. C. wire are sufficient for wavelengths up to about 4,000 ms. If there are too many turns, the circuit tends to whistle or howl.

The inner end of one choke should go to the plate and coupling condenser and the inner end of the other choke should go to the grid and to the other side of the coupling condenser. The outer ends should go to the L.F. transformer and by-pass condensers.

The efficiency of this coupling decreases when the wavelength decreases, just as in the case of resistance coupling, but if care is taken to avoid capacity between plate, grid and earth, it will still amplify down on wavelengths as low as 200 ms.

The valve socket should not be of the type which is moulded in ebonite, and the coupling should not be mounted on a valve plug, or the capacity will be too great for good efficiency on the short waves.

I have found on testing that the low capacity of a particular "Mullard Ora" valve made it more efficient than R valves on short waves.

A plug on which the coupling can be mounted is shown in Fig. 1. This plug has a much lower self capacity, and is much easier to make than a valve plug. A piece of ebonite is fixed on the socket to prevent short circuits between H.T. and Filament.

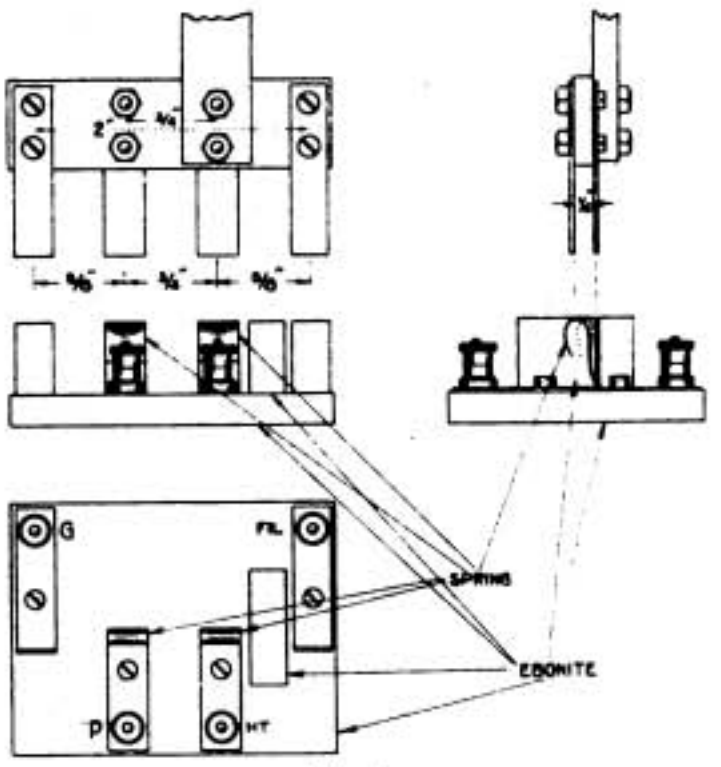


Fig. 1.

The next improvement overcomes the following disadvantages :—

(*a*) Any leakage to earth has to pass through the crystal to get back to the valves.

(*b*) Any A.C. picked up by the circuit can not easily get to earth.

(*c*) The L.T. and H.T. have to be carefully insulated from earth.

All these defects are avoided by connecting the first grid, not to the aerial, but to a secondary coil coupled to the aerial coil. The crystal blocking condenser is then disconnected from earth and connected to the free end of the secondary. The —*ve* filament may then be earthed.

If this secondary is loosely coupled it must be tuned, but if it is tightly coupled it is tuned by virtue of its close coupling, and should not have a variable condenser.

A step up can be obtained by winding 50 to 75 per cent. more turns on the secondary than on the primary. This will considerably increase the signal strength. If the step up is too high, it will be very difficult to prevent oscillation when the plate circuits are tuned.

If the directions of the windings of primary and secondary are in opposition, the reaction condenser can be connected between the first plate and the primary.

To diminish radiation when receiving C.W. the aerial may be connected to a tuned coil which is loosely coupled to the tuned H.F. transformer instead of being connected direct to it as in Figs. 2, 3 and 4.

Fig. 2 shows a 1-valve dual amplification circuit. The signal is received on the aerial and tuned in the usual way. The secondary reverses and steps up the H.F. voltages to the first grid. In the valve the H.F. is amplified and again reversed. A small portion passes back to the aerial through the reaction condenser, and the remainder is passed by the aperiodic H.F. coupling to the crystal. The H.F. is rectified by the crystal and applied to the blocking condenser. Signals would be audible if telephones were connected across this blocking

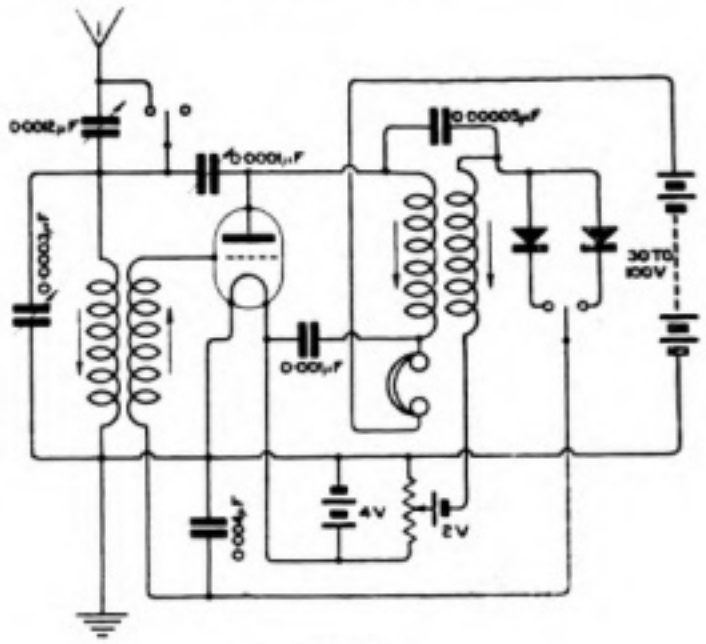


Fig. 2.

condenser. This condenser is, however, between grid and filament, and therefore the valve produces amplified currents in the telephones in the plate circuit.

Fig. 3 shows a two-valve circuit which is the same as Fig. 2, but with the addition of one valve connected by the aperiodic coupling for the H.F. and by an iron core transformer for the L.F.

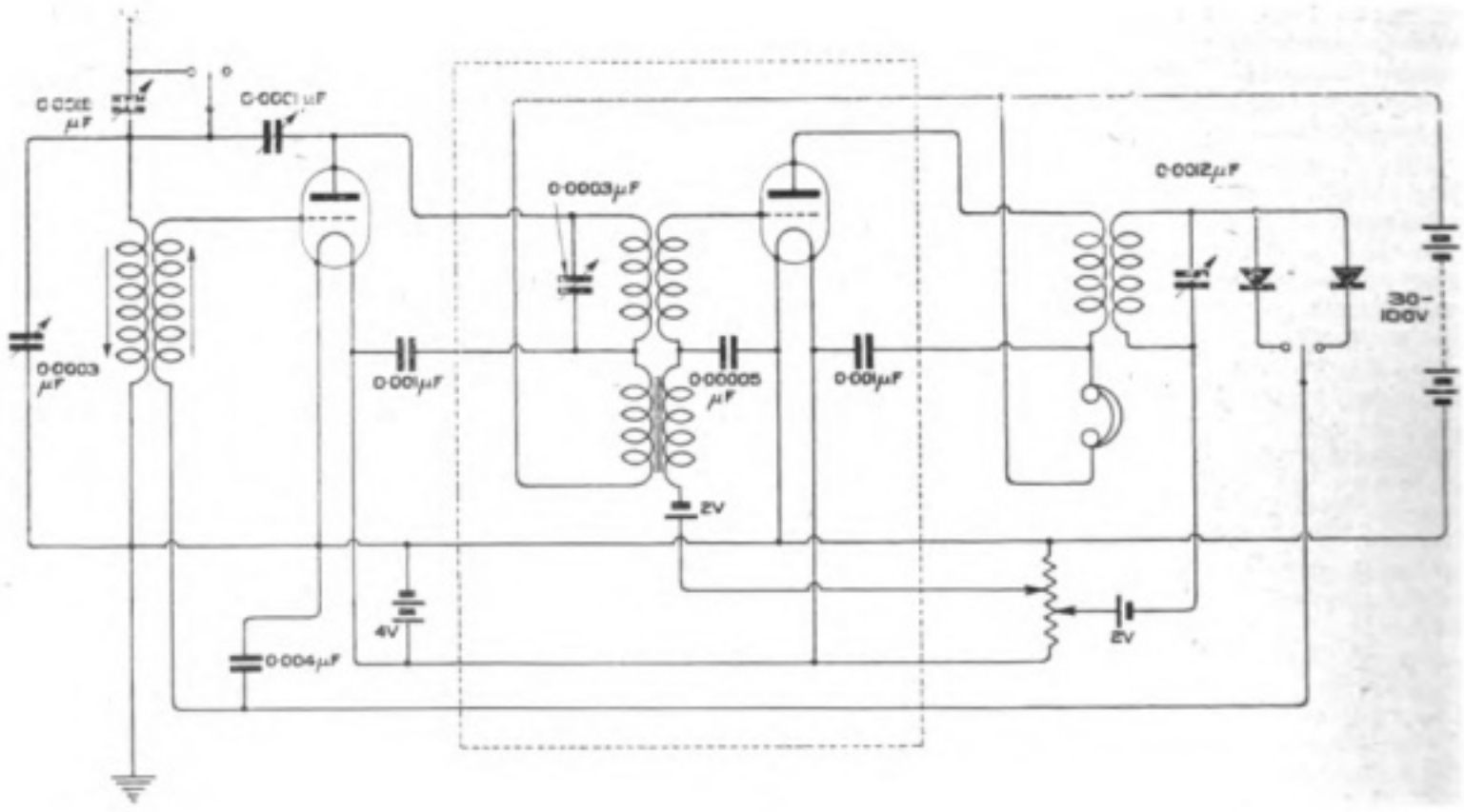


***Fig.* 3.**

In Fig. 4 a two-valve circuit is shown which uses tuned H.F. transformers for the intervalve coupling. This circuit is more efficient but more difficult to control.

It is sometimes advantageous when using a tuned H.F. transformer between valve and crystal to connect it so that the voltage is stepped down to the crystal because the crystal resistance is usually lower than the resistance of the valve.

The transformers which I shall describe can be used if the connections to the socket are changed. The tuning condenser is preferably left on the low resistance winding. In Fig. 4 the tuning condenser is shown on this winding, to which the crystal is also connected.

If these circuits buzz instead of oscillating, the trouble can generally be cured by reversing the crystal and adjusting the H.T. and grid voltages.

An instrument, containing a coupling similar to those described, for converting a L.F. magnifier into a dual amplifier is now on the market.

lap, I use coils whose wavelengths have the following values :—

190 ms, 250 ms, 350 ms, 450 ms, 600 ms, 800 ms, 1,000 ms, 1,400 ms, 1,900 ms, 2,500 ms, 3,500 ms, etc.

When one of these transformers is used in the aerial, the next higher can be used as H.F. intervalve transformer if it is tuned by a ·0003 μF variable condenser, and the next lower can be used as valve to crystal transformer with a ·0012 μF variable condenser. This makes duplicate or triplicate sets of transformers unnecessary.

When it is not intended to use H.F. tuned couplings, such a large number of H.F. transformers is unnecessary if a series condenser, with which the wavelength of any coil can be reduced, is used. Only the following coils are then required—190 ms, 350 ms, 600 ms, 1,000 ms, 1,900 ms, 3,500 ms, etc.

It should be noted that as the tuned transformer is used as A.T.I., an ordinary H.F. transformer

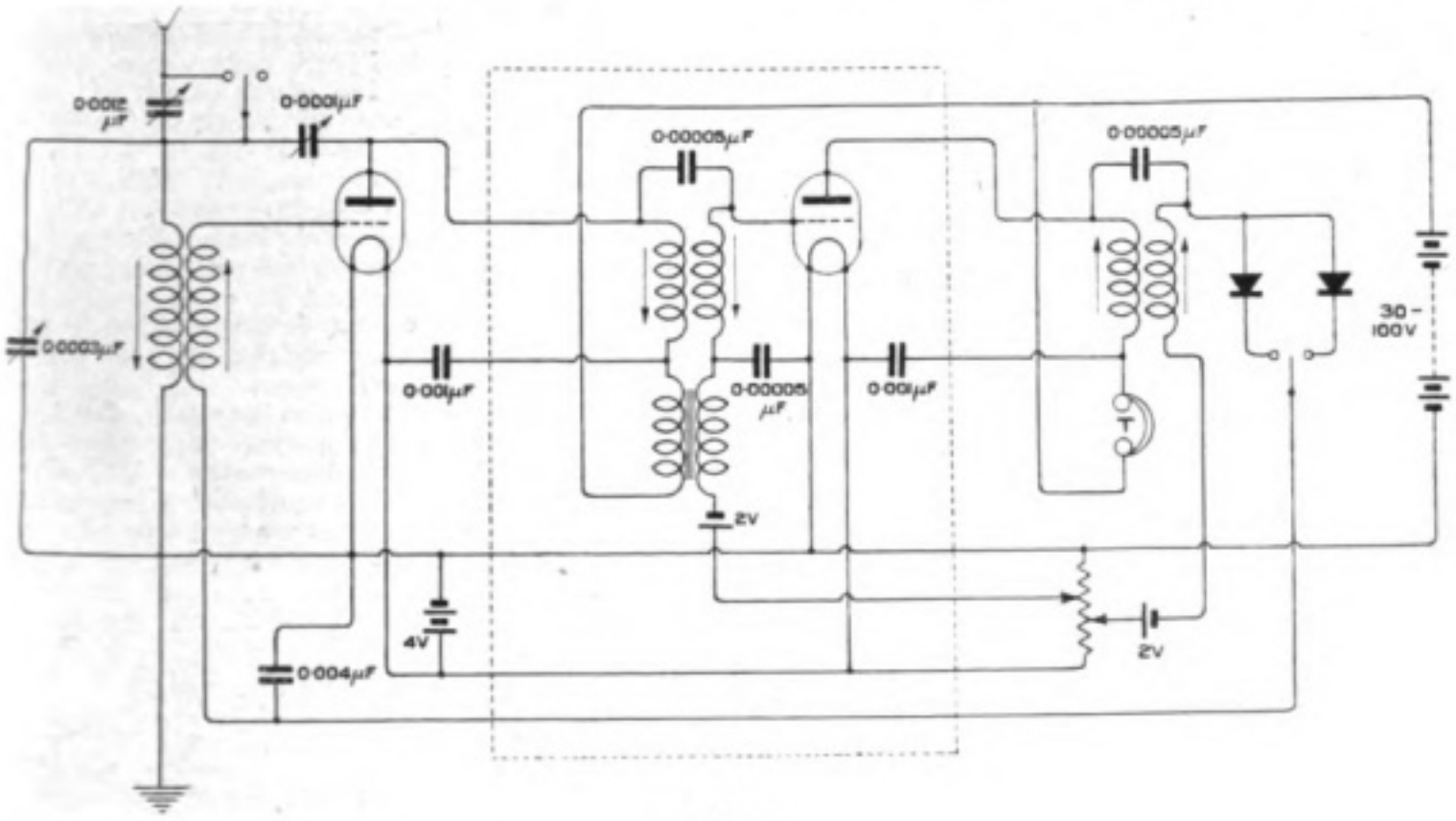


Fig. 4.

It is well-known that when the capacity of the parallel condenser in the aerial circuit increases, the voltage efficiency decreases. It is, therefore, not desirable to increase this condenser beyond about ·0003 μF. The capacity of the average aerial is also about ·0003 μF. Therefore, the capacity across the A.T.I. is about ·0003 μF. with the variable condenser at minimum, and about ·0006 μF. (or double) with the variable condenser at maximum.

The maximum wavelength of any coil is consequently about 1·414 ($= \sqrt{2}$) times its minimum wavelength.

If we try to work out a series of coils so that the wavelength of each coil is 1·414 times the wavelength of the coil below, we get a series of 15 values to include wavelengths from 150 to 27,200 ms.

This would not allow any overlap, and to get over-

wound with very thin copper or even resistance wire is quite useless.

My transformers have basket coils as primaries, and as a rough guide I give particulars of them in Table I. Lattice and other coils will no doubt be just as good.

As the secondaries carry hardly any current they may be wound with fine wire such as 42 S.S.C. It should be wound in narrow slots in a cardboard spider, so that it is as nearly as possible a single layer winding, which should then be boiled in wax.

It often happens that in manufacture a secondary develops a short circuit. This can be tested for as follows :—Tune in a C.W. station whose wavelength is of the same order as the wavelength for which the secondary is intended. Then hold the secondary near the aerial coil and retune. If the wavelength has increased, it is due to the

TABLE I.

Wavelength	S.W.G.	Inside diameter cms.	Outside diameter cms.	Turns.
190	18	NO DATA		
250 350	18 18	5·2	13	30
450 600	18 22	7·4 5·2	18·5 13	36 46
800 1,000	22 26	7·4 5·2	18·5 13	54 90
1,400 1,900	26 26	8	20	140
2,500 3,500	32 32	NO DATA		

self capacity of the coil under test which is then OK. But if the wavelength has decreased and tuning has become flat, the coil is faulty. The wavelength is decreased by the faulty coil on account of the fact that when the magnetic flux tends to thread the coil, eddy currents are set up which repel this flux, with the result that only a small fraction of the initial flux really threads the coil under test. This has the same effect as reducing the area of the air circuit through which the flux flows, and thus the apparent inductance of the aerial tuning coil is reduced.

As the H.F. transformers are tuned, a little extra capacity does not matter much, and they can be fitted to R valve plugs. If it is intended to interchange them with the aperiodic coupling, they should either be fitted with the low capacity plug previously described, or an adaptor should be made so that the R valve plug can be fitted to the low capacity socket.

It may seem rather strange to use a crystal detector in these days of valves, but when it is remembered that with one valve used for dual amplification, signals can be amplified 40 to 200

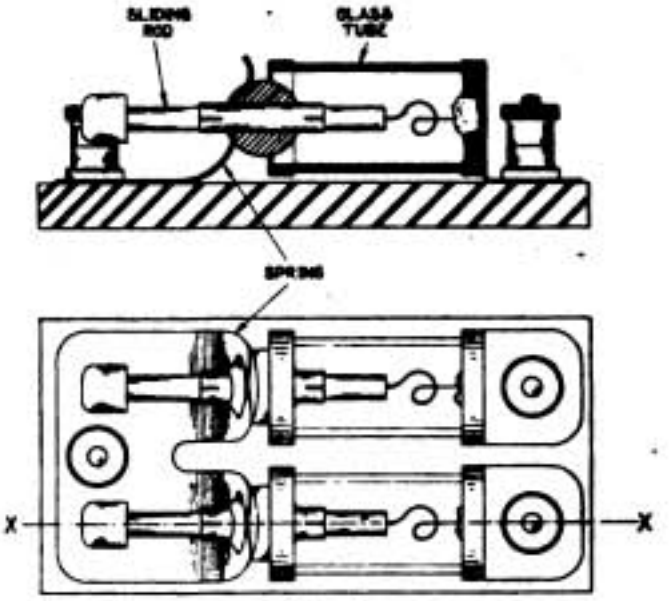


Fig. 5.

times, it will be seen that the valve is best employed as amplifier.

If two crystal detectors are used with a switch so that they can be set by comparison, no difficulty should be experienced with them, provided that they are quite rigid and fitted with good crystals such as treated galena, etc.

Fig. 5 shows a type of detector which is very stable. All unnecessary weight on the moving part should be avoided.

These circuits can be used for spark, C.W. and telephony, but are particularly good for telephony.

In conclusion I would like to thank PCGG for his regular transmissions, which have enabled me to make the experiments necessary to develop and perfect these circuits.

On Heterodynes

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

(*Continued from page* 197).

IN the earlier instalments of this article descriptions were given of two arrangements of heterodyne using double coils, one for the tuning circuit and the other for providing the necessary reaction. It is possible, however, to employ other circuit arrangements, such, for example, as electrostatic reaction between the anode and grid circuits, instead of electromagnetic coupling. The general scheme of such reaction coupling is indicated in Fig. 12.

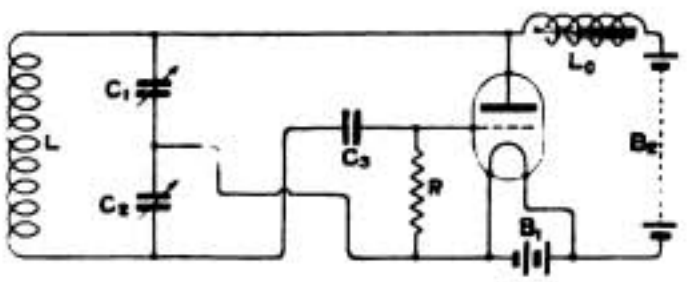


Fig. 12. Heterodyne Oscillator with Electrostatic Coupling.

In this diagram the inductance L of the oscillation circuit is shunted by two condensers in series, C_1 and C_2. One end of the inductance is joined to the anode of the valve, and the other to the grid, through a small condenser C_3, the function of which is solely to insulate the grid from the high positive voltage of the anode, which would otherwise be joined to it through the windings of the coil L, but at the same time it allows the passage to the grid of high frequency potentials from the coil L. The H.T. source, B_2, is connected to the anode as shown through the choke L_c, which offers a high impedance to the passage of radio frequency currents, and serves to confine those currents to their oscillation circuit, viz., L C_1 C_2. The grid is also joined to the filament of

the valve through the leak resistance R, which prevents the accumulation of high negative potentials on the grid wires (by reason of grid rectification), while at the same time it does not draw away any appreciable amount of the available high frequency energy in the oscillation circuit.

The action of the two condensers, C_1 and C_2, in series may be likened to that of a potentiometer, since they serve to subdivide the total available potential across the oscillation circuit into two parts, one of which—the potential drop across C_1—is across the anode circuit of the valve, while the other—the potential drop across C_2—is applied to the grid of the valve. Hence any initial disturbance of the potential of the plate of the valve is communicated to the oscillatory circuit, *via* C_1, and results in the establishment of a pulse of current round that circuit, causing a potential difference to appear between the terminals of the condenser C_2, which is applied back to the grid of the valve. The sign of this potential change applied to the grid being opposite to that derived from the anode, the initial disturbance is reinforced, and steady current vibrations or oscillations are produced.

This arrangement of the circuit may be compared with the better known one, shown in Fig. 13, in which the subdivision of the potential across the oscillation circuit is made by the tapping from the filament to some suitable point along the inductance, thus dividing the coil into two parts, L_1 and L_2, corresponding to C_1 and C_2. The ratio of the values of the condensers C_1 and C_2 is therefore important, since it determines the ratio of the voltages in the grid and anode circuits of the valve. Stable oscillations can only be produced when this ratio lies between certain limits depending upon the valve in use. This ratio often changes somewhat with the wavelength of the oscillations, since the two condensers are shunted by other parts of the circuit—the anode condenser by the H.T. battery and choke coil, and the grid condenser by the grid leak resistance.

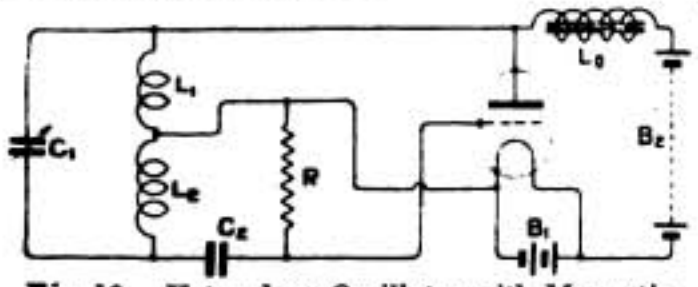


Fig. 13. *Heterodyne Oscillator with Magnetic Coupling.*

Using a circuit of this type, we can evidently build up a heterodyne with a single coil for each range of wavelengths, provided that we can vary two condensers in synchronism with one another. The simplest way of effecting this simultaneous adjustment is to mount two sets of vanes on one spindle in the manner indicated in Fig. 14, in which A and B are two sets of semi-circular fixed plates, mounted on opposite sides of the central spindle. The spindle carries two sets of moving vanes, C_1 and C_2, also mounted on opposite sides so that they interleave simultaneously with the two sets of fixed vanes. This double condenser would be connected in the circuit in the manner already indicated in Fig. 12, the spindle of the condenser being connected to the filament of the valve and the two sets of fixed plates being joined respectively to the anode and to the grid through the grid condenser C_3.

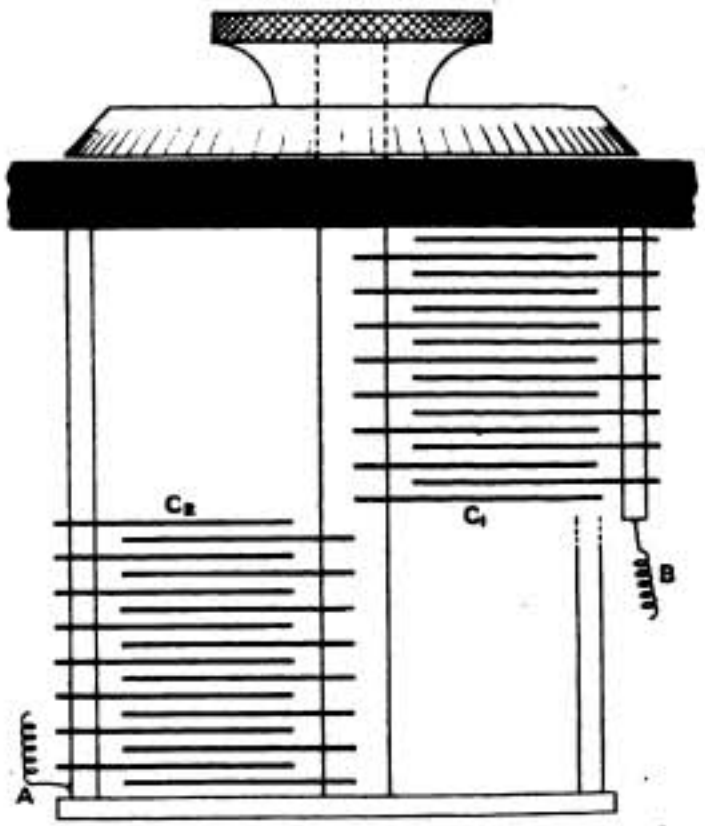


Fig. 14. *Arrangement of Double Condenser for Electrostatic Coupling.*

A double condenser of this type can be fitted into either design of instrument that has already been described in the earlier instalments of this article—Figs. 2 and 11—in place of the single variable condenser there shown. With this arrange-

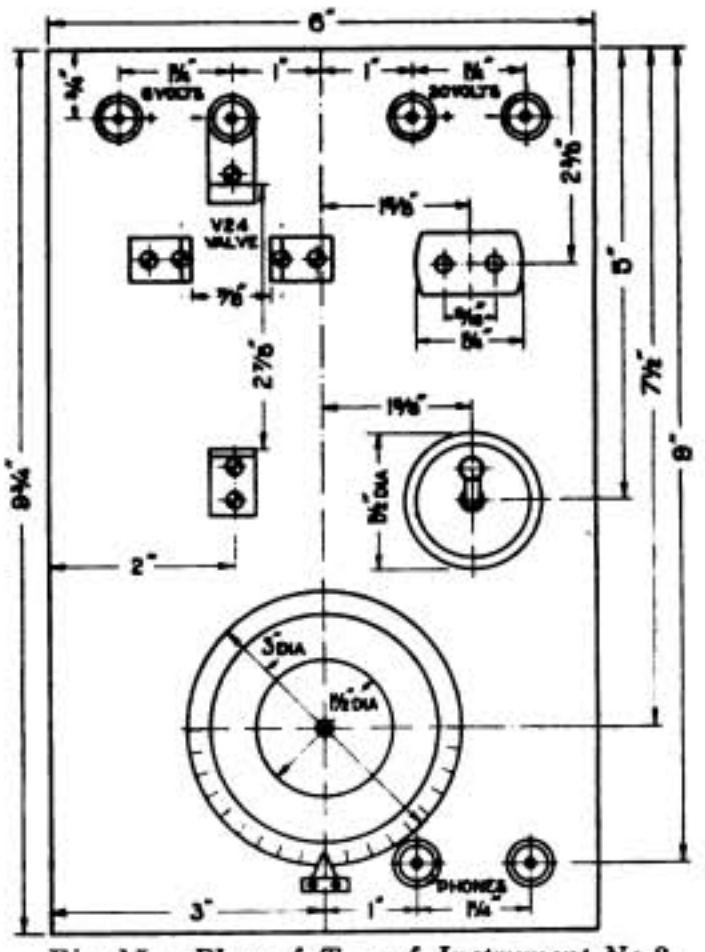


Fig. 15. *Plan of Top of Instrument No.3.*

ment the range switch is not required, and so can be omitted, together with one of the coil-holder sockets, since only one inductance is required for each range. In the space available in the instrument—the space occupied by the variable condenser of 0·0013 to 0·0015μF maximum capacity in the designs described above—it is only possible to fit a double condenser having a maximum capacity of each half of about 0·0006 microfarad. The effective capacity of the two parts, since they are joined in series across the coil when in use, is therefore only 0·0003 μF. A greater number of coils must be employed to obtain the same effective range of wavelengths as was obtained with the other arrangement. If a series of coils up to No. 1,000 the largest having an inductance of about 101,000 μF, is employed, the maximum wavelength obtainable will be just over 10,000 metres, since the maximum condenser capacity is much smaller than before. The values obtainable with "Burndept" coils are indicated approximately in Table III, and a suggested revised layout for the top of the instrument built on these lines is given in Fig. 15.

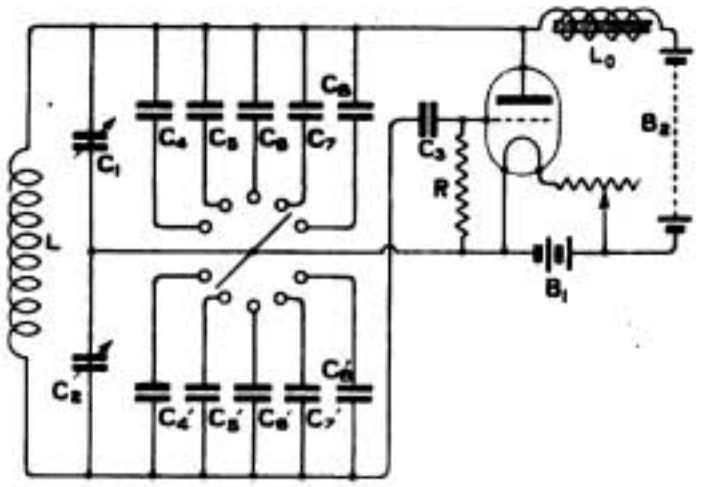


Fig. 16. Simplified Circuit Diagram of Instrument No. 4.

TABLE III.

Coils for Use with 0·0006 μF Double Condenser.

Coil No.	Wavelength (metres).	
	Minimum.	Maximum.
50	275	590
150	500	1,130
300	1,000	2,250
500	2,050	4,700
1,000	4,700	10,500

Many of the dimensions in this diagram are the same as the corresponding ones in Fig. 2, but where parts have been moved to new positions fresh dimensions have been given. The grid leak and condenser shown in Fig. 12 can be mounted up on the underside of the ebonite top of the instrument in any convenient position near the valve. Space will usually be found for these immediately under the valve-holder, so that they are quite convenient for connecting to the grid terminal. A condenser of about 0·00015 μF with a resistance of approximately 2 megohms will be found to function satisfactorily.

It should be mentioned here that the telephones which are often required for use in the heterodyne circuit can be used for the choke coil L_0 (Fig. 12) in the H.T. battery circuit. A choke of some sort is necessary here in order to prevent the battery forming a short circuit for the high-frequency currents, and a pair of telephones is usually quite effective for this purpose. With this connection, therefore, a pair of telephones should always be left in circuit, whether they are required for use as such or not, so that with this instrument it is

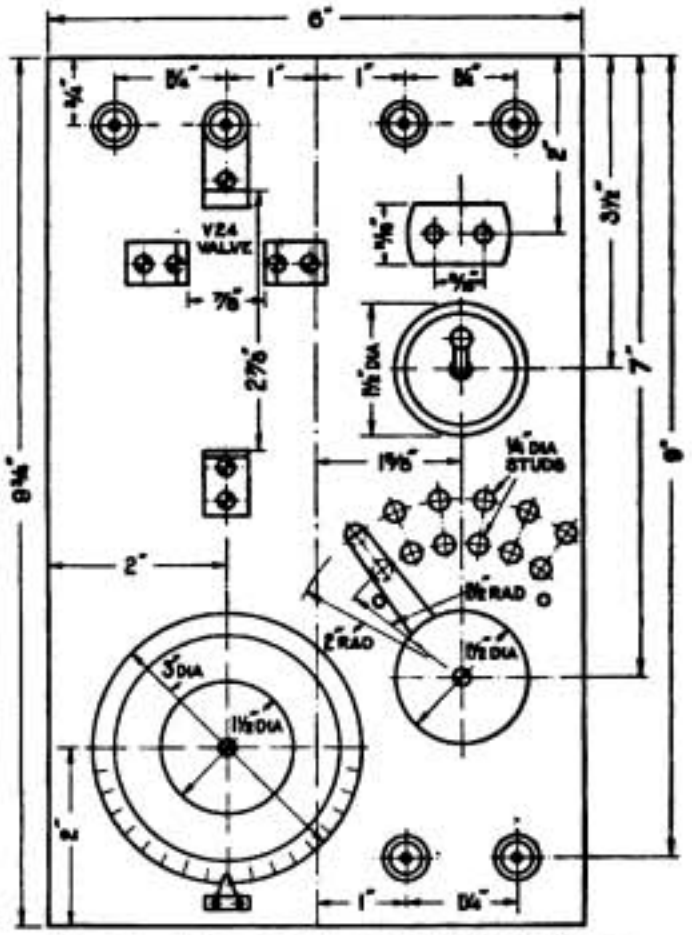


Fig. 17. Plan of top of Instrument No. 4.

unnecessary to provide the short-circuiting strap detailed in Fig. 8 in the second part of this article (page 195). Details of the valve-holder, etc., remain as set out in Figs. 4, 5, 6, 7 and 10.

This arrangement of instrument may be improved by increasing the range of capacity used with each

TABLE IV.

Range.	Condensers.	Values, microfarads	Effective Maximum value of complete Condenser.
1	Variable	0·0006(max.)	0·0003
2	$C_4 = C_4'$	0·0005	0·00055
3	$C_5 = C_5'$	0·001	0·0008
4	$C_6 = C_6'$	0·0015	0·00105
5	$C_7 = C_7'$	0·002	0·0013
6	$C_8 = C_8'$	0·0025	0·00155

coil, thus augmenting the wavelength range and opening out the scale. Since the space available for the double variable condenser is already full, an increase of the effective capacity can only be

obtained by connecting fixed condensers in parallel with the two parts of the variable condenser. The general scheme then becomes as shown in Fig. 16.

In this diagram C_1 C_2 and L remain as before, C_1 and C_2 being the two halves of the double variable condenser and C_3 and R are the grid stopping condenser and leak respectively. B_1 and B_2 are the filament and H.T. batteries respectively, with the choke coil L_c in circuit with B_2. This choke may here, as pointed out above, be made up of a pair of telephone receivers. In parallel with the double condenser C_1 C_2 a number of fixed condenser units are shown. These may be connected in parallel with C_1 C_2 by means of the double switch Sw. Convenient values to give to these condensers are set out in Table IV.

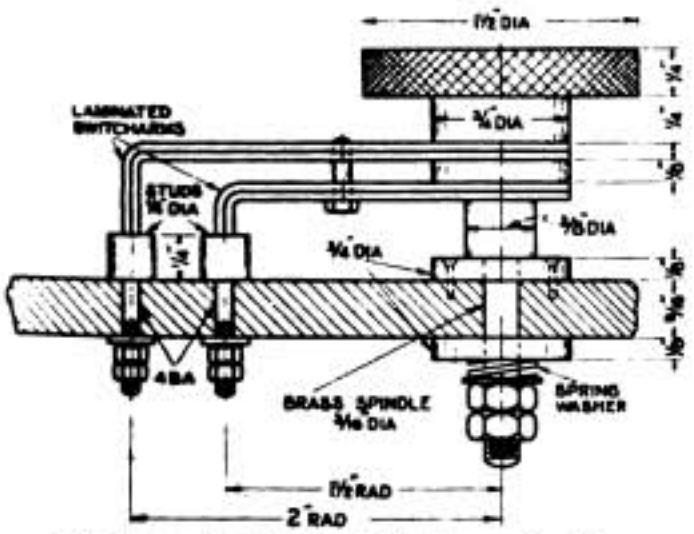


Fig. 18. Double Contact Range Switch.

The coils which are necessary with these condensers in order to ensure adequate overlapping of the various ranges are set out in Table V, which also gives the approximate wavelength range of the instrument with each coil employed for each point on the range switch which connects in the parallel condensers.

The plan of the top of an instrument designed on these lines is set out in Fig. 17, giving the leading dimensions. It will be noted that the general arrangement follows on the lines of those already described [instruments (1) to (3)], and that many of the parts are identical in detail. This remark applies to the clips forming the valve holder, to the condenser knob and scale, pointer and filament switch. A coil plug socket of the standard type should be secured in the position indicated, and no link for the telephone terminals is required (Fig. 8). The range switch is slightly different, since two sets of condensers require to be joined in circuit simultaneously. Details of a suitable switch are given in Fig. 18. It will be seen from the diagram in Fig. 16 that a double row of contacts is required. These can be arranged on the same side of the switch, as shown in Fig. 18, using a double laminated switch arm to bridge the successive pairs of contacts. The connection made to the spindle of this switch should be taken to the negative end of the valve filament, the first pair of contacts marked 1 in Fig. 17 being left free and the remaining five pairs connected to the fixed condenser in the manner indicated diagrammatically in Fig. 16. It should also be noted in connection with this diagram that no blocking condenser is required across the telephones and H.T. battery such as was used for the other designs. In fact, any such capacity, particularly across the telephones, is harmful in this arrangement and should be avoided in order to maintain the effective choking inductance of the telephones at as high a value as possible.

A further simplification of the electrostatically coupled arrangements here described is possible, and details of the method will be given in a further instalment of this article.

(To be continued.)

TABLE V.

Coil No.	Wavelength Range (Metres) for Points on Range Switch. (1)	(2)	(3)	(4)	(5)	(6)	Total Range (metres).
50	170–400	390–535	525–635	625–722	715–810	800–870	170–870
200	700–1,590	1,570–2,100	2,060–2,510	2,500–2,900	2,880–3,190	3,200–3,550	700–3,550
500	1,800–4,700	4,500–6,300	6,200–7,700	7,600–8,700	8,600–9,600	9,500–10,500	1,800–10,500
1,000	4,000–10,300	10,000–14,300	14,000–17,000	16,900–19,500	19,300–21,900	21,500–23,700	4,000–23,700

The Wireless Society of London.

The last Meeting of the present Session will be held on Wednesday, June 14th, at 6 p.m., at the Institution of Electrical Engineers, Victoria Embankment, when an Address will be delivered by Sir Oliver Lodge, F.R.S.

Some Notes on Telephony Transmissions

THOSE who listened in to the broadcasting of the progress of the Carpentier-Lewis fight arranged by the *Daily Mail* in conjunction with the Marconi Company are in a position to appreciate some of the future possibilities of the service.

It is no exaggeration to speak of the Broadcasting Service in this country as heralding a new era in social progress, and the enthusiasm with which the public use of such a service has been received in the United States will undoubtedly be echoed in this country.

For some time past wireless amateurs have enjoyed the transmissions of The Hague, Writtle and the Eiffel Tower, as well as experimental transmissions of speech and music from a number of other stations, but the transmission in connection with the Carpentier-Lewis fight may be regarded as the first definite step towards the fulfilment of the promises made by the Postmaster-General.

The reception of the transmission on the night of the fight has been reported as extremely good from all parts of the country, and numerous messages of appreciation have been received by the *Daily Mail*. The station from whence the transmissions emanated is located at Marconi House, and in the vicinity it is possible to hear transmissions from this station with a crystal receiver and an indoor aerial of even as little as ten feet of wire.

Figs. 1 and 2 give two views of the transmitting apparatus at Marconi House.

On the extreme left of the pictures are the aerial tuning inductances, and below them the fixed condensers. The aerial ammeter is visible alongside the inductances.

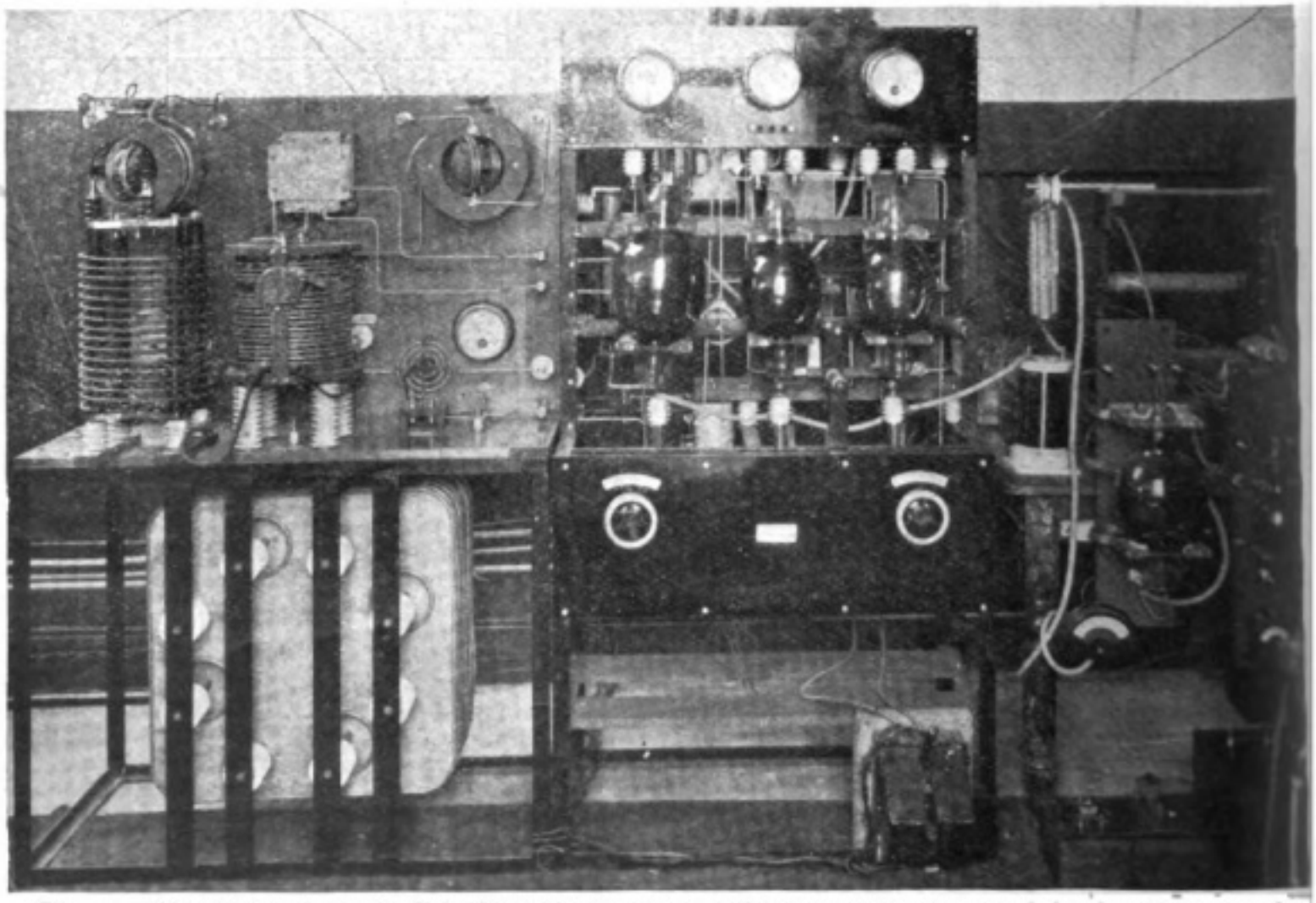


Fig. 1.—The Marconi House Telephony Transmitter. This apparatus was used for broadcasting the progress of the Carpentier-Lewis fight.

In the centre of Fig. 1 are three valves, that on the left being larger than the other two. This large valve is the main oscillating valve, and is of the Marconi-Osram type known as MT2. The other valves are rectifiers.

On the extreme right of Fig. 1 will be noticed two more valves, that on the left being rather smaller than the main oscillator and larger than that on the extreme right. These two valves constitute the control and sub-control valves.

When the microphone is spoken into the speech varies the current flowing through the microphone. This modulated current passes on to the primary of a small transformer, and so produces a second modulated current of a higher voltage in the secondary, which current varies the grid potential of the smaller of the control valves. This sub-control valve in its turn controls the valve imme-

diately on its left, which is the main control valve, capable of handling a very large amount of energy. This valve is directly coupled to the main oscillator valve, so that it produces a very powerful modulation of the high frequency current flowing in the aerial circuit.

The source of supply for the transmitter is first obtained from the Charing Cross Power Station. This supply is transformed into alternating current of high frequency. A step-up transformer next raises the alternating current to a suitable voltage and supplies the two rectifying valves producing double wave rectification. Ripple is eliminated by means of chokes and condensers, and the quality of the speech depends very largely on the extent to which the radiated wave is freed from ripples produced by low frequency alternating currents, and speech of a poor quality with a rough tone is often attributable to this cause.

In an official announcement made regarding the broadcasting service it was suggested that in addition to the many other uses to which the wireless telephone might be put there was also the possibility that in the future one might listen to sermons on Sundays. Fig. 3 shows another suggestion which comes, of course, from America. Here we see a wireless receiver and loud speaker erected in a church which is not otherwise provided with a preacher, and in this manner the sermon preached in another church, perhaps many miles away, is picked up and made audible to the congregation by means of the loud speaker.

In Paris, the wireless telephone installation of the Eiffel Tower is under the direction of General Ferrié and Commandant Julien. Fig. 4, which is reproduced by kind permission of *La Nature*, represents a group at the Eiffel Tower on an occasion when the famous French singer, Madame Ivonne Printemps, broadcasted a recital by wireless telephone

In addition to the transmissions from the Eiffel Tower, experimental transmissions are conducted daily from the station at Sainte Assise, near Melun,

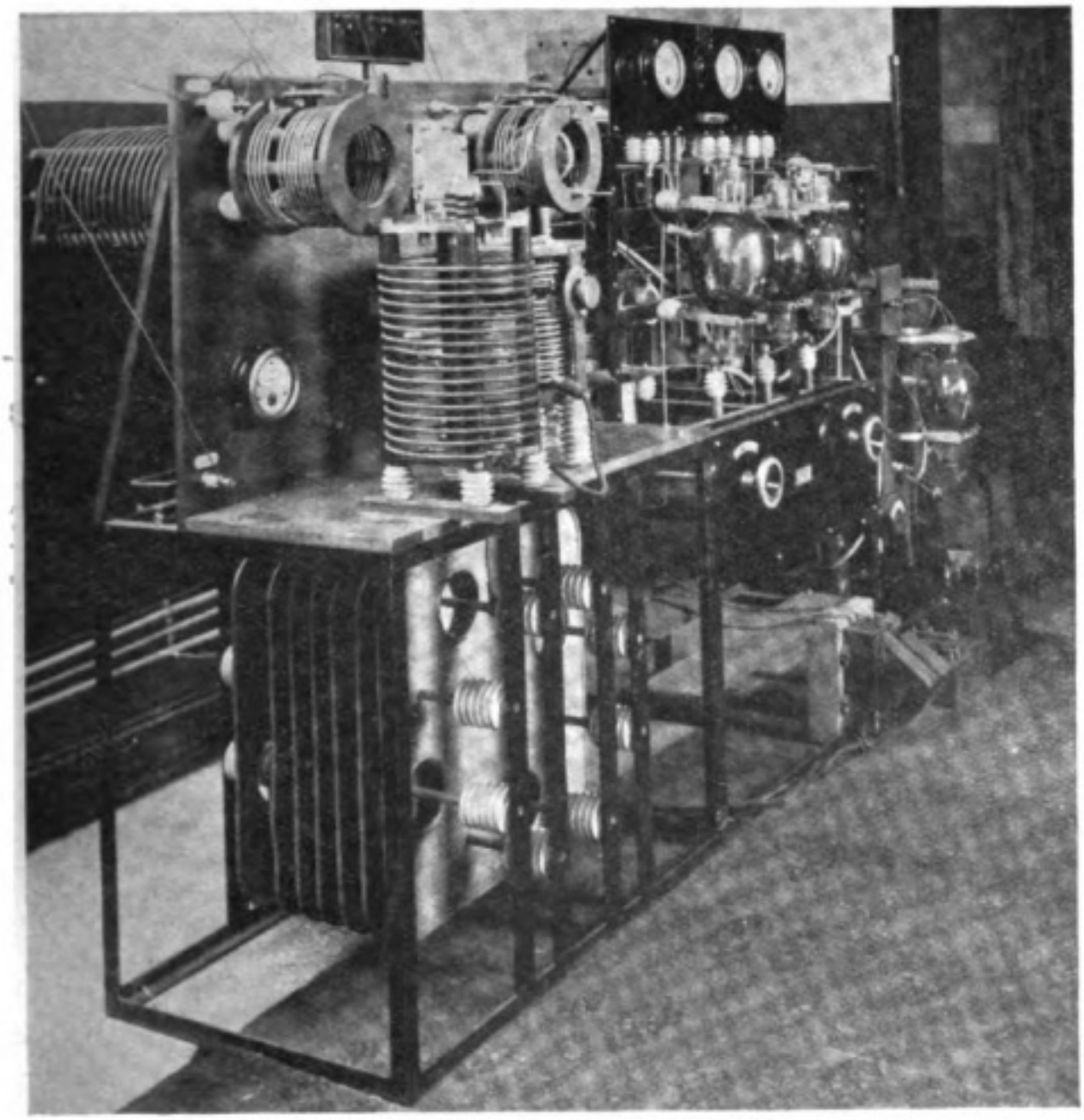


Fig. 2.—A side view of the Telephony Transmitter installed at Marconi House.

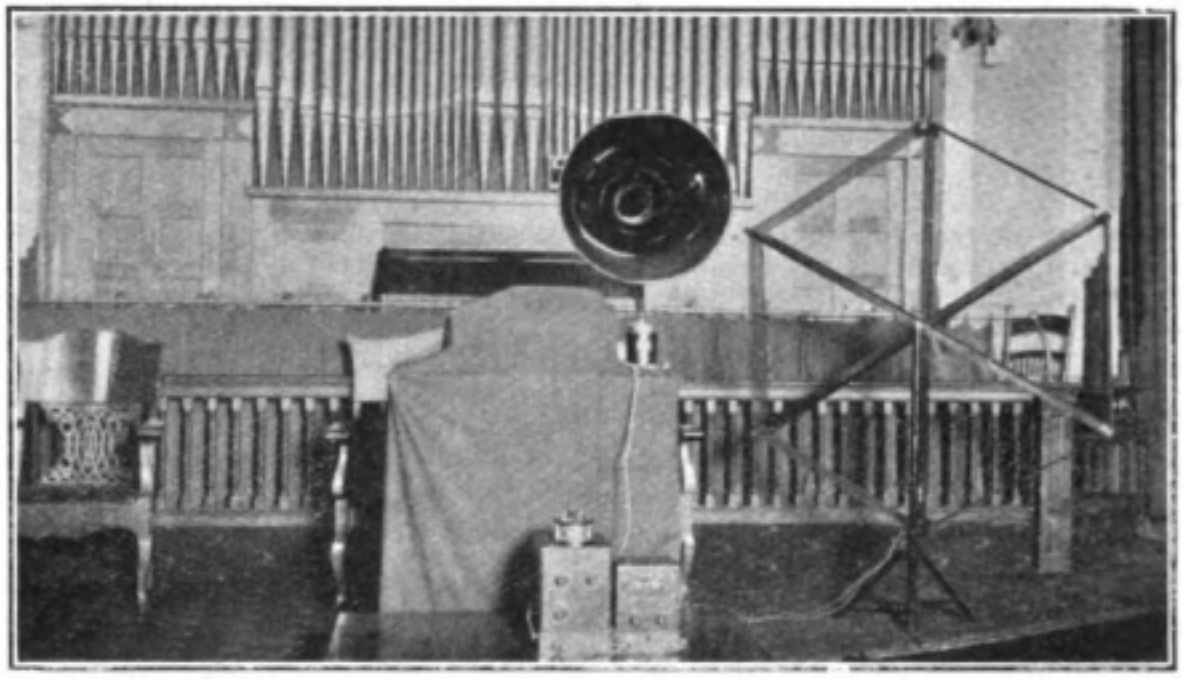


Fig 3. Wireless Receiving Apparatus insta'led in a Church.

whilst some very successful duplex transmissions have taken place between Bourget and Issy-les-Moulineaux. There are also experimental transmissions on a wavelength of 450 metres conducted by commercial companies in Paris. The transmissions from Eiffel Tower are conducted on a wavelength of 2,600 metres, and those from Sainte-Assise on 1,900 metres.

Fig. 4.—A Wireless Concert at the Eiffel Tower. From left to right · The famous singer, Mme. Ivonne Printemps, M. Sacha Guitry, M. Laffont, Under Secretary of State, and General Ferrié.

Experimental Station Design.

These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.

Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.

Although the information contained in the first few articles under this heading may cover ground already familiar to many readers, the succeeding instalments will advance by easy stages and in the course of the series the construction of an elaborate station will be evolved.

I.—THE AERIAL.

The first consideration in the construction of a station is the erection of the aerial. No definite instructions can be laid down, as circumstances are different in nearly every case, but the following points should be observed :—

(1) If there is a choice of site, select the one which is highest and least shut in by surrounding objects or hills. A church spire, tall chimney or other tall structure in the immediate vicinity of the aerial may impair its efficiency. The aerial should not be erected among a cluster of trees unless it can be well above them, neither should it be slung between walls and lower than the surrounding roof-tops. In considering a site it must be borne in mind that the ground level is really the mean level of the tops of the neighbouring objects.

(2) The running of the aerial parallel or near to telegraph or telephone wires should, if possible, be avoided. Such lines will absorb a good deal of energy that would otherwise be picked up by the aerial, and they may also give rise to noises during reception and even actual overhearing of telegraphic or telephonic messages may occur.

(3) With most aerials reception is not uniform in all directions, and if reception from a particular station is desired it is worth while, if possible, to arrange for that station to be located in the direction from which the aerial receives best. An aerial erected with its ends pointing N. and, S. and leading-in wires taken from the middle, will receive best from stations in northerly and southerly directions. Were the leading-in wires taken from the northerly end, reception would be best from stations situated to the N. If the aerial is to be steeply inclined the leading-in wires should be taken from the lower end.

(4) If a mid-point lead-in is to be taken from a level aerial, care must be exercised to see that connection is made at the exact middle. The leading-in wires must not be taken back beneath the aerial, but may either run down as vertically as possible or slope in a direction away from the aerial.

The length of the aerial is controlled by the wavelengths on which it is desired to receive. For efficient reception on wavelengths between 200 and 1,000 metres the aerial should not be too long, and one of two wires not more than 70 feet each, is suitable. It is difficult to tune a long aerial to short waves, whilst a short aerial can be made to receive the longest waves, though perhaps not as efficiently as a longer one. A single wire may be used of, say, 100 feet, but the two-wire aerial will generally be found more convenient, as the small changes of inductance such as are provided in tuning instruments, will vary a two-wire aerial through a bigger wavelength range for a given variation of inductance. Where conditions permit it may be worth while to erect two aerials, one a small one of either of the above dimensions for short wave reception and another much longer and specially suited for long wave work. Fig. 1 shows various types of aerials for short wave reception, and Fig. 2 aerials of a larger type.

The method of supporting the aerial must be left to the reader, as conditions are so varied, but a few general cases are taken which may offer suggestions.

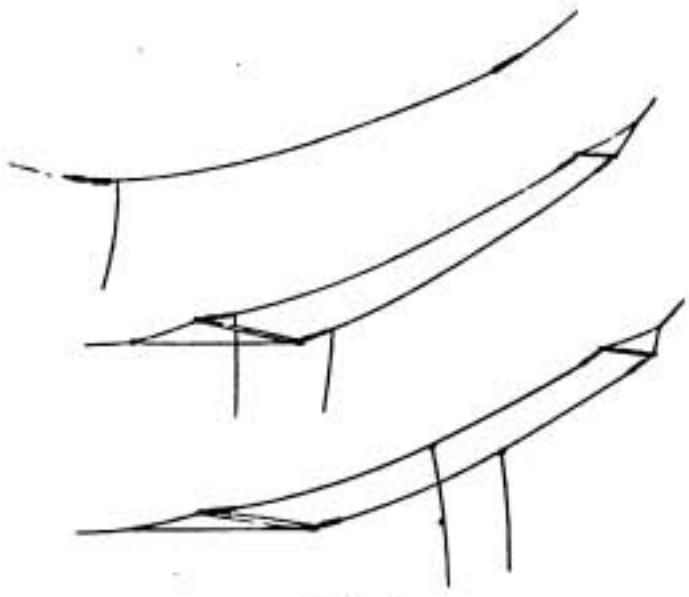


Fig. 1.

The use of a mast really necessitates some skill and experience in fixing, but with reasonable care and as much assistance as possible, the work can usually be successfully accomplished by the novice. It must be borne in mind that every foot in height that can be added to the aerial extends the range, and if any scheme can be devised to make it higher it is quite worth the extra trouble in carrying it out. Whilst admitting that good signals can be obtained on aerials fulfilling none of the desirable conditions mentioned above, it is always preferable to have maximum efficiency in the aerial, and so obviate unnecessary stages of amplification, with the attendant complications and manipulating

difficulties. Where reception is to be carried out with the use of a crystal detector, a high outdoor aerial is strongly recommended, and the use of short indoor aerials, or aerials of the frame type, should not be adopted. It is sometimes argued that high aerials are more liable to produce in the receiver noises due to atmospheric disturbances and

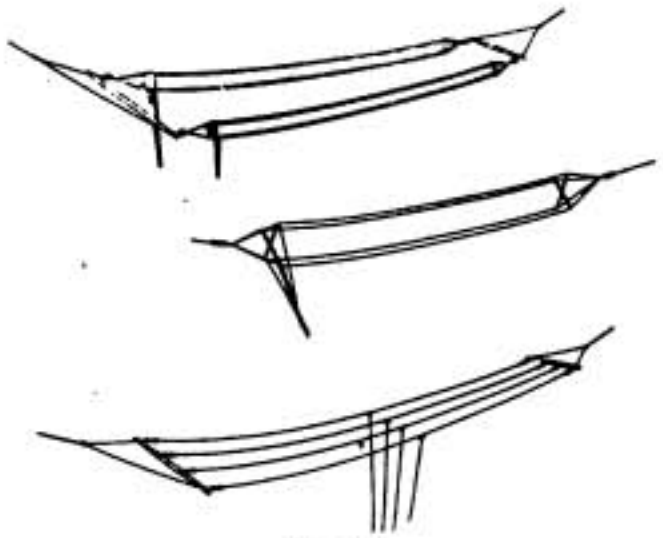


Fig. 2.

stray electrical discharges, but against this must be considered the fact that to produce a given strength of signal an indoor aerial will necessitate the use of amplifiers which, unless very carefully designed and of high grade manufacture, in themselves set up parasitic noises.

If one end of the aerial is to be a house-top it is better to terminate it on a small mast. If the roof is flat, the fixing of the mast is quite simple (Fig. 3), but if it is pointed, a chair must be made to rest across the ridge, as shown in Fig. 4. This chair must be strongly made to the design shown in Fig. 4, and should be held together with screws. Support should not be given to it by the top of the ridge, but by the sloping faces of the slates. A piece of thick felt or sacking placed across the ridge and extended down either side will prevent the chair from damaging the slates. This will also assist in keeping the chair in position, as vibration, due to the swinging of the aerial, and accompanied

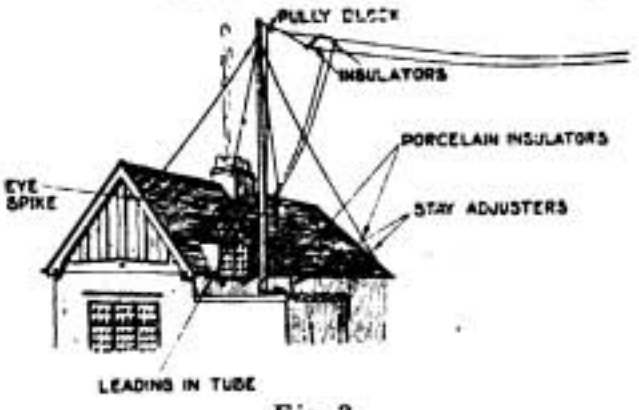


Fig. 3.

by side pull, may tend to push it out of position. This, as well as the mast and all other outdoor woodwork, should be given a protective coat of paint.

The mast must be guyed in four directions, so that it will stand vertical, irrespective of any pull that may be exerted by the aerial. Single No. 14 galvanised iron wire is usually strong enough for guys, provided the points of anchorage are further out from the base of the mast than the height of the mast itself. When only one set of guys is used they must be attached at a point about 6″ from the tip of the mast, in order to give plenty of support and to leave sufficient space to prevent the pulley becoming entangled in them. The question as to whether an additional set of guys is required is determined by any tendency the mast may have to bow. By using two sets of guys, one set at the middle and the other at the top, it is possible to give strength to a very slender mast.

Insulators must be inserted in the guy wires to prevent them acting as earthed aerials and so screening the main aerial, and these insulators will be seen in the figures.

A type, known as the "shell" insulator, is best for this purpose, as it has a high breaking strain and the shape of its flanges gives good insulation when wet. The insulators are inserted at either end of the guy wire so as to entirely insulate it, and should this insulated portion become more than 30 feet in length, other insulators should be put in, in the exact middle, if reception is to be carried out on wavelengths below 200 metres. The gauge of guy wire given above is suitable for masts less than 30 feet in height and supporting aerials not

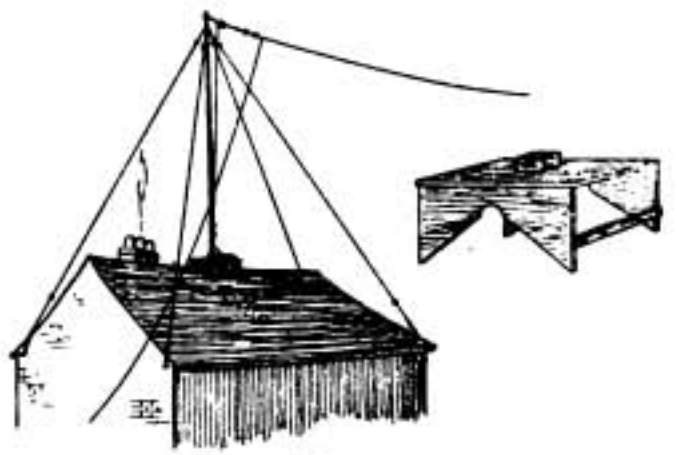


Fig. 4.

heavier than two 100′ lengths of 3/19 aerial wire. Where there is likely to be a greater pull due to a bigger aerial span, taller masts, or an aerial steeply inclined, heavier gauges must be used, such as single No. 8, 3/8 or 7/14. It is convenient to insert galvanised iron guy adjusters immediately below the bottom insulators in order that small adjustments can be made from time to time to keep the mast vertical. Guys and adjusters must be liberally treated with oil or grease before being left to the action of the weather.

For the points of anchorage of the guys malleable iron eye spikes should be used, driven home in the brickwork several courses down from the top. If a guy wire should pass round an iron gutter, a piece of felt must be wrapped round it at the point of contact to prevent risk of breakage due to friction and the acuteness of the bend. Tall, heavy masts cannot, as a rule, be supported by dwelling-house roofs, and if it is desired to have an aerial more than 20 feet above the roof, it is advisable to use a long mast reaching from the ground. For lightness the mast may consist of two poles spliced together and the dimensions of overlap, shown in Fig. 5, relative

to the length should be adopted. Light 30-foot poles usually have a butt diameter of 7″ and a tip diameter of 3″ Specially selected poles may have less taper. The "McGruer" hollow spar mast is very useful for roof fixing, owing to its extreme lightness. For amateur stations, iron masts are not to be recommended. Those not experienced in roof work, and who call in the assistance of a local builder, will only need, however, to draw his attention to the fixing of the insulators in the guys.

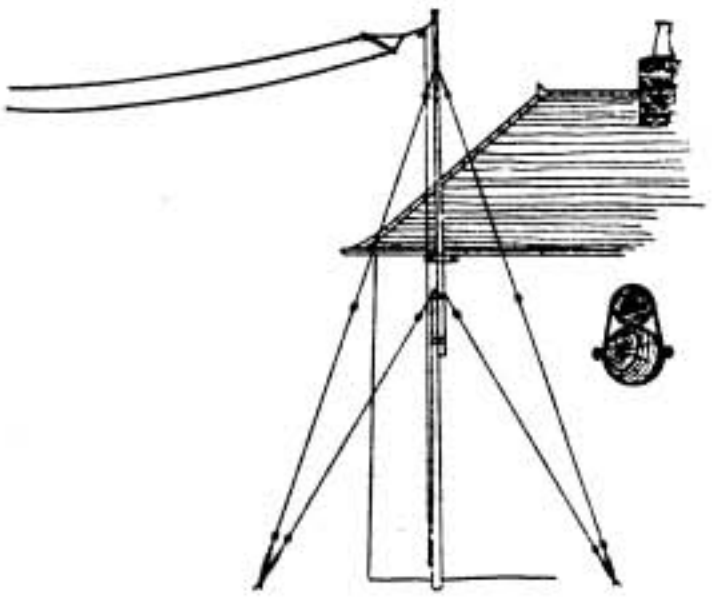


Fig. 5.

Masts erected from the ground and not standing alongside a house should also be guyed in four directions. Not only does this make a good strong job, but facilitates erection, for two sets of guys which are opposite to one another can be fixed and roughly made off to length while the mast is lying on the ground, and another set can be used for pulling the mast up. Fig. 6 shows a mast lying on the ground ready for erection, with a small pole for use as a derrick. Ladders are very useful for supporting the mast during raising, and will hold it in a partly raised position while adjustments are made to guys. All guys must be on, of course, before lifting the mast, and frequent adjustments made as it rises, in order that it will be more or less correctly guyed as soon as it reaches a vertical position. A sharp lookout must be kept that guys do not become entangled in trees or foliage, as the mast is raised, for any sudden tug exerted on the mast is apt to break it or cause it to lean at a dangerous angle. For amateur purposes the erection of such a mast will be rarely found necessary.

A circumstance that often arises is the fixing of a mast at the far end of a garden and where, in order to have the aerial of full length, it is not possible to arrange a back stay. Such a mast must be let several feet into the ground and a foundation made of boards having an area of at least 1 square foot, and also securely wedged at its base with pieces of timber to prevent any tendency it may have to move. To compensate for the pull of the aerial a forward strut, reaching in the case of a 30-foot pole to about 6′ up from the ground, must be provided. The base of the strut must have a secure foundation to prevent it driving further into the ground. It should be carefully fitted at the point of contact with the pole by making a slot about an inch deep and slightly undercut and giving the strut a wedge-like end.

The aerial may be of copper or bronze wire, and should preferably be light and flexible. A special wire has been made combining both lightness and flexibility by assembling a number of fine strands on a hemp core. Such an aerial, as well as being light and consequently having very little sag, is not so liable to kink, and moreover, possesses a large conducting surface, a property that is very desirable. Other varieties of wire may be used and, in fact, No. 18 bare copper is good enough. Stranded enamelled wire is sometimes used and possesses the advantages of having a large surface and not becoming easily oxidised.

Care should be taken in paying out the aerial wire. If it is in the form of a hank, loops should be taken from either side in turn, or, if it is on a reel, it should not be looped off, but the reel unwound. These precautions save a great deal of trouble by preventing kinks as the wire is being raised. Pulleys, of course, must be provided at the mast-heads. The ends of the wires are insulated from the halliards and the insulators should be very light to prevent sagging. For an ordinary single aerial, consisting of No. 18 wire, they may be made from scrap ebonite sheet and measure 2″ long by 1″ wide by ¼″ thick, holes being drilled in the ends to take halliards and aerial wire. The porcelain shell insulator has the advantage that, should it become damaged, the aerial will not fall. For the best results with two-wire aerials the spreaders must be at least 6 feet long and not too heavy. A light bamboo is suitable where there is not a great pull by the aerial wire. Alternatively, where more strength is required a wooden spreader with tapering ends will do. The greatest strain on the spreader is in the middle, and to prevent it bowing this must be its thickest part. Hollow spar spreaders

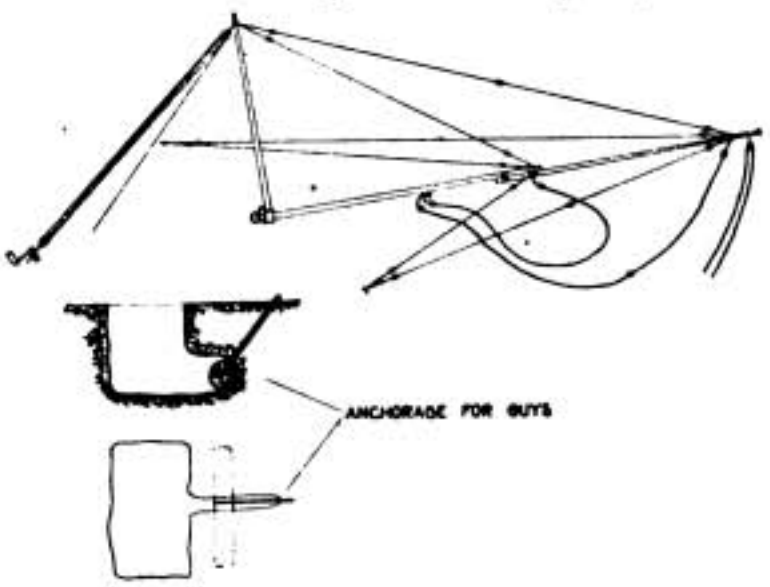


Fig. 6.

are also obtainable which are remarkable for their lightness. Fig. 7 shows spreaders, insulators, aerial and halliards.

Should a tree have been used for supporting the aerial, halliards must not be tied off taut to a point, or otherwise the swaying of the tree may break the aerial. This difficulty is overcome by fixing to the ground end of the halliard a weight sufficiently heavy to exert a pull that will keep

the aerial taut and free to rise and fall with the movement of the tree. A bucket filled with earth will serve as this counterpoise. An endeavour should be made to keep the down leads of the aerial at least 6 feet away from walls or other earthed objects. Fig. 8 (b) shows a method of bringing the aerial wire into the operating room, and consists of an ebonite tube through which runs a brass rod. Alternatively a porcelain tube, Fig. 8 (a), may be used, but the lead will require renewing after a

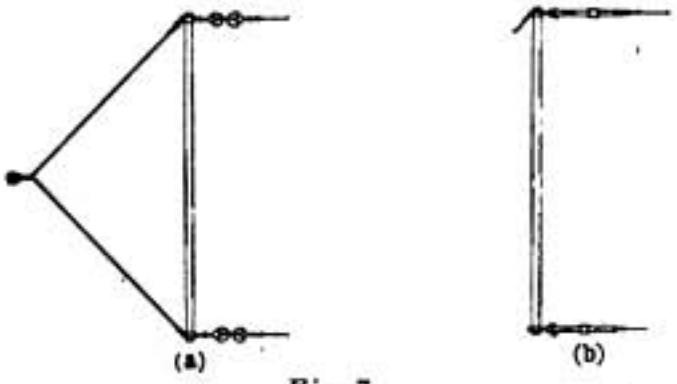


Fig. 7.

time owing to the perishing of the india-rubber. After the wire has entered the operating room it should pass almost directly to the instruments, and not wind about around walls for any distance.

It is not advisable that the instruments should be left permanently in circuit, and to guard them from damage by lightning an earthing switch must be arranged near to the point of leading in. A single-arm two-position switch, with china base and of good insulation, is suitable for the purpose. The aerial is brought to the switch arm and the lower contact joined to a wire making good contact with the earth, whilst a lead can be taken from the upper contact for connection to the instruments, thus serving either to put the instruments in circuit or to connect the aerial to earth.

In cases where it is not possible to erect an outdoor aerial, or where portability is required, indoor and frame aerials may serve for reception. The usual type of indoor aerial is distinct from a frame aerial, inasmuch as it has a free end which is not brought to the instruments and makes use of an earth connection. Its action is precisely that of the outdoor type, but it is of course, of smaller dimensions and does not possess all the advantages of an outdoor aerial. Such aerials are, in shape, similar to the outdoor kind, with the exception that they are much smaller and do not require so much attention to insulation. An aerial consisting of several well-spaced wires carried across a room, say, between picture rails on opposite walls and 20 feet in length will give good reception in an upstairs room when using valve amplifiers. A common error is that of running a wire round a room and leaving one end free and taking the other to the instruments, and operated in conjunction with an earth connection. This should not be done, as opposite sides of the aerial give equal potential fluctuations, due to the incoming ether strain, and consequently there is no current flow, and signals are only received on such aerials, because of distortion in the form of the wave. It would be better to convert such an aerial to the frame type by taking both ends to the instruments.

One way of arranging a frame aerial of fairly large dimensions is to drive brass screws into a wall at the four corners, wrapping them with insulating tape or putting over them small pieces of ebonite tube and winding with several turns of wire. The plane of the wall chosen must point in the direction of the station from which reception is desired. In the case of frame aerials this is more important than with the types previously described; in fact, if there is only a deviation of a few degrees, reception will not be obtained from the desired station. As it is improbable that a wall exists pointing in the precise direction, means should be adopted for making the plane of the aerial movable. One very good method of doing this is to wind the aerial on insulated pegs driven into the four corners of a door which, as it can be swung through 180° can be used for reception from any direction. It might be pointed out here that the marked directional effect of frame aerials has the advantage of providing for selective reception, and is very helpful in the elimination of jamming, for although two stations may be on exactly similar wavelengths, it is improbable that they will be situated in line with one another and the receiving aerial. The object of describing frame aerials made in this manner is to impress upon the experimenter the necessity for making the dimensions as large as possible, for if a wooden framework were used to support the turns of wire of equal dimensions to those provided by the above methods, it would be very cumbersome. Smaller frame aerials are, however, often adopted with a consequent loss of signal strength.

The number of turns wound on frame aerials depends on the wavelength on which it is desired to receive, and if reception is required over a long wavelength range, tappings must be made on the aerial so that varying portions may be connected in circuit. Wire of fairly good insulation must be used, and if the wavelength is to be short then single electric-light flex is suitable. For a square frame having sides 12 feet in length, three complete turns will tune from 280 to 600 metres, with a tuning condenser of maximum capacity 0·0005 mfd. When using a door 6 feet 6 inches in height

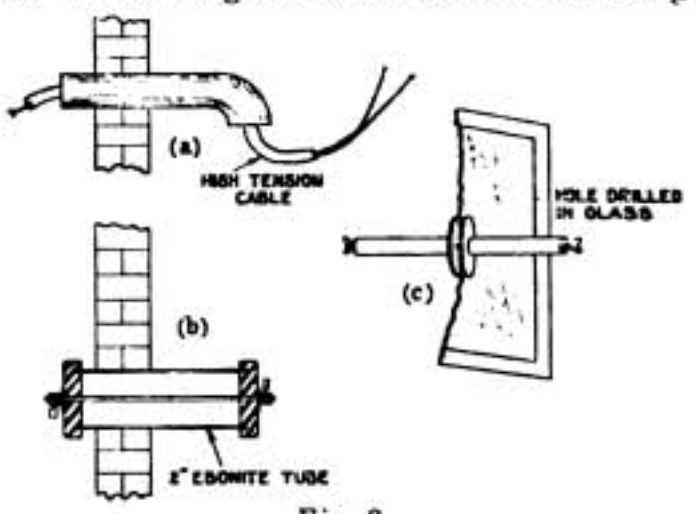


Fig. 8.

and 3 feet in width, nine turns of wire will approximately tune to the same range. With smaller frames finer wire will have to be used, because the many turns required would take up too much space if of the heavy wire. Frames having 3 feet sides will tune through this range, with 14 turns of D.S.C. wire wound with the turns touching. If

there is enough space to wind the turns a little apart the frame will be more efficient, as the capacity of consecutive turns being less there will not be such a potential drop across the end of the coil. As spaced turns have less inductance than ones closely wound, one or two more extra turns must be added to give an equal wavelength. For smaller frames still, many more turns are required but the total length of the wire used should be a little less to compensate for the increased inductance given by the concentrating of the wire into a smaller space.

The Wireless Boom from the Traders' Point of View.

NOW that the Postmaster-General has made it possible for the general public to participate in the reception of broadcasted signals, it is obvious that there will very shortly be a boom in the sale of wireless apparatus. It is apparent that in a very short time the demand for wireless gear in all centres throughout the country will be very great and a vast new field of enterprise will be opened to electrical and allied traders in the sale of receiving equipments.

Last week's flood of enquiries to manufacturers indicate that the business possibilities have not been overlooked, and already arrangements are being made for the establishment of agencies throughout the country. This has made an immediate demand for specimen sets, and the wholesaler who has completed his designs and can at the moment quote firm prices and deliveries is reaping a big harvest of orders.

The class of gear for which there is likely to be a good market requires careful consideration and retailers are advised to carefully think over the results of the recent high power broadcast tests and the reception obtained in various parts of the country.

It would appear that equipments can be divided roughly into three classes. Firstly, low-priced crystal sets designed for the man of limited means, and for operation on wavelengths of 300 to 425 metres when connected to aerials of the dimensions at present specified by the Postmaster-General. There is considerable scope in the designing of such sets and the greatest difficulty would appear to be the devising of a crystal that can be put into the hands of a man inexperienced in its adjustment. Such a set might be fitted with a tuning buzzer, and even a tuned wavemeter circuit for the purpose of setting crystal and tuning adjustments to the broadcast wavelengths, so that all the user has to do is to adjust his crystal until he hears the buzzer signals strongly, and then improve the tuning arrangements to bring them up to a maximum strength. These simple sets must not have too many adjustments, and it is thought that with a view to cheapness as well as limiting the adjustments they need not be supplied with variable condensers, but something on the lines of the almost continuously variable sliding inductance or variometer may serve to tune through the wavelength range. Although the utmost economy should be exercised in the design of such sets, there is no reason why from an electrical point of view they should not be thoroughly efficient and attention might be drawn to the poor economy of supplying such sets with inferior telephone receivers. Crystal reception is difficult enough in the hands of the novice, but if his telephone receivers are not of the most sensitive type his troubles will be enhanced.

The second-class of set is the single-valve receiver so designed that additional amplification can be easily arranged without changing the existing internal connections. It is hard to say at the moment which type of valve circuit will be best for the reception of the broadcast telephony, and owing to the small amount of short wave work that has been done in this country, excepting, of course, by the experimental establishments of the larger manufacturers, little has been done in the design of valve receivers suitable for reception on wavelengths of the order of 350 metres. Amplifiers designed for coupling to these sets of both high frequency and low frequency should be available, so that they can be purchased from time to time and an elaborate set built up in easy stages.

The third class of equipment is that designed to be complete in every way with a full range of adjustments and equipped with amplifying and loud-speaking arrangements. The skill of the manufacturer will be put to the test in the production of this class of gear, because not only must it be capable of giving maximum adjustments, but it must also be so designed that it can be operated by the novice. This may seem contradictory but one suggestion is that the finer and more permanent adjustment be arranged behind a locked-up panel and one or two handles exposed on the front for final tuning and amplifier control.

In addition to the sale of complete sets much business can be done in the sale and the supply of component parts of materials and a retailer will show his worth to the experimenter by the completeness of his stock in this direction. Under this heading should be included the many gauges of instrument wire, ebonite of various dimensions, sliding contacts, brass rods, contact studs, condensers, terminals and screws. A perusal of the pages of the modern American wireless journals will open the eyes of the British retailer to the many varieties of gear which he will be expected to stock.

Another class of business that will immediately open up as a result of a boom will be in assisting the general public in the erection of their aerials. Roof work is always difficult especially to a man unaccustomed to it, and a dealer who has to hand all the necessary components for aerial erection and understands how to set about this class of work is likely to do good business. The aerial being the first part of the outfit which is likely to be required by the customer taking up wireless, the firm that supplies and fixes it will no doubt secure most of the business with regard to the future needs of the station.

A fundamental consideration in the supply of wireless gear is that the retailer carries on his staff a man thoroughly acquainted with wireless telegraphy, who is in a position to advise the novice and solve the many difficulties he may encounter.

Wireless Societies of the United Kingdom

The following is a list of Wireless Societies in the United Kingdom, together with the addresses of the Secretaries. It is thought that this list will prove of general interest, especially to those beginning Wireless and requiring the assistance which the Societies are in a position to give them.

Aldershot and District Wireless Society, Farnborough Road, Farnborough, Hants.

Anerley Wireless Society, 14a, Weighton Road, Anerley.

Barrow and District Amateur Wireless Association, 19, Niger Street, Barrow-in-Furness.

Bishop's Stortford College Wireless Society, The College, Bishop's Stortford.

Blackburn (Y.M.C.A.) Wireless Club, c/o Y.M.C.A., Blackburn.

Bolton Wireless Society, 9, Raimond Street, Halliwell, Bolton.

Bournemouth and District Radio Club, 2, Iris Road, Winton.

Bradford-on-Avon Wireless Society, 4, Ivy Terrace, Bradford-on-Avon, Wilts.

Birmingham Experimental Wireless Club, 110, Ivor Road, Sparkhill, Birmingham.

Blackpool and Fylde Wireless Society, 6, Seventh Avenue, South Shore, Blackpool.

Bradford Wireless Society, 85, Emm Lane, Bradford.

Brighton Radio Club, 68, Southdown Avenue, Brighton.

Brighouse and District Wireless and Experimental Society, Oak View, Rayner Road, Brighouse.

Bristol and District Wireless Association, 5, Pembroke Vale, Clifton, Bristol.

Bristol Wireless Association, Portishead Rectory, Somerset.

Burton-on-Trent Wireless Society, 66, Edward Street, Burton-on-Trent.

Cambridge and District Wireless Society, 107, King Street, Cambridge.

Cambridge University Wireless Society, Post Office, 16, Trumpington Street, Cambridge.

Cardiff and South Wales Wireless Society, 16, Adamsdown Square, Cardiff.

City and Guilds Wireless Society, City and Guilds Engineering College, Exhibition Road, London, S.W.7.

Colchester Wireless Society, 10a, East Hill, Colchester.

Coventry Wireless Association, 14, Coundor Road, Coventry.

The Corinium Wireless Society, The Old Vicarage, Cirencester.

Cowes and District Radio Society, Pretoria, Castle Street, East Cowes, I.O.W.

Croydon Wireless and Physical Society, Meadmoor, Brighton Road, Purley, Surrey.

Cricklewood and Brondesbury Radio Club, 213, Fordwych Road, Cricklewood, N.W.2.

Crosby, Waterloo and District Wireless Society, 6, Cambrudge Road, Crosby, Liverpool.

Dartford and District Wireless Society, 84, Hawley Road, Wilmington, Dartford.

Derby Wireless Club, "The Limes," Chellaston, Derby.

Dewsbury and District Wireless Club, Willow Grove, 34, Lee Street, Ravenscourt, Dewsbury.

East Dorsetshire Wireless Society, Abbotsford, Serpentine Road, Poole.

Dundee and District Amateur Wireless Society, 33, Cowgate, Dundee.

Ealing Wireless Society, 52, Uxbridge Road, Ealing.

East London Radio Society, King George's Hall, East India Dock Road, E.14.

Edinburgh Wireless Club, 9, Ettrick Road, Edinburgh.

Epsom and District Amateur Radio Society, Cinema Royal, Epsom.

Exeter and District Wireless Society, 22, South View Terrace, Heavitree, Exeter.

Falmouth Wireless Club, The Old Grammar School, Killigrew Street, Falmouth.

Felkirk and District Radio Society, c/o The Old High School, Felkirk.

Fife and Distjict Wireless Society, Walkers Buildings, Dunbeath, Methil, Fife.

The Folkestone and District Wireless Society, 8, Longford Terrace, Folkestone.

The Gravesend Wireless Experimental and Model Engineering Society, c/o Globe Hotel, Gravesend.

Grimsby and District Radio Society, 256, Welhome Road, Grimsby.

Guildford and District Wireless Society, Ivydene, Guildford Park Road, Guildford.

Glasgow and District Radio Club, 7, Queen's Gardens, Glasgow.

Glevum Radio and Scientific Society, Burfield, St. Paul's Road, Gloucester.

Gloucester Wireless and Scientific Society, 1, Jersey Road, Gloucester.

Wireless Society of Greenwich, 18, Blackheath Rise, S.E.

Halifax Wireless Club, Y.M.C.A., Clare Hall, Halifax.

Handsworth Wireless Society, c/o The Y.M.C.A., Handsworth.

Hartlepool and District Wireless Society, 33, Grange Road, West Hartlepool.

Hounslow and District Wireless Society, Council House, Hounslow, Middlesex.

Huddersfield Wireless Society, 35, Bk. Cole Street, Aspley, Huddersfield.

Wireless Society of Hull and District, 16, Portobello Street, Holderness Road, Hull.

Ilford and District Radio Society, 12, Seymour Gardens, Ilford.

Ilkley and District Wireless Society, Lorne House, Richmond Place, Ilkley.

Ipswich and District Wireless Society, 46, Grove Lane, Ipswich.

Kensington Wireless Society, 2, Hollywood Road, South Kensington, S.W.10.

Kidderminster Wireless Society, 33, St. George's Terrace, Kidderminster.

King's College Wireless Society, King's College, Strand, W.C.2.

The list of Societies will be completed in our next issue.

Four-Electrode Valves and Their Circuits

(*Concluded from page* 235.)

Captain Donisthorpe (*in reply communicated*).

With regard to the remarks made by Mr. Scott-Taggart, I would like to state that I appreciate some of the difficulties which he has mentioned; but it was not my intention to deal with the commercial side of the question. I have only wanted to put before our members, who are amateurs, the general principles and workings of the circuits for the various types of four-electrode valves. But perhaps I might briefly go over this subject and tell them that by using one of these amplifiers shown at the meeting, economy is obtained; and another great point to be considered is the simplicity with which it can be used. This instrument can be put straight on to any sort of simple receiver, and results obtained without the manipulation of copious adjustments. The amplification obtained is not absolutely as strong as an amplifier with three valves, but nevertheless one gets a high percentage of amplification.

It is regretted that the Figure referred to by my colleague was incorrect, inasmuch as a condenser has been omitted, as he pointed out. The other question deals with the position of the transformers in the circuit. This is a question relating to the design of the particular instrument under consideration, so that no useful purpose will be served in going into the matter, as it is the general action of the circuits I wish to bring to our members' notice, and not constructional details of one particular type of apparatus.

With regard to Mr. Phillips's remarks, this instrument is not used for continuous wave reception by itself, but a separate heterodyne is employed in connection with it. It is possible to pick up C.W., and the reaction effects between the high-frequency transformer show a slight tendency to produce self-oscillation; but the adjustment can be made.

With regard to Mr. Child's remarks, this instrument is quite capable of picking up telephony, and will give you very satisfactory results. One point to be borne in mind when working this instrument in connection with telephony is to work it as far as possible over the oscillation point.

With regard to our President's remarks, I would state that one of these valves has been in continuous use for eight months.

Wireless Broadcasting.

THE CO-OPERATION OF FIRMS.

THE following official statement regarding the meeting of representatives of wireless firms called by the Postmaster-General on Thursday, May 18th, was made after the conclusion of the meeting:—

"A meeting of representatives of firms engaged in the manufacture of wireless apparatus was held this morning at the General Post Office to discuss the arrangements to be made to carry into effect the scheme recently announced by the Postmaster-General in the House of Commons for broadcasting matter (including music) by wireless sets.

"It was recognised generally that, in order to avoid interference, broadcasting stations would have to be very limited in number. Some of the representatives thought that not more than eight could work simultaneously in Great Britain, using the power (1½ kilowatts) and the band of wave-lengths (350-425 metres), allowed for the purpose, without such interference as would produce practical chaos. It was also recognised that the provision of a suitable daily programme at the various stations would be expensive, and that it was important in the interests both of the public and the manufacturing industry that the continuity of the service and the maintenance of a high standard in the programme should be ensured. The best means of attaining these objects seemed to lie in co-operation among the firms concerned, and it was suggested that one or possibly two groups should be formed, which should become responsible, both financially and otherwise, for the erection and maintenance of the stations and the provision of suitable programmes. In accordance with these suggestions it was arranged that the representatives of the various firms should collaborate in the immediate preparation of a co-operative scheme, or at the most of two such schemes, for consideration by the Post Office authorities."

All further arrangements for the service will probably be made in agreement between the various representatives of firms, and as we go to press we learn that the first meeting with this object in view is called for Tuesday, May 23rd.

Notes

WIRELESS POSITION-FINDING FOR AIR-CRAFT.

Since October of last year a wireless "position-finding" system has been under trial to enable air pilots to ascertain their position when flying on the Cross-Channel airways. This system has, on several occasions, proved to be of particular advantage in adverse weather conditions, and has been introduced as a regular feature of the civil aviation wireless service. It is a further development of wireless direction-finding which, during the past two years has proved of such great value to air navigation.

Until last October direction-finding work was carried out only by the Civil Aviation Wireless Station at the London air port of Croydon, and was limited to giving a pilot his compass bearing from that station. The Direction Finding station at Pulham Airship Base, Norfolk, has been successfully operated as the second station of the system during the past six months, thus enabling two bearings to be taken simultaneously upon a single aircraft, and its position determined by plotting the bearings upon a chart, the point of intersection giving the aircraft's position.

Direct intercommunication between Croydon and Pulham is effected by radio-telephony, and the pilot can be informed of his position with a high degree of accuracy under normal conditions. The radius of action for giving position is approximately 200 miles from the control station, which in this case is Croydon. Although primarily designed for radio-telephony, the system is equally adaptable for radio-telegraphy; the change-over being carried into effect by a simple switch in a few

seconds. The position can normally be given within two minutes. Similar facilities can be afforded from Croydon to aircraft engaged on inland flights and services.

Several instances have already occurred in cases of fog and storm where pilots have been informed of their position and enabled to reach their aerodromes in safety. The most noteworthy occasion was in February last, when an aeroplane flying over the airway between Paris and London, was navigated entirely by wireless, the pilot seeing the ground only on one occasion for a few minutes.

Pilots and navigators have been strongly urged in a Notice to Airmen, which has just been issued, explaining the working of the system to make a practice of utilising on every flight this important aid to navigation as the experience gained in the use of position-finding in good weather when pilots should be able to check the accuracy of the positions, will add to their confidence and proficiency in using the system when flying in bad weather.

Public Appreciation of Wireless.

The above picture shows the crowd which assembled outside the establishment of a wireless manufacturer to get first-hand the result of the Carpentier-Lewis fight.

Wireless Station Re-opened.

The wireless station at Grimsby was re-opened for commercial traffic on May 17th. The hours of working are 8 a.m. to 11 p.m. B.S.T., on a normal wavelength of 600 metres. The call sign is **GKZ.**

P.M.G. Licenses in India : New Regulation.

We are informed by the Director of Wireless, Ports and Telegraphs Department, India, that the Postmaster-General has agreed that a First and Second Class Certificate of Compentency, issued by the Department of Ports and Telegraphs, India, will be accepted in lieu of the corresponding class issued by the Postmaster-General, London, as qualifying an operator to work the wireless apparatus on a ship registered in Great Britain. Similarly, certificates issued by the P.M.G. are accepted on ships registered in British India .

Calendar of Current Events

Saturday, May 27th.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
Field Day.

Sunday, May 28th.

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

Tuesday, May 30th.

Transmission of telephony at 8 p.m. on 400 metres by **2MT**, Writtle, near Chelmsford.

Thursday, June 1st.

LIVERPOOL AMATEUR WIRELESS SOCIETY.
Open Night and Soiree.

BRADFORD WIRELESS SOCIETY.
Lecture by Mr. H. F. Yardley.

HOUNSLOW AND DISTRICT WIRELESS SOCIETY.
First Annual Meeting.

Friday, June 2nd.

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—Lecture by Mr. F. L. Hogg.

BRADFORD WIRELESS SOCIETY.
Lecture by Mr. H. F. Yardley.

Saturday, June 3rd.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
Half-day visit to Aerodrome and Wireless Station, Croydon, by kind permission of the Air Ministry (Members wishing to join this party should advise the Secretary at once).

Tuesday, June 6th.

THE INSTITUTION OF ELECTRICAL ENGINEERS.
6 *p.m.*—Savoy Place, Victoria Embankment W.C.2. "The Performance of Radio-telegraphy Transmitters with Special Reference to the Installation at the North Foreland," by Capt. Norman Lee. Also a Demonstration of a Dynamic Model of Tuned Circuits, by Professor C. F. Jenkins.

THE WOLVERHAMPTON DISTRICT WIRELESS SOCIETY.
8 *p.m.*—At 26, King Street, Wolverhampton. "The Electron Theory," by Mr. Blakemore.

Wednesday, June 7th.

NORTH ESSEX WIRELESS SOCIETY.
At the Technical Exhibits Tent, Essex Agricultural Show, Chelmsford. Demonstration of Wireless. (Also on the 8th.)

Thursday, June 8th.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
"The Thermionic Valve," by Mr. J. F. Turner.

Friday, June 9th.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
8 *p.m.*—"Reception of Wireless Telephony," by Capt. F. A. Whitaker, R.E.

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—Informal Meeting.

Wireless Club Reports

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

North Middlesex Wireless Club.*

This Club has recently acquired a Townsend Wavemeter, which we have had calibrated by the National Physical Laboratory.

Although this instrument was primarily intended for the use of our members, it has occurred to our Committee that we could be of use to the Secretaries and members of other Societies by undertaking to calibrate their wavemeters against ours. A small fee would be charged for this, and the work would be done by a qualified member of this Club.

The Hon. Secretary, Mr. E. M Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21, will be pleased to give further details to anyone interested on receiving an application through the Secretary of his Society.

Croydon Wireless and Physical Society.*

Hon. Secretary, Mr. B. Clapp, "Beadmoor," Brighton Road, Purley.

At a meeting of the Croydon Wireless and Physical Society held at the Central Polytechnic, Croydon, on Saturday, May 6th, 1922, one of the members of the Society, Mr. H. R. Rivers-Moore, B.Sc., A.M.I.E.E., gave a lecture on the "Improvement of Wireless Receiving Apparatus in Recent Years," starting with the magnetic detector and finishing with the modern valve apparatus. At the request of the lecturer the lecture was interspersed with questions from members, which led to some very keen discussions. The members agreed with one accord that they had spent a very enjoyable evening and passed a very hearty vote of thanks to the lecturer. The fact that Mr. Rivers-Moore is a member of the Society made the lecture all the more interesting.

Manchester Wireless Society.*

May 7th. High Power Station.—A small working party of 12 members began the preliminary work for the erection of the masts. This consisted of wire splicing and serving and joinery.

Mr. Brown, of "Redbrook," Baguley, has kindly placed his coach-house and loft at the disposal of the members, an offer which is greatly appreciated, otherwise, shelter from inclement weather would have been rather scarce.

In view of the fact that amateur wireless is being boomed by reason of the new broadcasting facilities, interest has been centred around the Society's activities at Baguley, and numerous enquiries are being received as to the nature of the work in hand, not a few of the "wirelessly curious" having visited the site, in order to obtain first-hand information.

The work will be carried out as speedily as possible and, weather permitting, should be complete in a few week's time.

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

Sheffield and District Wireless Society.*

Hon. Secretary, Mr. L. H. Crowther, A.M.I.E.E., 156, Meadow Head, Norton Woodseats, Sheffield.

The closing meeting of the season 1921-22 was held at the Department of Applied Science, St. George's Square, Sheffield, on the 28th April, when Mr. F. O. Hunt, of the Sheffield University, gave a most interesting and instructive lecture on "Anti-Submarine Research Work," illustrated by lantern slides and diagrams.

In a masterly and lucid manner the lecturer, while avoiding the disclosure of any official secrets, explained many of the devices used for the detection, obstruction and destruction of submarines and demonstrated the action of some of them by means of apparatus.

He held his audience for several hours, and interest was so keen that the discussion had to be postponed until the 5th inst. There was a large attendance at both meetings and Mr. Hunt was cordially thanked for his valuable paper.

Plymouth Wireless and Scientific Society.*

At the meeting held on Wednesday, May 3rd, a lecture and demonstration on the "Construction and Wiring of the Three-Valve H.F. Set," was given by Mr. Heal. With a set showing very fine workmanship and giving excellent results, the lecturer was able to deal with his subject in a very practical manner. Very useful hints were given on drilling ebonite and on French polishing.

On Wednesday, May 10th, a lecture was given on "The Armstrong Supersonic Heterodyne," by Mr. P. Arbery. This proved a very interesting and useful subject, as the method provides an easy way out of the great difficulties attending the reception and amplification of short waves. The method of heterodyning the incoming oscillations in such a way as to produce a beat note of radio-frequency and then passing these waves through an ordinary long wave H.F. amplifier is certainly very ingenious. Altogether this lecture should prove one of the most useful we have yet had.

It has been decided to abandon the ordinary weekly meetings during the summer and to replace them by frequent field days.

Full particulars of the Club may be obtained from the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

Kensington Wireless Society.*

A General Meeting was held at 2, Penywern Road, Earl's Court, on May 4th, at 8.30 p.m., the President, Captain Donisthorpe, in the Chair, when Mr. J. F. Turner, of the Wandsworth Wireless Society, gave a lecture on the "Inner Mysteries of Thermionic Valve Manufacture."

Mr. Turner dealt with the subject in a very masterly manner, and gave very interesting details of the many processes through which a valve passes during manufacture.

A number of valves of various types, some in process of manufacture, and other completed, were exhibited.

Some discussion ensued, and a number of questions were asked.

A very hearty vote of thanks was tendered to the lecturer, and the President welcomed on behalf of the Club, the visitors from the Wandsworth Wireless Society, and the Kew and Richmond Wireless Society.

He stated that he thought all Clubs, and more especially the smaller ones, could assist each other very materially by exchanging lecturers and by visiting each other.

Mr. Child then gave constructional details of a type of H.F. transformer with which he had been experimenting, and this again led to some discussion.

The meeting was then adjourned.

Hon. Secretary, Mr. W. J. Henderson, 2, Hollywood Road, South Kensington.

Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The weekly meeting of the above Society was held at the Y.M.C.A., Woolwich, at 7.30 p.m., on Wednesday, May 10th. The proposed 3-valve set having been constructed by Mr. Beeson and friends, was exhibited to the Club. Mr. McPherson and Mr. Beeson explained the principle and construction of the set. The idea was to use the first and second valve as H.F. amplifiers and the third as a detector. A feed back was made from the third valve to the first valve with L.F. intervalve coupling. This could be plugged in or out at will with this arrangement, which was virtually a two-valve H.F., one valve detector and one valve L.F. magnifier. Three valves were made to function as four. The set was tested and excellent results were obtained on the shorter waves, including some very fine telephony, but difficulty was found in getting long wave stations. Mr. Beeson agreed to give the set a prolonged test till next week, in order to get the best adjustments of condensers and resistances and transformers. A hearty vote of thanks was offered to Messrs. Beeson, Vincent and Frazer for their kindness in putting the set together.

It was resolved to have an exhibition of amateur home-made wireless apparatus at the monthly meeting at the Polytechnic at an early date. Several members offered to lend and demonstrate various pieces of apparatus.

All interested in wireless are invited to come then and inspect some of our various "gadgets."

The Wireless and Experimental Association.*

A very busy evening was spent on Wednesday, May 10th, at the Central Hall, Peckham, especially on business, made all the more urgent through the coming boom. It was decided to institute a campaign to get in touch with as many of the newcomers to the art as possible, firstly, for their gain, and secondly, for the general benefit by showing them how to avoid causing interference. The Club set will be brought into commission to show fresh members how simple reception can be made, and to give them confidence to produce similar results. The broadcasting concession was reviewed from every angle, as several members with powerful amplifiers were wondering what would happen if a neighbouring one and a half kilowatt set were to start up on full power. Mr. Ford, one of the members, exhibited and described a tuner of his own construction, embodying a standard three-coil holder, altered to make the adjustments much finer and at the same time, more convenient.

Considerable interest was aroused by a discussion on the balanced crystal receiver, more usually known as the Marconi Type 16 Crystal Set, and questions were asked if it were possible to utilise a perikon combination instead of the carborundum.

The Chairman then asked if anyone could give further information on some of his observations. They were to the effect that when receiving a telephony transmission, where D.C. was used in the transmitter, the generator hum occurred right on top of the speech and could not be cut out without weakening the speech. In the case of a transmitting station using rectified A.C., the generator hum did not occur on the same adjustment as that best for speech, but at several degrees on the condenser away from the correct tuning. As this effect had not been noticed, members were asked to make some observations with a view to getting to the root of the trouble.

We still have plenty of room for more members who are invited to put in an appearance at any of our meetings, or to write to the Assistant Secretary for particulars at 21, Troughton Road, Charlton, S.E.7.

The Leicestershire Radio and Scientific Society.*

The bi-monthly meeting was held on Monday, the 8th inst., at Headquarters. The President, Cyril T. Atkinson, Esq., being in the Chair.

The usual routine business was gone through, one new member being accepted. The President then made a few remarks on behalf of the Committee and himself, apropos to the increase in the number of "Aether Canaries" noticeable in the district this spring, and urged all members of the Society to do their best to prevent this misuse of apparatus by themselves or by others when possible.

The lecturer for the evening, Mr. E. Masters, was then called upon to give his paper on "The Theory of the Valve," which he did in his characteristic clear style. He dealt with the early experimenters' work from Edison *via* Sir. J. J. Thomson and others, to Fleming and De Forest, and very clearly described what goes on in the older type of two-electrode valve. Curves and diagrams were used to illustrate and elucidate points often very difficult to clearly understand.

The meeting closed with the according of a very hearty vote of thanks to the lecturer for his exceedingly interesting discourse.

All communications to be addressed to the Hon. Secretary, Mr. J. R. Crawley, 269, Mere Road, Leicester.

Hounslow and District Wireless Society.*

On Thursday, May 11th, Mr. Gordon Fryer, L.D.S., R.C.S. Engl., our Vice-Chairman, promised to deliver a lecture entitled "The Elementary Theory of the Valve," but owing to the reports in the daily press on the same day on broadcasting the fight, it was decided to postpone his lecture. The lecturer had brought along a quantity of apparatus, for which the members were very thankful, as quite a number of notables in the district called in to see if we could get the result. This Mr. Fryer did very successfully with four valves and a loud speaker, and everyone heard Marconi House. At the end of the meeting a hearty vote of thanks was passed to Mr. Fryer. Mr. Fryer will deliver his lecture next week.

A visit is being arranged to Croydon Aerodrome and the Slough Experimental Station.

If any gentleman is at all interested in wireless and would care to join *our* Society, the Hon. Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow, will only be too pleased to supply particulars.

Ilford and District Radio Society.

Thursday, May 4th. After certain preliminary business in connection with the accounts of our recent concert had been satisfactorily settled, the Chairman, (Mr. H. Lasman, called upon Mr. A. E. Gregory to open a discussion on "Low Frequency Amplification." All speakers were limited as to time and considerable amusement was caused by the rapidity with which sketches were drawn upon the blackboard. Resistance-coupled low frequency amplification excited much discussion, but argument became quite heated when several members got on to the causes and elimination of the "howling" which usually accompanies multi-valve amplifiers. Many varied devices, some of them totally opposed to all known laws of wireless, were put forward as infallible cures and each in turn was derided by the next speaker.

Several very interesting facts resulted from the discussion, however, particularly the point that transmitting valves with a high plate voltage make excellent low-frequency amplifiers and also that the tuned anode (crystal rectification) circuit is remarkable for the number of low frequency valves, that can be put behind it before howling and distortion arises.

Hon. Secretary, Mr. L. L. Vizard, 12, Seymour Gardens, Ilford.

The Hartlepools and District Wireless Society.

On Tuesday, April 25th, Mr. Wood, B.Sc., of Durham University, gave an exceedingly interesting lecture before the above Society. Mr. Patterson presided over a large number of members and friends.

The subject chosen by the lecturer was one of great interest at the present time, viz., "The Electron Theory"

Mr. Wood delivered his paper in quite an able and concise manner, considering the short time at his disposal, also the wide field over which this theory extends. By means of blackboard illustrations, he very simply explained facts which at first seemed very difficult to grasp. During the course of the evening, Mr. Wood referred to the excellent research work which had been accomplished by Sir E. Rutherford, Sir W. Crooks, Sir Oliver Lodge and Professor Soddy.

After the lecture a very interesting discussion arose, and the lecturer was kept busy answering questions, after which a hearty vote of thanks was proposed by Mr. G. Wenn, seconded by Mr. Marris.

The lecturer, in his reply, wished the Society every success. All present were then invited by the President to hear a few Morse signals on the receiving set which the Society had installed.

Hon. Secretary, Mr. R. L. Howey, 33, Grange Road, West Hartlepool.

Portsmouth and District Wireless Association.

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

Since our last report the Association has made rapid progress; there has been a large increase in membership and several interesting events have taken place. Reports having been received that a rival organisation, "The Portsmouth Radio Club," was being formed, negotiations were opened with its representatives, with the result that an amalgamation between this Association and the Portsmouth Radio Club took place on March 8th, to the satisfaction and mutual benefit of all concerned.

As the result of the increase of membership thus obtained it has been found possible to decrease the subscription.

An interesting and instructive series of progressive lectures on "Thermionic Valves" has been given by our popular member, Mr. J. H. C. Harrold, Associate I.R.E., while on the 19th April, Mr. Walters gave an interesting paper on "The Evolution of the Receiving Set" from the crystal stage to the two-valve combination in use at present.

The 26th April was a "red-letter day," being the occasion of a public demonstration and popular lecture on "Wireless Telegraphy and Telephony," by Mr. G. H. Watson, Associate I.R.E., which was held at the Portsmouth Municipal College by kind permission of the College authorities. The meeting was a great success and was greatly enjoyed by the members of the public present.

Forthcoming lectures will be found in the Calendar of Current Events.

Walthamstow Amateur Radio Club.

Meetings are held every Wednesday at the Y.M.C.A., Church Hill, from 7.30 to 10 p.m.

At a General Meeting held on May 3rd the following officers were elected: Chairman, Mr. A. G. Allan; Treasurer, Mr. C. Fewings; Hon. Secretary, Mr. R. H. Cook; and a Sub-Committee of the following members: Messrs. Peirce, Butler and Smith.

The membership has greatly increased in the last few weeks, but there is still plenty of room and new members will be greatly welcomed. A programme and lectures are being arranged for the coming meetings and the requirements of every class of amateur will be considered. Field days for the summer months are being considered.

If any local amateurs are in difficulties with their sets they are invited to come to us, and we will do our best to help them. All communications to be addressed to the Hon. Secretary, at 49, Ulverston Road, Upper Walthamstow, or personally at the Y.M.C.A. on Wednesday evenings.

Redhill and Reigate Y.M.C.A. Wireless Society.

A packed audience was able to realise at first hand, on Tuesday evening, some of the wonders of wireless telephony. The items of the concert were broadcasted from the Marconi wireless station at Writtle, Essex, and, in order that they could be "picked up," a set of receiving instruments was installed in the Y.M.C.A. Hall by Mr. H. A. Dossett, one of the company's experts. It was the first occasion of a public wireless concert being held in the borough, and the proceedings excited great interest, the hall not being large enough to accommodate all those who wished to be present.

Mr. H. G. White, one of the principal leaders in the Y.M.C.A. Wireless Society, presided, and in his introductory remarks said he wished to pay a tribute to the generous spirit of the Marconi Company in sending out these wireless concerts through the permission of the Postmaster-General.

The concert was prefaced with an announcement of the items, which were sung by Mr. Lauritz Melchior, the great Danish tenor, and these could be heard comparatively clearly by those near the instrument, and presently the first strains of a pianoforte solo, played by Mdlle. Morwenna Felce (Melchior's accompanist), came to the ears of the audience. The other items followed in regular sequence, but Mr. Dossett was handicapped by the "cutting in" of ship and aeroplane messages, which prevented any coherent continuance of the items of the programme. The chief "offender" in "cutting in" was the station at Boulogne. The stations at Havre, the North Foreland and the Croydon Aerodrome were also heard, and a conversation between a land operator and an airman in flight was quite distinct.

At the conclusion of the lecture Mr. White expressed the thanks of all to the lecturer, and congratulated him on his efficient handling of the instruments. He appealed for support of the society. A large number of those present then visited an exhibition of the society's instruments, many of which were "home-made" with simple tools. One which created much interest was a simple receiving set which had received concerts such as the audience heard that night. A collection taken in aid of the society realised a satisfactory sum.

The Hon. Secretary (Mr. F. Howell, Y.M.C.A., 111, Station Road, Redhill) will be pleased to forward particulars of membership to any gentlemen interested in wireless telegraphy.

The Leamington Spa, Warwick and District Radio Society.

At a meeting held on Tuesday, May 9th, with Mr. Sleath in the chair, it was unanimously decided to form a society as above. The following officers were elected: President, Captain Smith-Clarke; Vice-Presidents, Messrs. G. H. Champ and J. H. Evans; Secretary, Mr. F. A. Sleath; Treasurer, Mr. G. Kay; and Messrs. W. H. Reed, J. M. Richards, J. Clarke, L. J. Hills, F. Burton and Captain J. Hewitson. The entrance fee and annual subscription will be 2s. 6d. and 12s. respectively, payable in advance. A resolution was passed to approach the Education Authorities and the local Y.M.C.A. with reference to a club-room.

At about 8.30 the meeting was declared informal, and there was a short discussion on apparatus, etc., and it was also decided to commence general meetings with buzzer practice. In connection with the latter Captain Clarke kindly offered the loan of his Omnigraph for Morse teaching.

All enquiries should be addressed to the Hon. Secretary (Mr. F. A. Sleath), 31, Archery Road, Leamington Spa, and will be promptly attended to.

Brighton Radio Society.

Hon. Secretary, Mr. D. E. Underwood, 68, Southdown Avenue, Brighton.

At the usual fortnightly meeting of the above Society, held at its headquarters in Buckingham Road, Brighton, members were again fortunate in listening to a valuable lecture delivered by Captain E. A. Hoghton, F.P.S.L., M.Inst.P., when the lecturer lucidly explained the various types of "Multi-Valve Amplifiers" in use, emphasising that the ideal of experimenters should be to secure signals from long distances which are distinct and readable rather than to obtain comparatively loud signals from adjacent stations, which are invariably accompanied by undesirable extraneous noises. In this connection the advantages of specially designed high-frequency amplifying circuits were outlined by the lecturer, and upon the conclusion of the lecture many queries were put by members of the Society and replied to by Captain Hoghton. Demonstrations then took place with one of the latest types of 6-valve amplifying receivers, and it was particularly noticed how quiet this instrument was in working, signals being received from various stations in a very clear and satisfactory manner.

A vote of thanks to the lecturer was proposed by Mr. W. E. Dingle, President of the Society. This was seconded by Mr. A. Blackburn, the proceedings then being terminated.

Guildford and District Wireless Society.

The above Society held their usual weekly meeting at headquarters, 46, High Street, on Monday, May 1st. After the usual Morse practice, conducted by Major Harris, A.M.I.E.E., the members enjoyed an interesting "open discussion" evening. Questions regarding transformers and their action, and the screening of aerials from interfering bodies, such as overhead power wires, neighbouring railways and their electrical installations, etc., gave rise to some interesting remarks and discussion. The meeting closed about 9.30 p.m.

The Society is in its infancy, and the members are very pleased to know that Colonel the Earl of Onslow, O.B.E., D.L., J.P., has very kindly consented to become its first President. Like other societies, there is a keen desire to make for success, and therefore the kindness of the Earl of Onslow is fully appreciated.

There is still room for more members, and the Secretary will be pleased to hear from any who are interested; at the same time a hearty invitation is given to our Monday evening meetings, time 7 p.m.

Hon. Secretary, Mr. Rowland T. Bailey, 46, High Street, Guildford.

Radio Experimental Association (Nottingham and District)

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

On Thursday, the 4th inst., at the Mechanic's Institute, Nottingham, the members of the above Association had the pleasure of listening to a very interesting paper read by Mr. Ley. The subject "Valve Amplification," is one by no means easily dealt with, and Mr. Ley's rendering of it succeeded in elucidating numerous points on which many of us were rather hazy. Numerous questions were asked and suitably replied to by Mr. Ley.

The second part of the evening was taken up by a demonstration of a Mark III short wave tuner, converted to use for long waves. Constructional details were very clearly explained by Mr. Shepherd, who had been instrumental in converting the tuner. Before the close of the meeting a hearty vote of thanks was given to those who provided the programme.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise.* (2) *Four questions is the maximum which will be accepted at a time.* (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents*

"A.J.W." (Luton) *asks* (1) *Why* FL *is only heard weakly on a three-valve set no stronger than on a single valve.* (2) *For wave-range of two pancake coils wound with No.* 30 *D.W.S.* (3) *Why Hague concerts are only received weakly and how to tune out jamming stations.* (4) *Whether tuner and amplifier should be mounted in one box.*

(1) This appears to be due to having too much wire on the reaction coil so that the set will not stop oscillating; also, possibly the H.F. transformer is not suitable for this wavelength. (2) You do not give the diameter of the coils so that we cannot make any calculation. (3) This is probably due to the same causes given in answer 1 above. No details of set are given so that we are unable to form a good opinion. (4) There should be no harmful effect provided the parts are well spaced.

"CALPE" (Gibraltar) *asks* (1) *Which is the better wire for a receiving aerial,* 7/28 *or* 3/18 *copper, or multi phosphor bronze wires.* (2) *If any detrimental effects may be expected from a generating station* 300 *yards away from the aerial.* (3) *If enamelled wire is suitable for receiving inductances.* (4) *Which is preferable, one valve H.F. with crystal rectifier or crystal rectifier and one stage of L.F. magnification.*

(1) For small aerials either of the stranded copper wires will be found satisfactory. (2) There will possibly be a little noise due to leakage earth currents, but this should not interfere much with reception. (3) Yes, for single layer coils, but not for closely wound slab coils. (4) The crystal and L.F. magnification will be the simpler to operate, but better results with weak signals will be given with the former arrangement. A suitable circuit is given on page 90, Fig. 1, April 15th issue.

"A.E.T." (Nottingham) *asks if three-valve diagram is correct.*

This circuit is O.K. It is hardly necessary to have a separate resistance for each filament. The crackling and buzzing is probably caused by a bad joint somewhere in the circuit, or perhaps one of the valves is defective.

"W.L.B." (Bristol) *refers to Pocket Set article in March 4th issue, and asks* (1) *Quantities of wire required.* (2) *If* PCGG *would be heard in Bristol.* (3) *How the wire on basket coils is fixed in place.*

(1) For A.T.I., 2 ozs. of No. 36; reaction coil, 2 ozs. No. 26. (2) The set gives best results with French soft valves. With ordinary hard valves it may just be audible in your district. It is quite possible that the reaction coil designed may not be quite sufficient for hard valves. (3) Before the pegs are removed the coil is dipped in almost liquid paraffin wax. When dry the pegs are removed and solidified wax holds the coil together. The ends of the coil should be tied with cotton to prevent unwinding.

"H.L.E." (Montreal) *refers to Fig.* 13, *page* 727, *of last volume, and asks* (1) *If an ordinary intervalve transformer may be used in place of one marked* 8,000 *and* 20,000 *ohms.* (2) *If set will be as sensitive over a wave-range of* 600-24,000 *metres as a set with "tickler regeneration."* (3) *If "Ora" valves will give as good results as the valves recommended.* (4) *If all valves may be lighted with one filament battery.*

(1) Yes. (2) The capacity reaction will not be suitable for the very long wavelengths. It will be advisable to insert a magnetic reaction coil in the second anode circuit in place of the 10,000 ohm resistance shown. (3) Yes, if the anode resistance of No. 1 valve is reduced to 50,000 ohms. (4) Yes. Do not short circuit the part of A.T.I. which is not in circuit as shown in this diagram.

"A.L.M." (East Ham) *asks* (1) *If formers described are correct for single valve set.* (2) *What station was transmitting telephony and music on March 28th and 29th.*

(1) The reaction coil (small former) appears to be on the small side. (2) This was probably the Eiffel Tower Station.

"W.J.T." (Norbiton) *asks* (1) *Gauges of sample wire.* (2) *Why short wave set will not oscillate unless grid condenser and leak are disconnected.*

(1) "A" No. 46 S.S.C.; "B" No. 43 S.S.C.; "C" No. 32 German silver, the resistance of which is approximately 3·5 ohms per yard. (2) The set is not described, so it is hard to say. Probably the reaction is not correct; it may be either too much or too little. On short wavelengths it is critical.

"A.C." (Horbury) *asks for sizes of samples of wire and for particulars of telephone and intervalve transformers, and for H.F. transformer for* 1,000 *metres to use wire similar to samples.*

No. 1 is No. 38 S.S.C.; No. 2, No. 38 enamelled; No. 3, No. 29 S.C.C. Wind telephone and L.F. intervalve transformer on soft iron cores ½" diameter and 3" long. The telephone transformer should have 10,000 turns of No. 38 S.S.C. for primary and 1,000 turns of No. 29 S.C.C. for secondary. The L.F. intervalve transformer should have 10,000 turns of No. 38 S.S.C. for each winding.

For 1,000 metre H.F. transformer two windings each of No. 40 D.S.C. should be wound on a 1½" diameter former, 4" long.

"REVAL" (Bournemouth) *asks* (1)* *For criticism of switching arrangement to change over from transformer coupling to resistance capacity coupling.* (2) *Why resistances are necessary in resistance capacity coupling.* (3) *Why, with transformer coupling, only one winding is tuned by a variable condenser.* (4) *Gauges of samples of wire enclosed.*

(1) The switching can be simplified as shown in diagram (Fig. 1). Unless care is taken to keep leads well separated to reduce capacity effects, it will be found that these switching arrangements introduce considerable loss of signal

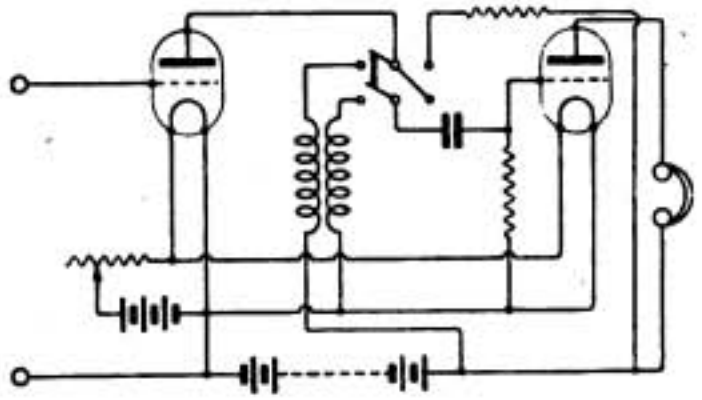


Fig. 1.

strength. (2) The resistance is necessary to provide the voltage change which operates the grid of the next valve. (3) These transformers are usually very tightly coupled so that tuning one circuit in effect tunes the other. If both circuits were tuned separately they would react on one another and reduce the efficiency of the whole combination. (4) Nos. 44 and 40 S.S.C. and No. 28 S.C.C. The No. 44 or No. 40 may be used for H.R. winding of the telephone transformer or for the H.F. transformer. The No. 28 may be used for L.R. winding of telephone transformer.

"SIRIUS" (Brighton) *asks how to add another valve with transformer coupling to his single valve set.*

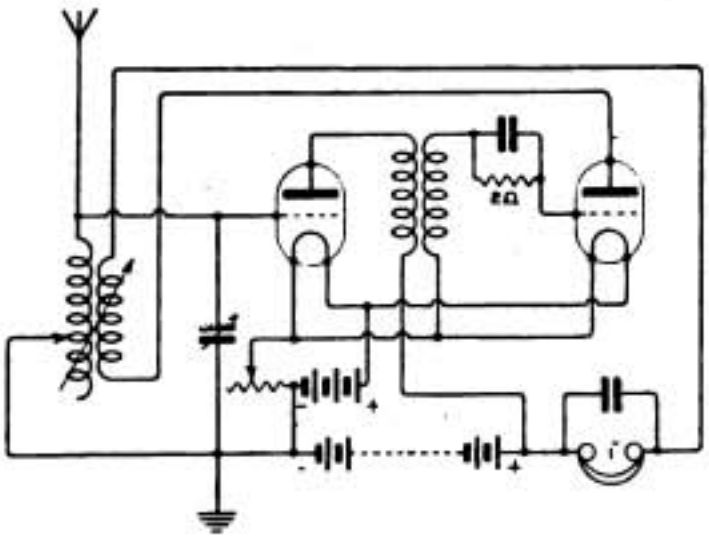


Fig. 2.

A diagram showing how to connect up is shown in diagram (Fig. 2).

"M.T.G." (New Cross) *asks* (1) *For criticism of single valve set.* (2) *If secondary condenser should be variable, and also its capacity.* (3) *Wave-range of set with* 200 *and* 500 *mhy. coils.* (4) *If interference from adjacent telegraph wires may be expected.*

(1) A small blocking condenser of 0·001 mfd. should be connected across telephones, also the grid condenser will require a leak of about 2 megohms. (2) This should be a 0·0005 mfd. variable condenser. (3) The maximum wave-length will be 300 metres. The coils are much too small for any useful work. Make a reaction circuit such as that described on page 90, April 15th issue, Fig. 3, using much larger coils than you have at present. (4) It is quite possible that there will be a certain amount of interference both from the wires and the electric railway.

"R.G.L." (Ashtead) *asks* (1) *for information regarding height of aerial required in a hollow garden at one end of which is a high tank.* (2) *If an amplifier may be connected to any ordinary receiver.* (3) *If possible to hear American H.P. stations on* 2,000 *metres.*

(1) 20 ft. is given as a good aerial height for a fairly open site. Your aerial should be higher than the tank, otherwise there will be considerable screening. Fix the mast on the top of the tank. (2) A low-frequency magnifier may be connected on to the telephone terminals of an existing receiver and it will magnify the signals. This is not the most efficient way of using valves. (3) We do not think there are any American H.P. stations working on such a wavelength. It is probable that you would not receive them on a simple receiver with L.F. magnification.

"P.B." (Birmingham) *asks for criticism of a two-valve set on which* **2MT** *telephony is weak.* Connect A.T.I. and A.T.C. in series not in parallel. You do not give sufficient particulars of your set to form an estimate as to whether the wave-range is suitable. Possibly the reactance tuning condenser on the first anode circuit does not tune to the 700 metres. Connect a 0·001 mfd. condenser across the high resistance winding of the telephone transformer.

"RUSKIN" (Herne Hill) *asks for details of a loose coupler for use as reaction to tune from* 180 *to* 400 *metres with a* 0·0005 *mfd. variable condenser in parallel.*

We presume that you intend to connect the condenser in parallel in the aerial circuit. For such short waves this is not recommended. Put it in series. An outer former of 3" diameter by 3" of winding of No. 22 D.C.C. should be used for the aerial circuit, preferably arranged with five tappings. Reaction inductance may be 2" in diameter by 1" of No. 28 D.C.C.

"H.D." (Hornsey) *has made the long range receiver described in the issues of February and March,* 1921, *is using a Mullard valve and* 2,000 *ohm telephones and home-made variable condenser; gives particulars of his aerial and wishes to know* (1) *Why he cannot receive signals.* (2) *If a zincite-bornite detector could be used with advantage.* (3) *The capacity of his condenser.*

(1) Without examining the set it is impossible to suggest the fault, as it may be due to a variety

of causes. We would recommend you to very carefully check your wiring and see that it is identical with that given. There is probably a break in your H.T. circuit, as you report no noise at all in the telephones. If everything seems in order, try reversing your reaction. (2) Little would be gained by adding a crystal detector to the set, at least, not until it functions correctly on the present arrangement. (3) As your moving plates are not triangular, we presume by "20 plates" you mean 20 fixed plates. Without knowing the thickness of the plates it is impossible to calculate the capacity, but presuming the zinc to be of the gauge usually obtained for household purposes, the capacity would probably be about 0·0004 mfd.

"C.H.E." (Chelmsford) *asks for a method of connecting a one-valve note magnifier to his valve receiving set with crystal rectifier.*

For circuit see Fig. 5, page 92, April 15th issue, and for the dimensions of an intervalve transformer, see issue of May 28th, 1921, page 152. A note magnifier, of course, considerably increases the strength of signals and your "V 24" valve should be quite suitable for use in the amplifying circuit.

"G.B." (Walsall) (1) *Submits circuit for criticism.* (2) *Asks whether "Oojah" coils and plug-in H.F. transformer would be suitable in the circuit.* (3) *How to arrange for reaction.* (4) *Whether the circuit is suitable for the reception of* **PCGG.**

The circuit is quite good, and providing the transformer is connected in the right direction and suitably wound, you should get good signals. (2) Quite suitable. (3) You should arrange reaction by connecting an additional coil in circuit with the plate of the first valve and coupling it to the closed circuit inductance which you show on the extreme left of your diagram. (4) Yes.

"HIGH FREQUENCY" (Watford) *asks* (1) *How to add an H.F. amplifier to the circuit shown in Fig* 1, *page* 30, *issue April* 1*st*, 1922. (2) *Whether it is necessary to alter the wiring of the panel.* (3) *The best method for using the set for the reception of telephony.* (4) *Number of turns of No.* 36 *D.S.C. wire for making intervalve oscillation transformer on a former of* 1" *diameter, and for wavelengths* 300 *to* 2,500 *metres.*

(1), (2) and (3) Arrange as in Fig. 3. (4) It is difficult to give the exact number of turns, and would recommend you to make a number of transformers and find by trial those most suitable for particular wavelengths. Helpful information will be found in Mr. Campbell Swinton's paper to the Wireless Society of London in the issue of June 25th, 1921, page 198. For 300 to 600 metres try 25 turns on the primary and secondary. For 600 to 800, 45 turns; for 800 to 1,200, 65 turns; and 1,200 to 1,800, 150 turns; and for higher ranges use capacity intervalve coupling. Instructions for interchanging resistance capacity and coils are given in the issue of April 29th, page 133.

"P.M.P." (Birkdale).—Your scheme for connecting one-stage H.F. amplifier is correct. Omit the condenser shown on the primary of the H.F. transformer unless you intend to make it variable and closely tune the circuit, in which case, the primary and secondary should be loose coupled. The finished circuit is a good one for the reception of telephony between 700 and 1,000 metres provided your transformer has the correct critical value. See reply to **"HIGH FREQUENCY" (Watford)** above.

"P.F.G." (Smallheath) *asks* (1) *For a three-valve receiver for telephony from* 300 *to* 5,000 *metres including* **PCGG.** (2) *The windings of coils for this set.* (3) *The most suitable telephones to use.* (4) *If a Sullivan H.F. transformer is satisfactory.*

(1) and (2) See issue of April 8th, 1922, page 37. The circuit given there is particularly suitable for your purpose. (3) You may use 200 ohm telephones or better, if high resistance, say 400, directly in the plate circuit of the last valve. If 120 ohm telephones are used you must employ a step-down transformer. (4) This type of transformer is particularly suitable, and no doubt the manufacturers who supply will show you how to connect it in the circuit that you have been referred to.

"B.W." (Barnsley) *asks* (1) *Whether it is better to use* 100 *feet single wire or* 140 *feet twin wire for aerial.* (2) *The meaning of* **2 MT.** (3) *If he is liable to damage his telephones by not using a telephone transformer.*

Depends entirely upon circumstances. For short wave telephony reception, the twin wire would probably give better results, and, moreover, it could be tuned through a long range of wavelengths by a smaller variance of inductance. (2) The call letters of the telephony transmitting station of the Marconi Scientific Instrument Company at Writtle, Essex. (3) 4,000 ohm. telephones direct in the H.T. lead may be regarded as satisfactory in the hands of a cautious experimenter.

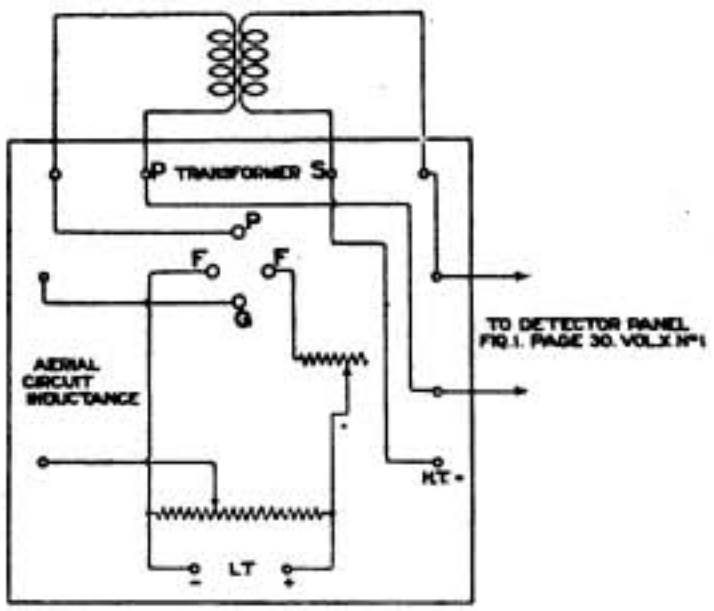


Fig. 3.

"E.S." (Manchester) *desires an explanation of the results he obtains with a second-hand pair of Sullivan telephones.*

Your telephones probably have a resistance of 120 ohms as you say they are wound with black enamelled covered wire, and most of the second-hand Sullivan telephones now on the market are of the low resistance type. This would account for your not getting signals with them on the 31A crystal receiver. We are of opinion that the telephones, being old, are probably out of adjust-

ment and are no longer sufficiently sensitive for use on wireless circuits, though they are still sufficiently good on the liberal current available of the house telephone circuit. We recommend you to completely dismantle the telephones and thoroughly clean and overhaul them, and if necessary, fit new diaphragms and use them in conjunction with your Marconi step-down transformer.

"R.L.C." (Wimbledon Park) *asks* (1) *Where to purchase glass and silver tube for syphon recorder syphons.* (2) *If necessary to use reaction with single valve slab inductance telephony set.*

(1) These can probably be obtained from any manufacturer of chemists' specialities, such as Messrs. Baird & Tatlock, Hatton Garden, London, E.C., at small cost. (2) Yes. A single valve set is not of much use without a reaction coil.

"A.H.B." (Portsmouth) *asks* (1) *How to convert a Marconi Type* 31a *crystal receiver to a single valve set.* (2) *If external panel may be used.* (3) *Best part of aerial from which to lead-in.*

(1) and (2) For a valve as note magnifier connect the grid and negative side of filament to the 31a telephone terminals and the telephones and H.T. battery to plate of the valve. An external panel may be used for a H.F. magnification, and should be arranged as shown in the diagram (Fig. 4). It

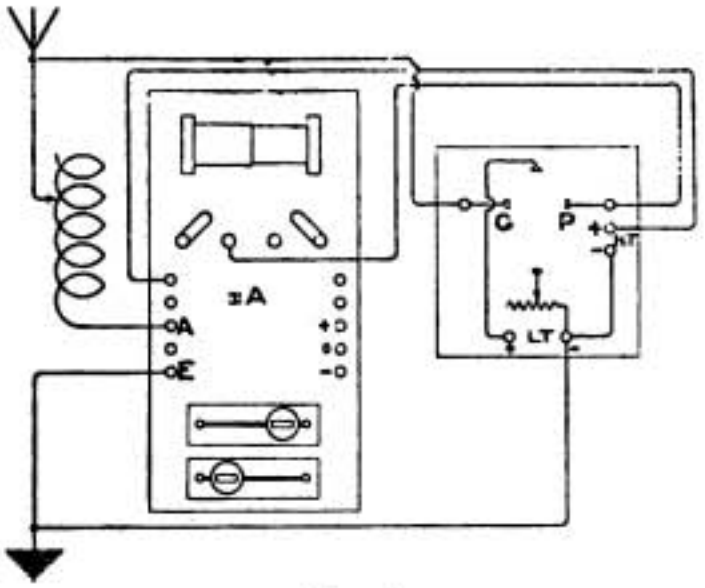


Fig. 4.

may be necessary to increase the winding on the crystal receiver sliding coil. The wave range of the set will be 200 to 2,800 metres. (3) This should be taken as near as possible to the receiving apparatus with a straight drop down from the aerial.

"CUSTOS" (Bradfield) *gets poor results from a reactance capacity coupling valve set, and asks* (1) *For particulars of windings.* (2) *If London telephony should be heard with two valves.* (3) *How many valves are required to get Hague,* **FL** *and other telephony on a loud-speaker.*

(1) There is a very good discussion on this subject in the issue of April 8th. This will give you the information you require. (2) Croydon telephony should be very strong. (3) At least five valves will be required, two of which should be note magnifier. There may be a certain amount of speech distortion.

"S.J.D." (Manchester) *asks* (1) *Wiring diagram for crystal set.* (2) *If aerial described is suitable.* (3) *If earth wire has to be insulated from wall of house.* (4) *If variometer may be used with crystal set.*

(1) *See* Fig. 3, page 60, April 8th issue. (2) This is a good aerial for such a set. (3) No. (4) A variometer, unless specially designed, only gives a small wavelength variation and is not to be recommended for your set.

"G.R." (East Ham) *refers to Fig.* 13, *page* 727, *and asks* (1) *If A.T.I.* 10" × 5½" *wound with No.* 28 *wire, will be suitable.* (2) *If interchangeable H.F. transformers may be used in place of resistance capacity.*

(1) The wire is too fine for an aerial circuit without magnetic reaction. Wind with No. 24 and use a loading coil if wavelength range is shorter than required. (2) They will probably be more efficient for short wavelengths than the arrangement shown.

"A.S." (Anvers) *asks how to clean and solder Litzendraht (enamelled) stranded wire.*

To satisfactorily solder this wire every strand must have the enamel cleaned off. Untwist the strands and hold them in a weak flame, such as a candle. The enamel will be almost burnt off and the wire can then be scraped clean with a knife or fine emery paper. For soldering use a flux composed of powdered resin in methylated spirits.

"R.P." (Westcliff) *asks* (1) *Why single valve set singals are better than those on a two-valve transformer coupled set.* (2) *If diagram is correct.* (3) *How to make two-valve set efficient.* (4) *The correct capacity across loose coupler secondary.*

(1) It seems obvious that the transformer cannot be suitable for the wavelength range of the set. Try a small condenser across the anode winding of the transformer. (2) Yes. (3) Connect grid leak to negative side of filament, and also use two similar valves. (4) 0·0005 mfd.

"C.J.B." (Marton) *asks* (1) *If crystal diagram is correct.* (2) *If steel wire may be used for an aerial.* (3 *If a number of trees will have screening effect.* (4) *Windings for telephone transformer for* 120 *ohm telephones.*

(1) As an elementary circuit this is correct, but it will not be very effective. Connect a small capacity condenser across inductance, as shown in Fig. 3, page 60, April 8th issue; also a 0·001 mfd. condenser across telephones. Owing to small inductance wavelength range will be very short. (2) No. (3) Screening will not be appreciable unless the trees are very close. (4) A suitable transformer will be 3 ounces of No. 44 and 6 ounces of No. 32, wound on a soft iron core ½" diameter by 3" long.

"A.H.A.K." (Abingdon) *has a T.F. receiver, and asks* (1) *How to add two additional resistance capacity coupled valves.* (2) *The values of resistance and condensers.* (3) *If it is correct that resistance amplifiers are not very efficient below* 1,000 *metres.*

(1) The T.F. receiver is small and compact, and there is not room for additional apparatus on panel. It is either necessary to do away with exciting L.F. valves or have another panel. The diagram of an additional panel is shown (Fig. 5). (2) Anode resistances 50,000 ohms and condensers 0·0005 mfds. (3) Yes.

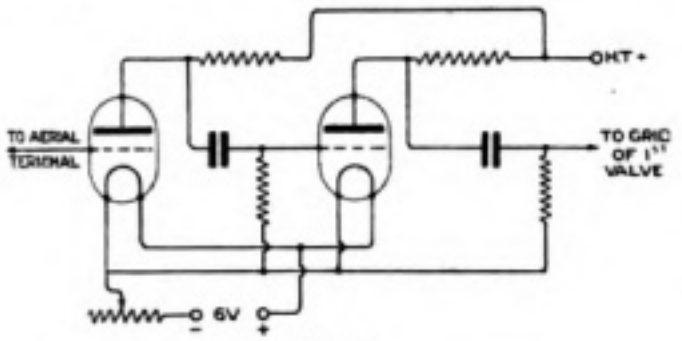


Fig. 5.

"C.L." (Highbury) *gives single valve diagram, and asks* (1) *If correct.* (2) *If an Ora valve will be suitable.* (3) *For a diagram showing how to add three other valves to set.* (4) *Wavelength of tuning coil* 10″×4″ *wound with No.* 28.

(1) Yes. (2) Yes. (3) The circuit given to **"B.D." (Leeds)** below, will be found very useful. (4) This will tune standard aerials to 5,000 metres with a 40-plate condenser across it.

E.H.W." (Bingley) *asks* (1) *If set described will receive* 400 *to* 3,000 *metres spark stations.* (2) *For improvements.*

(1) Maximum wavelength range at present is about 1,000 metres. The fixed 0·0015 mfd. condenser should be connected across telephones and windings altered as follows: primary 10″×6″ of No. 24, secondary 8″×5″ of No. 28. A small variable condenser should be connected across the secondary.

"B.D." (Leeds) *asks* (1) *For four-valve circuit diagram to fulfil certain conditions.* (2) *If Dutch Concert will be received.*

(1) The circuit shown in the diagram will be satisfactory. The circuit will be more selective if a coupled circuit is used as shown in Fig. 6. (2) Yes.

"EXILE" (Madeira) *asks* (1) *For suitable set on which to receive high-power European stations.* (2) *If such set would also be useful in Uruguay.* (3) *If there are any wireless dealers in his part of the world.*

(1) It would be possible to hear several H.P. European stations on a single valve set, but it would be advisable to make one with three or five valves. (2) On a five-valve set the European stations should still be audible, together with many of the American stations. (3) We do not know of any. It should be convenient to purchase from British manufacturers.

"ELSIE" (Romford) *asks for criticism of crystal set.* (2) *If it will receive C.W.* (3) *How to add a valve amplifier.*

(1) This circuit is incorrect. Rewire as Fig. 3, page 60, April 8th issue, omitting the potentiometer if desired. (2) C.W. cannot be received on crystal sets unless a means of breaking up the oscillations, such as a ticker, is used. This, however, is not advised. (3) A suitable circuit is shown in Fig. 1, page 90, April 15th issue.

"J.G.H." (East Sheen) *refers to page* 613, *December* 24*th issue, Fig.* 2, *and asks* (1) *If an A.T.I.* 11″×4½″ *of No.* 24 *may be used.* (2) *For*

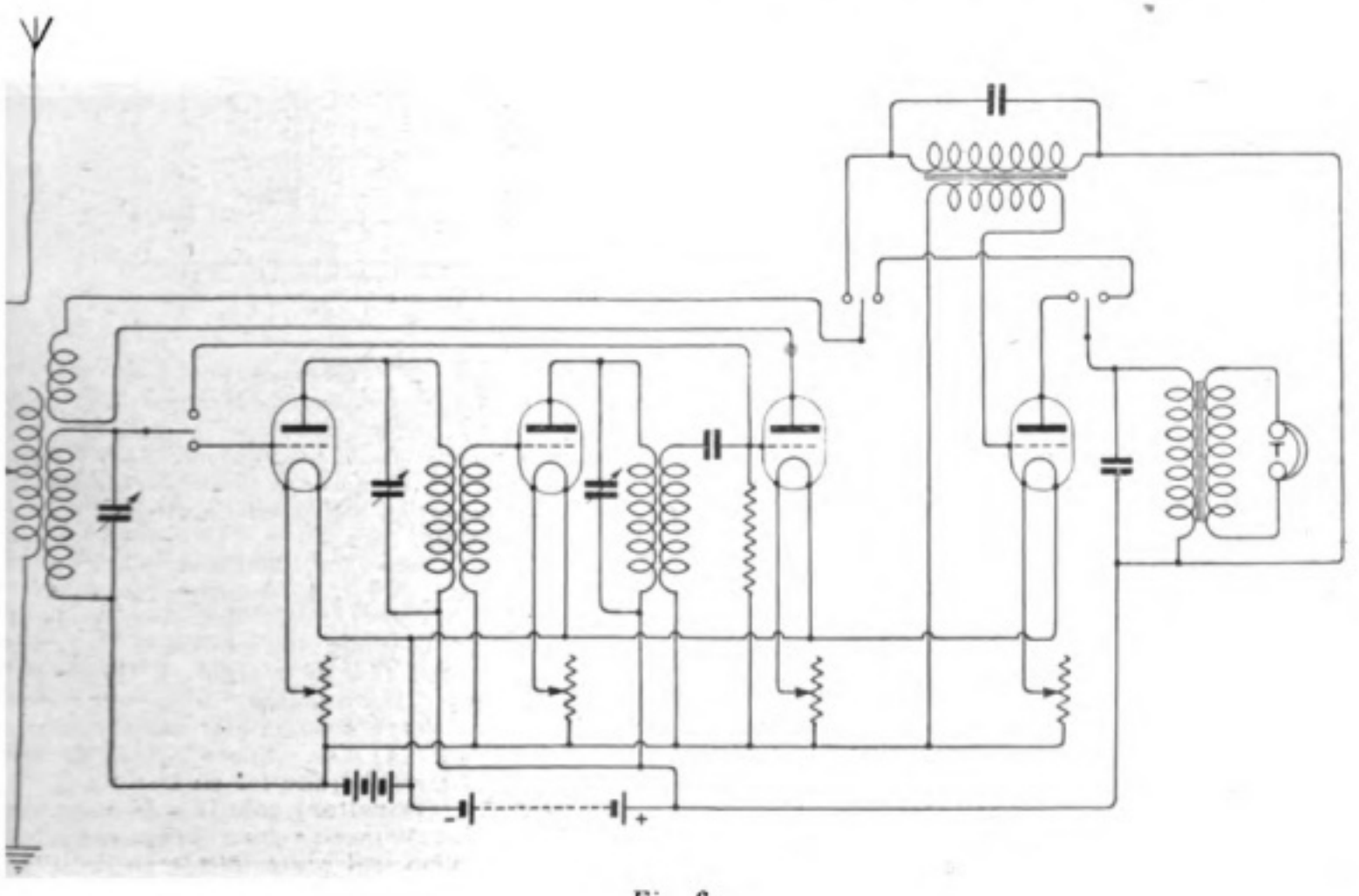


Fig. 6.

suitable reaction coil. (3) *Capacity of condensers.* (4) *Range of set.*

(1) Yes. (2) This may be 6″ × 3½″ of No. 28. (3) Variable condenser 0·0005 mfd., telephone condenser 0·001 mfd. (4) 600 to 4,500 metres.

"N.O." (Coulsdon) *asks* (1) *Why no telephony other than Croydon is received on single valve set.* (2) *Wavelength range of set.*

(1) There is nothing wrong with this circuit except that a variable condenser should be connected across the A.T.I. instead of across the reaction coil. The reaction coil should be increased to 4½″ diameter wound with No. 30 wire. (2) Wavelength range will be 400 to 4,500 metres. It should be possible to receive other telephony on this set, but one or two more valves would be a great improvement.

"J.S." (Blackburn) *asks questions regarding screening of amplifiers.*

Absolute screening is difficult, but it is effective if the amplifier is placed in a box of sheet copper or zinc. The signals should not be appreciably weakened.

former. (2) *Which of the windings will be the primary.* (3) *If 6-volt 60 amp. accumulator is suitable for L.T. on a single valve set with French "R" valve.* (4) *If circuit he submits is suitable for reception of concerts.*

(1) Use half oz. No. 38 for secondary. Other dimensions satisfactory. Closed core would be a little more efficient. Walls of ebonite tube should not be more than 1/16″ thick. (2) Join secondary to telephones. (3) Yes. (4) The circuit is that shown in the issue of March 4th, page 749, and is quite suitable.

"S.L." (Sutton) *wishes to know* (1) *Whether a G.P.O. relay non-polarised type and rewound with No. 44 S.W.G. will be sufficiently sensitive for operation by a two-valve receiver.* (2) *What would be the best circuit.*

(1) No. A polarised type is almost essential, operated by at least four H.F. or three L.F. valves. See discussion before Wireless Society of London on Recording in the issue of October 29th, 1921, page 468, and in particular try the circuit given on page 474.

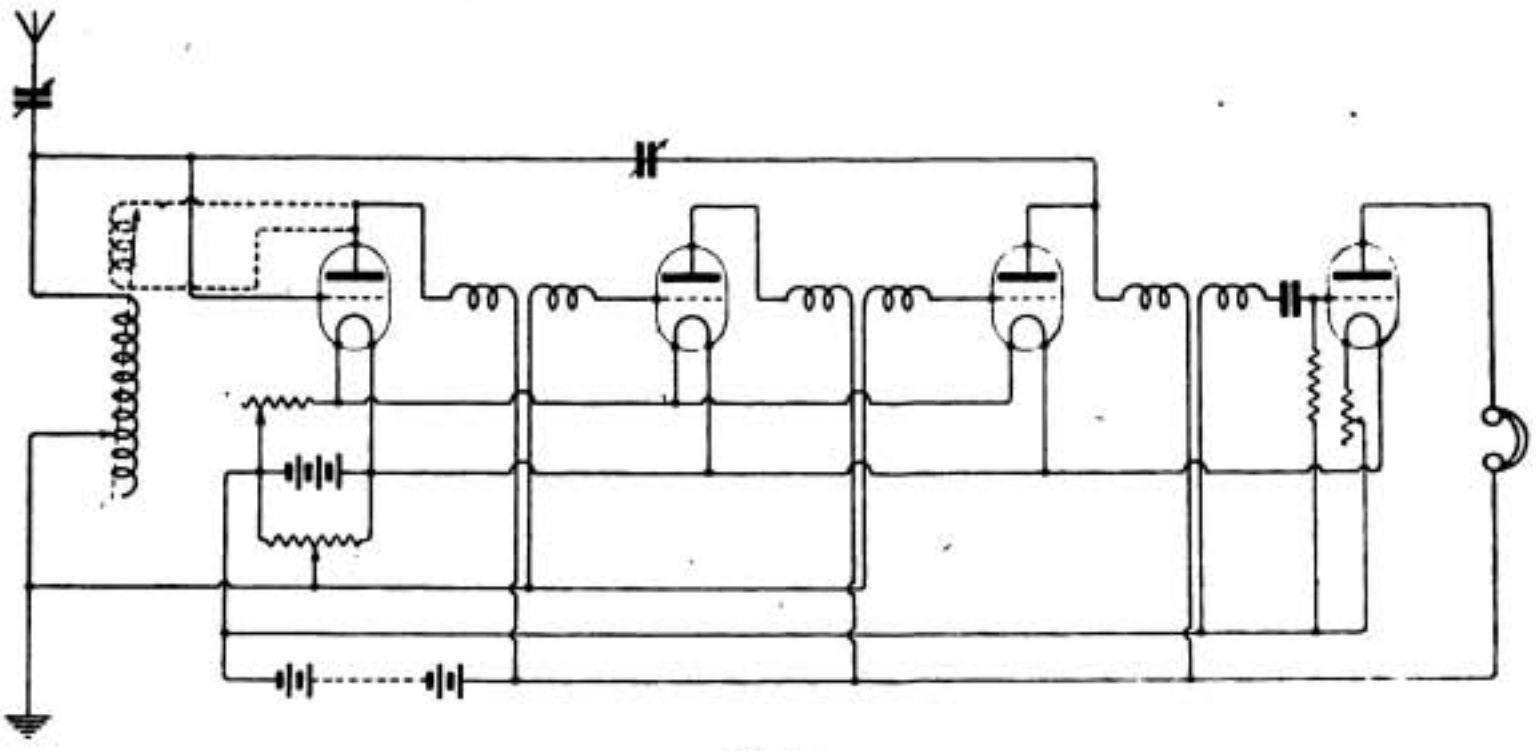


Fig. 7.

"——" (West Ealing) (1) *Gives a crystal circuit and asks for criticism.* (2) *Asks for the name of a book describing valve sets suitable for a beginner and whether American books are to be recommended.* (3) *Whether honeycomb coils can be used with a crystal set.* (4) *If the "school valve receiving set" will receive* **PCGG.**

(1) The crystal circuit is quite good, but do not use potentiometer and battery with a silicon detector. Maximum wavelength about 3,000 metres. (2) "The Amateur Valve Station," by Allan Douglas, Wireless Press, Ltd., price 1s. 6d. Many American publications are, of course, useful but are usually not on the lines of British practice and do not suit the conditions and regulations governing experimental wireless in this country. (3) Yes. (4) Yes, quite suitable.

"F.I." (Erdington) *asks* (1) *The suitability of certain dimensions for a step-down telephone trans-*

"SEMI-AUTO" (Dewsbury) *asks* (1) *For diagram of receiver employing three or four H.F. valves, size of inductances and condensers.* (2) *Whether four valves would be sufficient.* (3) *Whether he can use 220 v. D.C. mains in lieu of H.T. batteries.* (4) *Whether his aerial will be satisfactory.*

(1) See diagram (Fig. 7) A.T.C. 0·0015 mfd. air dielectric. Inductance for 1,000 metres, the wavelength of **PCGG**, A.T.I. 4″ diameter, with 4″ of winding of No. 30 D.C.C. Reaction coils 3″ diameter × 2″ winding No. 34 S.S.C. (2) Yes. (3) Cannot be used directly or through chokes on a 4-valve receiver. Try making up a very small capacity high voltage accumulator and charge it from the mains. (4) Yes. Space wires at least 6 ft. apart. If possible raise fat end.

"CALPE" (Gibraltar) *asks* (1) *If a tramway generating station 300 yards from proposed site of his receiving station will cause interference.* (2) *If*

specimen of mica is suitable and its S.I.C. (3) *Suitability of several types of wire.* (4) *Whether slab inductances are suitable for receiving purposes.*

(1) Very difficult to say. You do not mention whether the supply is single phase A.C. or direct. If the leads of the station do not pass the premises there may be little interference. (2) Yes, quite suitable. S.I.C. about 6. (3) Either of the wires you mention is quite suitable. For reception choose the lighter. (4) Slab inductances of the honeycomb type are thoroughly efficient but in assembling them keep them spaced about ¼" apart. See recent issue for replies to your earlier questions.

"CONTACT" (Bradford) *requires a 2-valve amplifier circuit transformer coupled with switch to cut out one valve, to be built as a separate unit to be coupled to 3-valve set.*

See diagram (Fig 8).

"ANODE" (Harrow) *requires assistance in the use of a French 6-valve amplifier, type* L1/1917.

It is regretted that we have no precise information regarding this set, neither have we had any experience in its manipulation. We cannot be certain of the wiring circuit as the set is of an early type. The usual pattern "R" valves are, as a rule, suitable for use with French amplifiers. Terminal L1. may be connected to one end of the reaction coil, the other end of which goes to the plate and L2 to H.T. plus. L1 and L2 should be bridged with a small condenser 0·001 mfd. Make sure that there is no connection between the L1 L2 windings and the H.T. terminals of the amplifier. To complete your set you need an A.T.I. and condenser and a reaction coil and an external rectifier-oscillator valve. The instrument is not designed for wireless work. The first three valves are probably H.F. though they have iron core transformers. The next is a detector valve, the grid control of which will probably require altering, and the other valves, note magnifiers.

"G.L.K." (Amsterdam).—The variometer you show is quite good type but is intended for use as a coupled circuit, that is, for aerial and plate circuits of a reaction receiver. Assuming that the diameter is 4½", then about 220 turns of wire will tune your aerial to 2,000 metres with your aerial tuning condenser in parallel. For diagram and mode of operation of the new "2-grid valve," see issue of May 13th.

"H.B." (Bradford) *asks* (1) *Whether his circuit is suitable for the reception of telephony.* (2) *If the use of an additional valve is recommended.*

(1) Your circuit is correct except that you have omitted the leak across the grid condenser and the bridging condenser of capacity 0·002 mfd. across the telephones and H.T. battery. You give the dimensions of your coils but omit the number of turns, also gauges of wires, and you do not give the arrangement of your aerial. (2) An additional note magnifier would be a marked improvement. A letter addressed to the author of the article you mention, c/o *The Wireless World and Radio Review*, would be forwarded.

"F.G. St. G." (Southwold) *gives a list of wireless materials he has to hand and which comprises parts for a single valve receiver complete and asks for circuit and general advice for setting up a receiving station.*

It is impossible to give all the information you require in these columns and we would advise you to obtain "The Amateur Valve Station," by Allan Douglas, Wireless Press Ltd., price 1s. 6d.

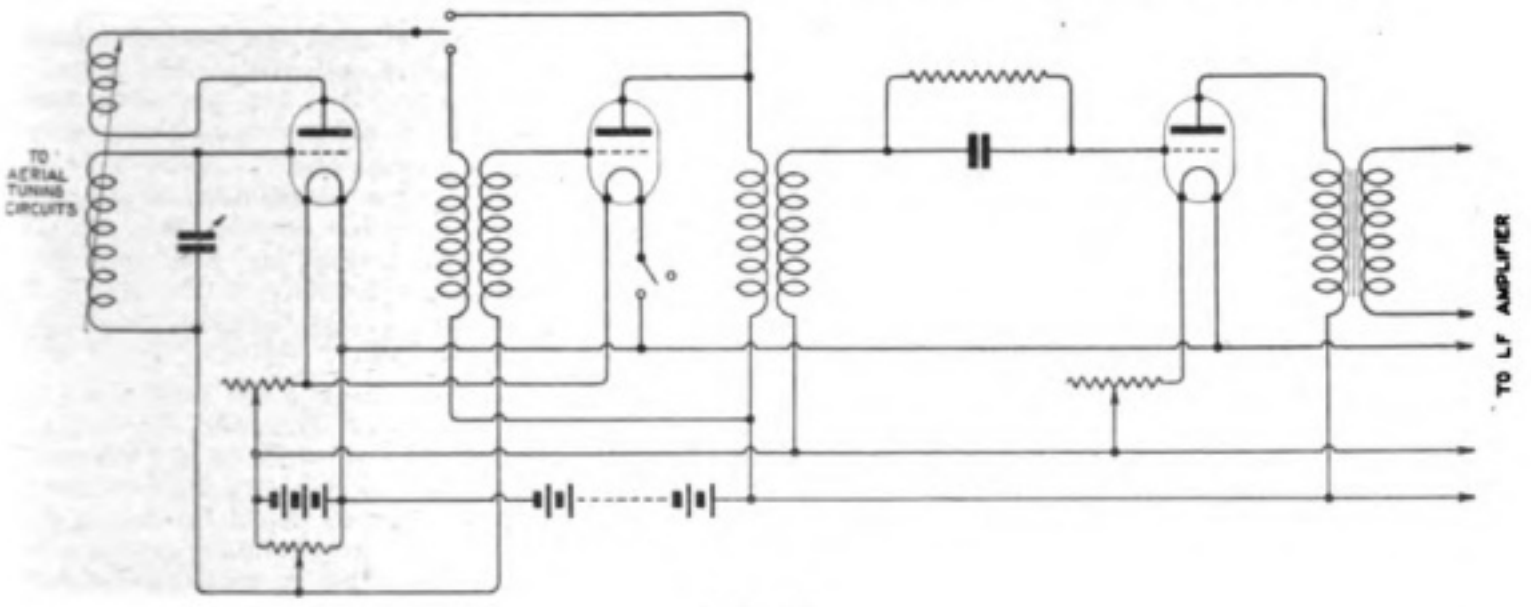


Fig. 8.

"M.G.M." (Churchtown) *asks* (1) *If the coils he has are suitable for making up a valve receiving set.* (2) *The size of the condensers required.* (3) *Whether telephone wires crossing his aerial at right angles and 10 ft. above will affect his reception.* (4) *If a single valve receiver would receive Chelmsford.*

(1) and (2) Yes, quite suitable. Connect up as in circuit, Fig. 2, page 140, April 29th issue, where other helpful details will be found. (3) It is usually a disadvantage to have your aerial crossed by telephone wire, although perhaps they will not have any very serious effect. If you get overhearing you should report the matter to the Post Office authorities. (4) It is doubtful if a beginner would be successful in receiving **2MT** on a single valve set in Lancashire.

"H.J.P." (Bristol) *asks* (1) *If his wiring diagram is correct.* (2) *Why his slab coils fail to function.*

Your wiring diagram is quite correct to that given on page 47. This circuit has since been amended, and

a correction is given in the issue of May 6th, page 179. (2) It is difficult to suggest what is wrong with your coils. Make sure that they are thoroughly dried out. When treating coils with shellac varnish it sometimes happens that the outside becomes dry whilst the interior retains a small quantity of moisture. Varnished coils should always be well baked.

"A.B.K." (Pretoria).—(1) Use circuit given on page 140, April 29th issue. You will need to obtain a grid leak. (2) It is impossible to say range of wavelengths without particulars of aerial and dimensions and windings of coils. (3) Make your set to the diagram given on page 140, but use your own inductances. A double pole, two-position switch might be added for connecting the A.T.C. in series or parallel with the A.T.I.

"F.C." (Romford).—(1) The voltage for the operation of most "R" valves is 4 to 6 volt filament and 30 to 60 volt plate. A tuner is required with the panel and should be a loose coupled one in order that one inductance may serve as A.T.I. and one as reaction. (2) We are not acquainted with stations having the call signs you mention. (3) We recommend you to use two or more valves. (4) 1430 B.S.T.

"C.W.T." (Blackheath) *asks* (1) *If crystal circuit he submits is correct.* (2) *How he can extend its range to* 20,000 *metres.* (3) *How to add a valve amplifier.* (4) *Whether it is better to use a valve functioning as detector amplifier or to amplify from his crystal.*

(1) Your circuit is quite correct. (2) There would be little use in extending the range of your set to 20,000 metres as it would only detect damped signals and there are no such signals on wavelengths exceeding about 5,000 metres. To increase the wavelength range add turns of wire in the aerial circuit and connect a variable air dielectric condenser between aerial and earth, that is, in parallel with your inductance. (3) and (4) Use a valve as detector amplifier and use the circuit shown on page 140, April 29th issue. You may use your crystal still as a detector if you like after H.F. amplification and reaction by using the circuit shown on page 124, April 22nd issue.

"J.T.Q." (Edgbaston) *asks* (1) *For criticism of four-valve diagram and values of condensers.* (2) *If* **PCGG** *will be heard.* (3) *If any advantage would be gained by using an ordinary aperiodic reaction coil, in place of existing tuned anode circuit.* (4) *If two more H.F. valves are added in his circuit, where should reaction coil be connected.*

(1) For short wavelengths the A.T.I. and A.T.C. should be connected in series, otherwise circuit is O.K. A 0·01 mfd. condenser across H.T. might be an advantage, and also a 0·001 mfd. condenser across the rectifier anode winding of inter-valve transformer. (2) Yes, if the windings of the aerial and secondary circuits are such as will tune to its wavelength. (3) For short wave work the tuned anode circuit will be very advantageous and the set will give as good results as one with two more resistance coupled valves. We do not advise making the change. (4) If two more H.F. valves are added for long wave work it will be advisable to substitute an ordinary aperiodic reaction coil in place of the tuned anode circuit.

"W.P.G." (Gloucester) *has a single-valve set without reaction, and asks* (1) *If grid condenser and leak are necessary.* (2) *If galvanised roof* 8′ *below lead-in will affect signals.* (3) *For criticism of circuit.* (4) *If jolting the table causes a ringing sound in telephones due to filament vibrating and varying the electron flow.*

(1) A grid condenser and leak would be a decided advantage. The condenser about 0·0003 mfd. may be made up of two pieces of tin 2″ × ½″, separated by a 3 mil. mica sheet. (2) Not to any appreciable extent. (3) The set is not of much use without a reaction coil. A suitable one would be 12″ of No. 28 on a 4″ diameter former, which should be connected between the anode of the valve and the positive H.T. This should slide in and out of the A.T.I. Connect a 0·001 mfd. condenser across the telephones. The variable condenser is probably sufficient for fine tuning. Your maximum wavelength will be about 6,000 metres. (4) Yes.

"J.W." (Oldham) *asks* (1) *For diagram of receiver with one H.F. valve for crystal rectification.* (2) *A suitable crystal to use.* (3) *Would such set be as efficient as one with a valve rectifier.*

(1) A suitable diagram is given in Fig. 1, page 90, April 15th issue. (2) A carborundum crystal may be used with the potentiometer. A zincite-bornite, or Galena, steelpoint combination may be used without potentiometer, the latter two detectors may be made more sensitive, but will not be so stable as the carborundum. (3) Yes. We cannot tell you the type of set used at **FPE**, but are certain signalling is not done by making and breaking of the aerial circuit.

"A.F.H." (Bishop's Waltham).—Owing to the ½″ spacing of the turns of your frame aerial its natural wavelength will be low, probably about 200 metres.

"A.S.C." (Mitcham) *asks questions regarding a crystal set.*

With the present inductances the results will be very poor, owing to the fine wire used for winding. The former should be made about 5″ diameter and wound with No. 24 wire. A tuning condenser, connected as Fig. 3, page 60, April 8th issue, will be found an advantage. Carborundum crystal may be used if desired. It would be more stable than the silicon. Mounting the apparatus on wood does not matter if the wood is thoroughly dry.

"L.J.H." (London, N.1).—We know of no other published information regarding the Beverage aerial other than that given in the recent article in our columns, nor do we know of any publication dealing with typewriter reception. It is possible that some mention of the typewriter for telegraph recording is made in Herbert's "Telegraphy."

SHARE MARKET REPORT

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

Marconi Ordinary	£2	16	4
,, Preference	2	11	10
,, Inter. Marine	1	14	6
,, Canadian		13	6
Radio Corporation of America :—			
Ordinary	1	6	0
Preference		16	0

PUBLICATIONS OF

THE WIRELESS PRESS LTD.

12-13, HENRIETTA STREET, STRAND, LONDON, W.C.2.

Arranged in Alphabetical Order.

ACQUIRING THE CODE. An Instruction Book for Beginners in Radio.

Gordon, E. P.

Medium 8vo. 31 pages. Illustrated.

Price 2s. 6d. Post free 2s. 9d.

This book has been written with the idea of assisting the newcomer in the radio field to a quick knowledge of the meaning of the dots and dashes which represent the Morse Code.

CONTENTS—Characters of the International Morse Code. Transmitting. Correct Key Manipulation. Adjustment of Key. Exercises in Transmitting. Receiving. Copy Work. Troubles. Questions. Use of Punctuation Signals, etc. Material for Receiving Practice. Code. Weather Bulletins. The Use of Call Letters. Press Matter.

ARMATURE MODEL FOR 1½ K.W. ROTARY CONVERTER

Price 1s. 3d. net. Post free 1s. 6d.

Shows every winding of the Converter Armature. Of great assistance to the student, amateur and instructor.

ALTERNATING CURRENT (Book II., Students' Library)

Penrose, H. E.

Crown 8vo. 48 pages. Price 1s. 4d. Post free 1s. 6d.

CONTENTS—Sine Law. Virtual Value. Phase. Lagging Currents. The Effects of Self-Induction. Inductance. Capacity. Arrangement of Condensers. Condensers with Alternating E.M.F. Leading Currents. Impedance and Phase. Resonance. Power. Power and Power Factor. Alternators and Converters. The Transformer.

ALTERNATING CURRENT WORK

Shore, A. A.M.I.E.E.

Crown 8vo. 163 pages. 86 diagrams and illustrations.

Price 3s. 6d. Post free 3s. 10d.

CONTENTS—Production of Alternating Current. Sine Curve. Current Curves. Root Mean Square Value. Power Curves. Power Factor. Idle Current. Inductance. Self-Inductance. Electromotive Force of Self-Induction. Growth of Current. Lenz's Law. Coefficient of Self-Induction. Angle of Lag. Impedance—Ohm's Law. Choking Coils. Construction of an Inductance Coil. Eddy Currents. Winding. Measurement of E.M.F. of Self-Induction. Capacity. Simple Condenser. Effects of Capacity. Phase of E.M.F. and Current. Back E.M.F. Calculation of Capacity. Capacities in Parallel. Capacities in Series. Relation between Current Voltage and Impedance—with capacity in circuit. Relation between Current Voltage and Impedance, Resonances, Mechanical Analogy, Natural Frequency. Transformers. High Frequency Resistance. Measurement of High Frequency Resistance. Guarding against High Frequency Losses. Electrical Measuring Instruments. Moving Iron Instruments, Hot-Wire Ammeters and Voltmeters, Electrostatic Voltmeters, Watt Meters, Power Factor Meters, Frequency Meters. Alternating Current Generators. Rotary Converters. Direct Current Motors. Voltage Ratio of Converter. Current available from Converter Rotating Field Alternators. Mono-Coil Alternators. Multi-Coil Field Alternators.

Nottage, W. H. B.Sc.

CALCULATION AND MEASUREMENT OF INDUCTANCE AND CAPACITY

Demy 8vo. 144 pages. Over 50 illustrations and diagrams.
Price 3s. 6d. net. Post free 3s. 11d.

The more generally useful formulae and methods of measurement for inductance and capacity are brought together in a convenient form in this book, which makes it of great assistance to experimenters.

CONTENTS—The Calculation of Inductance. Calculation of Capacity. Measurement of Inductance. Measurement of Capacity. High Frequency Measurements. Appliances for use in Measuring Inductance and Capacity. Tables. Index.

Eccles, W. H. D.Sc., A.R.C.S., M.I.E.E.

CONTINUOUS WAVE WIRELESS TELEGRAPHY. Part I.

Demy 8vo. 407 pages. 306 diagrams and illustrations.
Price 25s. net. Post free 25s. 9d.

CONTENTS—

Chapter I. Historical Survey of the development of Wireless Telegraphy, introducing the reader to the terms used and the physical phenomena involved and leading up to the advantages of Continuous Waves.

Chapter II. General electric and magnetic theory needed for the study of electrical oscillations in circuits and machines and for the study of electric waves; including the elements of the theory of electric and magnetic fields, both stationary and moving.

Chapter III. The elements of the properties of sine curves and their representation by vector diagrams are discussed and applied to oscillating currents and voltages. Root mean square, phase, power factor, reactance and impedance are fully explained.

Chapter IV. Deals with coupled circuits and transformers. Because of the very great variety of coupled circuits appearing in transforming plant, receiving apparatus, and amplifiers, the treatment analyses systematically and gives solutions for nearly all kinds of coupled circuit used in C.W. Telegraphy.

Chapter V. Treats of Ionic Tubes of all kinds, starting from the very elements of electron emission. The making and the interpretation of characteristic curves are described. The operation of the ordinary three-electrode tube as relay and detector is explained. The newer tubes, like the dynatron and the pliodynatron, are fully described.

Douglas, Alan L. M.

THE CONSTRUCTION OF AMATEUR VALVE STATIONS

Crown 8vo. 78 pages. 55 diagrams and illustrations.

Price 1s. 6d. Post free 1s. 8d.

The aim of the author in compiling this volume has been to place within the reach of the amateur a handbook which will enable him to obtain data that he has otherwise difficulty in acquiring, in order that he may construct for himself apparatus which he desires to make, but does not quite know how to design correctly.

CONTENTS—Theory of the Thermionic Valve. Suitable Circuits and Valve Reception. The Construction of Valve Control Panels. Transformer and Resistance. Capacity. Coupling. Tuners. Condensers. Battery Circuits. Telephone Receivers. Additional Apparatus Aerial and Earth Circuits. Connecting up of Apparatus.

Penrose, H. E.

DIRECT CURRENT (Book 1, Students' Library)

Crown 8vo. 64 pages. Price 1s. 4d. Post free 1s. 6d.

CONTENTS—Transmitter Medium and Receiver. The Electric Circuit. Ohm's Law. Resistance. Arrangement of Resistances in an Electric Circuit. Energy, Power and Work. Magnetism. Electro Magnets. Ammeters, Voltmeters and Wattmeters. Electrolysis and Elementary Accumulator. The Accumulator. The Continuous Current Generator. The Motor. Analysis of D.C. Motor. Self-Induction.

DICTIONARY OF TECHNICAL TERMS USED IN WIRELESS TELEGRAPHY

Ward, Harold

A most useful and necessary companion for all interested in Radio Telegraphy and Telephony.

Second edition. Revised and enlarged. 253 pages. Contains over 1,500 definitions. Size 2 by 3 inches. Price 2s. 6d. net Post free 2s. 8d.

MY ELECTRICAL WORKSHOP. A Book for the Electrical Experimenter

Addyman, Frank T.

Demy 8vo. 249 pages. 169 diagrams and illustrations. Price 7s. net. Post free 7s. 9d.

Contains a host of well illustrated original suggestions and explains very clearly the materials required and how to use them. An endless interesting entertainment can be had by following the hints and instructions given. No previous knowledge is required to get good results.

CONTENTS—Concerning Magnets and their Ways. Measuring Magnetism. Making an Electric Current. More about Cells. Wires and Joints. Magnets and Currents. Electro Magnets. What is Electricity? Measuring a Current. Electro-plating and Electro-typing. Currents and Magnets. Microphones and Telephones. The Telegraph. Making an Electromotor. The Dynamo. Electric Lighting—Arc Lights. Currents and Currents. Electricity at Rest. The Induction Coil and its Uses. The Magnetic North.

THE ELEMENTARY PRINCIPLES OF WIRELESS TELEGRAPHY

Bangay, R. D.

Crown 8vo. Published in two parts or bound in one volume. Price per part, 4s. net. Post free 4s. 5d. In one volume, 7s. 6d. net. Post free 8s. 3d. (Also printed in French and Spanish. Price 9s. Post free 9s. 9d. each).

CONTENTS—Part I, 212 pages. 132 diagrams. Symbols used in diagrams. Electricity and Magnetism. The principles of Wave Motion. Pressure Waves. Production of Waves. Production of High Frequency Oscillations. Production of Oscillating Currents in an Aerial. Coupled Oscillatory Circuits. The Wavemeter. Wireless Telegraph Receivers. Tuning Buzzer. Electrolytic Detector. Magnetic Detector. Atmospherics. Aerials. Distribution of Potential and Current along Aerials. Masts. The Insulation of Aerials.

CONTENTS—Part II, 241 pages. 152 diagrams. Curve Diagrams. The Theory of the Dynamo. Continuous Current Dynamo. Eddy Currents. Theory of the Transformer. Phase Relation between Current and Electromotive Force in Tuned Circuits. Excitation of Spark Transmitters. Spark Dischargers. The Oscillation Valve: as a Receiver, as a Magnifier, as a Transmitter. Reception of Continuous Waves.

ELGIE'S WEATHER BOOK FOR THE GENERAL READER

Elgie, J. H.

Crown 8vo. 251 pages. Well Illustrated. Price 5s. Post free 5s. 6d.

This book is not tiresomely technical but is written in a well-read readable way. Anyone who wants to know more about weather will find it a pleasant as well as a competent guide.

CONTENTS—The Atmosphere. Wind. Clouds. Rain. Snow, Hail and Dew. Fog. Depressions. Thunderstorms. Anti-Cyclones. Frost. Thermometers. Vibration. Halos and Coronas. Supposed Weather Signs. Climate. Weather Vocabulary. Index.

FIFTY YEARS OF ELECTRICITY. The Memories of an Electrical Engineer

Fleming, J. A. M.A., D.Sc., F.R.S.

Crown 4to. 371 pages. 111 plates.

Price 30s. Post free 31s.

This most useful and interesting book gives a comprehensive view of the chief triumphs of applied electricity during the last half-century. Every phase of electrical work is covered.

CONTENTS—Introduction. Telegraphs and Telephones from 1870 to 1920. Dynamos, Alternators, Transformers and Motors from 1870 to 1920. Electric Lamps and Electric Lighting in the Last Fifty Years. Electric Heating, Cooking and Furnaces in Five Decades. Electric Supply Stations, Storage Batteries, Railways and the Transmission of Power. Electric Theory and Measurements. Wireless Telegraphy and Telephony. Conclusion. Appendix.

Penrose, H. E. **HIGH-FREQUENCY CURRENT AND WAVE PRODUCTION (Book III, Students' Library)**

Crown 8vo. 64 pages. Price 1s. 4d. Post free 1s. 6d.

CONTENTS—High-Frequency Currents. Energy stored in a Condenser. Transformer Charging a Condenser. The Induction Coil. General Conditions for Oscillations. Wave Motion. Pressure Waves. Measurement of a Wave. Damped and Undamped Waves. Transmitter in General. The Simple Transmitter Emergency Set: Oscillating Circuit. Emergency Set: Open Circuit. The Transformer. Closed and Open Circuits. Coupling. Tight and Loose Coupling. Shock Excitation and Quenching. General Conditions at Receiver. The Receiver.

Hawkhead, J.C. and *Dowsett, H.M. M.I.E.E.* **THE HANDBOOK OF TECHNICAL INSTRUCTION FOR WIRELESS TELEGRAPHISTS**

Second Edition. Revised and Enlarged. Demy 8vo. 310 pages. 240 diagrams and illustrations. Price 7s. 6d. Post free 8s. 3d. (Also printed in Spanish. Price 9s. net. Post free 9s. 9d.)

CONTENTS—Part I, Preliminary Considerations. Primary Cells. Accumulators. Current Electricity: its Laws and Units. Magnitism. Electromagnets. Dynamo, Motor, Rotary Converter. Inductance. Direct and Alternating Current Measurements. Condensers. Part II, Electro-Magnetic Waves. The Receiving Circuit. Part III, The 1½ K.W. Set. Emergency Transmitting Apparatus. The 1½ K.W. Aerial. ½ K.W. Sets. 5 K.W. Sets. Portable Sets. Faults.

Bucher, E. E. **HOW TO CONDUCT A RADIO CLUB**

4th Revised Edition. 148 pages, with 135 diagrams and illustrations. Price 5s. Post free 5s. 5d.

CONTENTS—Advice for the Amateur. The Formation of a Radio Club. Instruction in the Telegraphic Codes. A 200 Meter Amateur Set. An Amateur's Wave Meter and its Uses. The Measurement of the Logarithmic Decrement. Examples of 200 Meter Amateur Sets. The Quenched Spark Discharger. The Receiving Tuner. Receiving Directors for Wireless Telegraphy. The Vacuum Valve Amplifier and Beat Receiver. The Radio-Variometer. An Experimental Wireless Telephone.

Bucher, E. E. **HOW TO PASS U.S. GOVERNMENT WIRELESS LICENSE EXAMINATIONS**

New edition, revised and extended. 142 Questions and Answers. Size 6 by 9 inches. Fully illustrated. Price 5s. net. Post free 5s. 4d.

Penrose, H. E. **MAGNETISM AND ELECTRICITY FOR HOME STUDY**

Contains 50 graded lessons. Eminently suitable for a Secondary School Text Book.

Crown 8vo. 515 pages. 224 diagrams. Price 6s. net. Post free 6s. 6d.

The various facts and theories of Electricity and Magnetism are elucidated subtly but surely. No effort has been spared by the author to explain the subject so clearly and thoroughly that no one can misunderstand him. At the end of each lesson is placed a series of questions which enable the reader to test his progress and assure himself that his knowledge is well grounded.

Harris, P. W. **THE MAINTENANCE OF WIRELESS TELEGRAPH APPARATUS**

Crown 8vo. 127 pages. 52 diagrams and illustrations. Price 2s. 6d. net. Post free 2s. 10d.

SUMMARY OF CONTENTS—Arrangement of Apparatus in 1½ K.W. Set; Marine Type Switchboards; Combined Starter and Field Regulator; Carbon Brush; Adjustment of Brush Holder; 1½ K.W. Converter and Disc Discharger; 1½ K.W. Converter and Asynchronous Disc; ½ K.W. Converter (E.C.C. Type); ½ K.W. Converter (Machine Type); ½ K.W. (Motor Generator). Magnetic Key (5 K.W. Type); 1½ K.W. Transformer (showing connections); Transformer ½ K.W. Type; Transformer 5 K.W. Type; 10 inch Coil; 1½ K.W. Set with ½ K.W. Emergency Apparatus; 1½ K.W. Set Emergency Arrangements; ½ K.W. Cabinet Set; ½ K.W. Cabinet Set, Scheme of Connections; 5 K.W. Set Connections; Connections of Marconi Multiple Tuner;

Marconi Plain Tuner; Connections of Marconi Valve Receiver; Marconi Crystal Receiver, No. 16 (showing Connections); Marconi Combined Crystal and Magnetic Receivers (showing Connections); Marconi Crystal Receiver, No. 20B; Marconi Crystal Receiver, No. 26 (showing Connections); Marconi Crystal Receiver, No. 31 (showing Connections); Telephone Transformers; "T" Aerial; "L" Aerial; Method of Joining Aerial Downlead; Turnbull Insulator; Bradfield Gland; Chloride Accumulator; Marconi Portable Wavemeter (showing Connections).

THE MARCONI OFFICIAL GRAMOPHONE RECORDS

For self tuition in receiving Morse Signals

Price per record, 5s. (Packing and postage 9d. extra)

Set of Six 10-inch Double-sided Records 30s. (Packing and Postage free.)

SERIES I. Record 1. *One Side.*—The Morse Code, including full figures, abbreviated figures and punctuation signs, as printed in the Postmaster General's Handbook. *Reverse.*—Difficult letters which experience has shown give most difficulty to learners; also a sentence sent slowly. Record 2. *One Side.*—A Press message sent at a speed of approximately 10 words per minute. *Reverse.*—A similar message at a speed 50 per cent. faster.

Record 3. Both Sides.—Dummy messages, properly numbered, timed and counted, as exchanged between ships and stations, and *vice versa*.

Record 4. *One Side.*—Difficult business message, containing figures, fractions, Stock Exchange terms, etc.,; one or two mistakes have been introduced and then corrected in the accepted style. *Reverse.*—Code words and cipher transmitted at a normal rate of 20 words per minute.

Record 5. *One Side.*—Various messages, such as would be met with in an ordinary day's transmission, sent at the rate of 25 words per minute. *Reverse.*—Messages in French, Spanish and Italian.

Record 6. *One Side.*—Signals from two distinct transmitters on different notes; Press message transmitted at 25 words per minute jammed by similar matter at lower speed. *Reverse.*—Mixed messages jammed by Press messages.

SERIES II. Record 1. *One Side.*—Morse Code, including full figures, abbreviated figures, and punctuation signs, as printed in the Postmaster-General's Handbook (Sounder Record). *Reverse.*—Simple Press, sent slowly (Sounder Record).

Record 2. *One Side.*—Italian Press, 25 words per minute. *Reverse.*—French Press, 25 words per minute.

Record 3. *One Side.*—Spanish Press, 25 words per minute. *Reverse.*—Portuguese Press, 25 words per minute.

Record 4. *One Side.*—Figures and fractions at moderate speed. *Reverse.*—Poldhu Press, with interruptions by voices, whistles, and various noises, to teach the reception of signals in conditions of difficulty from interruption.

Record 5. *One Side.*—"Distress Record" in which two ships working are interrupted by a third which sends the SOS signal. The traffic of the ship in distress is then expeditiously handled. This is a very dramatic record, exactly reproducing the wireless conditions at sea when a cry of distress is sent out. *Reverse.*—Ship and shore working with correct "T.R.s" and properly coded messages.

Record 6. *One Side.*—Messages from ship to shore at 25 words per minute, with jamming from French Press. *Reverse.*—Messages from shore to ship at 25 words per minute, jammed by similar Press.

Obtainable from all Dealers selling "His Master's Voice" Records.

MILITARY SIGNAL CORPS MANUAL

White, J. Andrew, Major

Crown 8vo. 570 pages. 260 illustrations. Price 12s. 6d. net. Post free 13s. 3d.

Part I. Is devoted to the Organisation of the U.S. Army.

Part II. Drill Instruction.

Part III. Technical Instruction and Land Wire and Radio Apparatus.

Part IV. Transmissions.

Part V. Field Service.

The greater part of the contents is of general interest, over 200 pages being devoted to Wireless and other forms of signalling.

MORSE CODE CARD

Contains full alphabet, with punctuation marks, figures, abbreviations, and contractions. Price 2d. Post free 3d.

Rye, A. L.

MORSE MADE EASY

A system for rapidly learning the Morse Code. Price 3d. net, or post free 3½d.

Bangay, R. D.

THE OSCILLATION VALVE—THE ELEMENTARY PRINCIPLES OF ITS APPLICATION TO WIRELESS TELEGRAPHY

Crown 8vo. 215 pages. Price 6s. Post free 6s. 6d.

CONTENTS—General Consideration of Wireless Telegraph Receivers. The Oscillation Valve. The Fleming Valve. The Three-Electrode Valve. The Application of the Oscillation Valve to Receivers. The Valve as a Magnifier. The Valve as a High-Frequency Magnifier. Reaction between Sheath Circuit and Grid Circuit of Valve. The Application of the Three Electrode Valve to Transmitters. The Theory of the Soft Valve.

Penrose, H. E.

THE OSCILLATION VALVE (Book V., Students' Library)

Crown 8vo. 50 pages. Price 1s. 4d. Post free 1s. 6d.

CONTENTS—General Definitions. Electric Currents through Gases. The Fleming Valve. Characteristic Curves. The Three-Electrode Valve. Characteristic Curves of Three-Electrode Valve Detection and Amplification. Low-Frequency Amplification. High-Frequency Amplification. Continuous Wave Reception.

White, J. Andrew

PRACTICAL AMATEUR WIRELESS STATIONS

Medium 8vo. 136 pages. 110 diagrams and illustrations. Price 5s. Post free 5s. 6d.

An experience book containing the best suggestions of 33 experimenters on building, installing and operating experimental stations for radio-communication.

Bucher, E. E.

PRACTICAL WIRELESS TELEGRAPHY

Demy 8vo. 352 pages. 340 illustrations. Price 12s. 6d. Post free 13s. 3d.

White, J. Andrew

PRACTICAL AVIATION

Medium 8vo. 197 pages. 200 illustrations. Price 12s. 6d. Post free 13s. 3d.

CONTENTS—Theory and Principles of Flight. Elements of Airplane Design. Flight Stability and Control. Materials, Stresses and Strains. Rigging the Airplane. Fundamentals of Motive Power. Pistons, Valves and Carburettors. Ignition, Cooling and Lubrication of Engines. Types of Motors. Operation and Care of Engines. Instruments and Equipment for Flight. First Flights and Cross Country Flights. Aerobatics and Night Flights. Meteorology for the Airman. Aerial Gunnery and Combat. Bombs and Bombing. Reconnaissance and Fire Sporting. Nomenclature of Aeronautical Terms.—French Equivalents—Phonetic Pronunciation—Metric Conversion Tables—Rules for Mensuration.

Batcher, Ralph R., E.E.

PREPARED RADIO MEASUREMENTS WITH SELF-COMPUTING CHARTS

Oblong medium 8vo. 132 pages. Price 10s. 6d. Post free 10s. 11d.

CONTENTS—Antenna. Audibility. Austen Cohen Transmission Formula. Bjerknes' Formula. British Thermal Units. Cable Measurements. Calories. Antenna Capacity. Co-efficient of Coupling. Condensers in Series. Corrections to Inductance Formulæ. Decrement. Distributed Capacity of a Coil. Eddy Current Loss. Energy in Condenser Charge. Energy in an Oscillating Circuit. Effective Height of an Antenna. Effect of Parallel Condensers in Tuning. Electro-magnetic Coupling. Electrostatic Coupling. Frequency and Wavelength. Form Factor of an Antenna. Harmonics. Heat from an Electrical Circuit. Horsepower. Hysteresis Loss. Inductance Coil

Design. Inductive Reactance. Impedance. Iron Losses. Kilowatts. Loading Inductance. Logarithmic Scales. Multiple Layer Coil Design. Optimum Wavelength. Parallel Condensers in Tuning. Phase Angles. Power Factor. Radiation Resistance. Reactance. Resistance. Series Condensers in Tuning. Single Layer Coil Design. Spiral Coil Design. Transmission Formulæ. Turns per inch (wire). Capacity of Variable Condenser. Watts. Wavelength and Frequency. Wavelength Charts. Winding Data.

RADIO TELEPHONY

Goldsmith, Alfred N. (Ph.D.)

Med. 8vo. 256 pages. 226 illustrations. Price 15s. net. Post free 15s. 9d.

CONTENTS—*World Aspects. Personal Aspects. Uses of Radio Telephony;* Ship to Ship and Shore to Shore, Trans-oceanic and Trans-continental, Exceptional Regions, Train to Train and Station to Station, Underground, Aeroplane, Submarine, etc. *Radio versus Wire Telephony.* For Land Telephony, For Oversea Telephony. *Broad Problems Involved in Radio Telephony.* Radiation of Modulated Energy, Causes of Speech Distortion, Non-Linear Amplification and Speech Distortion, Secrecy of Communication in Radio Telephony, Stray Interference in Radio Telephony. *Sustained Wave Generators.* Arcs, Radio-frequent Sparks, Vacuum Tube Oscillators, Alternators of Radio Frequency. *Modulation Control in Radio Telephony.* Degree of Control, Stability of Control, Rating of Radiophone Transmitters, Types of Control, Microphone Transmitter Control, High Current Microphones, Vacuum Tube Control Systems, Ferromagnetic Control Systems, Comparison of Control Systems. *Antennas and Ground Connections.* Radiating Systems. *Reception Phenomena.* Detector and Amplifier Types, Beat Reception Selectivity in Reception, Interference with Radiophone Reception, Telephone Receivers, Receiving Apparatus, Strays, Range in Radio Telephony. *Radiophone Traffic and its Regulation.* Duplicate Operation, Ship to Shore Radio Telephony, Long Distance Radio Telephony, Future Development of Radio Telephony. *Index of Investigators and Topics.*

THE RADIO EXPERIMENTER'S HAND BOOK

Coursey, P. R. B.Sc. (Eng.) F.Inst. P., A.M.I.E.E.

Medium 8vo. 113 pages. 99 diagrams and illustrations. Price 3s. 6d. Post free 4s.

The aim of the true Wireless experimenter should not be merely to purchase a complete installation or to build one up from a complete set of working drawings, but rather to design his set to meet his own requirements. The object of this handbook is to foster, if possible, such an attitude by indicating the chief features of such design work and the principles upon which it depends.

CONTENTS—The Aerial. Circuit. Receiving Tuners. Receiving Amplifiers and Detectors. Heterodynes. High Frequency. Measurements and Calculations.

RADIO INSTRUMENTS AND MEASUREMENTS

320 Pages. Fully illustrated. Price 9s. Post free 9s. 5d.

CONTENTS—Part I. Theoretical Basis of Radio Measurements.

Part II. Instruments and Methods of Radio Measurements.

Part III. Formulæ and Data.

THE 1½-K.W. SHIP SET (Book IV., Students' Library)

Penrose, H. E.

Crown 8vo. 74 pages. Price 1s. 4d. Post free 1s. 6d.

Emergency Set: Accumulators. The Marine Switchboard. The Induction Coil. 1½-k.w. Marconi Standard Set. Inverted Rotary Converter. Low-Frequency Circuit. The L.F.I.C.I. and Power. Functions of the Main Condenser. The Transformer. Charging and Discharging of Condenser. Aerial Tuning. Inductance and the Short Wave Condenser. The Magnetic Detector. Stand-bi Side of Multiple Tuner. Tune Side of Multiple Tuner. Operating the Multiple Tuner. The Crystal Detector. Comparison of Magnetic and Crystal. The Aerial. Fault Tracing.

SELECTED STUDIES IN ELEMENTARY PHYSICS. A Handbook for the Wireless Student and Amateur

Blake, E. A.M.I.E.E.

Crown 8vo. 176 pages. 43 diagrams and illustrations. Price 5s. net. Post free 5s. 4d.

CONTENTS—Part I.—Introduction. General Survey of Physics. Aether and Space. Matter, Force and Motion. Harmonic Motion. Waves and Wave Motion. Work and Energy. Stress, Strain and Elasticity. Aether and the Electromagnetic Theory of Light.

Part II.—Atoms and Molecules. Chemical Action. Heat and Temperature. Thermo-Chemistry of the Simple Voltaic Cell. Chemical Names and Formulæ. The Quantitative Meaning of Chemical Symbols and Formulæ. The Construction of Chemical Equations. Valency: Chemical and Electro-Chemical Equivalents. Index.

Willis, S. J.

A SHORT COURSE IN ELEMENTARY MATHEMATICS AND THEIR APPLICATION TO WIRELESS TELEGRAPHY

Demy 8vo, 182 pages. 120 Diagrams. 5s. Post free 5s. 6d.

The author, bearing in mind the particular needs of the Wireless Experimenter, prepared this book with a view to assisting him in his work.

CONTENTS—Logarithms, Geometry, Algebra, Trigonometry, Vectors, Use of Squared Paper, Solutions to Examples, Useful Constants, Tables (Logarithms, Antilogarithms, Trigonometry), Index.

Hoyle, Bertram
M.Sc. Tech., A.M.I.E.E.

STANDARD TABLES AND EQUATIONS IN RADIO-TELEGRAPHY

Demy 8vo. 159 pages. Price 9s. net. Post free 9s. 5d.

CONTENTS—Section I.—Useful Formulæ and Equations.

Section II.—Four Figure Tables of Logarithms, Natural Logs 1 to 100, Natural Sines, Natural Cosines, Natural Tangents, Table of Haversines, Table of Function **Q** for Use in Lorenz's Equation $L_s = an^2 Q^{cms}$, Table of Function **X** for Use in Rayleigh's Equation $L_s = 4\pi\ an^2 X^{cms}$, Table of Correction Functions A and B for Use in Correction Formula, Table of Constants for Stefan's Formula for "Pancake" or Torodial Coils—Stranded Conductors, Single Strand Conductors, "Eureka" Resistance Wire, Aluminium Wire, Effective Resistance R′ of Copper Wires Carrying High Frequency Currents. Tables of Values of Log. Dec. δ (per half period) calculated from the accurate formula of Bjerknes by the Author; Table for the Determination of the Degree of Coupling K′, Specific Inductive Capacities, Specific Electrical Resistance Table, Volume Resistivity of Solid Dielectrics, Relation between Sparking Distances and Impressed Voltage, Table of Disruptive Voltages taken between Clean Brass Balls of the different sizes, Table of Dielectric Strengths, Gilbert's Table (Ordinary Catenary), Weights and Measures, Synopsis of Unite, Table of $160\ \pi^2\ \frac{(h)^2}{\lambda}$ for use in finding Radiation, Resistance of Antennæ, Table Bd $\times\ 10^{10}$ for Use in Calculating Corona Voltages, Table showing the Depth of x cms. at which the Current Value is $\frac{1}{100}$th of the Surface Value, Table of Aerial Form Factors a.

Section III.—Examples.

Section IV.—Notes on Elementary Arithmetic for Operators, Specific Gravities and Approximate Weights:—Metals; Various Solids; Woods, dry; Liquids, Gases; Fractional, Decimal and Metric Equivalents of One Inch, English and Metric Conversion Table, Conversion Factors, Wire and Sheet Gauges, Wire Gauges, Screw Threads, Nuts, and Bolts, British Association Threads, British Standard Whitworth Bolts, British Standard Fine Screw Threads, American Standard Sellers Threads, Acme Standard Threads, Screw Threads for Gas and Water Pipes; Wood Screws; Pipe Bends and Tees, Pipe Flanges, British Standard Pipe Flanges, Filling Holes in Cast Iron, Temperature Speed of Pulleys.

Penrose, H. E.

STUDENTS' LIBRARY—USEFUL NOTES ON WIRELESS TELEGRAPHY

Book I.—Direct Current.

Book II.—Alternating Current.

Book III.—High-Frequency Current and Wave Production.

Book IV.—The 1½ k.w. Ship Set.

Book V.—The Oscillation Valve.

(See separate entries under titles.)

Coursey, Philip R.
B.Sc. (Eng.) A.M.I.E.E.

TELEPHONY WITHOUT WIRES

Demy 8vo. 414 pages. Over 250 diagrams and illustrations. Price 15s. net. Post free 15s. 9d.

SUMMARY—Conductive and Inductive Methods. Photophones and Thermophones. Early Attempts at Telephony by Long Electromagnetic Waves. The Conditions for Successful Wireless Telephony by Æther Waves. Discontinuous Wave Generators for Radio-Telephony. Spark Generators. Practical Forms of Quenched Spark Gap. The Generation of Continuous Oscilla-

tions by Quenched and other Spark Gaps. Multiphase Spark Transmitters for Radio-Telephony. Arc Oscillation Generators. Vacuum Oscillation Generators. Alternators and Frequency Raisers. Modulation of the Transmitted Energy. The Efficiency of Wireless Telephone Transmitters. The Braun Tube Oscillograph. Receiving Apparatus for Wireless Telephony. Receiving Amplifiers. Interference Prevention. Fields of Use for Wireless Telephony. Summary of Results Achieved.

TEST QUESTIONS AND ANSWERS ON WIRELESS TELEGRAPHY

Price of each Series of Questions or Answers 2s. 6d. net. Postage 3d.

Invaluable for self-examination. Series 1. The Elementary Principles of Wireless Telegraphy Part I.—Series 1a. Book of Model Answers. Series 2. Covering the Ground for the Postmaster-General's Examination. Series 2a. Book of Model Answers. Series 3. The Elementary Principles of Wireless Telegraphy. Part II.—Series 3a. Book of Model Answers.

THERMIONIC TUBES IN RADIO-TELEGRAPHY AND TELEPHONY

Scott-Taggart, John

Demy 8vo. 424 pages. 344 diagrams and illustrations. Price 25s. net. Post free 25s. 9d.

CONTENTS—Two-Electrode Valves and the Theory of Thermionic Currents. The Three-Electrode Vacuum Tube. The Vacuum Tube as a Detector. The Vacuum Tube as an Amplifier Retro-Active or Regenerative Amplification. Multi-Stage High Frequency Amplifiers. Multi-Stage Low-Frequency Amplifiers. Combined High and Low Frequency Amplifiers. Multi-Stage Retro-Active Receiving Circuits. The Reception of Continuous Waves. Transmission of Continuous Waves with Vacuum Tubes. Vacuum Tube Oscillators, Wavemeters, Capacity Meters, and other Measuring Instruments. The Vacuum Tube in Wireless Telephony. The Dynatron. Miscellaneous Vacuum Tube Devices.

THE THERMIONIC VALVE AND ITS DEVELOPMENT IN RADIO-TELEGRAPHY AND TELEPHONY

Fleming, J. A. M.A., D.Sc., F.R.S. etc.

Demy 8vo. 279 pages. 144 diagrams and illustrations. Price 15s. net. Post free 15s. 9d.

CONTENTS—

Chapter I.—Historical Introduction.

Chapter II.—The Fleming Oscillation Valve.

Chapter III.—The Three-Electrode Valve.

Chapter IV.—The Thermionic Valve as a Generator of Electric Oscillations.

Chapter V.—The Thermionic Detector in Radio-Telegraphy.

Chapter VI.—The Thermionic Oscillator and Detector in Radio-Telephony.

Chapter VII.—Recent Improvements in Thermionic Apparatus during European War, 1914–1918. Appendix. Index.

VACUUM TUBES IN WIRELESS COMMUNICATION

Bucher, E. E.

Second Edition. Demy 8vo. 178 pages. 130 diagrams and illustrations. Price 12s. 6d. net Post free 13s. 3d.

CONTENTS—The Oscillation Valve. Practical Applications of the Valve. Cascade Amplification by the Vacuum Valve. The Regenerative Vacuum Valve Amplifier. Combined Regenerative and Cascade Amplification Systems. The Vacuum Valve as a Detector of Continuous Waves. Audio Frequency Tuning Circuits. Special Circuits for the Vacuum Tube. Wireless Telephony. The Dynatron Detector and Oscillator.

WIRELESS EXPERIMENTER'S MANUAL

Bucher, E. E.

Medium 8vo. 354 pages with 273 diagrams and illustrations. Price 12s. 6d. Post free 13s. 3d.

Dowsett, H. M. M.I.E.E.

WIRELESS TELEGRAPHY AND TELEPHONY—FIRST PRINCIPLES, PRESENT PRACTICE, AND TESTING

Demy 8vo. 331 pages. 305 diagrams and illustrations. Price 9s. Post free 9s. 9d.

CONTENTS—

Chapter I.—The Nature of Electricity and of the Atom.
Chapter II.—On Phase Displacement Effects in Elementary Circuits.
Chapter III.—The Spark Discharge.
Chapter IV.—Continuous Wave Transmitters.
Chapter V.—Thermo-Ionic Effects and Oscillation Valve Phenomena.
Chapter VI.—The Special Apparatus used for High-Speed Transmission and Reception.
Chapter VII.—The Measurement of Electric Current and of Electro Motive Force.
Chapter VIII.—The Measurement of Resistance.
Chapter IX.—The Measurement of Capacity.
Chapter X.—The Measurement of Inductance.
Chapter XI.—The Measurement of Frequency.
Chapter XII.—The Measurement of Dielectric Strength.
Chapter XIII.—The Measurement of Decrement.
Chapter XIV.—The Measurement of the Direction, and the Distance of Transmitting Stations, and the Intensity of Received Signals.

Fleming, J. A. M.A., D.Sc., F.R.S. M.Inst.E.E., etc.

THE WIRELESS TELEGRAPHIST'S POCKET BOOK OF NOTES, FORMULÆ, AND CALCULATIONS

352 pages. Size 7½ by 4½. 39 diagrams and illustrations. Price 9s. net. Post free 9s. 5d.

CONTENTS—Mathematical Notes. Units, Dimensions and Systems of Measurement. High-Frequency Resistance and Inductance Measurement. High-Frequency Current and Voltage Measurement. Capacity Measurement and Pre-determination. Bridge Methods of Measurement of Resistance and Inductance. High-Frequency Cymometer Measurements. Wavelengths and Decrements. Aerials and Electric Radiation. Transmitters and Transmitting Circuits. Receiving Circuits and Detectors. Practical Information for Wireless Operators. Various Mathematical Tables.

Martin, Marcus J.

THE WIRELESS TRANSMISSION OF PHOTOGRAPHS. (*The only Book on the Subject.*)

Second Edition. Demy 8vo. 145 pages. 77 diagrams and illustrations. Price 5s. Post free 5s. 6d.

CONTENTS—Introductory. Transmitting Apparatus. Receiving Apparatus. Synchronising and Driving. The "Telephograph." Selenium Cells. Preparing the Metal Prints.

YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY

(Published Annually in April.)

Demy 8vo. 1922 Edition contains over 1,450 pages. 15s. net. Post free 16s. 3d.

CONTENTS—Wireless Laws and Regulations of all Countries of the World. Map prefaces each Section, indicating Wireless Stations. Alphabetical List of Call Letters. Dictionary of Technical Terms. Patents. Research Work during Year. Literature of Wireless. Technical Articles by Leading Scientists.

A special feature of the 1922 Edition is a specially drawn map, which gives for the first time, a simple means of finding the distance and true direction of Wireless Stations in all parts of the World, from London as the centre.