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THE WIRELESS WORLD
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A MAGAZINE DEVOTED TO WIRELESS TELEGRAPHY AND TELEPHONY

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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.

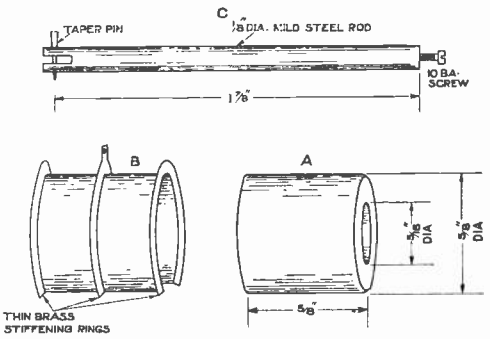


Fig. 1.

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).

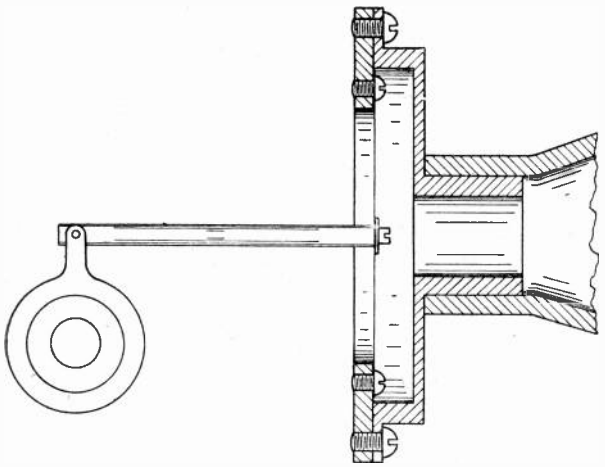


Fig. 2.

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

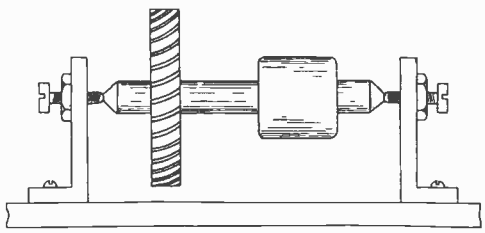


Fig. 3.

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

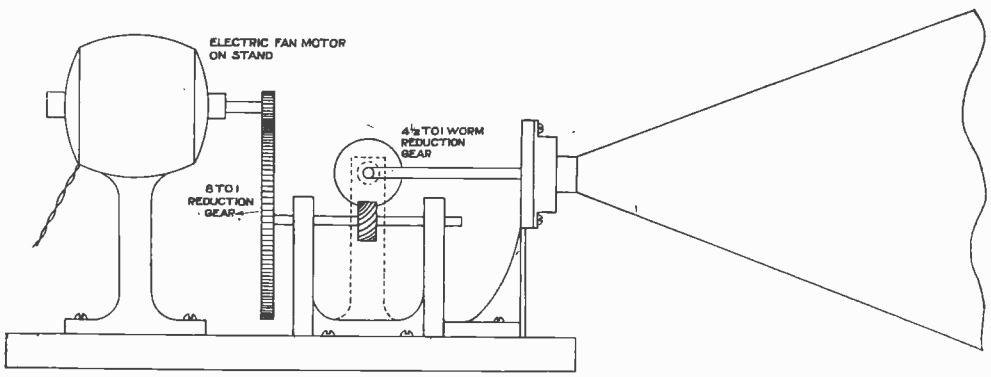


Fig. 4.

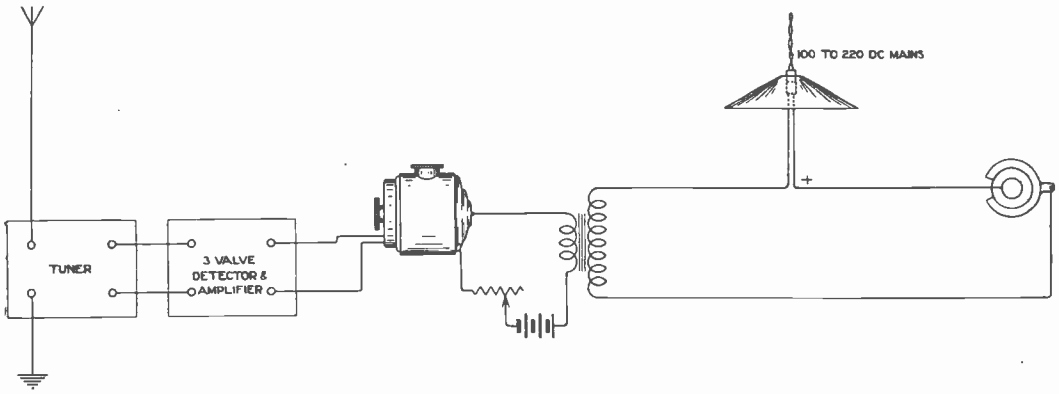


Fig. 5.

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.

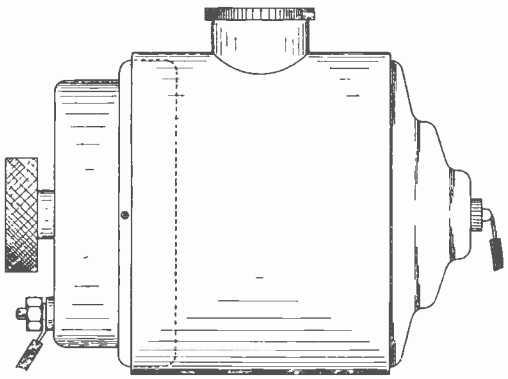


Fig. 6.

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.

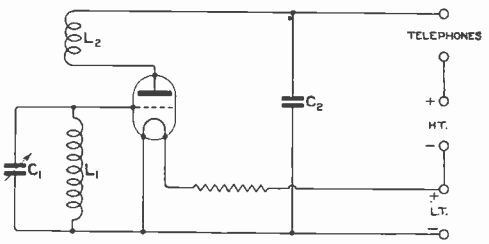


Fig. 1.

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

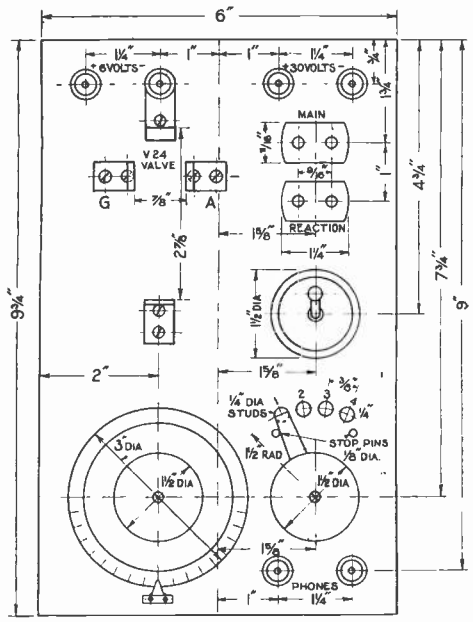


Fig. 2.

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 0·0049	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.

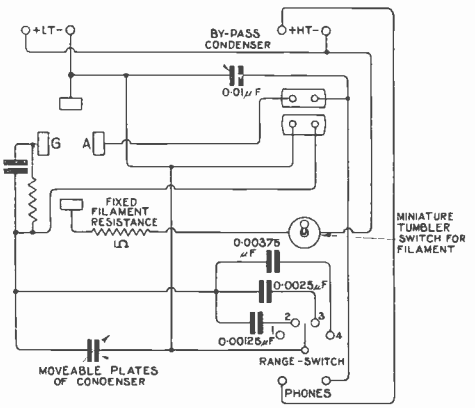


Fig. 3.

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 $9\frac{3}{4}'' \times 6''$, so that if mounted as the top of a box $4\frac{3}{4}''$ 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.

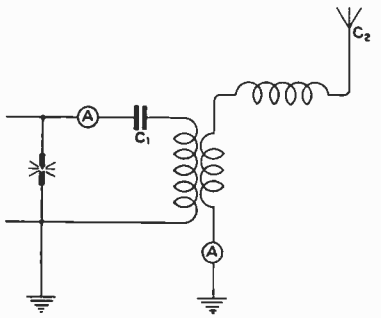


Fig. 1.

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

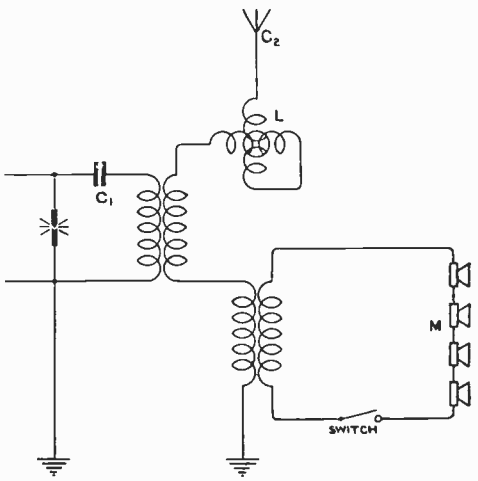


Fig. 2.

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

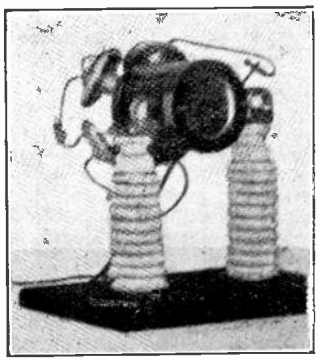


Fig. 3.

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.

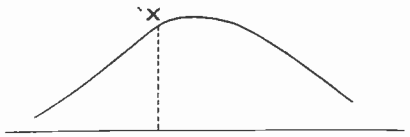


Fig. 4.

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

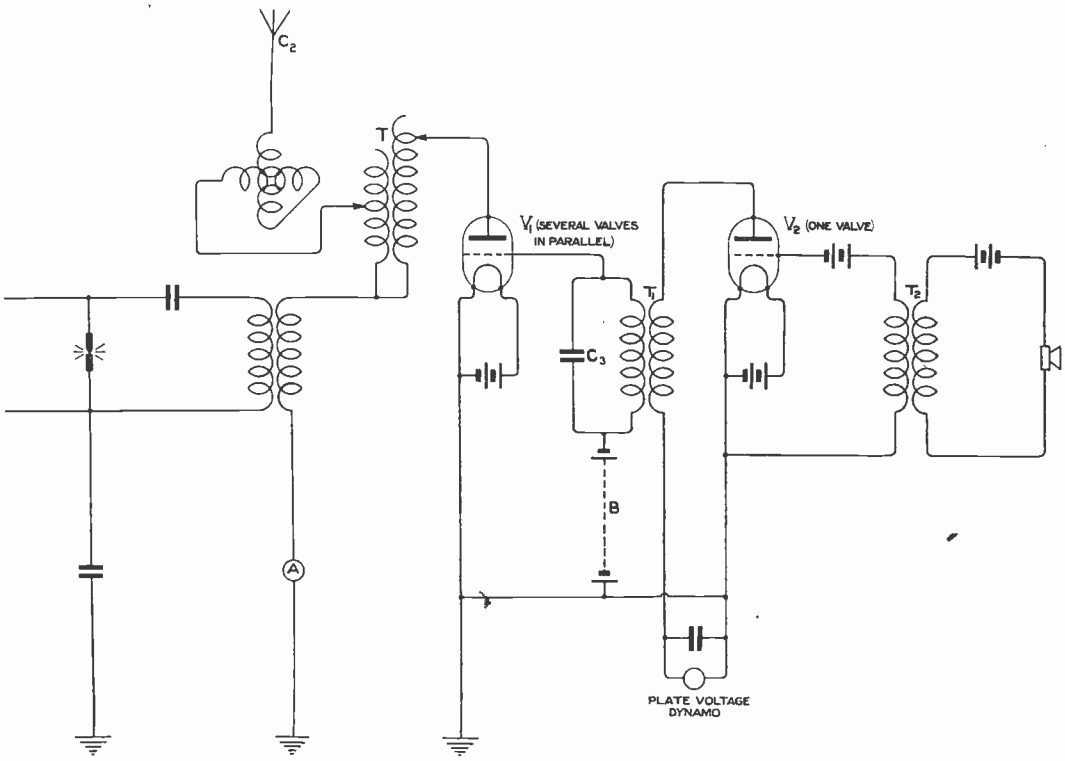


Fig. 5.

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 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.

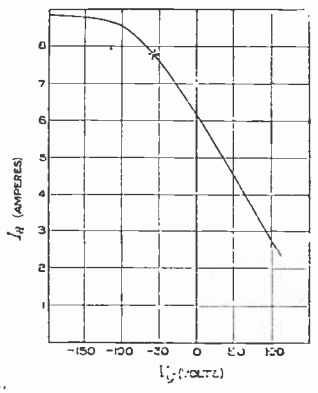


Fig. 6.

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 - - - - - - - - 15A

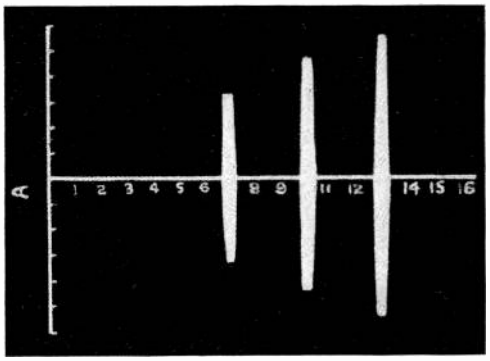


Fig. 7.

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,

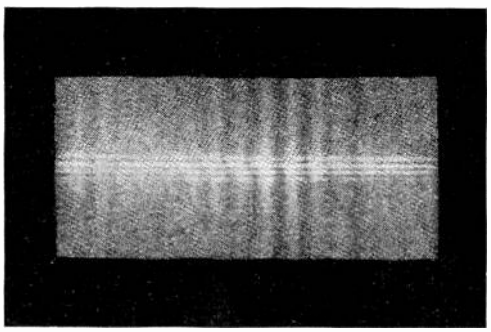


Fig. 8.

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 milliam-

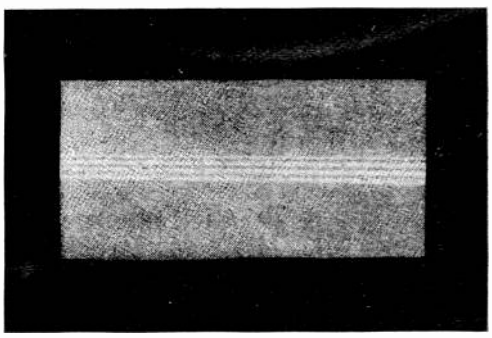


Fig. 9.

meter 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.

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

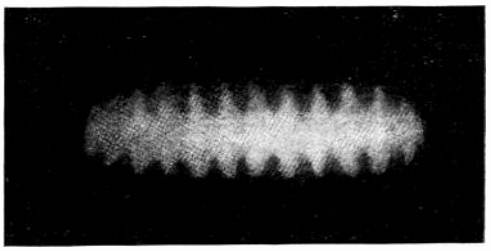


Fig. 10.

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

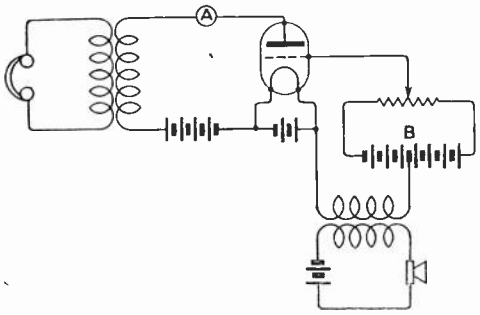


Fig. 11.

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

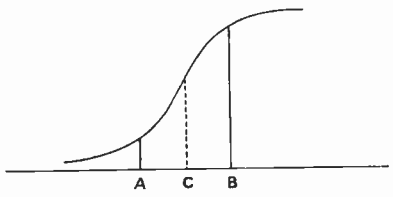


Fig. 12.

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 E. 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.

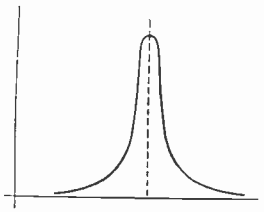


Fig. 1.

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—

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

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.

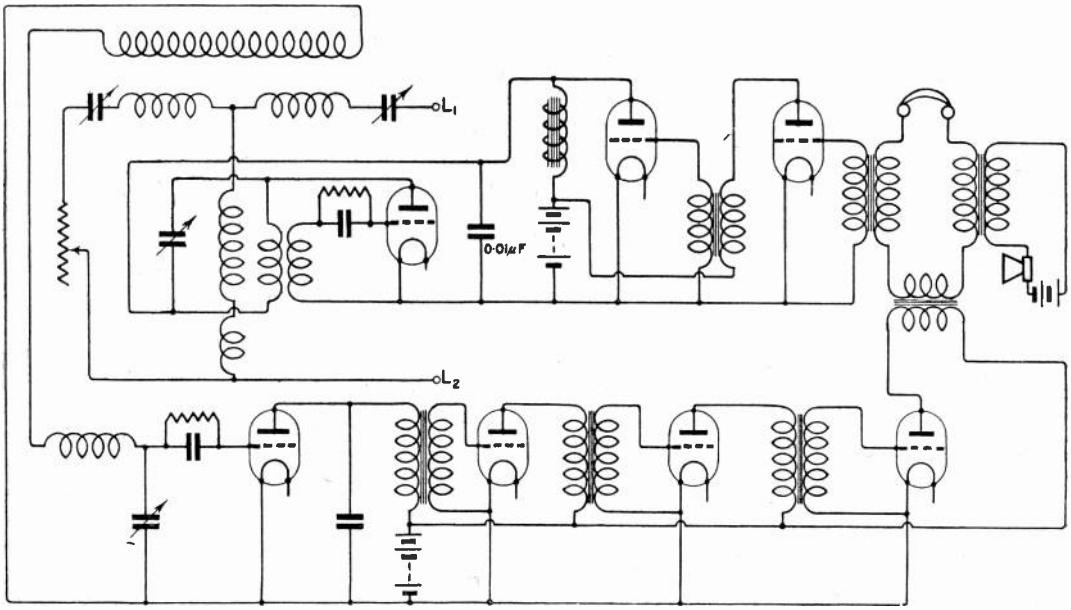


Fig. 2.

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.

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

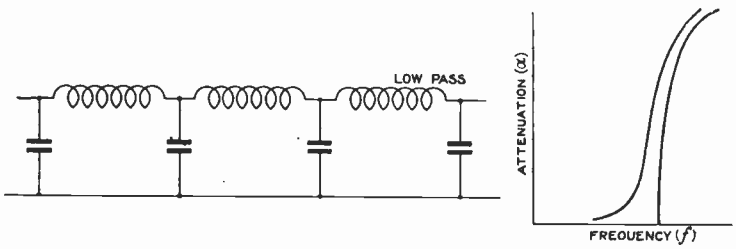


Fig. 3. Campbell's Filter.

(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

$(Q/2\pi - P/2\pi)$, 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.

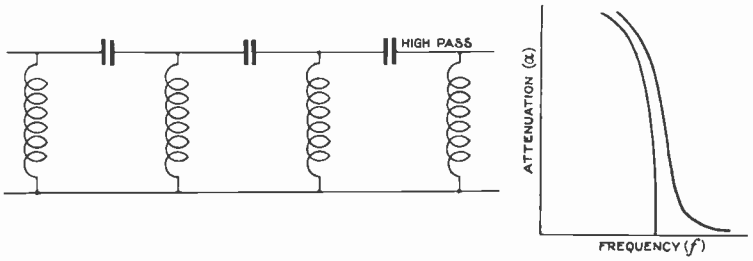


Fig. 4. Campbell's Filter.

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.

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.

(*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.

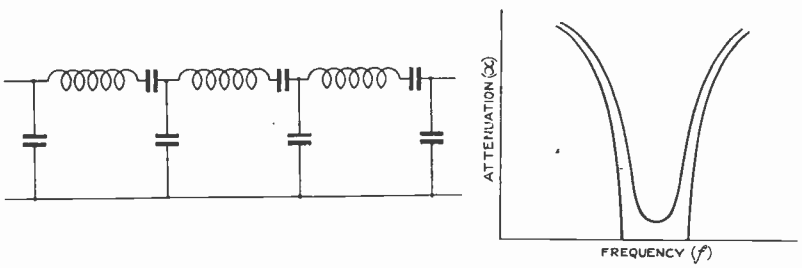


Fig. 5. Wagner's Filter.

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

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.

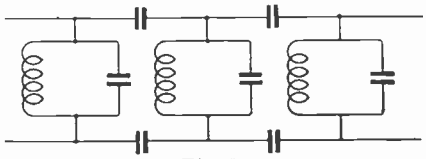


Fig. 6.

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

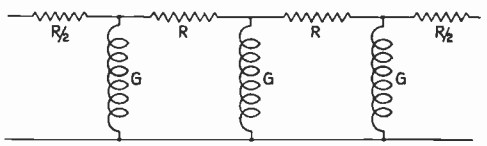


Fig. 7.

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.

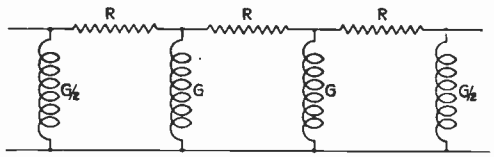


Fig. 8.

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

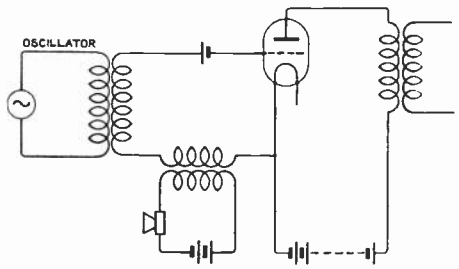


Fig. 9.

(5) The Wire Problems.

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

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

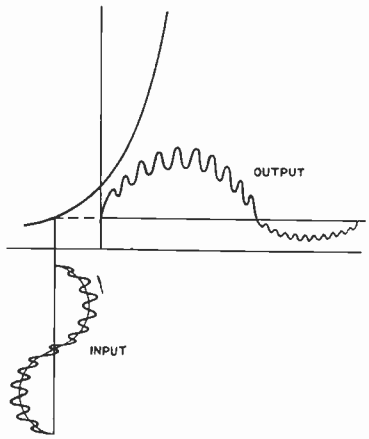


Fig. 10.

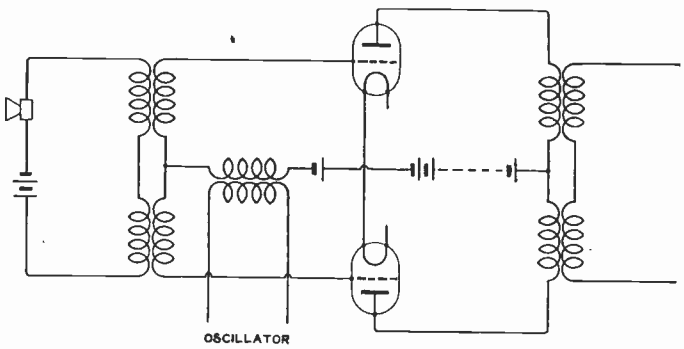


Fig. 11.

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.

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 $\sqrt{R + j\omega L/G + j\omega C} = \nu L/C$ at the higher frequencies. Thus it could be balanced by a pure resistance.

Actually, however, when the impedance of the

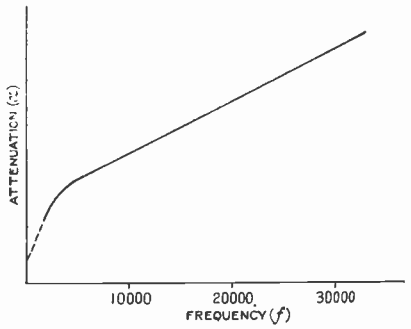


Fig. 12.

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.

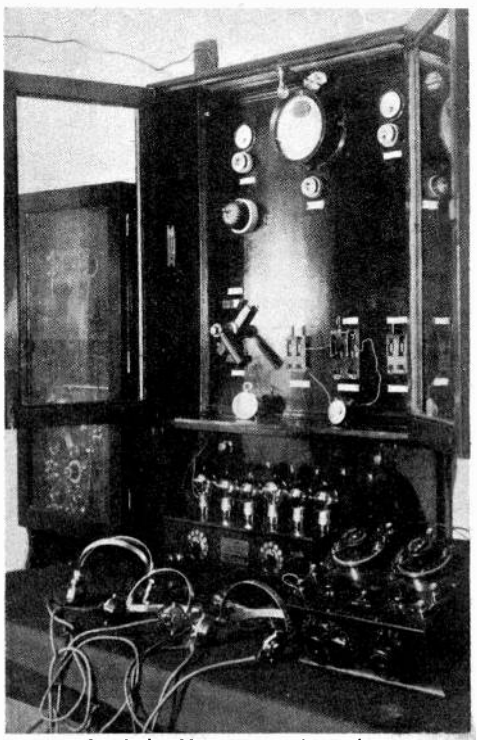
Other countries also have their "romantic" calls. Ostend could not be better designated than by **OST**, and she is quite justified in using it because Belgium's Berne-allotted calls include all those between **ONA** and **OTZ. PRG**, Prague, is one of the most striking abbreviations in daily use, whilst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

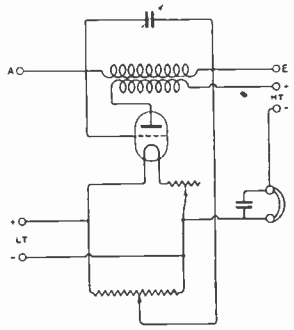


Fig. 1.

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

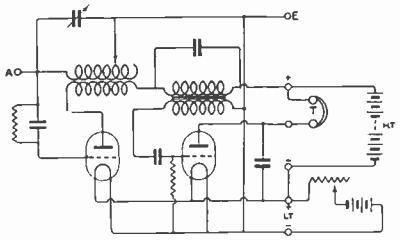


Fig. 2.

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.

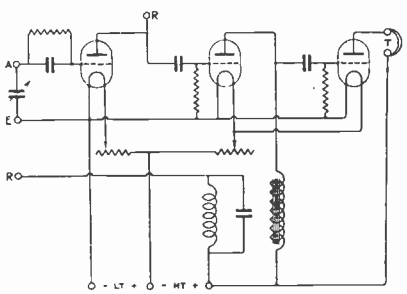


Fig. 3.

* 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

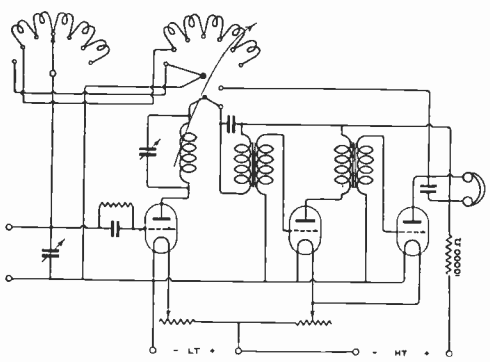


Fig. 4.

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.

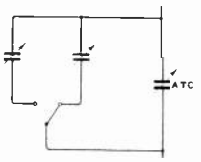


Fig. 5.

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.

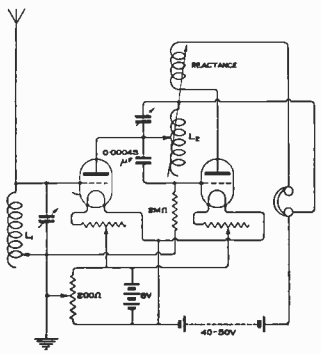
Wireless for Polar Expedition.

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."

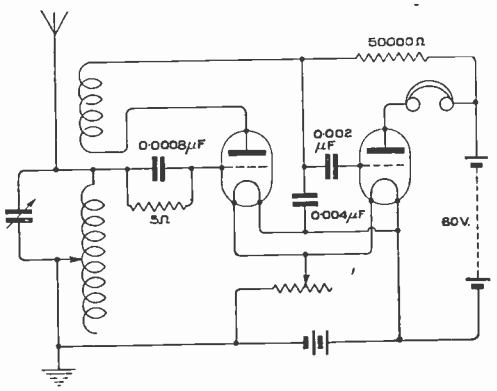
Comment is needless. Perhaps the *Daily Express* may discover I.D.O., or the *News of the World* may tell us all about Nauen. Who knows? We live in an age of discovery!

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.*

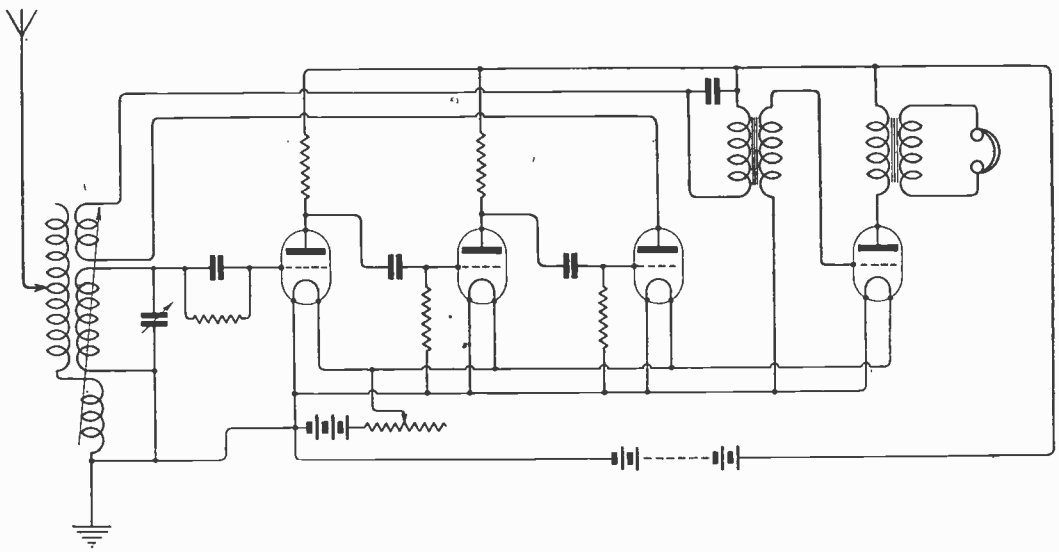


Fig. 1.

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.

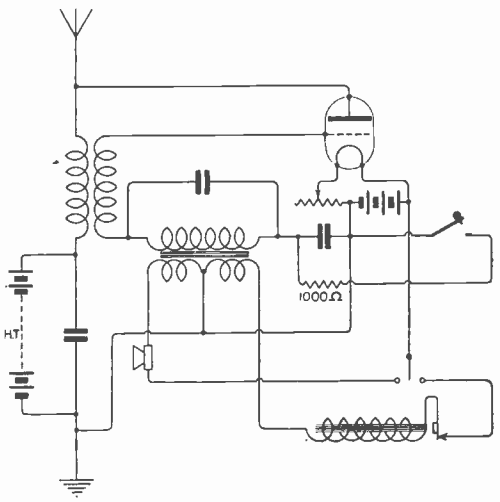


Fig. 2.

"**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* 2*nd 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* 52*a 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 ¼ 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 ⅛ 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.

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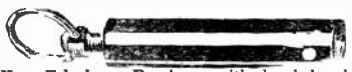

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