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A COMPARISON OF THE SELF-CAPACITIES OF SINGLE LAYER AND MULTILAYER COILS

By W. J. BROWN, B.Sc.

IT is not intended to give here a mathematical treatment of the subject, but rather to show the application of a simple and very approximate method for comparing the self-capacities in various forms of tuning inductance. No attempt will be made at the calculation of the actual self-capacity.

It is, first of all, necessary to give a definition of the self-capacity of any coil.

Any coil used in practice has, besides inductance, a "self-capacity" between each pair of neighbouring turns of wire, and also between each pair of consecutive layers.

If the coil is connected up in any A.C. circuit, its action is not that of a pure inductance, but that of an inductance having a condenser of a certain definite capacity connected across its terminals. The capacity of this condenser may be defined as the "Equivalent Self-Capacity" of the coil.

Fig. 1(*a*) and (*b*) shows the two equivalent circuits :—

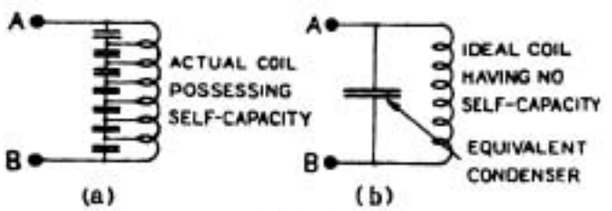


Fig. 1.

Now, suppose we take the ideal inductance, having the equivalent condenser connected across the ends, and we maintain a constant alternating voltage V across the terminals AB.

Let C = capacity of the equivalent condenser.

f = supply frequency.

Then current flowing through the condenser

$$= I_c = 2\pi f.V.C \quad . \quad . \quad . \quad (1)$$

i.e., with constant supply voltage and frequency the condenser current is proportional to the equivalent self-capacity.

We can now apply this to the determination of the equivalent self-capacity, by taking each little element of self-capacity in the coil, in turn, finding the condenser current through the element, and finally combining all these currents to find the total condenser current flowing between the terminals A and B; this gives us a measure of the equivalent self-capacity.

The above is most clearly illustrated by taking a few examples: For simplicity in calculation, conditions are taken which would never be met with in practice, but as the results are only intended to be comparative, this does not matter.

First, we will assume that the capacity between any two neighbouring turns in the coil (either in the same layer or in consecutive layers) is equal to 1 microfarad.

Next we assume that an A.C. voltage of 1 volt is maintained across the ends of the coil, with a frequency of such that $2\pi f = 1$.

Let us take a coil having one layer of twelve turns, Fig. 2.

Fig. 2.

Then the capacity between each pair of consecutive turns = 1 microfarad, and the voltage between each pair of consecutive turns = $\frac{1}{11}$ volt.

Substituting in equation (1)—

$$I_c = 2\pi f.V.C.$$
$$= 1 \times \frac{1}{11} \times 1 = \frac{1}{11}$$

Therefore, current through each element of self-capacity = $\frac{1}{11}$ microamps. As all the elements are in series, the total condenser current from A to B = $\frac{1}{11}$ microampere.

Since voltage between A and B = 1 volt. The equivalent self-capacity is given by :—

$$I_c = 2\pi f.V.C$$
$$C = \frac{I_c}{2\pi f.V.}$$
$$= \frac{\frac{1}{11}}{1 \times 1} = \frac{1}{11}\ \mu F$$

Now, consider a coil having the same total number of turns, but wound in two layers. (Fig. 3.)

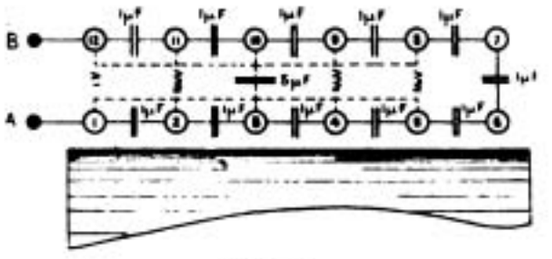


Fig. 3.

Here we have, as in the previous case, the 11 elementary capacities between turns, all in series.

In addition to this we have a "layer capacity" between turns Nos. 1, 2, 3, 4, 5 (all in parallel), and turns Nos. 8, 9, 10, 11 and 12 (all in parallel).

This layer capacity may be taken as approximately 5 mfds., since there are five turns in parallel in each layer. The voltage across the capacity varies from 1 volt between turns 1 and 12, to $\frac{3}{11}$ volt between turns 5 and 8.

The mean voltage across the "layer capacity" is, therefore, $\frac{11 + 3}{2 \times 11} = \frac{7}{11}$ volts, and the layer condenser current (from equation 1) is :—$1 \times \frac{7}{11} \times 5 = \frac{35}{11}$ microamps.

Added to this, we have the condenser current between turns = $\frac{1}{11}$ microamp.

∴ Total condenser current = $\frac{36}{11}$ microamps.

∴ Equivalent self-capacity = $\frac{36}{11}\ \mu F$

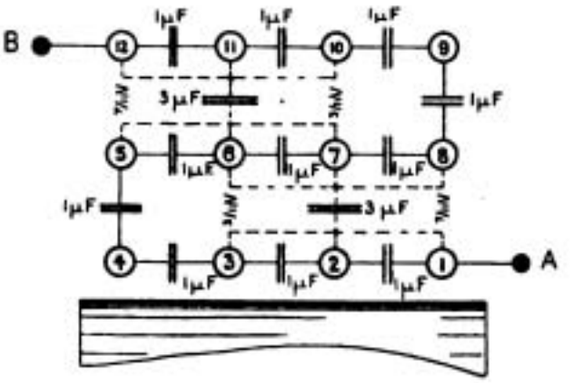


Fig. 4.

Now we will take a coil having three layers of four turns each, and treat it in the same way. (Fig. 4).

Taking the first pair of layers : the layer capacity is between turns Nos. 1, 2, 3, and turns 6, 7, 8, and is therefore = 3 μF.

The voltage varies from $\frac{7}{11}$ to $\frac{3}{11}$, having a mean value of $\frac{5}{11}$ volt. Hence, the layer condenser current = $\frac{5}{11} \times 3 = \frac{15}{11}$ microamps. Now, the capacity between the first two layers is in series with that between the second and third layer, so that the total layer condenser current between A and B = $\frac{15}{11}$ microamps.

Adding to this the condenser current between turns, of $\frac{1}{11}$ microampere, we get a total condenser current of $\frac{16}{11}$ microamps. Hence the equivalent self-capacity = $\frac{16}{11}\ \mu F$. In the same way we may work out the equivalent self-capacity

for various other arrangements of layers and turns, and some results are tabulated below.

No. of layers.	Turns per layer.	E.S.C. between turns.	Layer Capacity.	Mean volts between layers.	Layer condenser current.	Total condenser current.	Total E.S.C.
1	12						μF
2	6		5 μF	volt.	micro-amps		"
3	4		3 "	"	"		"
4	3		2 "	"	"		"
6	2		1 "	"	"		"
12	1		0	0	0		"

In the above table it has, of course, been assumed that the mean radius of the coil remains the same in every case.

It is interesting to compare the cases of coils having respectively—(*a*) two layers of six turns each, and (*b*) six layers of two turns each. The first is known as a "Two-Layer" coil, while the second is generally known as a "Pancake" coil; as, however, the term "Pancake Coil" usually includes coils wound on the "Basket" principle, it might be as well to term coil (*b*) above, a "Disc" coil.

We will assume that the two coils (*a*) and (*b*) have the same mean radius, and we first notice that their inductances are equal. Referring, however, to the table on this page, we see that the self-capacity of coil (*b*) is only $\frac{1}{9}$ that of coil (*a*): the coil (*b*) is thus greatly to be preferred for use as a tuning coil.

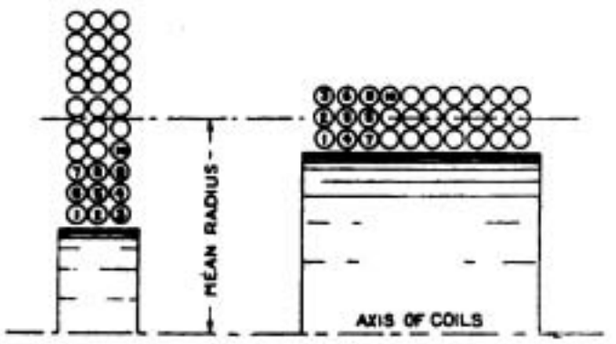


Fig. 5.

On comparing Figs. 5 (*a*) and 5 (*b*), it will be seen that the "disc" coil consists really of a *pile-winding*, except that it is executed in spiral instead of in cylindrical fashion. It is seen from a comparison of Figs. 5 (*a*) and (*b*) that the self-capacities of the disc-coil and of the pile-wound coil having the same mean radius are approximately equal. Other considerations show that the inductances of these two coils are also equal, so that the coils are almost equivalent (electrically) in every respect.

Now, it is well-known that a two-layer coil has four times the inductance of a single-layer coil of the same length and mean radius, while taking only twice the amount of wire; a three-layer coil has nine times the inductance of a single-layer, and so on. It is obvious, then, that great economy can be effected, both in wire and in space, by winding a coil in several layers.

The layer-wound coil may, as seen above, take the form of either—(1) a plain layer-wound coil; (2) a pile-wound coil; (3) a disc coil.

The first has a very high self-capacity, as seen from the table, and is, therefore, unsuitable for use as a tuning coil. The second has a low self-capacity, and is quite suitable for use in a wireless receiving set, but the winding by hand of such a coil is a very tedious operation, as anyone who has tried it will agree. The third form of coil (disc coil) has a low self-capacity, like the pile-wound coil, and may be very easily wound, as follows:—

A former should be made, consisting of two large discs of wood, with a small thin disc between, the three discs being bolted or screwed together. This former is mounted in the lathe, or on any spindle capable of rotation, and is simply wound with wire to the required depth (see Fig. 6); it is not essential that the wire should lie quite evenly, in layers, though if it can be made to do so, so much the better, as this keeps down the self-capacity. The wire may be left on the former when in use, or, if desired, the whole may be soaked in paraffin wax. When cold the former may be unscrewed, and the coil carefully drawn off the inner disc. The

latter method has the advantage of leaving the former ready for the winding of other coils.

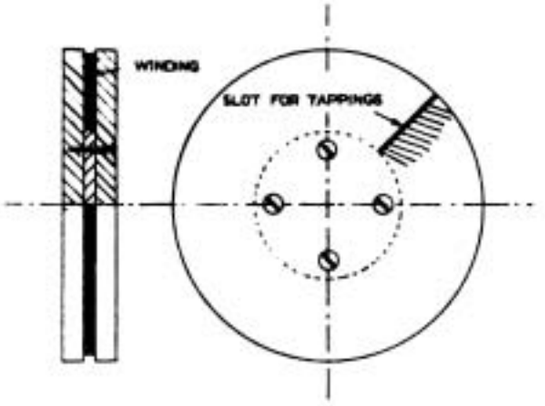


Fig. 6.

In order to take off tappings from such a coil, one or more sawcuts may be made down one flange of the former; at suitable intervals during the winding of the coil, loops of wire may be brought out through the sawcut, to act as tappings.

Considerations of the "pancake" or "disc" coils, from a theoretical point of view, led the author to experiment with this type of winding.

Having at hand a section of the secondary winding of an induction coil (believed to be the standard Marconi 10-in. emergency coil), this was tried as the aerial tuning inductance of a direct-coupled two-valve set. This coil was about 5 ins. in diameter, and ⅛-in. thick, and was wound with No. 36 S.W.G. wire.

A somewhat smaller disc coil, wound with No. 40 S.W.G. wire, was used as a reaction coil. Using the regulation amateur aerial, this set brought in Eilvese (Hanover) on about 9,500 metres, with no condenser across the A.T.I. With a condenser across the A.T.I., Annapolis came in quite clearly.

Previously, single-layer coils had been in use, tuning up to about 8,000 metres with no condenser. The disc coils gave signals of about the same strength as those given by the single-layer coils; and whereas the single-layer coils had several pounds of wire on, and took days to wind, the disc coil took only a few ounces of wire, and such a coil could be wound in half-an-hour in the lathe.

Two such coils may be used in conjunction as a loose-coupler, with a third coil for reaction; the coils being arranged parallel to each other. Two disc coils connected in series would make a very convenient variometer, covering a fairly wide range of wavelengths.

The author hopes that this article will give some encouragement to amateurs who are contemplating the construction of a long-wave receiving set, by showing that it is not necessary to build up enormous single-layer coils, nor to impair the efficiency of the set by connecting a large condenser across a comparatively small aerial and tuning inductance.

A VALVE PANEL SET

By G. LAWTON.

I PROPOSE in the following note to give a description of my wireless station, which is easy to operate, and gives good results.

The aerial consists of 2 copper wires (18 gauge) suspended at a height of 28 feet, with a total length of 50 feet, he feeder, or lead-in, being 20 feet in length. The aerial is of the L type. It is badly screened on all sides by houses.

The earth wire is soldered to the water pipe, a length of No. 8 gauge copper wire being used. The receiver employed is of the 1-valve type, viz., a Marconi M9 valve panel, fitted for C.W. or spark, which gives excellent results.

The high-tension battery is 60 volts, an accumulator supplies the 4-volt filament current.

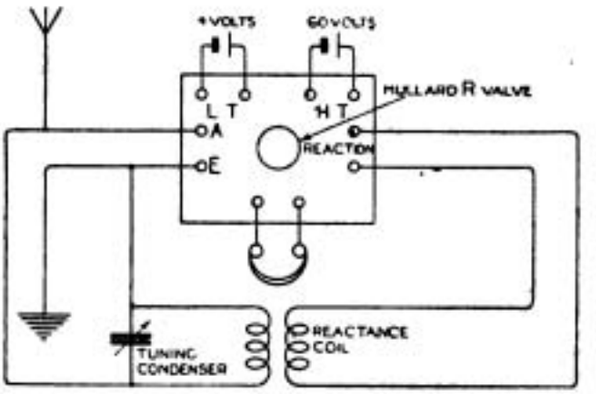
A VALVE PANEL SET

The tuning is done by slab inductances, which can be easily fitted to the Marconi panel. Good loose coupling between the reaction and the tuning coil can be obtained with the discs 5 inches apart. Lafayette is quite clear when this coupling is used.

The circuit employed is shown in the diagram.

The tuning is done by the condenser as shown. The reactance circuit is aperiodic. Malta, Moscow, Madrid, Budapest and Gibraltar are received clearly in broad daylight.

By using different slabs a range of wave-lengths from 600 to 24,000 metres is obtained. This apparatus is, as the diagram shows, of simple design, yet it is very efficient. The only adjustments necessary being at the condenser and coupling coils. I find it a

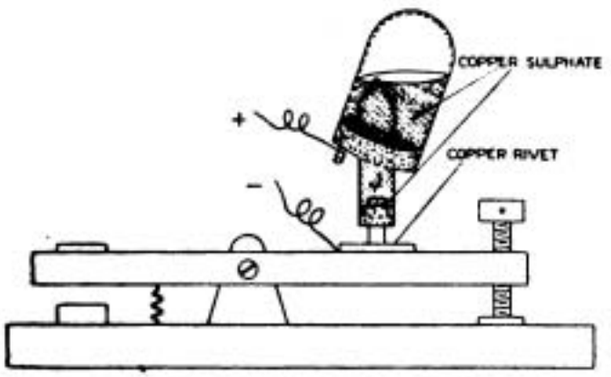


great improvement on the slider-tuning inductance.

MENISCUS MICROPHONES

A PAMPHLET just issued from the Government Press at Cairo, for the Egyptian Ministry of Public Works, describes a new form of microphone devised by Mr. E. B. H. Wade, Director of Research.

The principle of the instrument, which is very simple, was inspired by Mr. S. G. Brown's microphone, but the two are really quite dissimilar. The arrangement of the essential parts is shown in the accompanying



sketch, in which J is a glass tube drawn out to a fine point with an orifice at the top, about 0·3 m.m. in diameter. This tube is pushed through a rubber stopper in a piece of inverted test tube, which lies at an angle as shown. The apparatus is filled with a solution of copper sulphate and terminals for the electric circuit provided in each tube. The whole arrangement is mounted on a tilting table.

The level of the liquid is so adjusted that the orifice of the pipe J just pierces the meniscus of the solution. The tilting table is then moved until the orifice just grazes the meniscus and the microphone is ready for use. In these circumstances a current of from 2 to 3·5 milliamperes will flow through a telephone circuit of 1,000 ohms resistance with 15 volts, and sound vibrations transmitted to the base of the instrument will be greatly magnified in the telephone.

Mr. Wade suggests that the action of the microphone is dependent on the liquid in the tube J being pumped in and out of the orifice by the sound vibrations. As the liquid is forced out it forms a little bump in the surface of the meniscus, over the orifice, and thus provides a greater section of liquid to conduct the current between the terminals. As the liquid recedes again the path for the current is restricted and its resistance increased.

The inventor says that the process of adjusting the instrument is quite easy and simple. (*The Engineer.*)

EXPERIMENTAL WIRELESS TELEPHONY

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

(*Continued from page* 144.)

DISCUSSION.

Admiral Sir Henry B. Jackson : I wish to thank Mr. Coursey for giving us such a very instructive lecture. He must have taken a lot of trouble to get out these details. I do not know personally much about wireless telephone transmitting, but I know something about reception, and I think he has given us some hints which may improve our reception. Sometimes I get absolutely perfect speech and next day it is very distorted, but I shall know now where to look for things that have troubled me very much. I must say that the trouble Mr. Coursey has taken deserves our very great thanks, and he has given us a very successful demonstration.

Mr. C. F. Phillips : First of all we have to congratulate Mr. Coursey on a very wonderful demonstration of a new method of applying valves. I have hitherto seen no publication on any use of the saturated valve nor on the uses to which he proposes to put it now. The method of using such a valve in place of choke control is extremely interesting, but more interesting, I think, is the application of that system to the smoothing out of ripples. He showed that it could be employed to remove sounds from an A.C. supply, and I think he also said it could be used to smooth out commutator ripples from D.C. supplying the transmitter. I should very much like to know what amount of current in milliamperes he assumes that such a valve could pass to a transmitter. Secondly, as regards the grid modulation. The lecturer said that the modulation obtained could not be greater than the steady current flowing. That is quite evident, but as this modulation is limited by the value of the steady current flow, if one had a decent modulation transformer, surely one could obtain better modulation by inserting resistances to lower that steady current. Otherwise one could use regulators and rheostats in that circuit if one's speech is distorted, or insert resistance between the modulation transformer circuit and the microphone. Thirdly, I should like to ask a question with regard to the circuit used in the R.A.F. sets. In Fig. 11 the explanation of the object of the iron core choke in the H.T. supply was very carefully given by Mr. Coursey, but what about that little coil joining the plates of the two valves together, which is, I take it, a radio frequency choke. If he could give us a few words about its action it might be interesting. Fourthly, I think we ought to thank Mr. Coursey for preparing and giving us such a wonderful demonstration.

Mr. L. McMichael : With regard to my set I really had not the least idea that I was going to be called upon to speak this evening. I have got quite good results with my set, and a range of 30 to 35 miles using 10 watts—C.W., of course, not telephony. I will send a fuller description of it for publication with the discussion.

Mr. L. McMichael (*communicated*) : At the request of the author of this paper I am giving some practical details of my transmitting gear.

Source of Supply.

An ex R.A.F. generator (normally used, is driven by a small air propeller giving 600 volts from one commutator and 6 volts from the other), I find that by putting into the low voltage end a potential of from 10 to 20 volts, it becomes a good motor generator—a field circuit resistance is advisable, and to keep within license limits it is run to give a H.T. voltage of about 400 volts. A 0·5 mfd. condenser, C_1, Fig. A, is placed across the H.T. terminals, and a choke coil L is important.

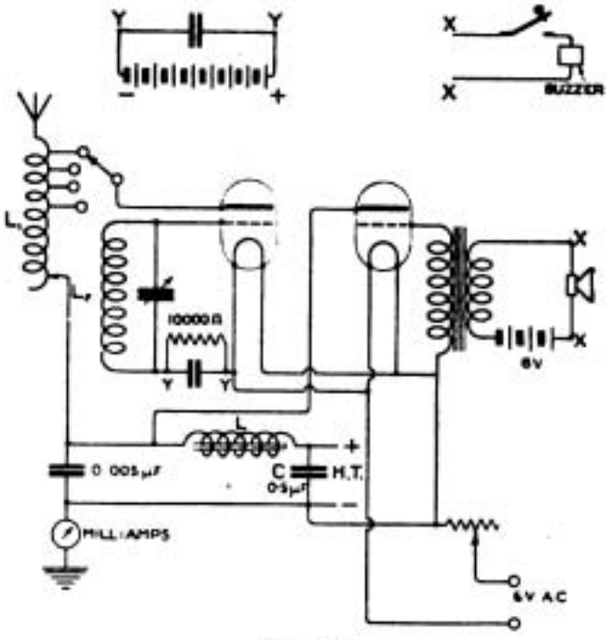


Fig. A.

Upon the efficiency of this choke depends, to a marked extent, the quality of the speech emitted.

Tuning Coils.

With the very limited power granted the experimenter, it behoves him to study efficiency from every point of view, and my own experience is that to obtain 1,000 metres on a normal aerial, an aerial inductance, L_1, of about 150 turns on a 4-in. ebonite former should be used—turns spaced

½ a diameter and the wire used should be stranded insulated, say 25/40. Reaction coil, L_2 may be on a 3-in. ebonite former and contain about 200 turns of 30-gauge D.S.C. wire. Across this I usually employ a variable condenser.

Valves.

My experience has been that for 10 watts and under, using the comparatively low voltage of 400, the ordinary "R" type French valve is suitable—this must be chosen with some care, however, and every valve will not stand the strain. If expense is not of great importance, or where higher potential is to be used, it is preferable to use the "B" type valve—if only one "B" valve is to be used this should, of course, be placed on the "control" side. My valve lighting is done with alternating current. I use a small step-down transformer from my mains at 200 volts to 6 volts, and with a rheostat in series the glow of the filament affords an easy method of regulating aerial current output.

Microphone.

After having used and tried innumerable types of microphone I cannot whole-heartedly agree with Mr. Coursey that it is quite so easy to find a good one—at any rate, I have found nothing to beat the standard R.A.F. type, which is excellent, does not easily heat up and the capsule being removable is easily replaceable. Current used at 6 volts I find to be 0·1 amps. at rest, about 0·9 amps. during speech the latter figure being by no means fixed. For microphone transformer I find the R.A.F. type also good, though I have not had time to experiment in this direction. A grid leak of 10,000 ohms is a useful size and should be shunted by a condenser of usual small value. I have also made use, successfully, of the arrangement of imposing a negative potential on the grid of the power valve, of anything from 10 to 45 volts (inserted at Y and Y), with a small condenser across the battery to allow oscillating current to pass.

For transmitting C.W.

The control valve is removed and a key may be placed in the grid circuit or plate circuit. I also find it useful where prolonged tests are to be carried out to have a change-over switch at XX in microphone circuit, to insert a buzzer and key instead of speaking. An illustration of the set is given in Fig. B.

In conclusion I would like to add to those of the other speakers my thanks to Mr. Coursey for his most instructive and well illustrated lecture.

Mr. Maurice Child: I should like also to congratulate Mr. Coursey on the very beautiful apparatus he has shown us for demonstrating the various circuits to-night. There are one or two little points on which I think it might perhaps be useful to have further information. Mr. Coursey mentioned the question of coupling the aerial circuit inductively with the main oscillating circuit. Of course, this is undoubtedly a very desirable thing to do, but it might not be always appreciated; but there are certain difficulties in connection with this coupling. I think, first of all, it is rather essential that such a coupling should be loose, otherwise we get the usual double wave effect due to the coupled circuits Consequently, if we have a loosely coupled aerial circuit on such small power as 10 watts, there is not going to be a great deal left to get to the aerial. There is bound to be some lost in the coupling. It would also be very important to make the aerial circuit of very low resistance with these coupled circuits, as if you have an aerial which is not very well constructed, you will get serious losses. It was suggested by a speaker just now that we could help the microphone control circuit by putting a resistance in series with the transformer, but I was thinking it might be better from the point of view of getting good articulation and less distortion due to the transformer itself if one could arrange to make the iron core adjustable. That would have rather the same effect on

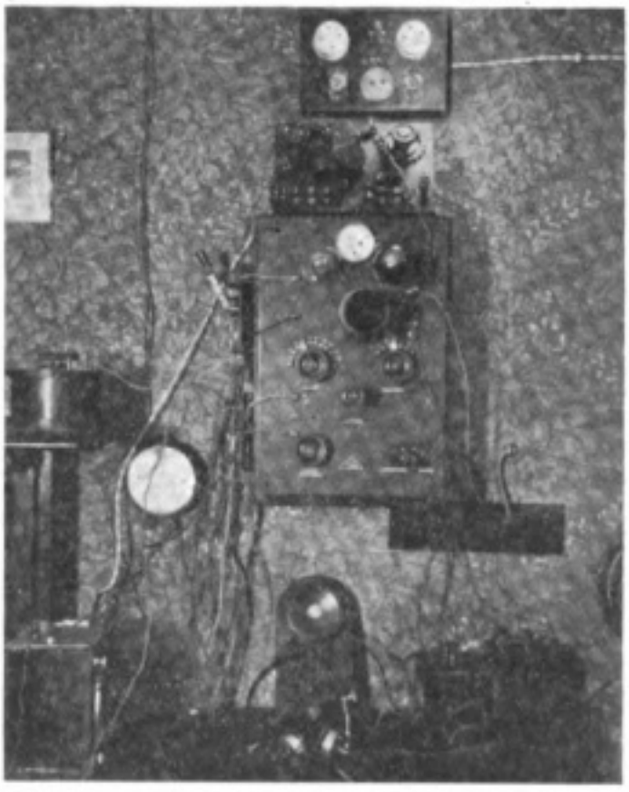


Fig. B.—Radiotelephone transmitter used by Mr. L. McMichael.

the voltage on the secondary, and perhaps we should not get quite so much distortion due to the iron core in the transformer. A telephone engineer told me that a closed core is not the best type of transformer to use for speech. With regard to the aircraft transmitter that Mr. Coursey has shown, I have also one of these, but I have given it up. I did not like it. One thing I find about it is that the wavelength it will give us on a standard aerial is nothing like 1,000 metres, and, consequently, I was rather chary about it because of the Post Office stringent regulations regarding wavelength. The inductance in it is not big enough to give the regular wavelength of 1,000 metres.

Mr. W. W. Burnham: I do not think I can add anything much to what has already been said. Mr.

Child just referred to the R.A.F. set. I think it is quite easy to increase the wavelength to 1,000 metres by just an alteration of the main and reactance coils. I have given it a good test and it seems an efficient instrument, and I can transmit speech about 20 miles with it. I do not think I have any more to add.

Mr. G. G. Blake: It has been a most interesting and useful paper, and I do not think I have many remarks to make, except perhaps with regard to the type of microphone used. I have tried several methods of control and find that where one gets good control with one particular method—such as grid control—with a certain microphone, the same microphone used in some other circuit will not give the same speech quality, but by putting a low resistance one in place of a high resistance microphone one gets equally good control. I would rather like to know what Mr. Coursey may have to say on that.

Mr. A. A. Campbell Swinton: I am sure you would wish me to thank Mr. Coursey for his very valuable paper, which, as you say, was excellent, and must have taken a great deal of trouble to prepare. It is full of interesting and valuable matter. I can mention that I have been making experiments in wireless telephony. I have got two stations, one at my office in Victoria Street, and one at my house in Chester Square, a distance of half-a-mile from each other. At my office I have A.C. available from the mains, and I have no difficulty in transforming it up to 1,600 volts. I have got a 3,000-volt transformer, but it has got a middle terminal. One set uses two valves to rectify the A.C., and with condensers and a choke coil to smooth it out, you get rid of all sound. At my house I use a motor generator, one like we had in the Flying Corps. Originally, it was designed to be driven by an air-screw on the end of it, and I put a motor on it and that works equally well, but it makes a little noise. One of the advantages of A.C. is that you can have an apparatus that makes no noise at all, whereas with running machinery you are bound to get noise. There is one question I would like to ask Mr. Coursey. He has got a battery in circuit with his microphone in all the diagrams shown. I do not think I use a battery in connection with the microphone at all. I think we get current through the microphone by induction from the transformer.

I am sure you will all wish me to accord to Mr. Coursey a hearty vote of thanks for his paper.

Mr. Philip R. Coursey (*in reply*): I should first like to thank Admiral Jackson, Mr. Campbell Swinton, and the other speakers for their kind remarks about the paper. I am afraid it was only a humble effort and put together at short notice. There are such a crowd of subjects one could outline with regard to telephony, and so many different parts that one could speak about that I have not been able to include anything like the whole this evening.

With regard to Mr. Phillips's remarks about the use of that extra little choke coil in the choke control method. Fundamentally, of course, it is put there to stop high frequency currents from getting back to the iron core choke coil. Theoretically, of course, when a high-frequency p.d. is impressed upon an iron-cored coil, and if the voltage is at all high the tendency is that the end turns at least will break down after a short time. It is, however, possible to dispense with it, and I am not using it in the demonstration apparatus. There is, I think, also another reason for its use: The valve I have marked V_1 in Fig. 3, (the modulating valve), is directly in parallel with the oscillating valve. Such a valve only acts as a resistance between its plate and filament. True, it is a high one, but, nevertheless, it is going to draw away from your antenna some oscillatory current. That little air core choke coil tends to stop some of this leak, and to prevent some of the loss through the modulating valve. I do not know whether it has any other uses as well, but these, I think, are the most important ones. With regard to the current that can be passed through the saturated valve, when, of course, the valve is saturated by dimming the filament the current is rather small, but if you use the positive grid method you can get the full saturation current of the valve. I have not measured this current with the arrangement I have got here to-night, but I have passed 10mA through such a V24 valve as I am using here, although the valve then gets rather warm. Of course, it is possible to use more than one valve in parallel, if you wanted to have more current. However, whether it is of any practical use I would not like to say at the moment.

I am sure we are much obliged to Mr. McMichael for the details of his set which may be most useful.

Mr. Child made a few remarks re inductive coupling. I quite appreciate the fact that it is difficult and requires some care in its use, but I do not think the loss is quite so serious as he seems to think, provided the coupling is properly adjusted. I think both he and Mr. Phillips mentioned the use of a rheostat in series with the transformer with grid modulation, in order to improve the articulation. The same effect can also be obtained in this set by putting a shunt across the primary winding. Also, it might be possible to get better articulation by using a transformer having an air gap in series with its iron core, although it is worth while remembering that the primary winding of the microphone transformer is traversed by direct current from the battery, and that consequently the core may be saturated and the permeability may not then be much higher than air. When the iron has a large section and is unsaturated, you do not get anything like so much distortion of the speech.

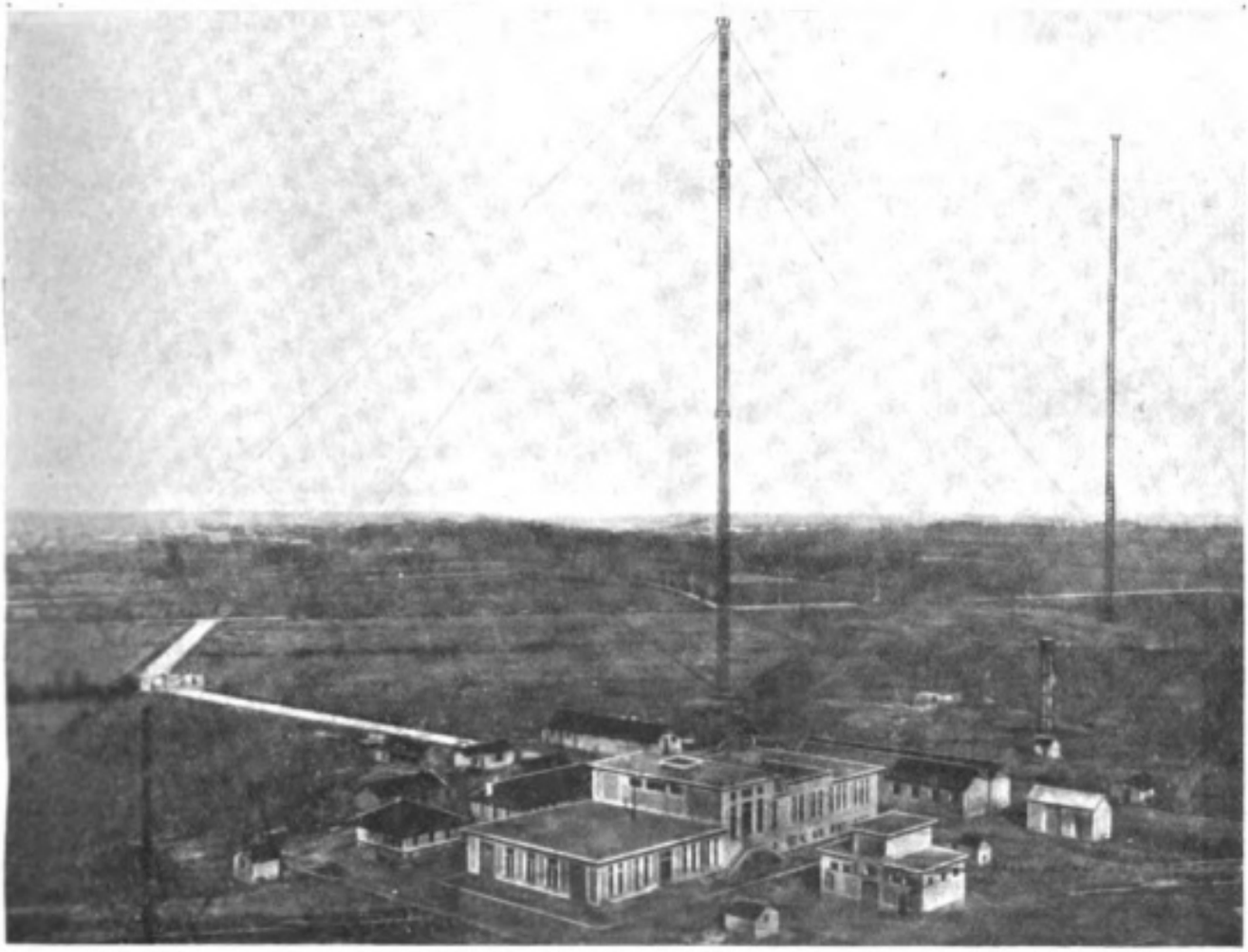
I think the question about increasing the wavelength of the TWA Mark II set has already been dealt with by Mr. Burnham.

With regard to the modulation and microphone transformers and Mr. Blake's remarks about the different microphones, it is often said that better speech is obtained with special low resistance microphones. Of course, this is the case for those circuits in which aerial circuit modulation is used, but I personally do not think it is necessary to have a special microphone in other cases, provided that your circuit is suitable for the microphone you are

using. The standard microphone that has been developed after years of research work by the Post Office for ordinary telephonic transmission ought to be as good a microphone as one could get for use in a direct current circuit. Of course, where the difference very often comes in is that the commercial telephone set uses a high voltage battery in series with a big resistance—the resistances of the windings of the indicators and relays at the telephone exchange are high, and the lines also often have considerable resistance. I am inclined to think that given a proper circuit the fault of bad articulation is to be found more in the circuit than in the microphone itself.

I am afraid I do not follow Mr. Campbell Swinton's remarks about the microphone battery, because in all these cases I have dealt with, except aerial circuit modulation, the microphone is in a separate (low frequency) circuit, and therefore requires its own battery.

NANTES WIRELESS STATION



The above photograph shows a general view of the wireless station at Nantes, whose call **UA** *is probably familiar to most amateurs. This station, which belongs to the French Navy, has at present six masts, to which it is proposed to add a further four. This addition will make it possible to increase the wavelength from* 11,000 *metres to* 20,000 *metres. This alteration will enable the station to guarantee communication with French warships at any distance.*

NOTES ON DESIGNING AN EXPERIMENTAL STATION

By H. B. Dent (ex-Lieut. R.A.F.).

THE following notes are intended as a guide for those who, contemplating the installation of receiving apparatus, do not wish to go to the expense of purchasing ready-made sets. Constructional details are not given, as these have appeared, from time to time, in the pages of *The Wireless World.*

One of the most important parts of the apparatus is the aerial, and time and labour expended on this is well repaid. The actual design must depend upon the local conditions, but where possible an inverted "L" type twin-wire aerial gives very efficient results under the conditions laid down by the P.M.G. The two wires should not be less than 6 feet apart, and a single wire down-lead from the highest end will enable the horizontal portion to be longer than if a twin-wire down-lead was adopted (*see* Fig. 1).

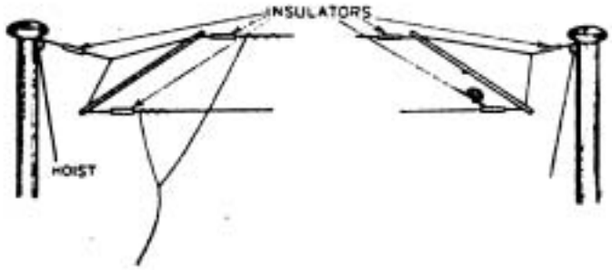


Fig. 1.

In this type of aerial the total length of wire must not exceed 140 ft. from free end to instruments.

The earth connection may be any suitable quantity of wire netting buried directly under the aerial to a depth of 4 to 6 feet, according to the nature of the soil, the writer has found a piece 3 ft. by 6 ft. to answer very well.

With reference to receiving apparatus the beginner will find that a plain-aerial single-valve regenerative circuit (*i.e.*, a circuit having A.T.I., coupled to which is a coil in the plate circuit of the valve, thus impressing the oscillations in that circuit on to the grid circuit and thereby increasing the amplitude of the oscillations on the grid of the valve) will give very satisfactory results with the minimum knowledge necessary for tuning and the handling of valve circuits. Care, however, should be taken in using this type of circuit, as it is in reality a transmitter of weak oscillations when the plate and grid coils are too tightly coupled, the effect of which can be felt at a considerable distance by those using sensitive apparatus.

As it is extremely difficult to obtain efficient results over all wavelengths by using only one A.T.I. and reaction coil (plate coil), the apparatus may be designed so that the oscillatory and detector circuits are two separate units.

By this method of construction, and by adopting one four pole change-over switch the same detector can be made to answer for two oscillatory circuits covering different ranges of wavelengths (*see* Fig. 2).

In this circuit arrangement the same A.T. condenser can be made to tune both A.T. inductances, but if desired, each aerial circuit unit can have a condenser incorporated in its construction. Fig. 3 illustrates apparatus made on this principle, "A" being detector unit with valve totally enclosed, and contains filament resistance, grid leak, blocking condenser and telephone plug. "B" contains A.T. inductance reaction coil and condenser.

Various aerial circuits can thus be used with one detector, the connecting leads,

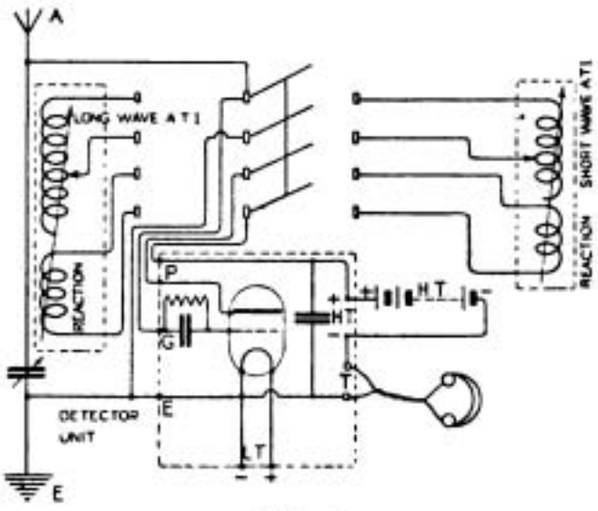


Fig. 2.

four in number, being quickly interchangeable. In the set illustrated the reaction leads are twin "flex" ending in a plug—shown in "B" set.

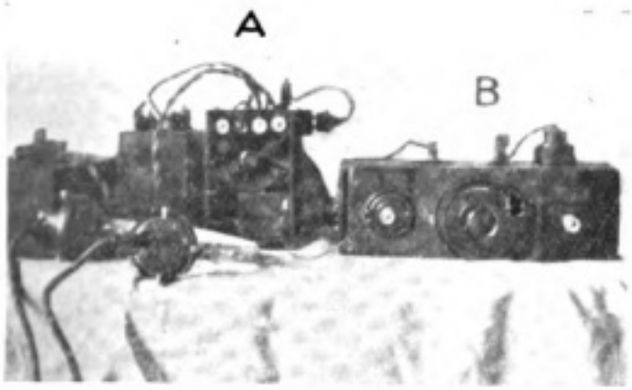


Fig. 3.

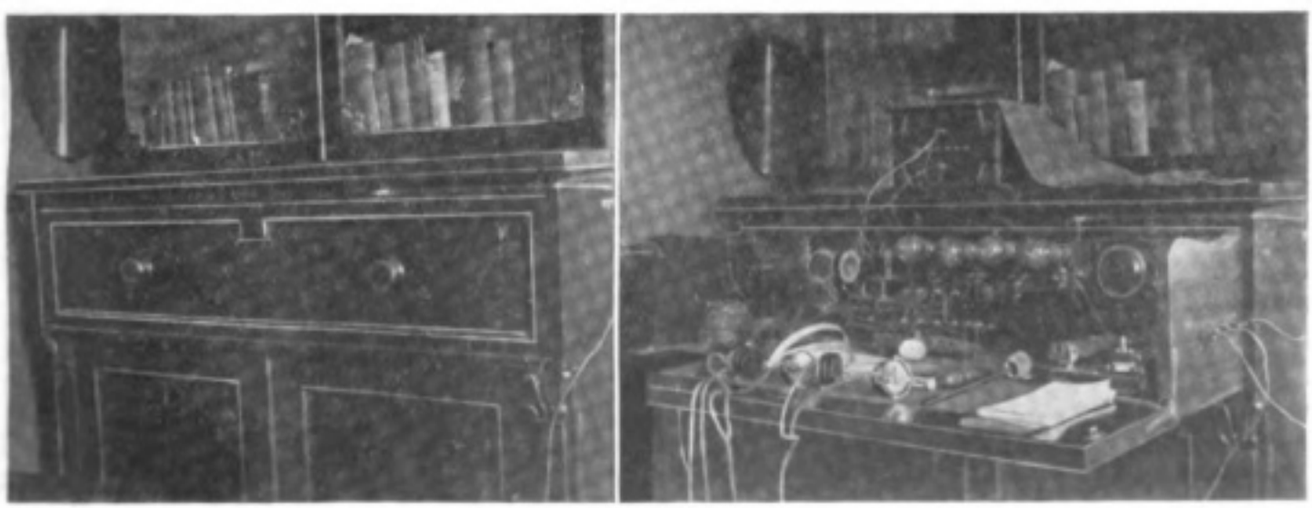
Before connecting up the apparatus, each piece should be thoroughly tested so that when connected up if signals cannot be received the reason must lie in faulty connections and not through faulty apparatus.

The following notes will enable the experimenter to quickly locate the cause of the non-functioning of the set.

1. To test if set is oscillating. Touch the aerial terminal with the finger, if a loud click is heard in telephones, set is oscillating. If no click is heard in telephones, the cause of non-oscillation of set may be :—
   (*a*) Reaction coil coupled too loose to A.T.I.
   (*b*) Reaction coil leads reversed.
   (*c*) High-tension battery connected up wrong way.
   (*d*) Aerial shorting to earth.
2. Common causes of "howling" :—
   (*a*) Reaction coil coupled too tight to A.T.I.
   (*b*) Too much H.T.
   (*c*) Break in lead from grid of valve to A.T.I.
3. Hisses and loud clicks, growls, etc., are often caused, otherwise than from atmospheric disturbances, by one or more cells of the high-tension increasing in internal resistance, thus causing the voltage of that or those cells to drop, or more often, fluctuate.

The single valve regenerative circuit gives plenty of ground for initial experiment, and enables the beginner to obtain a fair knowledge of the characteristics of valve circuits. When these are mastered the handling of tuned circuits with multiple valve amplifiers can be undertaken.

WIRELESS IN A WRITING BUREAU



The above photograph illustrates an unusually neat set contained in a writing bureau. This set is due to General Palmer who kindly supplied the photograph at our request.

ON MAGNETIC DETECTORS*

By Prof. E. Wilson, M.I.E.E.

(Professor of Electrical Engineering at King's College, London.)

BEFORE dealing with magnetic detectors in detail I think it would be well if one said something about magnetic instability, since, of course, as you will see, the whole subject depends on the stability of magnetism. I shall start off by just making an elementary diagram of what may be termed a transformer or ring, having its secondary coil attached to a ballistic galvanometer G, Fig. 1. We can have a resistance R, if necessary, to keep the galvanometer deflection on scale. The primary is attached to a storage cell battery B, through a mercury reversing switch Sw. This mercury reversing switch has to be supplied with a resistance between points 1 and 6 in order that we may get to the particular point on the magnetisation curve which I want to investigate. This resistance is adjustable, and we can short-circuit it if we wish. An ammeter A is placed in the circuit for measurement of the current.

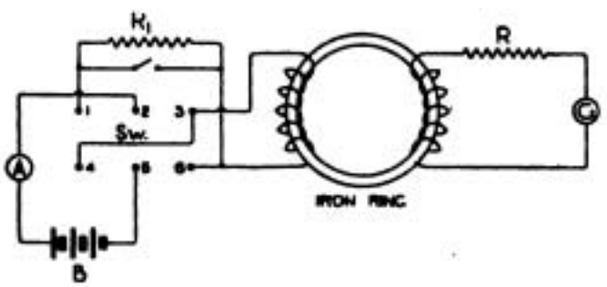


Fig. 1.

Now the ballistic galvanometer is an instrument which measures quantity of electricity. By a suitable calibration it will enable us to test all the changes of flux which go on in the ring when we vary the primary current. Hence, if we close the secondary circuit when the primary current is steady, and then get a deflection on the ballistic galvanometer, we know there must be some change in the magnetisation of the ring. Well, now, supposing that we are going to trace out the hysteresis or **B-H** loop by means of this method. What we should do would be this. If the switch Sw is put over from one side to the other, the magnetising force due to the primary current will be reversed from the point 1 to the point 2, Fig. 2. Now to trace out the

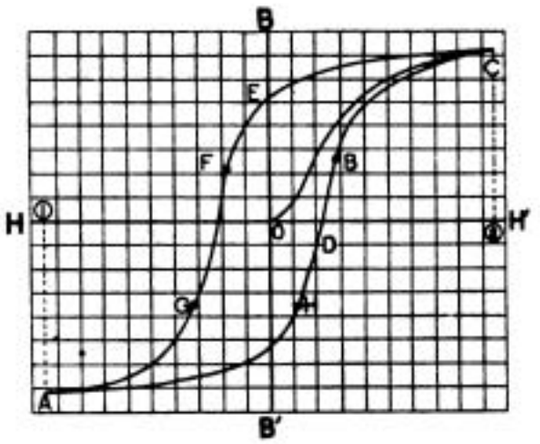


Fig. 2.

whole curve it is quite obvious that you must be able to control the magnetising force to get to a point on the curve when the switch is thrown over, so as to drop the resistance R_1 into circuit. Hence, when you reverse the switch Sw, you take the flux from the value A, and instead of its rising to C you stop at a value such as B. In that way you can trace out the hysteresis loop, by taking various values for the resistance R_1.

Now suppose you stop on the steep part of the curve, *i.e.*, suppose I take the magnetising force through zero to a certain value of **H** at some particular point. We will call that point D. Now at that particular point we maintain the magnetising current steady, and then close the secondary circuit on to the galvanometer. If, then, you give the ring a tap with a piece of wood you will get a deflection on the ballistic galvanometer. That effect is due to a change in the magnetisation although the magnetising force is in no

* Lecture delivered before the King's College Wireless Society, on Monday, May 23rd, 1921.

way changed. Now that is a simple experiment of fundamental importance in connection with magnetic detectors because there you have an illustration of magnetic instability. After making these experiments it occurs to one that you might be able to change the magnetism in this particular way by other methods than merely tapping the iron by a piece of wood. Well, as a matter of fact, if you subject the ring to high frequency oscillations as in W/T you find that you can get the magnetism in the ring to change in very much the same way as if the iron is tapped with a piece of wood. It has been suggested that these effects are due to eddy currents, but as a matter of fact if you laminate your iron you still find that they persist and that you have this magnetic instability.

I will now leave this subject and turn to what has actually been done in the development of magnetic detectors for W/T. Sir Ernest Rutherford, I think, was the first person to publish a statement that he had detected wireless signals by the aid of a magnetic detector. I think it was about the year 1896, and what he did was not to use the magnetising force in the way I have already indicated, but he connected a coil between two horizontal

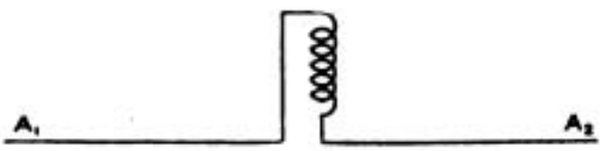


Fig. 3.

antenna wires, as indicated in Fig. 3. In this little coil he placed a bundle of steel wires. He also investigated different materials. As you will see from the hysteresis loop of a specimen of iron or steel (Fig. 2), when you remove the magnetising force you are left with a residual magnetism. As a matter of fact, in that particular case he found out that it was very easy to remove these residual effects in such a little bundle of magnetised wires. He was not working on the part of the curve marked D in Fig. 2, but the rapidly oscillating currents shook out the residual magnetism OE (Fig. 2), to some value near zero. With this bundle of magnetised wires he got a steady deflection on the instrument from an oscillator about half-a-mile away. I think you may say that was the starting point of magnetic detectors.

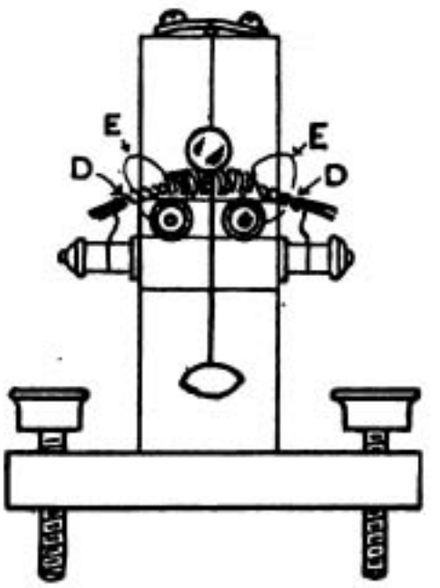


Fig. 4.

It is obvious that such a method has not, of course, the advantages necessary for regular working of a wireless station, because every time after a signal the bundle of wires have to be taken out and re-magnetised. This method could not be tolerated in practice, and nobody realised that more than Sir Ernest Rutherford.

I may say that in this laboratory experiments were made in connection with wireless telegraphy with this little piece of apparatus which I have on exhibition here, which was intended to make the magnetic detector more automatic in its nature. This piece of apparatus has got a little bundle of wires, mounted with four terminals on a piece of ebonite. By means of a stationary coil on the specimen it was possible to magnetise the little bundle of wires inside without having to remove them from the coil. This re-magnetisation was done automatically by suspending from a fixed support a small moving coil carrying a contact,

so that what happened was this—the contact was made to the local circuit which closed the magnetising coil on to a battery and magnetised the magnet. This brought back the coil to its central position, and then, on receipt of waves, the magnetism was wiped out from the little bundle of wires and the coil gradually went back until the contact was closed again to re-magnetise the wires.

The arrangement was sketched on the board and is shown in Fig. 4. On the bundle of wires there are two coils, one connected to a local magnetising circuit and the other used for received oscillations. You understand that there must be a time interval between the spot of light getting to the end of the scale and the application of the magnetising force and the removal of the spot of light back again.

The next stage, I think, was the magnetic detector as we have it to-day—the Marconi magnetic detector. Of course, as you readily understand, the earlier methods were not much good for practical wireless telegraphy, and it became necessary to introduce something to enable you to continuously record your signals. I think I must now illustrate the next stage of affairs, because you see up to the moment we have been dealing with these little magnetised bundles, and we must now make use of the effect which I shall first talk about.

We must now imagine that you have the iron continuously magnetised, and that you are going to make use of the magnetic instability which occurs and which is made permanent when on a special part of the hysteresis loop. Some of the experiments which were made in this laboratory were carried out in this way with quite little rings of iron. These little rings were supplied with a current which continuously carried the iron through this cycle of operations by means of a current reversal arrangement. This reversal arrangement consisted of a couple of fixed plates and a couple of movable plates in some dilute copper sulphate, the wires from the battery were brought to the fixed plates, and a couple of wires, which were brought out to a couple of slip-rings on the shaft, convey the current to the winding. These springs and slip-rings were corrected respectively to the two rotating plates. Now, by such a means as that you are able to pass an alternating current round your little ring and make the alternations as slow as you please. Now if you imagine that such an arrangement as that is connected to one coil on the little ring, as shown in Fig. 5, another coil on the ring can be connected to the telephone, and a third coil is connected to the antenna. You are then in a position to do three things. You can vary the magnetising force so as to take your iron continuously round the hysteresis curve ; you can listen in the telephones attached to the second circuit ; and if the variations are sufficiently slow, then you can receive the signals from a distance in the third coil. Evidently this is an improvement really on the earlier arrangement of a bundle of wires.

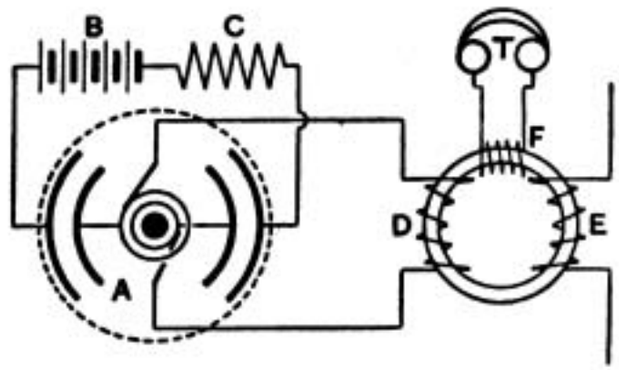


Fig. 5.

Turning the reverser round slowly you get signals with varying intensities at different points on the hysteresis curve. They practically die out on the apex, no matter how highly the iron is magnetised. There is a portion where you do not get them, and then you get them with increasing strength along the parallel portions of the loop, marked FG and HB in Fig. 2. The ideal receiver must not show any variations in the strength of received signals.

The Marconi detector, perhaps as you know, is a very simple affair. It consists of a band of fine divided iron wires, which are nsulated and passed through a little tube and

through a couple of coils. One of these coils is attached to the telephones and the other to the antenna, and therefore when the H.F. oscillations are received they give rise to a magnetising force on the iron. In the Marconi detector the magnetising force is applied to the iron by a couple of horseshoe magnets. The band of iron is driven round by means of a clockwork apparatus. The arrangement is shown in Fig. 6. The two coils with the iron band forms merely a transformer pure and simple, but when the band is rotated, and supposing that you arrange that these magnets are south-south on the outside holes and north-north in the centre, then you will get a piece of apparatus which is capable of responding to the high-frequency waves and responding to them continuously so long as you keep the band moving.

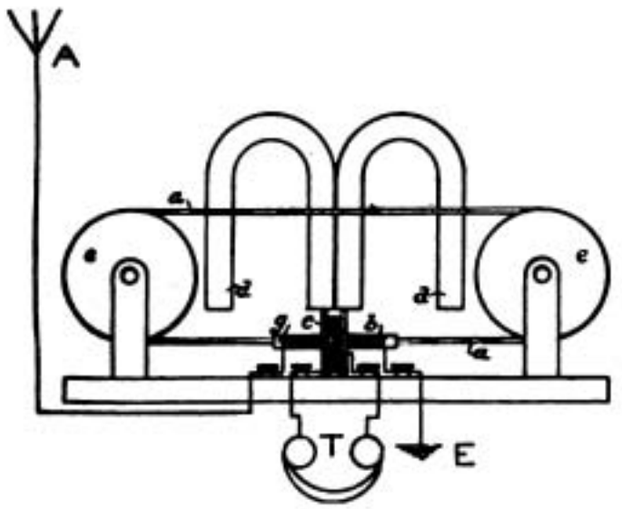


Fig. 6.

It is quite obvious that during the process of passing through the reversal of field due to the magnets you get this tremendous sensitivity. Any received impulses which come in the aerial coil will then at once set up an electromotive force in the telephone circuit which will correspond to and be as a matter of fact a received signal. Now I am afraid it is not so clear to see the operation of this instrument as it is to see the operation of that little coil. It is fairly easy to understand, but it is not quite obvious to see what is going on there. As a matter of fact, one wants to really understand what magnetism is before you can properly see what is going on in a piece of iron when it is magnetised. Of course, there are those who say that the magnetism is due to molecular changes under the influence of the external force, and if you try to reverse their position they do not all get reversed.

As a matter of fact there is a great deal more in it that we now know, and I think it is fairly well established that magnetism in iron is due to molecular causes. We find cases in which one and the same material can be at a certain atmospheric temperature in a highly magnetic state or in a non-magnetic state. Moreover, you can find non-magnetic materials which, when put together, form a magnetic material. Magnetism is in some way connected with molecular arrangement as I said before. Copper, aluminium and manganese are non-magnetic if each material is taken separately, but combine them into an alloy and you have magnetic material. And similarly with regard to the effect of temperature. If, say, you take a piece of 25 per cent. nickel steel you get a material which is non-magnetic when hot, but if you cool it down that material is a highly magnetic material, and when you have the same material at some other temperature its properties are all different. If you had a chemical analysis of it made it would tell you that there was the same stuff there. And in the same way you can have iron oxide produced in one way non-magnetic and produced in some other way it is highly magnetic and a most searching analysis will show that these are absolutely identical. There is no question that the magnetic property is due to molecular arrangement. That is about as far as we have gone with certainty.

Well, now, if you imagine that there is an alteration in the molecular arrangement and you vary external forces, all I can say in this particular case is that as the band approaches magnet No. 1 these molecular arrangements are in a certain direction which, when you get opposite the second magnet, pass through a complete change, and it is during that particular interval that the oscillations which have been

received in this aerial circuit give you the violent change in field, and induce an electromotive force in the telephone circuit. Some people explain this action by saying that the hysteresis is wiped out, but there is something more in it than that. Of course, we are just on the fringe of the subject. Anyway, probably as we go along we shall be able to understand more and more about this wonderful subject of magnetism.

Before I make any experiments I want to draw your attention to a comparison between magnetic detectors and the thermionic valve. In both we have a species of transformer. The magnetic detector is really a transformer, and, as you probably know, the valve is a piece of apparatus that for many years was utilised very much in the same way as these magnetic detectors, that is to say, the energy received by the valve was all the energy you had to work on and there was no amplification and no trigger action. By the invention of the three-electrode we have a means whereby a very minute amount of energy can easily be turned to control a very big source of energy such as for operating a Morse inker, working telephones and so on. Some day or other somebody will apply trigger action to a magnetic detector. I am quite certain about it. It has been a dream of mine and sometimes I think I have got it, but then it goes again. I have made many experiments. Some day, however, somebody will discover a means whereby the arrival of a minute amount of energy will set free the vast store of energy which these molecules actually possess. We may then have got a piece of apparatus which is more sensitive than the valve and very much more simple. It is one of those things that if it does happen will revolutionise wireless telegraphy. One does not know, and it does not do to predict either, but I cannot see why it should not be done. It is a problem which wants solving. I hope it will be a member of the King's College Wireless Society who may solve it, as it is a problem which is well worth thinking about. In physical research work there is always something to think about and ponder over and this is one of the things that remains to be done. The magnetic detector is a piece of apparatus which is like the valve was before the introduction of the three-electrode.

A demonstration was then given using a small transformer ring which could be brought to the sensitive point on its magnetisation curve, and its secondary winding then connected to a ballistic galvanometer, as in Fig. 1. On giving the iron a sharp tap the galvanometer was violently deflected, thus indicating the great change in the magnetisation of the iron brought about by the blow.

The iron used in the ring in this experiment is extremely soft, and I have had some Stalloy wire wound with silk, but I found that it did not work. You must therefore choose a material in which this magnetic instability is very pronounced, but when you get the material which gives the most pronounced effect you are still up against the difficulty, unless you can induce trigger action into it, that you can never hope to compete with the valve from the point of view of sensitivity.

In a second demonstration a home-made magnetic detector was connected to a frame aerial, which picked up signals from a second frame aerial connected to a buzzer transmitter. The signals picked up by the magnetic detector were rendered audible to the audience by means of a three-valve note magnifier and a loud-speaking telephone.

In conclusion, all I have got to say is this, as I said before, the lecture has been passing over old ground; but I often think that it does one good to go over old ground. Certain things do not perhaps occur to you at the time, but when you begin to look back again they suddenly crop up. I do not think there is any more profitable manner of originating new ideas. It is surprising how one gets hold of a particular idea which you do not think much about, until some day you wake up to the fact that you have in it got hold of the solution of some other problem. Perhaps I have quite accidentally put something into your minds which may help you to suddenly spring upon some new idea. Things are liable to develop in this way, and if I have done anything in that way the time will have been well spent.

WIRELESS CLUB REPORTS

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

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At the meeting of the above on May 11th every member had the opportunity of checking his keying on a Morse Inker, and though some of us knew we were not great at "spacing and marking," the demonstration proved necessary to show how bad we really were.

Mr. Horwood, our indefatigable instructor, seemed the least downhearted, and he has set his mind on an all-round 10-words-a-minute reception for all the members, and it looks, at present, as if he will get it.

At a meeting on May 18th a member expressed the fear that our more junior members were not being sufficiently catered for, and it was resolved to elect a special agenda committee.

Under the chairmanship of Mr. G. H. Horwood, Mr. Kloots was elected to represent the advanced, Mr. Voigt the intermediate, Mr. Selden the elementary, and Mr. Lee the very elementary members.

All members will thus be able to voice their wishes, and we hope to be in a position to know and administer to their needs.—Geo. Sutton, A.M.I.E.E., Hon. Secretary

Brighton Radio Society.

(Affiliated with the Wireless Society of London.)

A meeting of the Society was held on April 7th, when there was a good attendance.

The President announced that a handsome gift of apparatus had been made to the Society by Mr. Magnus Volk, comprising a complete crystal receiver, a portable receiving unit, and a portable transmitting set, together with several useful accessories. It was unanimously decided that a formal vote of thanks be sent to Mr. Volk for his extreme kindness and interest in the Society. The work of installing the main set was left in the hands of the Technical Committee.

A definite form of log was then presented to the members, and it was decided that records should be kept on these logs by members as regards the results attained with their own sets, the logs to be handed in to the Technical Committee fortnightly. One new member was elected.

Arrangements are now complete for a Morse Class for the benefit of members desiring practice in this direction

A meeting of the Society was held on April 21st, the attendance being excellent.

An interesting and instructive Paper was read by Mr. W. E. Dingle entitled "The Construction of a Two-Circuit Single Valve Short-Wave Receiver," who afterwards kindly demonstrated the set, and gave a blackboard diagram of the connections. There was no further business and the meeting concluded at 10 p.m.

The North London Wireless Association.

(Affiliated with the Wireless Society of London.)

The Association's first field day was duly held on April 23rd. Unfortunately the weather was bad and the occasion was not altogether the success anticipated. However, the meeting was well supported and a short programme of transmission and reception was successfully carried out. It was unanimously decided that the Association should hold regular field days, and the Secretary was asked to arrange the next outing on as early a date as possible.

The Association's twenty-second meeting was held on the 7th inst., the President in the chair. The minutes of the previous meeting were read and confirmed. At this meeting an interesting and instructive Paper was read by Mr. Walter Jonghin on "Fault Testing in Receiving Circuits." Many of the common troubles met with by amateurs and the proper manner of correcting them was very ably demonstrated by Mr. Jonghin, and a hearty vote of thanks was accorded him at the conclusion of the Paper.

The Association's Library is making good progress, and gifts of books have been made by Dr. Knight and Messrs. A. de Villiers, F. S. Angel and W. A. Saville. Five new members have been elected. All communications and enquiries as to membership, etc., should be addressed to the Hon. Secretary, Mr. J. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1.

Bradford Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting of the above Society was held in the Club-rooms on Friday, May 6th, a large number of members being present. After the usual business had been completed the members retired to the instrument room, where two single-valve receivers were on view. The first set to be examined was a Mark III short-wave tuner converted for valve reception up to 30,000 metres belonging to Mr. N. Hammond, Hon. Treasurer. Good results were obtained. The next set being a single valve receiver specially constructed for the reception of short-wave telephony, the owner, Mr. A. Barber, then proceeded to show the capabilities of this little tuner by allowing the members present to hear telephony, music, etc., for at least an hour, this being transmitted by one of our local friends. There is no doubt that the results were excellent. After a short discussion on various subjects the meeting closed after an evening well spent.

A meeting was held in the Club-room on Friday, May 20th, with Mr. A. Bever in the chair, when Mr. Wood, of Low Moor, one of our recently elected members exhibited his complete "Polaris" set and three-valve amplifier. Good signals were obtained from various British and Continental stations and our best thanks are due to Mr. Wood for the opportunity of seeing this compact receiving set at work.

The following new members were duly proposed, seconded and elected:—Messrs. D. Hammond, A. Sykes and Marshall.

Mr. Eskdale has promised to demonstrate the M 15 Receiver which he has recently acquired

from the Marconi Scientific Instrument Company, and we are also promised a short Paper on "Valves."

Will all members and intending members please note that during the absence of Mr. J. Bever, who is on service with the Defence Corps, all communications should be addressed to Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds, who has temporarily undertaken the secretarial duties.

The Radio Scientific Society.

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

At a meeting of the Society held in the City School of Wireless Telegraphy on April 20th, 1921, a lecture was given to the advanced section of the Society by Mr. A. T. Holmes on a five-valve resistance amplifier. Mr. Holmes laid great stress on the effect of capacity in this type of amplifier, and illustrated his remarks with apparatus of his own design and construction.

At a meeting held on May 4th, 1921, a lecture was given to the elementary section by Mr. Halliwell, assisted by Mr. Whitehouse, on plotting the characteristic of a valve. Several valves were compared, members bringing their own valves to be tested.

At a meeting held on May 11th an advanced lecture was given by Mr. E. A. Edwards on Aerials. Old types of aerials were described, followed by those of the present day. Formulæ were given for calculating the wavelength, etc., of aerials. A general discussion closed the meeting.

All communications should be sent to the Secretary, Mr. H. D. Whitehouse, 16, Todd Street, Manchester.

Dartford and District Wireless Society.

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

An extremely interesting meeting of the above Society was held on Friday, May 20th, 1921, at Dartford Grammar School, a good attendance of members being recorded. Dr. L. J. Miskin, M.B., presided, with Mr. J. R. Smith, A.M.I.E.E., Vice-President.

The minutes of the previous meeting were read and confirmed and various business items discussed.

Dr. Miskin proposed that the members occasionally give lectures on any wireless subject with which they are familiar, relating their experiences and experiments in connection with their work.

Dr. Miskin commenced by lecturing on "The Elementary Principles of Wireless." The various elementary principles governing the transmission and reception of wireless signals were explained, commencing with etherical oscillations and their comparison with those of light and sound in respect of transmission and reception. The lecturer dealt very effectually with such items as frequencies, velocities, wavelengths, inductances and capacities, the members very much appreciating the information given.

The Vice-President, speaking on behalf of the members, thanked Dr. Miskin for his interesting lecture, and pointed out the advantage of studying the elementary principles of wireless with a view to further research on more difficult problems.

The Society have now installed a complete crystal receiving set, and all persons interested in wireless are invited to communicate with the Hon. Secretary, Mr. E. C. Deavin, 84, Hawley Road, Wilmington, Dartford.

The Gloucester Wireless and Scientific Society.

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

At a general meeting of the above Society on May 12th, at the headquarters at Sir Thomas Rich's School Science Laboratory, the first lecture of the summer programme was given by Mr. J. Pittman on "Dynamos." It was followed by some discussion and questioning. The next lecture will be upon the different colour photograph processes. Buzzer practice was run for an hour or so, and it was noticed that the average speed is getting much better. Anyone interested in wireless telegraphy and telephony can obtain particulars from the Hon. Secretary, Mr. J. J. Pittman, 1, Jersey Road, Gloucester.

Manchester Wireless Society conducting experiments with a portable receiving set.

Cambridge and District Wireless Society.

A meeting of the above Society was held on Wednesday, May 18th, at 8 p.m., at the reading-room of the Photographic Society, Ram Yard. The growth of the Society was again made mani-

fest by the addition of some more members, which totals now well over thirty. After the reading of the minutes, it was agreed upon that the next meeting should be three weeks hence, so as to coincide more nearly with the publication of *The Wireless World*. Leaflets were then distributed on which was the constitution of the Society.

Major Batchelor (President), in the chair, then called upon Mr. W. S. Farren to deliver a discourse on the elementary principles of wireless telegraphy.

Mr. Farren dealt with this subject very ably, showing by means of a dynamical instrument the analogy between wireless telegraphy and the ordinary transference of energy from one source to another.

At the close of the meeting a vote of thanks was passed to Mr. Farren for the lecture he had given. The next meeting is to be held on June 18th at 8 p.m. at the Photographic Society's reading room, Ram Yard, Bridge Street, when the Secretary will deliver a lecture on "Valves and their Fundamental Principles."

The Wimbledon and District Wireless Society.

An exhibition of wireless apparatus was held by the above Society on Wednesday, May 11th, at the Technical Institute, Wimbledon.

The very fine selection of apparatus on view served to emphasise the remarkable progress made in this science in the last few years.

The very best thanks are due to Messrs. R. H. Tingey, who, with the aid of their four-valve amplifier, succeeded in making signals from distant stations audible throughout the large hall in which the exhibition was held and also in recording same on a tape machine. To Messrs. F. O. Read & Co., Ltd., and Messrs. H. D. Butler & Co., for their very fine display of apparatus and "gadgets." To Messrs. The Wimbledon Apparatus Company for the exhibition of a very compact and efficient telephony transmitter, and to Messrs. Bower & Co. of Wimbledon, for the display of a large selection of high frequency electro-medical apparatus.

In addition to the above a fair selection of apparatus was exhibited by members of the Society, some of which were unique from a constructional point of view.

The exhibition aroused considerable interest throughout Wimbledon and District, and between 300 to 500 people passed through the hall between the hours of 7.30 and 10 p.m.

This Society is holding informal meetings on Wednesday evenings at 7 p.m. until further notice, when facilities will be offered for buzzer practice, etc. The dates of our next monthly meetings are June 8th, July 6th, September 21st, October 22nd.

Intending members should communicate with the Hon. Secretary, Mr Wm. Geo. Marshall, c/o Technical Institute, Wimbledon, or 48, Warren Road, Merton, S.W.19.

Plymouth Wireless Society.

A meeting of the Plymouth Wireless Society was held on Friday, May 20th, Mr. W. J. Lewarn in the chair.

Mr. J. K. A. Nicholson, A.M.I.E.E., gave a lecture on "Valves." This was the first of a series of lectures on this subject, which the lecturer has kindly consented to give, extending over about six weekly meetings.

Mr. Nicholson dealt exclusively with the "Electron Theory," and explained fully the vacuum valve and its uses. All present thoroughly appreciated the lecture and a vote of thanks was passed to Mr. Nicholson.

The Willesden Wireless Society.

The membership of our Society is now about thirty, the recent announcement in *The Wireless World* having met with a very gratifying response.

Permanent headquarters, available during the whole week, have been secured, and the Society will take possession immediately the necessary furniture is obtained.

A licence has been applied for, and a three-stage amplifier is being made up by members for the Club's use.

Meetings are held every Tuesday evening. Further particulars can be obtained from the Hon. Secretary, Mr. F. A. Tuck, 87, Mayo Road, Willesden, N.W.10.

South East Essex Wireless Club.

The general monthly meeting of the above Club was held on Monday, May 2nd, at the Club-room, High Street, Wickford, nearly all the members being present. The Hon. Secretary, Mr. F. A. Mayer, gave a lecture on "Scope for the Amateur Wireless Worker," which was much appreciated by all present. Meetings have also taken place on each Monday during the last month, when the evening has been spent on buzzer practice and beginners' instruction.

The West London Wireless and Experimental Association.

On Thursday, May 19th, the Society listened to a very interesting lecture from Mr. Hirst on the synchronization of clocks by means of time signals, and illustrated a device of his own invention which he had provisionally protected.

It is anticipated that a lecture and demonstration will be given by Captain W. R. H. Tingey in the near future, and a notification will be made when the date has been fixed.

The course of wireless, which comprises a series of lectures and has been specially arranged for new members, commenced on May 3rd. It is hoped that prospective members will join at as early a date as possible to avoid missing the first lectures.

The Society still proposes to continue the Morse practice class, "listening in on Club apparatus," and the answers to queries raised by members, the latter having been found particularly instructive.

Particulars of the Society and its activities will be gladly furnished by the Hon. Secretary, Mr. S. J. Tyrrell, 6, Providence Road, Yiewsley, Middlesex.

The King's College Wireless Society.

A society under the above name was formed last March at King's College, Strand (L.U.), and is now starting upon its activities with about thirty members. The fixtures for this term are:—An historical Paper by Prof. E. Wilson, M.Inst.C.E., M.I.E.E., upon Magnetic Detectors, illustrated by a demonstration with the original apparatus used by

him in his pioneer work on this subject; a Paper by Mr. C. C. Redshaw on Various Receiving Circuits, and a Paper by Mr. F. S. Robertson, M.I.E.E., on Valve Manufacture, in which some valuable first-hand information is anticipated. Morse practice is also being arranged. The College already has a transmitting license, and possesses some useful apparatus and an aerial, from which a lead-in is to be taken into the Society's room. It is hoped to get into touch with other colleges of London University with a view to carrying out experiments.

Aldershot and District Wireless Society.

A wireless society has been formed in this district under the above name. At the first general meeting the officials were elected.

The subscription has been fixed as follows:—Full members, entrance fee, 5s.; subscription, 10s. 6d. per annum. Associate members, entrance fee, 2s. 6d.; subscription, 5s. per annum. Members of the Services, 1s. per month. Associate members are those under 16 years of age. Ladies are eligible for membership, and it is interesting to note that we have a lady member of the committee, who is a very keen experimenter.

As soon as the necessary premises can be obtained, it is proposed to open a lecture room, library and laboratory. A transmitting and receiving license will be applied for.

At the meeting held on Monday, April 18th, at Gulwell's Restaurant, Farnborough Road, Mr. W. K. Alford gave his presidential address under the title of "Wireless, 1850—1921." He reviewed the various advances made during this period and gave details of the various experiments carried out by Morse, Hughes, Wheatstone, etc., in line telegraphy and, later, the work of Lindsay, Henry, Hertz, and others. He detailed many of the inventions of Marconi, from the time when he first used the elevated aerial wire to the present time. The lecturer outlined the different systems of W/T., the functions of the valve, and its applications to C.W. transmission and reception were fully explained and clearly illustrated by diagrams and graphs. The development of W/T. during the war occupied a large portion of the address and various problems and difficulties which were occupying the attention of experimenters to-day were indicated.

A very interesting feature was the large collection of apparatus on view, which was in itself a graphic illustration of the advance made in the science of wireless.

A hearty vote of thanks was accorded Mr. Alford for his very interesting and instructive address.

On Monday, May 2nd, Mr. J. F. Herd, A.M.I.RadioE., late instructor in W/T., R.A.F., gave a very fine lecture on the "Principles of Wireless." In a lucid manner and with the aid of blackboard diagrams, he showed how electric waves were produced and propagated into the aether, and by means of analogies, indicated the functions of the various parts of the apparatus used. He gave a very full explanation of wave motion and high-frequency oscillations and illustrated by means of suitable apparatus their practical application to wireless telegraphy.

The lecture proved of great interest and was productive of a keen discussion at the conclusion. One feature was the amusing mnemonics employed by the lecturer, and his witty asides caused roars of laughter.

A very hearty vote of thanks was accorded Mr. Herd and the Chairman, Mr. E. Lynam, expressed the feelings of those present when he said that we should look forward with great pleasure to Mr. Herd's future lectures.

Although only a few weeks old, the Society is firmly established and new members are being enrolled at each meeting. Any lady or gentleman interested who would care to join is invited to write to the Hon. Secretary, Mr. J. Henry Hill, Farnborough Road, Farnborough, Hants.

Wandsworth Wireless Society.

The inaugural meeting of the above Society was held at the Technical Institute, High Street, Wandsworth, on May 6th, at 7.30 p.m., the chair being taken by Mr. D. N. Griffiths, B.Sc., A.M.I.M.E.

In a short address the Chairman emphasised the fact that the need of a wireless society had been long felt in Wandsworth, and judging by the attendance at the meeting of so many enthusiastic supporters who had in view the formation and success of such a society, it augured well for that need being supplied.

He bore in mind also that the power of imparting knowledge was not present in everyone to a like degree, and, therefore, suggestions of the most meagre nature were not to be despised.

After thanking the governors of the Institute, who were represented by Messrs. Settle and Finlay, for their offer to use the physics laboratory as headquarters, the convener, Mr. F. V. Copperwheat, was called upon.

The aims and objects of the Society formed the base of his remarks, and at this juncture it was proposed that the Society be called the Wandsworth Wireless Society. This proposition being seconded, the Secretary and Committee, consisting of the Chairman, Secretary and two members, Messrs. Prior and Milsom, were elected. All present agreed to accept the offer of the physics laboratory as headquarters of the Society. The business having been disposed of, the meeting was declared at an end, and the Committee withdrew to decide on a code of rules and discuss other necessary matters.

Intending members should communicate with the Secretary, Mr. F. V. Copperwheat, 9, Birdhurst Road, Wandsworth, S.W.18.

Smethwick Experimental Wireless Club.

The Club is now holding its meetings at the Smethwick Municipal Technical School on Tuesday evenings at 7 o'clock. It is hoped to increase the membership of the Club. Would all those interested communicate with the Hon. Secretary, Mr. R. H. Parker, 31, Wilson Road, Smethwick, Birminghan .

Barrow and District Amateur Wireless Association.

During the past month the above-mentioned Association have held regular meetings on Monday evenings in their Club-rooms, Market Street, Barrow-in-Furness.

WIRELESS CLUB REPORTS

Following the very successful exhibition and demonstration of wireless apparatus, as reported in previous issue of *The Wireless World*, quite a number of interested gentlemen have visited the Club-rooms, and, in most cases, have become associate members, being eligible, in accordance with the Club's rules, for " promotion " to rank as full members in twelve months' time (or less, at the discretion of the Committee), and upon qualifying with regard to Morse (sending and receiving) and the theory and manipulation of apparatus.

A definite portion of each Club night is allocated to Morse practice, one of the senior members, Mr. J. Hanks, being in charge.

Informal lectures by the Club Secretary, Mr. E. Redpath, have been given upon the last four Club nights, the series being specially arranged to suit the requirements of the new and, more or less, inexperienced members.

The ground covered included General Principles of W/T., Theory and Action of (*a*) Transmitters, (*b*) Receivers (Crystal Type); Typical Construction of T. and R. Sets; Manipulation of Small-power Transmitters and Mark III Receiver.

Particular attention was given to " portable " apparatus, as it is the intention of the Committee to put a complete portable transmitting and receiving station into operation as soon as possible, with a view to practical outdoor experience during our all too brief summer.

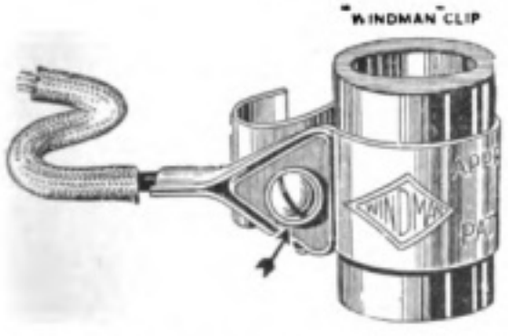
Handsworth Y.M.C.A. Wireless Station.

The above Club has opened up operations, and Mr. H. Bidmead gave an interesting lecture on the construction and uses of the Club plant.

NOTES

Earthing Clip.

An ingenious earthing clip device is shown in the accompanying illustration, which goes by the name of the " Windman " earthing clip.



Points of originality in this accessory are the triangular washer, marked with an arrow, which does not turn when the screw is tightened, and the adjustability of the band to any circumference. The band is of copper, and will therefore make excellent electrical contact.

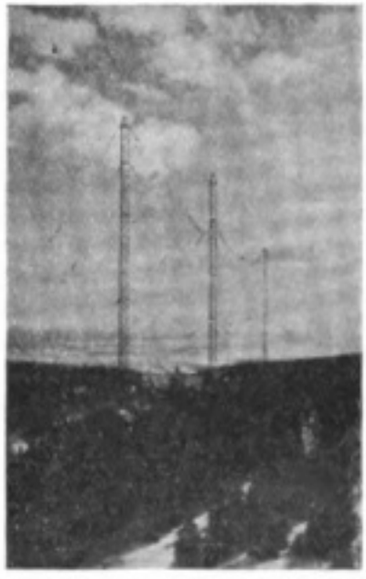
Wire and Metal Gauges and Equivalents.

Messrs. H. Rollet & Co., Ltd., of 34 and 36, Rosebery Avenue, E.C.1., have sent us copies of a little booklet giving metric equivalents and other information regarding gauges, etc.

We think perhaps the booklets would be of interest to readers of *The Wireless World* to whom Messrs. Rollet & Co. will be pleased to send a copy on receipt of 2d. for postage. This firm has large stocks of brass and copper materials such as the amateur is continually in need of for constructing apparatus.

Berlin Telephony.

Though we have not yet received any official information, it is apparent that Königswusterhausen (LP) is employing increased power for telephony transmission. The wavelength is 2,000 metres. Reception should be easy with only one valve, so that amateurs who fail to get this telephony may reasonably assume that there is something wrong with their set.



The Radio Station at Christiania (LCH).

Catalogues Received.

We have received copies of the very interesting new catalogues just issued by Messrs. Economic Electric Limited, and Messrs. Mitchells. Any wireless enthusiast will find much to interest him in these little booklets. Messrs. The Hart Accumulator Company have also sent us a copy of their excellently prepared catalogue of accumulators for every purpose. The storage batteries specially designed to replace the usual dry cells for high tension voltage should make a special appeal to amateurs.

Club Reports.

The suggestion has been made by the Bristol and District Wireless Association that, in the publication of Club Reports, the name and address of the Secretary should appear immediately below the name of the Society instead of at the end of the report. Will those Clubs who desire to follow this suggestion kindly send in their reports so arranged.

A CHEAP AND CONVENIENT LOOSE-COUPLER MADE WITH SLAB INDUCTANCES

By Ed. McT. Reece.

FOR some considerable time the writer has used a set of "slab inductances," which he has found particularly valuable for experimental work on account of the possibility of (1) eliminating so-called "dead end" effects by using one coil only at a time, and (2) minimising the capacity effects which become so evident between the unused portions when only a few turns of a large coil are actually in circuit.

It was found necessary, however, to devise some means of mounting or enclosing these coils so as to incur the least possible risk of damage to the winding in handling and to afford a convenient way of interchanging them for the various wavelengths required and of inductively coupling one coil to another. If this is not done, time is wasted in disentangling the coils from various other parts of the gear, to say nothing of the trial to one's patience and temper when one discovers a loose end lying against both H.T. battery terminals.

The following, though simple, is very effective in practice, allows of considerable modification to suit the reader's requirements and materials at hand, and may be applied to most types of multi-layer coils such as basket, honeycomb, etc.

Fig. 1.

A number of circular pieces, of a diameter large enough to fit comfortably in the centre of each coil, is cut from fairly stout cardboard. These are soaked in paraffin wax or, alternatively well shellaced, sufficient being prepared to fill the entire space in the centre of each coil level with the surface (Fig. 1).

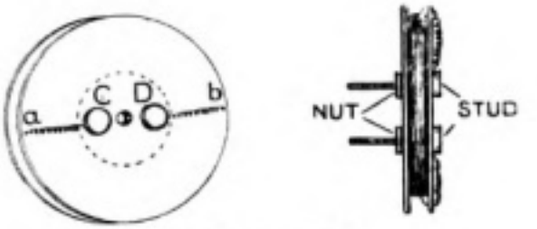
A number of pieces of cardboard (two for each coil) of a diameter of about ½ in. larger than the coil which is being dealt with is then prepared. These should also be paraffin waxed and placed one each side of the coil which is already fitted with the centre discs described above. Holes are drilled as shown in Fig. 2*a* and 2*b*, care being

Figs. 2—*a and b.*

taken not to approach too near the inner windings of the coil. The outer holes, A and B, should be equi-distant from the centre hole, the distance between them being exactly the same for each coil.

The centre hole should be slightly over ¼ in., A and B being of sufficient bore to allow of two ordinary brass contact studs passing through. The latter should be obtained of sufficient length to allow of their projecting ⅝ in. on the other side of the coil (Fig. 3*b*).

Two holes (A and B—Fig. 3*a*) are bored with a needle near the top of one of the outer pieces of cardboard, the ends of the coil passed through them, and, after scraping



Figs. 3—*a and b.*

the insulation away, connection made to studs C and D respectively; the nuts on

the other side being tightened up securely (Figs. 3*a* and 3*b*).

If necessary, the outer edges of the slab may now be secured either by lacing with ordinary black thread (a rather crude but effective method) or by filling up with sealing or paraffin wax as preferred, the latter method giving a better appearance and finish to the coil.

A piece of wood about 12 ins. long by 3 ins. wide is procured and fitted each end with uprights consisting of pieces of 1 in. wood 3 ins. high by 2½ ins. wide (Fig. 4). The latter can be secured to the base by countersunk screws from underneath.

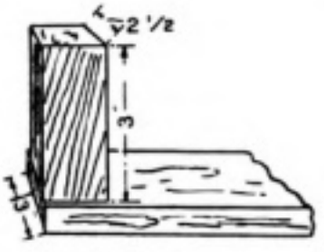


Fig. 4.

Two pieces of ⅜ in. ebonite, 2½ ins by 2 ins., are each fitted with two terminals (G and F), as shown in Fig. 5. The distance between the two terminals should correspond exactly with the distance between the holes A and B in Fig. 2.

These pieces are screwed down—one on the top of each upright in such a manner that the two terminals face inwards.

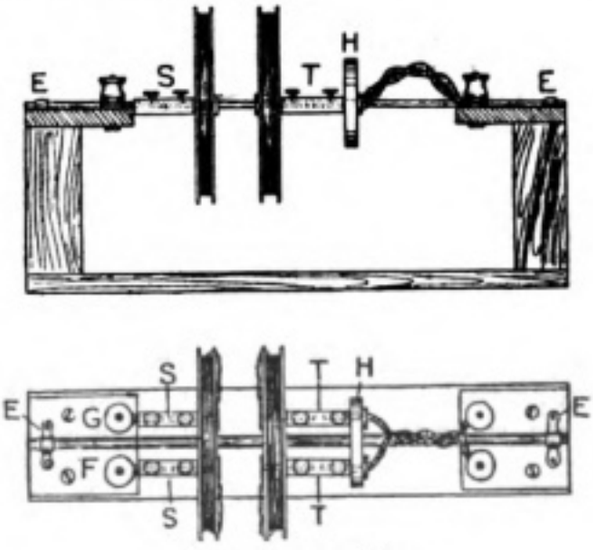
Figs. 5—*a and b.*

A small clip (E) shaped out of a piece of ⅜ in. brass or copper strip, is secured on top of each piece of ebonite in the position shown in Fig. 5, ordinary wood screws being used of sufficient length to enter the wooden upright underneath, and thus assist in securing the ebonite rigidly.

These clips grip the ends of a brass rod, ¼ in. in diameter and 12 ins. long, which extends between the two uprights.

Two pieces (one for each terminal of the left-hand upright) of No. 10 bare copper wire are twisted to the shape shown in Fig. 5*a*. These, when placed on the terminals, should extend about ⅝ in. beyond the edge of the ebonite (Fig. 5), and are each fitted with a binding screw 1¼ in. long (S and S—Fig. 6*b*).

If the brass rod be now withdrawn a few inches either to right or left, a coil, prepared as previously explained, may be slipped on and good connection made with the terminals G and F by simply securing the projecting studs of the coil to the unoccupied ends of the binding screws—a matter of seconds.



Figs. 6—*a and b.*

The method of coupling two coils together inductively when using a double or reaction circuit is illustrated in Figs. 6*a* and 6*b*.

A circular piece of ebonite ⅜ in. thick (H—Figs. 6*a* and 6*b*), is obtained. The diameter may be about equal to that of the circular discs of cardboard previously mentioned, but is not important. (Hard wood may be used, but ebonite is preferable.) A centre hole is bored and it is fitted with two studs in a manner similar to that used for the coils, care being taken that the distance

between these studs is exactly the same as that for the coils. Two binding screws (T and T) are placed on the projecting ends and a piece of twin flexible wire connected from the heads of the studs to the two terminals of the right-hand upright.

If now another coil be slipped on the rod the reverse way to the first, connection may be made to the circular piece of ebonite by means of the binding screws T and T and thence to the right-hand terminals through the flex. Coupling may be varied by moving the ebonite (and therefore the coil), backwards and forwards.

The length of brass rod mentioned has been found quite enough to allow of sufficiently loose coupling between the coils, when tuned coupled circuits are employed.

One of the greatest advantages of the above described coupler is the manner in which the connections of either coil may be reversed in a few seconds by simply loosening the coil from the binding screws, revolving it through a semi-circle and reconnecting it to the binding screws, a quick method of changing the connections of the reaction coil which will be appreciated by all valve workers.

BOOK REVIEWS

TELEGRAPHY, TELEPHONY AND WIRELESS.

By J. POOLE, WH.SCH., A.M.I.E.E.

London: Sir Isaac Pitman & Sons, Ltd. Pp. vii + 120, 7″ × 4¾″. Price 3*s*. net.

This little book, which is one of the "Common Commodities and Industries Series," aims at giving in the limited space of 120 pages a summary of the chief features of telegraphic, telephonic and wireless methods of communication. The treatment is hence very brief, and can be little more than introductory to a more detailed consideration of the three subjects. The historical method of treatment has been used in the main, and on the whole the selection of material has been good, bearing in mind the prime objects of the work, viz., a not over-technical exposition of the fundamentals of these methods of communication.

As regards the telegraphy and telephony sections of the book, the apparatus and methods described are necessarily those of the Post Office, while in the wireless section the Marconi apparatus and methods have been dealt with much more fully than any other types. A few minor misprints have been noted, but apart from these both text and illustrations are good. The seven chapters are devoted respectively to the following branches of the subject: Introductory considerations of Electricity and Magnetism; Sources of E.M.F.; Electric Bells and Relays; Telegraphy; Telephony; Telegraph and Telephone Lines; Wireless Telegraphy; Wireless Telephony. The last chapter, however, consists of four pages only, and gives but a bare outline without any detailed technical discussion of the apparatus employed.

P.R.C.

HET DRAADLOOS ZENDSTATION VOOR DEN AMATEUR (TELEGRAFIE EN TELEFONIE).

By J. CORVER.

's—Gravenhage: N. Veenstra, 1921, pp. 106).

The author of this book is a frequent contributor to *Radio Nieuws*—the organ of the wireless amateur movement in Holland—and is therefore well known to the readers of that journal. The book will doubtless be of use to Dutch amateurs, as it contains a non-mathematical account of the various transmitting systems, old and new, from the point of view of the experimental amateur.

The first system described is the buzzer transmitter; this is followed by a description of the Rhumkorff coil, and its use with plain aerial and coupled circuit systems. Very detailed instructions are given for mak-

ing a portable spark set to be fitted to a bicycle, and also for making a hot-wire ammeter. Details are given of the construction, calibration and use of a wavemeter, both for determining wavelength and decrement. Two chapters are devoted to radiotelephonic transmitters using valves, and in the concluding chapter the question of earthing is discussed, together with measurements on aerial systems.

G. W. O. H.

RELATIVITY, THE ELECTRON THEORY AND GRAVITATION.

By E. CUNNINGHAM, M.A.

London : Longmans, Green & Co., 1921. Pp. vii + 148, 8½″×5¾″. Price 10*s*. 6*d*. net.

This book is the second edition of "Relativity and the Electron Theory," by the same author. Compared with the first it has been nearly doubled in size, and now gives a much wider treatment of the subject. Originally the work dealt with the two theories—Relativity Theory and Electron Theory—and their inter-relations, but the new edition goes much further—beyond Einstein even—and shows that Einstein's generalised relativity theory is by no means the last word on the subject. Of especial interest to radio workers, who are now much more concerned about the electron than heretofore, is the generalisation of the relativity theory by which it has been possible to find for the electron as natural a place in the theory of the universe as that accorded to gravitation in Einstein's theory. The book in appearance is very mathematical, although the use of formulæ has been restricted as much as possible, but it also contains much interesting and readable text as well, and has been well printed and prepared.

P.R.C.

CORRESPONDENCE

To the Editor of *The Wireless World*.

Sir,—The following may prove of interest to some of your readers :—

While listening on λ 600 metres at 0026 hours this morning I overheard FFS (S. Maries-de-la-Mer, Gulf of Lyons) conducting business with the s.s. *Caledonia* MNU.

I was using three "French" valves, one as rectifier and two as low frequency amplifiers, and the signals from FFS were so loud that I could hear them with the telephones on the table and those of MNU nearly as loud.

With the amplifier I listened to FFS sending a message addressed to "Col. W——, s.s. *Caledonia*," and as he repeated the message I switched over to the ordinary crystal (Perekon) detector and the signals on this without any ampification were "good" from FFS, and as MNU acknowledged the message his signals were quite readable.

Kerienik is situated approximately lat. 13° N, long. 23° E, and the distance to FFS is something over 2,000 miles.

According to the "Year Book" the normal range of FFS is 380 miles, and that of MNU 250 miles.

I think this is another striking example of the favourable conditions which sometimes exist during the hours of darkness for long distance transmission on small powers in tropical latitudes.

It will be interesting to know if this is a record distance over which an ordinary 1½ kW. ship set has been heard without amplification.

I was using a military Mark III Tuner and my aerial has a mean height of 60′.

I am, Sir,

WILSON FINDING.

W/T Inspector, Sudan Telegraphs.

P.S.—The time 0026 hours was G.M.T. plus 2 hours.

FRENCH AMPLIFIER L1.

The following extract from a letter received from a reader of *The Wireless World* is published in the hope that the hints contained therein may be of some service to those who are experiencing trouble with this type of amplifier.

"I have noticed that you have a good many enquiries from readers about the L1 French Amplifier, which is apt to be rather troublesome. I do not know if it is generally known, but I have found that all my trouble with the amplifier disappears on using 6 volts instead of 4 volts for the filaments, thereby lighting these brightly. I employ 90 to 100 volts on the plates and it is necessary to maintain this voltage to prevent oscillation. This does away with all howling, but as the apparatus will hardly oscillate at all under these conditions and a separate heterodyne is necessary for C.W., unless one likes to break the plate circuit of one of the first three valves for a reaction coil. Contrary to what I have heard stated I find that this instrument gives excellent results on wavelengths as low as 600 metres. A source of trouble I have experienced is faulty insulation in the windings of the H.F. transformers, giving rise to appalling noises in the telephones."

. QUESTIONS AND ANSWERS

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

HIC et UBIQUE (Gt. Shelford) *is having trouble with burning out of the rectifying valves in a two-valve resistance amplifier. He asks the probable reason.*

The set is quite correct as sketched, and should give no trouble. Two possibilities occur to us. (1) That your actual wiring does not agree with your sketch, and that the full battery voltage is getting across the rectifying valve while the resistance is in series with the amplifying valve only. Or (2) The grid condenser, which you mark as "? leaky" is very seriously leaky or even broken down. In this case you would get excessive positive grid potential on the second valve leading to very heavy electron currents with consequent overloading and shortening of life.

A.C.S. (Switzerland).—(1) A No. 55 amplifier would probably cost about £40. It is a very good amplifier when used in conjunction with a suitable tuning circuit.

(2) This appears to be an ultra-audion regenerative circuit. It should be quite satisfactory if condenser C_1 is made variable, and C_2 connected between the plate and filament instead of between the grid and filament.

(3) Good results should be obtained with an R valve.

(4) An iron core inserted in the A.T.I. or secondary windings would greatly increase the inductance of the windings, increasing the wavelength and reducing the frequency. The circuit would not oscillate with radio frequency.

RELAY (New Southgate) *asks* (1) *Should it be possible to operate a single-wound polarised relay (working on* 20×10^{-6} *amp.) off a single valve (V24) receiving set.* (2) *If so, for the best diagram of connections for set.* (3) *Approximate internal plate filament resistance of a V24 valve.*

(1) Yes.

(2) Any type of circuit except a grid condenser rectifier will do; put the relay in series with the telephones, shunting it with a condenser. If you use a grid condenser the relay will work inverted; this will not matter if the relay has a spacing as well as a marking contact.

(3) Of the order of 10,000—20,000 ohms, depending on the part of the characteristic used.

E.E.G.B. (Holt).—(1) The diagram illustrating your circuit is very indistinct. You appear to have a crystal connected in series with the telephones, H.T. battery, reaction coil and anode. This is wrong, and the crystal should be left out altogether. The grid condenser and leak will give you rectification. Do not short-circuit unused portions of your aerial inductance.

(2) This is practicable, but requires careful handling. As the H.T. positive is earthed all other parts of the oscillation generating circuit, especially the filament battery, should be well insulated from the earth. The aerial circuit should not be auto-coupled, but should be entirely separate from the oscillation generating circuit, as shown in your second diagram.

(3) An R valve would be suitable; 30 volts would not be sufficient anode voltage with an R valve even for receiving.

(4) Intervalve transformer should have 1 oz. to 3 ozs. of No. 44 S.S.C. wound on a ¼" diameter soft iron wire core.

H.B. (Tonbridge) *asks* (1) *Can slab inductances be used with success for crystal sets.* (2) *Is zincite-galena a successful compound.* (3) *Is a variable condenser absolutely necessary.* (4) *Is an enclosed diagram of a crystal receiver correct.*

(1) Yes; but such coils are only of much advantage for wavelengths which are too high for efficient crystal reception.

(2) We have no experience of this combination.

(3) Not if you have continuously variable inductances for tuning purposes.

(4) No; it is nearly as wrong as it could possibly be. See Fig. 3, page 756, of the issue for January 22nd.

J.B.B. (Helston).—The transformer recommended on page 759 was a low frequency iron-cored transformer, having a "turns ratio" of about 1 to 1. The resistance values are not very important. A suitable transformer can be made by winding a primary with 1 oz. and a secondary with 3 ozs. of No. 44 S.S.C. wire on a soft iron core, ¼" diameter.

S.O.S. (Essex).—(1) The windings given in the reply referred to will be suitable for your set, as such windings are not greatly affected by the type of valve used.

(2) Windings of ½ oz. and 1½ ozs. of No. 44 will be fairly suitable. Ordinary layer winding will do for these coils.

(3) There should be little difference in performance between these sets, if well made, but the Fig. 3 circuit is more easily adapted to a large wavelength range, and is more convenient to handle.

(4) Not very good. S.I.C. varies—generally about 3.

C.W.T. (Dorchester).—(1) and (2) Yes, certainly; but why not use the same batteries for each, as can easily be done with a little arrangement. See various multi-valve circuits in these columns.

(3) Refer to Editor.

(4) MPD 2,800 ms. FL varies within a few hundred metres about this figure.

QUESTIONS AND ANSWERS

G.G. (Douglas).—You will find a circuit for telephone transmission in Fig. 7, page 674 of the issue for December 25th, the diagram being accompanied by useful hints on construction. Your receiver and amplifier should be adaptable for telephonic reception, but you will probably have to reduce the dimensions of some of the windings to get down to the wavelength of your transmitter.

H.H.L. (East Acton) *asks* (1) *If connections of set in a diagram are correct.* (2) *What wavelength will it reach.* (3) *How many sheets of tin foil 6" × 4" with glass 5-64ths" as dielectric would be required for a capacity of 0·005 mfds.*

(1) Yes.

(2) About 2,000 ms. Inductances wound on shorter formers of greater diameter would give you bigger wavelength for the same length of wire.

(3) Twelve sheets of dielectric.

TRAMP (Birmingham).—(1) A horizontal frame aerial is not efficient. We should prefer a vertical frame, not more than 6' square.

(2) Detailed information for frame aerials is given in the issues for May 29th and June 12th of last year.

(3) Yes; it will be necessary to advise the P.M.G. of the proposed aerial.

(4) An earth lead is not necessary with a frame aerial.

X.Y.Z. (Bournemouth).—Your circuit is rather complex, having three tuned circuits, and we do not advise its use. Fig. 1 gives the connection of an additional valve for rectifying.

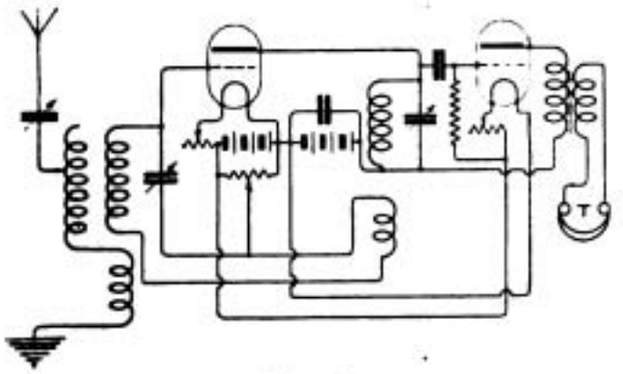


Fig. 1.

A.E.H. (Portsmouth).—(1) See Fig. 2.

(2) No: it would give very poor results indeed.

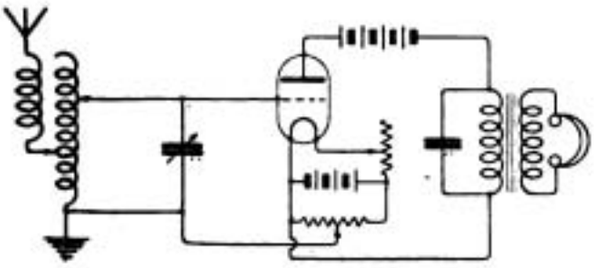


Fig. 2.

MICROFARADITE (Epsom).—(1) The best coils to use are single-layer solenoids for short waves. For long waves pancake or pile-wound solenoids may be used.

(2) Condenser A = 0·002 to 0·003 mfd. variable.
B = 0·002 fixed capacity.

(3) The circuit is quite good. The reaction should couple into the grid winding, which it does not do in your diagram. Also the condenser B should be connected across the H.T. battery as well as across the telephone transformer, as a path of low impedance to high frequency currents.

(4) For a suitable receiver with windings, etc., see the recent constructional article on a "Single Valve Long Wave Receiver."

E.C. (West Norwood).—Indoor aerials are rarely effective. You might try it, but we doubt if you will be successful. A frame aerial with more magnification would be more suitable.

BRIGHTON COLLEGIAN (Brighton).—(1) Put the aerial condenser on the aerial side of the grid connection.

(2) A.T.C. should be at least 0·005 mfds.

(3) It is impossible to give the wavelength, as you do not give any information as to the sizes of your inductances.

(4) Yes.

H.A. (Barnsley).—(1) and (2). There is an initial licensing fee and an annual fee. It is not necessary to forward the license each year for renewal, provided the fee is paid.

(3) POZ is the German station at Nauen. MGZ is a P. & O. vessel, the *Khiva*, but possibly the MGZ you have heard is transmitted by Nauen and means Mean Greenwich Time. You must not expect to find up-to-date information in your Year Book, which is two years old

(4) Yes, apparently C W.

C.R.R. (Clacton).—(1) Connect apparatus as per diagram: Fig. 3.

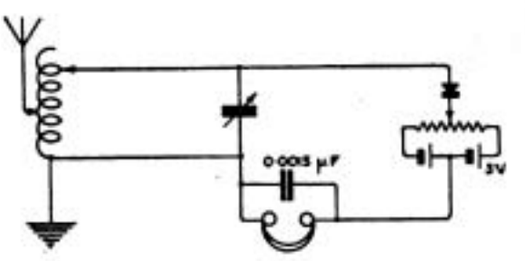


Fig. 3.

The crystal holder is rather elaborate for carborundum. You will get better results with a steel plate or needle point instead of the copper wire.

(2) If "tubular resistance" is a wire resistance of the order of 3,200 to 5,000 ohms, it may be used for a potentiometer if a sliding contact is fitted to it.

(3) You should get many ships and coast stations, and also Eiffel Tower and Poldhu. Your maximum wavelength will be slightly under 3,000 ms.

(4) The current through the detector will be about 100 micro-amperes. The current to be

supplied by the crystal will depend upon the potentiometer resistance. Two good dry cells each 1·5 volts (not pocket lamp size) will last a considerable time.

The current to be supplied by the crystal will depend upon the potentiometer resistance. Two good dry cells each 1·5 volts (not pocket lamp size) will last a considerable time.

P.W. (Leamington).—(1) B valves are "harder" than the R type, and require much greater anode potentials. They are transmitting valves.

(2) A 3-valve amplifier—two valves H.F. magnification and rectification, and one valve giving L.F. magnification. (Fig 4).

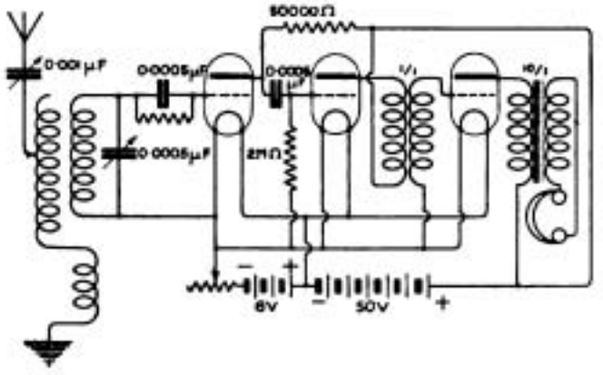


Fig. 4.

H.P. (Liverpool) *asks* (1) *Is an Ediswan valve (E.S.2) suitable to work in conjunction with a Mark III short wave tuner.* (2) *For a diagram showing how to connect up the valve to two terminals marked "valve" on the tuner.* (3) *If this valve is not suitable, could we recommend one.* (4) *If the resistance of the telephones is in any way wrong for use with Mark III tuner, when wound to* 3,000 *ohms.*

(1) Yes.

(2) You will notice that the detector change-over switch has to be raised to make contact with the tall contacts. (Fig. 5).

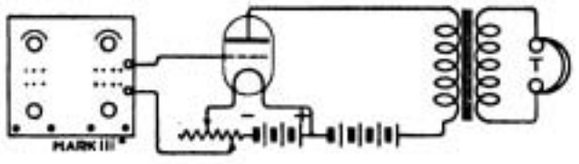


Fig. 5.

(3) You can use E.S. or R or V24 valves.

(4) Telephones are quite all right for crystal set. They cannot be used in conjunction with telephone transformer in a valve set. Telephones for this should be 120 ohms.

ANXIOUS (Bournemouth) *asks for information as to connecting up a detecting valve on a Mark III Tuner.*

(1) Terminals marked "Valve" on the Tuner should be joined to the grid and filament of the valve either through a grid condenser and leak, or through a potentiometer.

(2) Yes, in the anode (or, "sheath") circuit of the valve, not to the terminals marked "Telephones."

(3) Your circuit requires the addition of a leak—of about 2 megohms—across the condenser in your grid circuit, which condenser should be about 0·0002 mfd. The circuit is otherwise correct.

(4) Filament about 5 volts—use a 6-volt battery with regulating resistance in series; plate, 30 volts or upwards.

E.H. (Croydon) *asks for criticism of his set, particulars of which he encloses, and* (2) *Is there any inexpensive list of stations, names and letters.*

(1) The circuit appears satisfactory. Have you tried a potentiometer to the crystal? The aerial downlead should be at right angles to the main aerial; it must not be brought down to form a sharp angle with the aerial. No. 28 wire is too fine for aerial circuits; as a general rule do not use any finer than No. 24. Your present inductance tunes the aerial to 2,500 ms., approximately. The secondary wavelength, if your capacity value of 0·000042 mfds. is correct, will be only 880 ms. If its value is 0·00042 mfds., as it should be, the maximum secondary wavelength will be 2,800 ms.

(2) The April 30th issue gave a list of stations, with times of working and wavelengths. The "Wireless Year-Book" gives a complete list of station call letters, but the price is 21s. Possibly you could purchase an old issue cheaply through the Exchange and Mart column.

C.H. (Nunthorpe) *asks* (1) *Which is the most suitable aerial for use with the long-range single-valve set described in "The Wireless World"—the G.P.O. 70′ double, or the* 100′ *single.* (2) *Criticism of diagram enclosed.* (3) *Is the enclosed sample of wire suitable for the aerial.*

(1) Probably better results will be attained with a 100′ single wire; but why not try both, and see which is the better of the two.

(2) The aerial and earthing arrangements are quite good. As you have plenty of room, arrange for the horizontal part of the aerial to be clear of the house.

(3) The wire is quite suitable.

CIVILIAN (Manchester).—(1) The connection should be as shown in the wiring diagram, *i.e.*, negative H.T. and positive L.T.

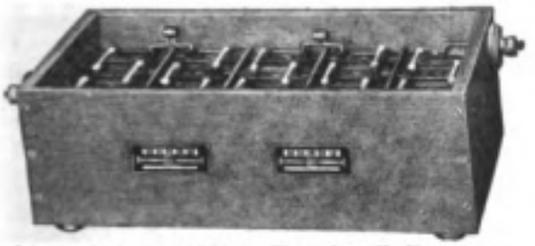
(2) It is a matter of experiment. Probably not.

J.W.R. (Stanmore).—(1) If the tube is 3¼″ outside diameter, and ¼″ thick, the wood plugs in each end should be 3¼″ diameter, so that they fit tight into the tube. The length over all should be 3½″.

(2) As shown in Fig. 14, page 724, all the condensers in the one clamp are connected, the common end joined to the long-short wave switch arm, and the other ends to the studs.

(3) To use with a single-wire aerial join the loading inductance across the condensers and connect the aerial and earth, and also A and B of the amplifier across the condensers. Make a few tappings on the loading inductance. The maximum wavelength of the set would be about 13,000 ms.

(4) Yes.



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QUESTIONS AND ANSWERS

SENOR CHISPA (Texas) *encloses two diagrams for criticism.*

The circuit would be greatly improved if a secondary tuning condenser were used. The circuit shown is correct for L.F. magnification, except that there should be no grid condenser, and also the filament resistance should be on the negative side of the filament. Perhaps your iron-cored transformer is not very efficient. It should have a large number of turns, say, 10,000 in each winding.

INQUIRER (Wimbledon). — (1) Generally speaking, this value is much too high. A total capacity of 0·006 mfds., variable and fixed condensers, was recommended in a recent constructional article for the reasons given therein. You might use your condenser for a 10,000 to 20,000 ms. circuit, but not for shorter wavelengths, owing to the comparatively small amount of inductance required with such a large capacity.

(2) Air dielectric is used for variable condensers, as it makes the construction easier; but for fixed capacity condensers, ebonite or mica is used, owing to the higher specific inductive capacity. The capacity between the metal plates with an ebonite dielectric is about 2·5, and with a mica dielectric eight, times as much as with an air dielectric.

(3) Three valves is the minimum number to use with a frame aerial to obtain good results.

(4) These valves have rather flat bends in the anode characteristic, and the use of a grid condenser and leak for rectification will be an advantage.

L.M.T. (Barrow-in-Furness) *asks* (1) *Is the two-electrode Fleming valve any improvement on the crystal for reception.* (2) *Do any firms manufacture these valves.* (3) *If a diagram he sends is correct, and, if not, why not.*

(1) No. A crystal is more sensitive, but the valve is the more stable of the two.

(2) It may be possible to obtain these valves from the Marconi Telegraph Company.

(3) In addition to variable filament resistance it is necessary to use a potentiometer across the battery, the slider being connected through the telephones to the bottom of the A.T.I. so that the plate may be adjusted to the best potential for rectification.

T.R. (Preston).—(1) Yes, the tin formers are hopeless. They form a L.R. closed circuit, which will reduce the inductance effect of the windings to a negligible quantity. Make formers of cardboard, well varnished.

(2) Give diameter of new formers, also condensers available and wavelength required.

(3) Reactance coils are used in conjunction with valve sets. The function of a R.C. is to magnetically couple together the anode and grid circuits of a three electrode valve, so that some of the big oscillations in the anode circuit are put back into the grid circuit in such a way as to help to maintain the anode circuit oscillations, or, if the coupling is tight enough, to set up continuous oscillation in the circuit.

J.W.C. (London).—(1) This depends entirely on the size of the frame and the tuning condenser, about neither of which you say anything. For an average frame, and 0·001 mfds., you would get about 5,000 ms.

(2) The suggested condenser is quite unsuitable. For good results the condenser should be variable, with air dielectric, say, ten moving plates of 10 cms. radius, with eleven fixed plates, the thickness of the dielectric being 2 ms. If this is not possible, build an air condenser of fixed capacity with about the same area of plates, preferably making some of the plates removable.

(3) About 100 ohms.

(4) Apply to the Secretary, G.P.O., London.

F.A.T. (London).—(1) The exact dimensions of these coils are difficult to predict, particularly with the little information you give about your aerial. For A 12 to 20 turns of, say, No. 20 wire on a 3" former should be sufficient. B must be determined by experiment in each case—try 50 turns of No. 24, on a 2½" diameter former.

(2) Up to 20 milliamps, or even somewhat more.

(3) Very difficult to predict, as it depends on the H.F. resistance of your aerial, about which we know nothing. Under good conditions of earthing, etc., you might get 200 milliamps.

(4) An anode power input of 35 milliamps at 200 volts, as you suggest, is quite in order, but will probably be difficult to get with efficient oscillation on two R valves.

N.L.Y.F. (Reading).—(1) The aerial system is satisfactory, as is the receiver, except that the coils appear to be wound in multilayers, which will give very poor results.

(2) The inductance of such coils is by no means an easy matter to compute, and in view of the fact that they will be almost useless for receiving purposes, we do not think the value of the results would justify the expenditure of labour necessary to obtain them.

(3) There are no simple methods of calculation for the general cases you quote, but you will find a good deal of information on the subject in Eccles' "Handbook," and also in "Radio Instruments and Measurements," published by the American Bureau of Standards.

(4) We certainly think you will find coils with less wire useful for short wavelengths. We should recommend you to rewind the old coils, and also to wind the new set, either as basket coils or honeycombs. You will find suitable sizes in various recent replies.

SPARKS (Cambridge).—(1) and (2) The aerial should be quite satisfactory if only one lead in is used. This should be from the end marked "A."

(3) Telephone wires crossing the aerial 5' below it will not seriously affect signals if they cross nearly at right angles to the line of the aerial, but we doubt if you will get sanction for such an arrangement, owing to the risk of your aerial fouling the telephone lines.

(4) The wires used are too fine. Wind the primary with No. 24, and the secondary with No. 28—preferably increasing the secondary capacity slightly. The telephones should be on the earth side of the H.T. battery, and a grid potentiometer would improve results.

"AMATEUR" (Kingston).—We regret that we have no information with regard to this amplifier, which is very uncommon in this country, and of quite unusual design. We should advise you to write for further particulars to the Telefunken Company.

W.P.A. (New Barnet).—(1) Complete design of a complicated multivalve set to conform to certain special requirements is quite outside the scope of these columns, which are intended to help amateurs with specific difficulties. The circuit of Fig. 1, page 730, January 8th issue, approximates fairly closely to your requirements.

(2) This crystal should give fairly good results.

(3) This (the production of beats with a reaction coil in a crystal circuit) is not possible, owing to the fact that the circuit possesses no power of generating local oscillations to beat with the incoming signals.

(4) See various articles in the volume just completed.

"SIG" (Devizes).—(1) Your aerial condenser is too small (0·0007 mfds.) for series use; it would be more useful in parallel with the A.T.I. The two aerial coils should be in series, not as shown. Maximum wavelength will be about 2,000 ms.

(2) Yes, the suggested scheme is quite O.K.

(3) Transformer windings may be ½ and 1½ oz. of No. 44 on an iron core for A and B, the high resistance sides to be connected to the grid of the valve. Transformer C may have two windings, each of 1 oz. of No. 44, on a similar core.

(4) 20-30 volts should be sufficient.

S.W.R. (London) *asks various questions with reference to the single valve long range receiver recently described.*

(1) Standard P.M.G. aerial consists of 100′ of single wire, or if a twin aerial is used, the length of either side must not exceed 70′. Any considerable reduction below these amounts will adversely affect the results obtained.

(3) With suitable constructional alterations, and a suitable H.T. voltage, almost any hard receiving valve may be used.

(3) Enamel covered wire might be used for the coils, but is not recommended, owing to the risk of damaging the insulation and also the increased self capacity of the coils so wound.

(4) The telephone resistance should be about 120 ohms if a transformer is used, and 4,000-8,000 ohms if no transformer is fitted.

B.R. (Oxford).—(1) The scheme you submit is of little use. It contains several unjustifiable assumptions, and even if these were found in practice to hold good, the instrument would be much too insensitive to be of any value.

(2) Valves with a metal plate outside the glass envelope give fairly good results, but have certain drawbacks in practice.

(3) This scheme also is not workable, as you would cause very little change of magnetic flux by your signals applied in this way.

(4) We are afraid that you would not find an X-ray tube a satisfactory substitute for an aerial. X-rays do produce conductivity in air through which they pass, but not to an extent which would make this in any way possible. (We note that recently we have received a batch of questions from you almost monthly. In view of the large demands on our space we are afraid we must decline to deal with any more for the present.)

E.R. (Birmingham).—(1) The connections of the set are not correct. Put the telephones between the condenser and the potentiometer, and not between the condenser and the A.T.I. as shown.

(2) and (3) Both quite satisfactory.

(4) The presence of the telegraph wires will probably weaken signals a little, but should not do so seriously.

H.A. (Greenwich).—(1) Except in quite special cases the use of two valves in parallel offers very few advantages. It is certainly not a good way of applying two valves to a receiver for general purposes. We do not like your fixed aerial series condenser.

(2) See Fig. 4, page 663, issue for December 11th. You can omit the reaction coil there shown if you wish to.

G.C. (Gt. Yarmouth).—(1) Your telephone transformer is wrongly connected. Put the L.R. winding across the telephones. The A.T.I. is too small for the other dimensions of the set. Introduce an additional coil, 10" by 6", wound with No. 24 in the aerial. Aerial condenser should be somewhat larger.

(2) Wavelength maximum will then be about 4,000 ms.

(3) Introduce a potentiometer for the crystal, and provide a shorting switch for the A.T.C.

(4) 0·00055 mfds.

G.A.H. (Farnborough).—(1) Possibly the permanent magnets are weak, and require re-magnetising, or the windings may be connected so that the current makes both coils of one earpiece of the same polarity. Try reversing the connections of one coil.

(2) There is not sufficient information given with regard to the circuit for any explanation to be given.

(3) The single wire aerial will probably give the best results.

(4) No.

H.J.F. (Birmingham).—The wavelength range will not be 600-6,000 ms. with the present secondary. The maximum wavelength will be about 3,500 ms. Rewind it with No. 36 wire, for 6,000 ms. The A.T.I. should be wound with wire not thinner than No. 24. Wind the 4½" former with this gauge, and arrange to connect the A.T.C. either in series or in parallel with the A.T.I. Connect a 0·002 mfd. blocking condenser across the telephones and the anode battery.

SPARKS X (Consett).—(1) Diagram submitted is quite O.K. The values are as follows:—A = 0·0003 mfds, B = 9,000 mhys., C = 11,000 mhys., D = 0.0009 mfds. E and F impossible to state. E should be 0·00005 mfds., with a 3 megohms leak, and F 500 mhys.

(2) Used with a grid condenser a Q valve requires at least 150 volts. If this condenser is omitted about 50 volts will be ample.

(3) Yes.

(4) Maximum wavelength will be about 3,500 ms., which will not be affected by winding the secondary with finer wire.

H.F.W. (Marefield Park).—(1) The circuit is not designed for crystal rectification. The reaction coil is not suitably proportioned for a secondary inductance, and is shown untuned.

(2) "Billi" Condenser is a name given by the Marconi Co. to a small variable condenser made by them for secondary circuits, the maximum capacity of which is, approximately, 500 micro-micro farads, *i.e.*, 500 billionths of a farad—hence the name "Billi."

(3) Almost as good, depending on the efficiency of the transformer.

(4) Inductances and capacities can be calculated with fair accuracy by means of tables and formulæ given in Nottage's book, "Measurement and Calculation of Inductance and Capacity," obtainable from *The Wireless World* publishers.

E.C.A. (Fellxstowe) *asks* (1) *Is it possible to adapt a Q or V.24 valve to an ordinary land telephone receiver in order to magnify the speech and, if so, could we give an idea of the circuit required.* (2) *Is it possible, by having the leads of an aerial running parallel to a land telephone line to get the speech induced off the telephone line into a wireless receiver which consists of a type 70A Marconi tuner in conjunction with a type 55A valve amplifier.*

(1) Yes. There are two ways of doing this—in both cases using a two-valve low-frequency magnifier. In the first case two leads to the ordinary telephone receiver should be connected to the input terminals of the L.F. magnifier, and in the second case an ordinary microphone and battery is connected in series with the input transformer of the magnifier and the microphone placed against the earpiece of the telephone receiver. The second case will give better results, as there is not so much magnification of the line noises other than the required speech.

N.B.—The Post Office do not allow any alterations as in the first case to be made to their instruments.

(2) This may be done, but not with a type 55 H.F. amplifier. The currents set up in the aerial would be L.F. induction currents, and not H.F. radiation currents—therefore, H.F. receiving gear would not be suitable. It would be necessary to use a L.F. amplifier to detect this.

H.J. (Brighouse).—(1) This coupled jigger is quite suitable for a crystal receiver and will have a wavelength range up to 3,000 ms., if a 0·0003 mfd. variable condenser is connected across the secondary.

(2) and (3) This is commonly used as a reaction unit for a single valve receiver. You do not give any particulars *re* size of formers and purpose for which it is to be used. Therefore, we cannot give you a winding.

Z.B.Z. (S.S. Porfell).—(1) The connections to the 31 type are correct. You do not show the circuit of the valve panel. Is there a grid condenser and leak? if not your anode voltage of 50 is too much—the valve will be an inefficient rectifier.

(2) The information given is insufficient to enable any explanation to be given.

(3) To use a valve as a L.F. magnifier, use a crystal rectifier in the 31 and connect the telephone terminals to the grid and negative of the filament of the valve. Short circuit the grid condenser and leak, if present. Short circuit the reaction coil terminals and use the existing valve panel telephone terminals.

AMATEUR (Lowestoft).—(1) Try the arrangement given in Fig. 6 for connecting up your various pieces of apparatus:—

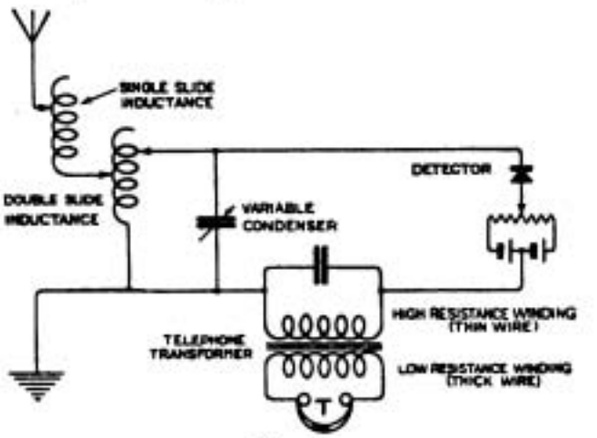

Fig. 6.

You cannot expect good results with an earth 150′ away. Cannot you bury a large metal plate or a big piece of wire netting much nearer than that.

HOROLOGIST (Eastbourne).—(1) Yes.

(2) Owing to the large amount of inductance required—approximately 500,000 mhys.—and unless very large formers were used, the resistance of the inductance would greatly increase the damping factor and also would give a large I^2R loss.

F.C.A. (Westcliff-on-Sea).—(1) and (2) There are, generally speaking, two types of telephone—high resistance and low resistance. The high resistance (2,000 to 8,000 ohms) are inserted directly in crystal circuits, while the low resistance are used in conjunction with a telephone transformer. Good 8,000 ohms telephones will usually give slightly better results than low resistance with a transformer, but 2,000 ohms may not be so good. When using a valve circuit it is not advisable to use a high resistance telephone as the anode voltage applied to the valve may break down the insulation of the fine wire used. It is better to use a telephone transformer and low resistance telephones.

(3) There is no regular programme of wireless concerts in England at the present time. The Dutch concerts are given every Thursday night and Sunday afternoon on 1,100 ms.

(4) You have probably connected up the windings so that they are of the same polarity. Try reversing the direction off the current through one of the bobbins of each telephone.

CRYSTAL (Hull).—You will obtain the best results by using cylindrical single-layer coils. For the A.T.I. use a 6″ former 13″ long, wound with No.

24. For the primary coil use a 5" former 6" long, wound full of No. 24 DCC. For the secondary coil use a 6" former 6" long, wound full of No. 28. Make a number of tappings in each coil.

(2) To obtain proper coupling one coil should slide in and out of the other.

(3) This varies according to the telephones, and is best found by experiment. It will be about 0·001 to 0·002 mfds.

(4) Yes, the charge for the license is 10s. per year.

WHISTLING WATERS (Stoke).—(1) If, as it appears, the down lead lies under the horizontal part of your aerial, results will be very poor, owing to the small angle between these parts.

(2) The circuit is fair, but you will require six volts for the filaments. The filament resistance should then be arranged to control the currents to both valves. The coil P should be shunted by a condenser, say, 0·002 mfds. A telephone trans former and L.R. telephones would improve results.

(3) You should get PCGG with a better aerial—probably not with the one at present in use.

(4) About 0·00035 mfds.

T.I. (Rochdale).—(1) 0·00013 mfds.

(2) 12" × 8", wound with No. 28, would be required, but we should advise you to increase the size of the condenser two or three times, using less turns on the loading coil.

(3) The circuit is correct, but results will be very poor with only a single valve. The positive pole of the H.T. battery should be connected to the plate.

(4) A potentiometer is not required in the plate circuit of a valve.

MINUS (Hornchurch) *asks* (1) *For a circuit to use L.F. amplification after one stage of H.F. amplification followed by crystal rectification.* (2) *If the circuit would be suitable for telephony.* (3) *Capacity of a certain condenser.* (4) *If condensers of this size would be too large for the circuit.*

(1) See Fig. 7.

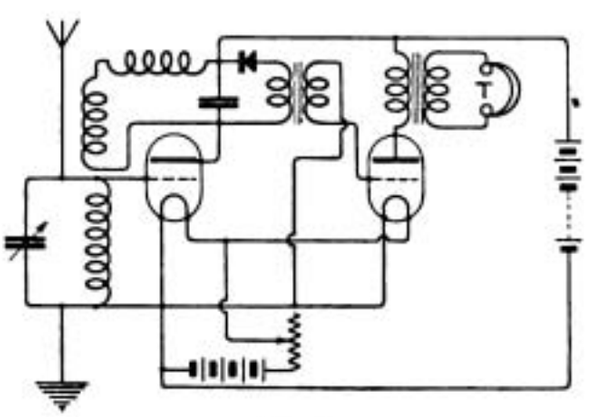

Fig. 7.

(2) Yes.

(3) 0·00023 mfds.

(4) No, they would be rather on the small side.

W.E. (Streatham).—(1) We cannot follow your calculations. The number of sheets of dielectric should be :—A = 6, B = 30, C = 18, D = 1½; *i.e.*, use double thickness of dielectric between foils, with three pairs in all.

(2) In the example quoted (page 462, September 18th issue) the area of each plate should certainly be 44·1 cms., and not 22·05 as given.

L.O.W. (London).—(1) The sample of wire sent is No. 40.

(2) We cannot give the reason for this effect, which is unusual. It may possibly be due to a thin film of oxide on the cat-whisker, which is temporarily broken down by the stronger buzzer signals.

(3) This effect (sounds in a valve circuit on first switching on, disappearing after half a minute working) is also unusual. It may be due to internal actions in either the cells or the valve : we cannot say which without making tests. In any case the trouble appears fairly harmless.

R.F. (Cults).—(1) No, connect as in diagram, Fig. 8.

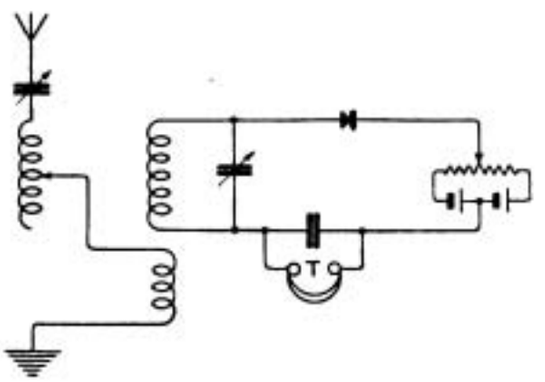

Fig. 8.

(2) Formula is correct if lengths and areas are measured in centimetres instead of in inches. Owing to this the true capacity of the condenser given as 0·00007 mfds. will be 2·54 times this value. This is considerably too small for a series aerial condenser.

(3) and (4) No. 28 is too fine for the A.T.I. : rewind with No. 24. With a secondary condenser of 0·0003 mfds., range of the set will be about 3,000 ms. A 0·002 mfd. condenser across the telephones will somewhat improve results.

SHARE MARKET REPORT.

The Wireless Group has been much calmer during the last fortnight, and a slight depreciation is noticeable in the shares.

Prices as we go to press, June 2nd, are :—

Marconi Ordinary	£2	10	0
,, Preference	£2	10	0
,, Inter. Marine ..	£1	7	0
,, Canadian		8	0
Radio Corporation of America :—			
Ordinary		8	9
Preference		10	3

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A SIMPLE METHOD OF DESIGNING TUNING COILS

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

IN ordinary electrical engineering work use is frequently made of the formula $H = \frac{4\pi}{10}\frac{IN}{l}$, expressing the value of the flux in lines of magnetic force per square centimetre in the inside of a magnetic circuit of length l round which a current of I amperes flows N times. This formula is the basis of one often used to calculate the inductance of a coil, viz., $L = \pi^2 D^2 \frac{N^2}{l}$, since the inductance of the coil can be numerically expressed as the number of linkages which the flux makes with the turns of the coil per ampere of current flowing through the winding.

The inaccuracy of this simple formula for all except extremely long coils, or completely closed magnetic circuits, has led to its frequent modification by many radio workers. One of the most useful of these is that first devised by Prof. Nagaoka, of Tokyo, and of which details are published in the *Bulletin of the Bureau of Standards*, Vol. 8. The modification introduced takes the form of a correcting factor k, which is always less than unity, but which closely approaches that figure for extremely long windings. This factor corrects for the uneven distribution of the magnetic flux near the ends of the coil, as were the flux always uniform the simpler formula would be correct for all cases. Tables of the values of this factor k are given in the *Bulletin* above referred to, in terms of the ratio $\frac{D}{l}$. This formula, viz., $L = \pi^2 D^2 N^2 k/l$, is very convenient for the calculation of the inductance of a coil when its dimensions l and D are given, since k can be found from the tables, and the expression then evaluated, but it is not nearly so useful for the more practical problem of the *design* of a coil to have any desired inductance value.

In this connection it is, perhaps, not so generally known that Nagaoka's formula as given above may very easily be modified in such a manner that the design of a coil thereby becomes comparatively easy, so that all unnecessary "trial and error" methods can be eliminated.

Taking the above formula, we may write it as follows:

$$L = \pi^2 D^2 n^2 lk$$

$$\text{or } L = \pi^2 D^3 n^2 \left(\frac{lk}{D}\right),$$

where $n = N/l$ = the number of turns of wire per centimetre length of the coil, D = the diameter of the winding measured to the centre of the wires, and l = the axial length of the coil. In this form it is much more useful (as will be shown below) provided that we have access to a table or curve giving values of the factor (lk/D). Values of this may be worked out from the tables and formulæ given by Prof. Nagaoka, and some

curves obtained by the writer in this manner have been published in the *Electrician*.*

For still greater convenience in use we require the inductance to be given in microhenries, and all the dimensions to be in inches. We may therefore rewrite the above formula again, thus :—

$$L = \pi^2 D^3 n^2 \left(\frac{lk}{D}\right) \quad \text{[Inductance and dimensions in cms.]}$$

$$= D^3 n^2 \left(\pi^2 \times \frac{lk}{D} \times 2{\cdot}54 \times 10^{-3}\right)$$

$$= D^3 n^2 k_1 \quad \text{[Inductance in microhenries. Dimensions in inches.]}$$

in which we have written k_1 for the whole expression—

$$\left(2{\cdot}54\ \pi^2\ \frac{lk}{D} \times 10^{-3}\right)$$

In order to simplify the calculations, values of this factor k_1 are set out in the table below, and may be used directly in this formula in a manner which we will now discuss.

(NOTE : For convenience in setting out the values of this factor k_1 and of the factor k_2 referred to below, all the figures in the table have been multiplied by 10,000, so that if these factors are used in the formula directly from the table, it is necessary to divide the answer by this figure (ten-thousand) in order to obtain the correct results for the inductance in microhenries).

(1) Given the number of turns per inch (n), as determined by the size of the wire, and given a suitable diameter (D) in inches, to find the length of winding, l in inches required to yield a given inductance. We have L = microhenries, known, also D and n, so that we can at once work out the appropriate value of k_1 by direct substitution, thus :—

$$k_1 = \frac{L}{D^3 n^2}$$

Referring to the table below, we find the corresponding value of the ratio $\frac{l}{D}$, and by multiplying this by the known value of D we at once get l the length of the coil in inches.

(2) Given the maximum length of the coil (which may, perhaps, be determined by some structural considerations of the panel or unit on or in which the coil is to be mounted) and the number of turns of wire per inch, to find the diameter required for a given inductance. We now have L, l, and n given, so that the above arrangement of the formula is not quite so suitable. It is easy, however, to throw it into a convenient form, thus :—

$$L = \pi^2 D^2 n^2 lk. \quad \text{[Inductance and dimensions in cms.]}$$

$$= n^2 l^3 \left(\frac{D^2 k}{l} \times 2{\cdot}54 \times \pi^2 \times 10^{-3}\right)$$

which may be written—

$$L = n^2 l^3 k_2 \quad \text{[Inductance in microhenries Dimensions in inches.]}$$

Values of k_2 are also given in the subjoined table. In this case from the given data we can calculate k_2 and then from the table get $\frac{l}{D}$. Then the required diameter = the length of the coil divided by this value of $\frac{l}{D}$.

(3) Given convenient values for the length and the diameter of the coil to find the number of turns that must be wound on per inch of the coil, so that it may have the required inductance. We now have L, l, and D given, so that either of the above arrangements of the formula may obviously be employed.

(4) Given all the dimensions of the coil, viz., l, D and n, to find its inductance. Again, in this case either of the above forms may be employed, since given l and D their ratio is known and therefore also both k_1 and k_2, from either of which the inductance follows immediately.

* *Electrician*, 75, p. 841, September, 1915.

Ratio l/D.	$k_1 \times 10^4$.	$k_2 \times 10^4$.	Ratio l/D.	$k_1 \times 10^4$.	$k_2 \times 10^4$
0·01	0·08764	87640	1·00	172·6	172·6
0·02	0·3063	38290	1·50	289·5	85·76
0·03	0·6311	23370	2·00	410·2	51·29
0·04	1·049	16390	2·50	532·5	34·09
0·05	1·537	12290	3·00	655·1	24·27
0·06	2·126	9842	3·50	781·8	18·23
0·07	2·774	8089	4·00	904·0	14·12
0·08	3·486	6810	4·50	1030·0	11·31
0·09	4·264	5851	5·00	1153·0	9·223
0·10	5·095	5095	5·50	1276·0	7·690
0·15	9·926	3080	6·00	1402·0	6·488
0·20	16·03	2004	6·50	1529·0	5·565
0·25	22·90	1466	7·00	1653·0	4·818
0·30	30·38	1126	7·50	1778	4·215
0·35	38·78	942·0	8·00	1903	3·717
0·40	47·32	739·1	8·50	2028	3·303
0·45	56·50	620·1	9·00	2152	2·952
0·50	65·88	526·9	9·50	2279	2·659
0·55	75·56	454·0	10·0	2404	2·404
0·60	85·13	394·1	15·0	3663	1·085
0·65	95·81	348·9	20·0	4908	0·6137
0·70	106·5	310·6	25·0	6162	0·3 45
0·75	116·9	277·1	30·0	7415	0·2747
0·80	127·9	250·0	35·0	8670	0·2021
0·85	138·7	225·9	40·0	9926	0·1551
0·90	149·6	205·2	45·0	11180	0·1227
0·95	161·2	188·0	50·0	12430	0·0994

All values of k_1 and k_2 in this Table must be divided by ten thousand to obtain inductance in microhenries.

The following numerical examples to illustrate each of these four possible cases which may arise in practical design should serve to explain how to use the tables to the best advantage. For anyone requiring to work out many coils it is recommended that he plot out curves from the figures given in this table, so that the values of k_1 and k_2 may be obtained easily from them for all intermediate values as well as for those tabulated. Greater speed is thus obtainable in using the formula.

NUMERICAL EXAMPLES.

(1) *Given* : Coil diameter = 4 ins., number of turns per inch length = 25. Inductance required = 1,158 microhenries, *to find the length.*

We have, $k_1 = \frac{L}{D^3 n^2} = \frac{1158}{64 \times 625}$

$= 0{\cdot}02895.$

Hence, from table, $l/D = 1{\cdot}5$, when k_1 is multiplied by 10,000.

Therefore, $l = 1{\cdot}5 \times 4 = 6$ ins. = required length.

(2) *Given :* Coil length = 6 ins., number of turns per inch length = 25 Inductance required = 3,260 microhenries, *to find the diameter.*

We have, $k_2 = \dfrac{L}{l^3 n^2} = \dfrac{3{,}260}{216 \times 625}$

$= 0{\cdot}02771.$

Hence, from table, $l/D = 0{\cdot}75$, when k_2 is multiplied by 10,000.

Therefore, $D = 6/0{\cdot}75 = 8$ ins. = required diameter.

(3) *Given :* Coil diameter = 4 ins., coil length = 6 ins. Inductance required = 1,158 microhenries, *to find the necessary number of turns per inch length of coil.*

We have $l/D = 1{\cdot}5$.

Hence, from table $k_1 = 289{\cdot}5/10{,}000$

$= 0{\cdot}02895.$

$\therefore n = \sqrt{\dfrac{L}{D^3 k_1}} = 25$ turns per inch.

(4) *Given :* Coil diameter = 4 ins. ; coil length = 6 ins. ; number of turns per inch length of coil = 50, *to find the inductance.*

We have, $l/D = 6/4 = 1{\cdot}5$.

Hence, $k_1 = 289{\cdot}5/10{,}000$

$= 0{\cdot}02895.$

$\therefore$ Inductance of coil is given by—

$L = D^3 n^2 k_1$

$= 4^3 \times 50^2 \times 0{\cdot}02895$

$= 4{,}632$ microhenries.

It should be pointed out that the above method of calculation is only applicable to single layer coils, or to two or three layer bank wound coils, in which the radial winding depth of the coil is very small compared with the coil diameter.

The same method of calculation is applicable to pancake or basket coils if a slight alteration of the meanings of the symbols is made. (See *The Wireless World*, 7, p. 384, October, 1919).

For thick coils the formulæ become much more complicated.

REPORTING THE DERBY RESULT BY WIRELESS

The photograph shows the Marconi Wireless Telephone Set used to report the result of the Derby.

FRAME AERIAL RECEPTION

By W. H. F. Griffiths.

NOW that frame aerials, in conjunction with modern multi-valve amplifiers, are being more extensively used, a few notes concerning reception by this method may be of interest to amateurs.

Just as the vertical down-lead of an ordinary aerial is the portion which intercepts the vertically propagated electrostatic component of the incident wave, so the wires forming the vertical sides, A and B, Fig. 1, of the receiving frame are the portions in which the oscillatory E.M.F.'s are induced.

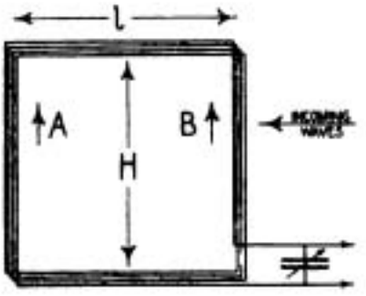


Fig. 1.

These E M.F.'s tend to cause feeble oscillatory currents to flow in the same direction in the sides A and B, *i.e.*, both upwards or both downwards, as indicated by the arrows in Fig. 1, and these currents would oppose each other, or, rather, if the E.M.F.'s were exactly equal in phase they would neutralise each other and no current would flow. But the E.M.F.'s are not *exactly* in phase, due to the fact that the advancing wave cuts the side B slightly before A, causing a difference of phase

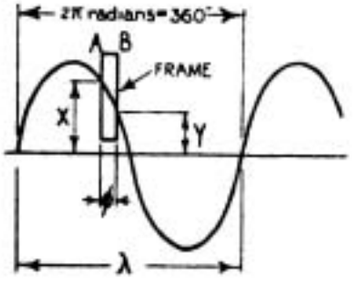


Fig. 2.

proportional to the ratio of the horizontal distance between the vertical sides to the length of the wave being received, as indicated by Fig. 2.

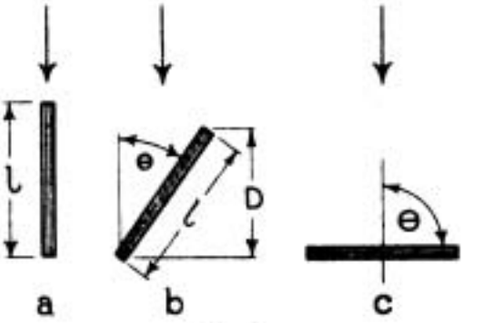


Fig. 3.

If the plane of the frame is in the same direction as the advancing wave, this horizontal distance will be equal to the length of the frame (Fig. 3a), but if it is inclined at an angle θ to the direction of the wave then the effective horizontal distance D, between the vertical sides will be $l \cos \theta$ (Fig. 3b). If the plane of the frame is at right angles to the direction of the incoming waves, then $\cos \theta$ becomes zero (Fig. 3c), and there is therefore no phase difference (the wave

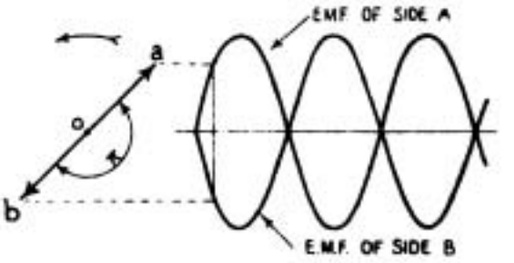


Fig. 4.

cuts both the vertical sides of the frame simultaneously), so that the E.M.F's. induced in the vertical sides are exactly equal in amplitude and in phase ; they, therefore, in this case, neutralise each other, and consequently no current flows round the frame and no signals are received. This effect is depicted vectorially by Fig. 4, where oa and ob represent the equal E.M.F's. in the vertical sides A and B of the frame respectively, when the phase difference

between them is zero, *i.e.*, when the frame is at right angles to the wave or when the length of the frame is infinitely small; the resultant E.M.F. is zero.

Now if there is a slight difference of phase between the E.M.F's. of the two vertical sides, although their amplitudes or R.M.S. values are equal, their actual values at any given instant must differ slightly, as may be seen by reference to Fig. 2, where X represents the instantaneous value of the E.M.F. induced in the frame side A, and Y the instantaneous value of that induced in side B, and it is this instantaneous difference of potential (equal to X—Y in Fig. 2), which causes the feeble oscillatory currents to flow round the receiving frame, which then acts as an inductance in an ordinary closed oscillatory circuit. In other words the vertical sides of the frame act in a differential manner, and the action can be shown by the vector diagram given in Fig. 5,

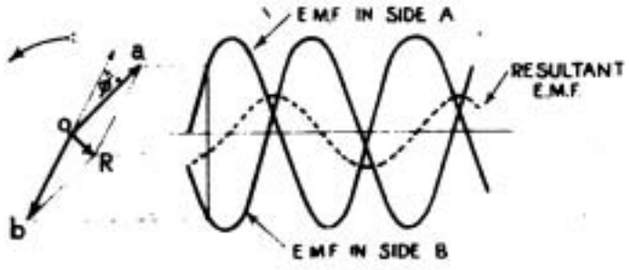


Fig. 5.

where oa and ob represent the two opposing E.M.F's. and ϕ the angle of phase difference between them, as met with in practice, except that the angle ϕ is exaggerated; it may be less than 0·1 of a degree. In this diagram OR is the resultant E.M.F.

The resultant amplitude of the current flowing round the frame is obviously proportional to the phase difference, and, as this phase difference is given by:

$$\phi = 2\pi \frac{l \cos \theta}{\lambda}$$

where l and λ must be in the same units and ϕ is the angle of phase difference in radians, the term 2π is the number of radians in the phase angle (360 degrees) passed through during one complete cycle of the wave, it is clear that the maximum signal strength is obtained when the plane of the frame is in the direction of the incident waves, *i.e.*, when θ equals 0 and cos θ becomes unity.

In order to obtain a complete expression for the "Effective Height" of a frame equivalent to the vertical down-lead of an ordinary aerial, the above expression for the angle of phase difference must be multiplied by the height of the frame H, and also by the number of turns T on the frame; H because the potential drop in the vertical side of the frame is proportional to the length of the electrostatic component of the incident wave intercepted, and T because the complete frame may be regarded as a number of single turns connected up in series with a consequent addition of all the small instantaneous potential differences in them. The effective height is then:

$$h = 2\pi \frac{l \cos \theta}{\lambda} H.T$$

(H, l, h and λ must be in the same units.)

In passing it may be noted that the greatest possible phase difference would be obtained if the length of the frame was made equal to half the wave-length. Although this case is not met with in practice, it is interesting to note that under these conditions with the frame in the position of maximum reception, the phase difference between the E.M.F's. of the two vertical sides A and B, Figs. 1 and 2, would be π radians, or 180 degrees, so that they would always, at every instant, be exactly equal in amplitude and

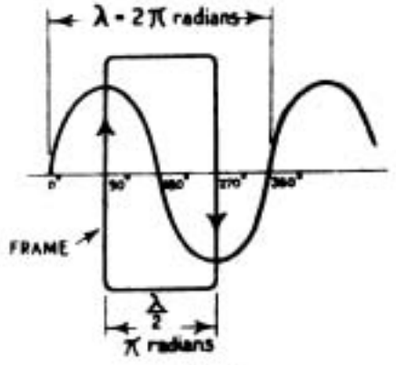


Fig. 6.

opposite in phase as indicated by Fig. 6, and could therefore be arithmetically added, since they tend to produce a current flow in the same direction round the frame as shown by Fig. 6. The vector diagram (Fig. 7) illustrates this.

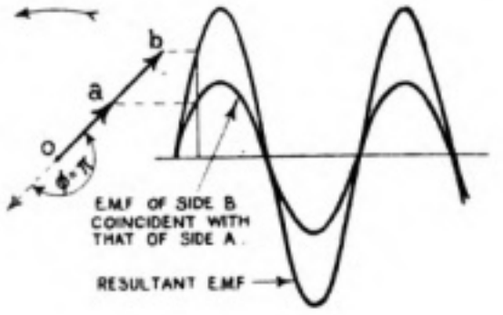


Fig. 7.

It would appear from the first inspection of the expression for the " Effective Height," that short waves are received on a frame aerial more efficiently than longer waves due to the greater phase difference obtained, but this is not so for the following reason. For shorter wavelengths the inductance of the receiving frame would have to be of a lower value in order to obtain resonance (the capacity in the circuit is only variable within limits), and this would necessitate a reduction of the number of turns and/or a reduction of the length of the frame l and the height of the frame H ; each of these three factors is in the numerator of the effective height expression. As the natural wavelength of a circuit is proportional to the square root of the inductance and the inductance is in turn proportional to the square of the number of turns, and also to the square of the length of turn, if the wavelength is halved then the inductance of the frame must be divided by four, which means that either the length of turn—$(2H + 2l)$—must be halved or that the number of turns must be halved. Obviously, the latter method should be chosen, for in the former two factors of the effective height expression would have to be halved instead of one. Therefore, referring again to the formula for effective height, it is seen that if the wavelength is halved, l/λ is doubled and T is halved ; the value of the expression thus remains unaltered. It can be clearly seen from this that the reception of long waves by means of a frame aerial is just as efficient as that of shorter waves.

A FRENCH HIGH POWER STATION

The Buildings of the Wireless Station at Lyons (YN)

A UNIVERSAL AMPLIFIER SUITABLE FOR ALL WAVELENGTHS*

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

THE production of an amplifier that will respond equally well to all wavelengths, from the 180-metre wavelength imposed by the authorities for many amateur stations up to the 20,000-metre wavelengths, and more, in use in several of the Continental and American stations, is a matter of considerable interest, not only to amateurs, but also to other scientific investigators.

In many commercial stations, as, for instance, in those on board ship, as a rule only a very limited range of wavelengths is dealt with, so that the usual design of amplifier can be made to give effective results over the whole range that is required. In the larger receiving stations, moreover, there is no difficulty in providing several separate amplifiers suited for a number of particular wavelengths. When, however, we come to the ordinary amateur, this individual usually wishes to be able to efficiently receive both the shortest and the longest wavelengths that are emitted, while at the same time, by reason of the expense and also owing to the exigencies of space, in this case a number of separate amplifiers are usually out of the question. Thus probably only one amplifier is provided, and this is usually only really efficient for waves of medium length, giving inferior results, both with very short waves as also with very long ones.

The so-called resistance form of amplifier, in which succeeding valves are connected together by small condensers, is probably the form of instrument that, without alteration or adjustment, will give the greatest range as regards wavelengths. Unfortunately, however, resistance amplifiers do not appear to be at all suitable for short waves; indeed, in the author's experience, they only begin to become effective with wavelengths of about 1,000 metres. Again, even for long waves, resistance amplifiers appear to require more valves than do transformer amplifiers in order to get the same result, in the proportion of seven or eight as against six.

No doubt transformer amplifiers can be made to operate with a wide range of wavelengths by employing transformers with tappings on the primary and perhaps best also on the secondary circuits, so that the number of primary and secondary turns in use can be varied at will. Such arrangements, however, require complicated switching devices which, unless very skilfully constructed, are very apt to give trouble, while there is the objection that the electrostatic capacity of the unused turns is apt to cause a certain loss in efficiency.

A very simple solution of the problem has been recently suggested to the author by one of our members (Mr. H. H. T. Burbury, of Crigglestone, Wakefield), who has had the happy idea of constructing a six-stage amplifier in which the first three transformers, which are of the air-core variety suitable for radio-frequency, are made readily removable, each being fitted with four pins connected to the ends of the primary and secondary circuits, exactly similar to the pins at the base of the "R" valve, while "R"-valve sockets of the usual construction are employed for the transformers to fit into.

A number of different sets of transformers, wound with different numbers of turns to suit different wavelengths, can thus be used; while to bridge over the difference between one set of transformers, each with a particular number of turns, and the next set, each with a larger number of turns, and thus obtain proper resonance, adjustable condensers are employed across the primaries of the transformers. In this way, with a sufficient number of interchangeable transformers, the best possible results can be obtained on a single instrument with any wavelength.

The amplifiers which are shown this

* A paper read before the Wireless Society of London on Wednesday, June 1st, at the Royal Society of Arts.

evening are constructed on this principle, and have been put together in the author's laboratory by his assistant, Mr. Sidney Langley.

Six-valve Amplifier.

The first instrument is, as you will see, a six-stage amplifier, the first three valves being operated at radio-frequency, while the fourth is a detector valve supplied through a leaky condenser, the last two valves operating at audio-frequency.

The first three air-core radio-frequency transformers each consists simply of a flat circular disc or bobbin of ebonite, with a groove round the periphery in which the primary and secondary coils are wound. In most cases the primary and secondary are wound simultaneously off two spools in the same groove, the primary and secondary having an equal number of turns; but in other cases the primary and secondary have been wound in two separate grooves close together.

In connection with this point it may be of interest to mention that Mr. Burbury has tested the relative advantages of winding the primary and secondary in separate grooves, or in the same groove, employing two separate coils the distance between which could be varied so as to change the amount of coupling. He found that, in spite of what the textbooks say, the tighter the coupling the better, and so now prefers to wind his primary and secondary together in the same groove. When this is done, however, it is necessary to give careful attention to the insulation of the wires, as otherwise a short circuit may prove disastrous. Plain enamelled wire scarcely seems sufficiently reliable, and it is best to use double silk-covered wire, or enamelled and single silk-covered wire. Wires of from 40 to 45 S.W.G. give good results.

The interchangeable air-core radio-frequency transformers in the amplifiers shown this evening consist of flat bobbins of ebonite from $2\frac{1}{4}$ to 3 inches outside diameter and from $\frac{1}{4}$ to $\frac{1}{2}$-inch in thickness, with a peripheral groove from $\frac{1}{8}$ to $\frac{1}{4}$-inch in width and from $\frac{1}{8}$ to $\frac{1}{2}$-inch in depth, according to the number of turns of windings to be accommodated. For receiving 300-metre waves, 50 turns for both primary and secondary will be found sufficient, while 100 turns give good results for 600-metre waves. For longer waves, say, of 1,000 metres and upwards, we have transformers in which primary and secondary have each 250, 400, 650, 1,000 and 2,500 turns, the latter being suitable for receiving Carnarvon, Lyons and

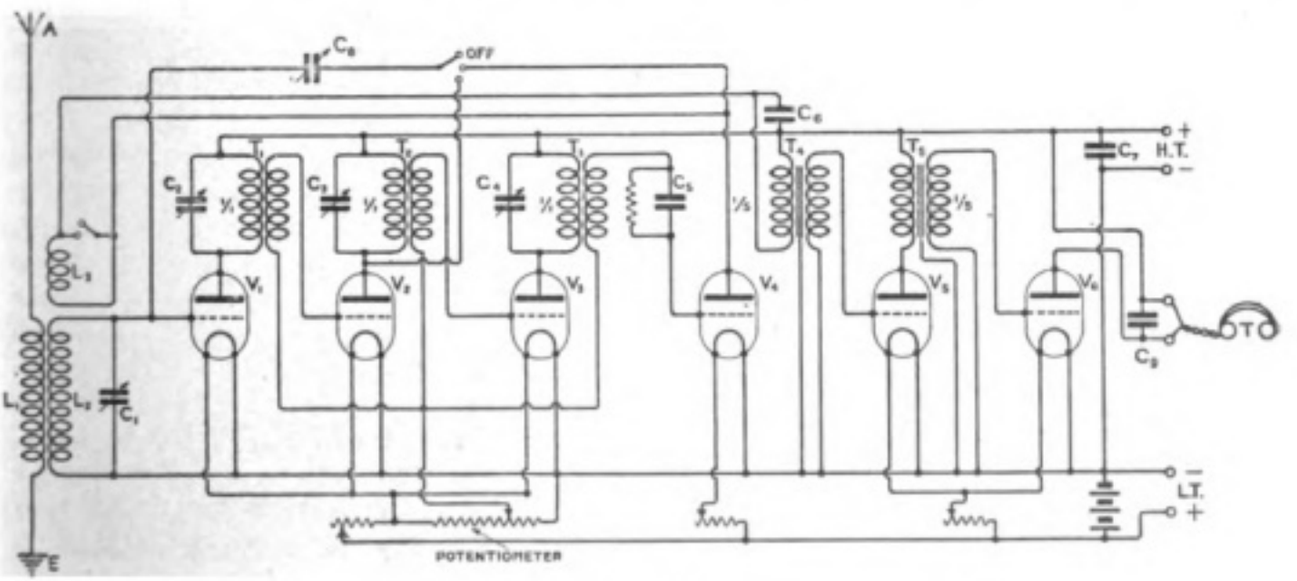


Fig. 1.

Lafayette, near Bordeaux, the latter having, it is understood, a wavelength of 23,450 metres. These numbers of turns and dimensions give good results, but it is very possible that still better effects might be obtained by using more turns in the secondary than in the primary in various ratios. These transformers can be made very quickly and cheaply, and the ease with which they can be replaced one by another renders experiments with them very simple. They are, therefore, in the author's opinion, particularly suited to amateur use.

A complete diagram of the connections of the six-valve amplifier is shown in Fig. 1, in which V_1 V_2 V_3 are the three valves working at radio-frequency. V_4 is the detector valve, and V_5 and V_6 valves work at audio-frequency.

T_1 T_2 T_3 are the three removable radio-frequency transformers, while T_4 and T_5 are fixed audio-frequency transformers, iron-cased and with iron cores, with step-up transformation of 1 to 5, these two latter instruments being of Messrs. Sullivan's well-known ironclad make.

The adjustable tuning condensers C_2 C_3 and C_4 connected across the primary windings of the radio-frequency transformers each have four semi-circular fixed plates 3½-inch radius, and four movable plates 2⅜-inch radius, giving a maximum capacity of about 0·0002 microfarad. Possibly condensers of somewhat larger capacity would be better, especially with use for the very long waves; but for short and medium waves those fitted seem to work very well. It is largely a question of the number of transformers with different windings used, the greater the number of differently wound transformers that there are available the less the tuning capacity there is required in the condensers.

In the instrument shown the three transformer tuning condensers have to be adjusted separately, and in some ways, though more troublesome, this seems to have an advantage, as, owing to slight irregularities in the transformers, and also perhaps to some extent in the valves, the best results are obtained with slightly different adjustments in the case of each of the three. Mr. Burbury, however, uses sliding condensers all connected together, so that one adjustment alters all three condensers simultaneously. Similar simultaneous adjustment could easily be provided for in the instrument shown by fitting each of the condensers with a gear wheel and gearing them together by means of idle gear wheels between them, so that all three sets of condenser plates would rotate simultaneously.

The leaky condenser, C_5, employed to produce detection in valve V_4, has four tinfoil plates of about 1 square inch effective dimensions, with mica insulation giving a capacity of about 0·001 microfarad, the grid leak used in connection therewith being of 5 megohms.

A small condenser, C_6, used to bye-pass, for high-frequency currents, the primary of the audio-frequency transformer, T_4, has a capacity of about 0·002 microfarad. The usual condensers, C_7 and C_9, of 1 to 2, and of 0·001 microfarad capacity respectively are also connected across the high-tension battery and the telephones. A potentiometer of about 200 ohms resistance is employed to control the grid voltage of valves V_2 V_3 and V_4, while the two audio-frequency valves have a separate rheostatic control to their filaments from the four other valves.

The instrument is arranged so that either magnetic or electrostatic reaction can be employed. As shown, the magnetic reaction is obtained by means of a coil connected between the plate of the fourth valve and the primary of the transformer, T_4. A switch is used to short-circuit this reaction coil when not in use. Provision is also made for electrostatic reaction between the plate of either the second or fourth valve and the grid of the first valve through a small adjustable condenser, C_8, which has two movable and two fixed plates of the same dimensions as those of the condensers C_2 C_3 and C_4, the maximum capacity being about 0·0001 microfarad.

For the reception of C.W. signals, either the magnetic or the electrostatic reaction can

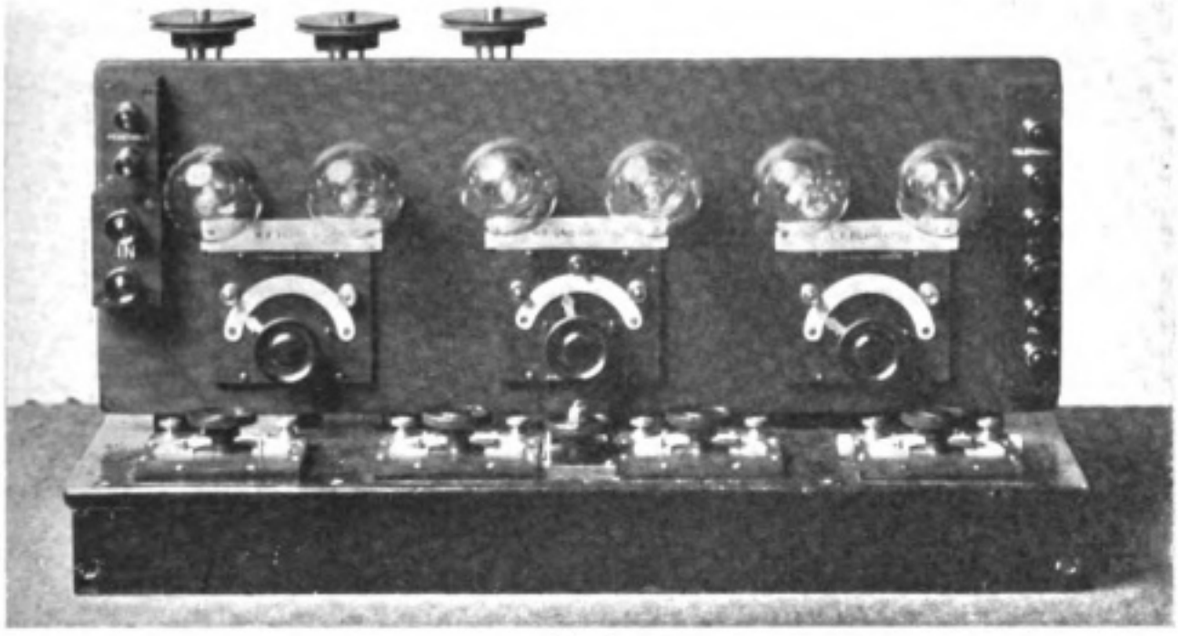


Fig. 2.

be used to make the instrument self-heterodyning, or a separate heterodyne can be employed.

Fig. 2 shows the appearance of the front of the instrument. The input terminals, as also those for connecting the magnetic reaction coil, are on the left, while all the other terminals are on the right. The three

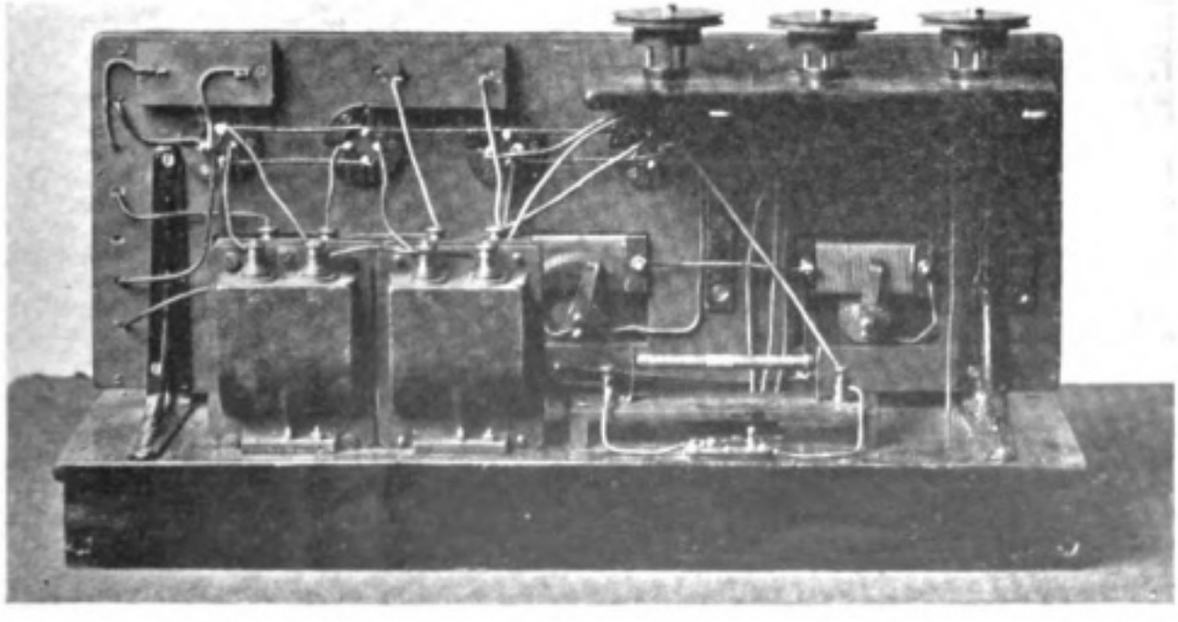


Fig. 3

removable radio-frequency transformers, with their connection pins, will be observed at the top on the left. The potentiometer is on the centre of the upright part of the instrument, with the two filament-control rheostats one on each side of it, while below are the three tuning condensers for the radio-frequency transformers and the adjustable condenser for capacity reaction. In the centre, below the potentiometer, is a three-way switch for connecting the capacity reaction condenser to the plate of the second or fourth valve, or for disconnecting it.

Fig. 3 shows the back view of the instrument, with the three radio-frequency transformers on the right, at the top, and the two audio-frequency transformers on the left. The leaky condenser and its leak are at the bottom, and the bye-pass condenser, C_6, and the telephone condenser, C_9, at the top, on the left. The back of the valve sockets and of the potentiometer, and one filament rheostat, are also visible.

Two-valve Amplifier.

The other amplifier shown is a much simpler instrument, with only two valves. It is, however, also suited for every description of wavelength. It requires only one transformer to connect together the two valves; but this transformer, as

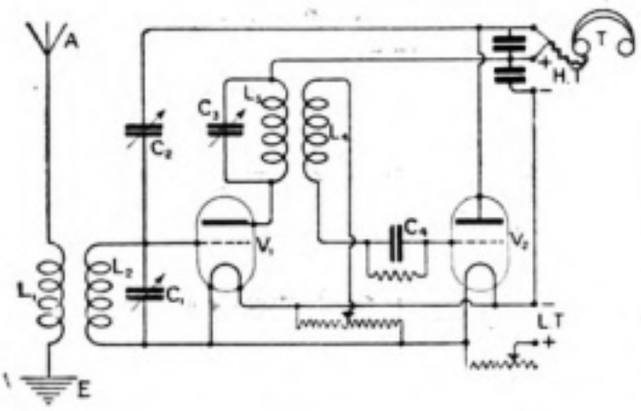


Fig. 4.

in the case of the transformers used in the larger amplifier, is made replaceable so that a transformer with windings specially suited to the special wavelength can be employed. The primary winding is also shunted by a tuning condenser as before.

Fig. 4 shows the connections, from which

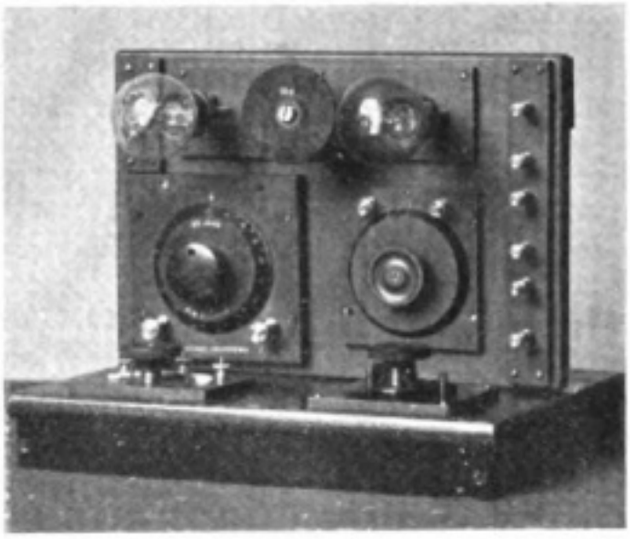


Fig. 5.

it will be seen that the grid of the second valve is controlled by a potentiometer, and is coupled to the secondary of the transformer through a leaky condenser so as to cause detection. A small adjustable condenser, C_2, is also fitted to give electrostatic reaction between the plate of the second valve and the grid of the first valve.

Fig. 5 shows a view of the front of the instrument, in which the transformer is placed between the two valves. Under these

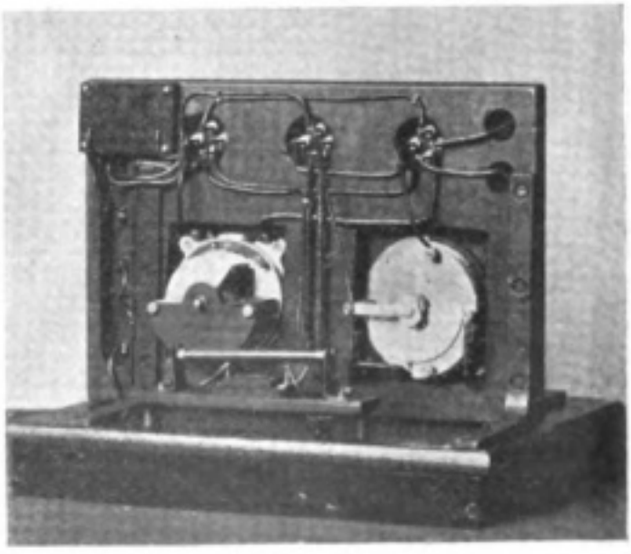


Fig. 6.

are the two adjustable condensers for tuning the transformer and for capacity reaction respectively, while at the base are the potentiometer and filament resistance.

Fig. 6 is a view of the back of the instrument, showing the two adjustable condensers and the leaky condenser.

This instrument is wonderfully effective, seeing that it has only two valves. It works well on all wavelengths and is very sensitive when used by itself. If coupled up to a three-valve note magnifier it gives signals very nearly as loud as does the six-valve amplifier.

Nothing specially novel beyond Mr. Burbury's removable transformers is claimed for either of these instruments; but it is hoped that the particulars and dimensions given may prove of service to amateurs and others who wish to construct their own apparatus. The writers of textbooks seem generally to consider the question of dimensions, particularly those of the windings of transformers, as beneath their notice; but, after all, these are matters of some considerable practical importance.

DISCUSSION.

Admiral Sir Henry Jackson: I would like to mention to Mr. Campbell Swinton that I have had a considerable amount of experience with these transformers thanks to Mr. Burbury. On Christmas day he sent me a high frequency amplifier transformer which I have now had six months' experience with, and I will give you a few tips. My experience agrees with Mr. Campbell Swinton's. My transformers are of different sizes, and the windings are made in a groove ⅛ inch wide. The capacity of my condenser is variable from a minimum of 25 micro-microfarads to 250 micro-microfarads. I should not go higher than 250 capacity because signals then begin to get dead. I have five transformers, and some of these have more windings in the secondary than the primary. My shortest wave transformer has got 80 turns in the primary and 100 in the secondary originally wound together with double silk-covered wire. The first time I used them they burnt out, and I think that after that experience I shall never wind two wires together again. I re-wound the coil and I find it much more satisfactory to wind one on the top of the other. I get the shortest waves with 80 and 100 turns respectively; next is 120 and 150 turns with which I get 900 metres and 1,600 metres very well. The next one has 400 turns, both primary and secondary. I have also experimented with a variometer type of transformer. It is not very successful, although I get signals with it. I thought that a good variometer having a fixed condenser might work better. This works, but does not give good results. Mr. Burbury also sent me a capacity resistance coupling unit so that I could use transformers or capacity resistance. The transformer works very much better, and should be put in the first valve, as it works much better in the first than in the second. I think that is all I have got to say about my own and I will give you some details of Mr. Burbury's set. The set has been designed with magnificent care. It has three valves with transformer coupling and nine sets of transformers, making 27 transformers altogether; Mr. Burbury thinks that each transformer requires tuning and he has therefore provided a sliding condenser. He has flat-plate condenser with which you can tune each valve quickly, and he has also got some small screw condensers with two plates which he puts in the primary as well, and by means of these nine condensers and seven transformers he gets marvellous results. He has put an enormous amount of work in it, and with this very wonderful amplifier he can get anything between 200 and 23,000 metres.

Mr. P. R. Coursey: There are a few questions I would like to ask, but beforehand I think we all ought to thank Mr. Campbell Swinton for giving us some practical constructional details of wireless apparatus. Practical details on which apparatus can be built is one of the most pressing needs of the present time.

I would like to ask Mr. Campbell Swinton how many transformers he finds necessary to cover a range from 300 up to 3,500 metres, allowing just sufficient overlap on the two condensers to cover all the wavelengths. I would also like to enquire whether he has experienced any difficulty arising from self-oscillation. That is a trouble usually present with any transformer coupled amplifier, and is very difficult to overcome.

The more valves you employ the more stray coupling there is and the more difficult it is to stop the whole set oscillating. I would like to ask Mr. Campbell Swinton if he has had any trouble in stray capacities when adjusting the tuning condensers. As the condensers are quite small I thought it possible troubles might be produced by this means. The idea as a whole is a very useful one, and certainly the results just shown are excellent. When you wind the primary and secondary transformer together an additional coupling factor is introduced by the capacity between the two windings. This takes the place of the condenser in a resistance capacity or a capacity coupled amplifier, and possibly might have some effect on the results, particularly as the transformer and two windings are put on together.

There seems to be some little uncertainty as to the exact wavelength of the Bordeaux station. I believe the official figure is 23,450. I do not know whether they are working on that wave, but it is the one they are supposed to work on.

It has been stated, I believe, that where the two windings of the transformer are put on together varying the ratio of the turns on the secondary and primary does not make much difference, particularly if the two wires are wound together, and when one of the windings is tapped one does

not appear to obtain the full value of the mutual inductance. It would be interesting to know whether Mr. Campbell Swinton has carried out any experiments in this direction.

Mr. R. C. Clinker : I think it would be interesting if Mr. Campbell Swinton could give us figures in microhenries. The number of turns most useful, but it would also be interesting to know the actual inductance in addition to the number of turns.

Major B. Binyon : There is one thing I would like to mention in connection with transformers. I believe Mr. Matthieu, of the Signal Experimental Establishment, suggested a design such as is shown in Fig. A. Apparently the essence of a good transformer is to have the maximum coupling with the minimum capacity, and Mr. Matthieu suggested a simple form of construction with which, I believe, he had great success, and it struck

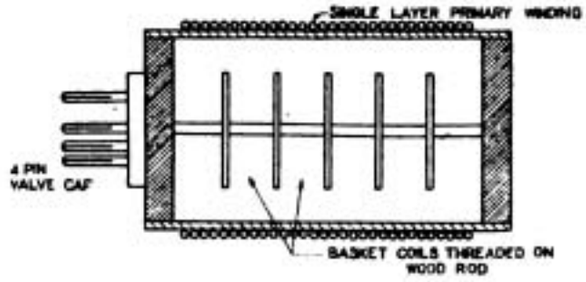


Fig. A.

me that amateurs might find it useful. Three or four small basket coils all arranged as shown and the primary is wound just as an ordinary cylindrical coil. Mr. Matthieu claimed that a very good coupling was obtained, having a low capacity between primary and secondary.

I believe Professor Crowther patented a variometer form of transformer which Mr. Campbell Swinton mentioned and with which, I believe, he got quite good results, although I do not know much about it.

It seems one ought to be able to get a variometer transformer to work very well.

Mr. A. A. Campbell Swinton (*in reply*) : Mr. Coursey asked me how many transformers I use. We have 300 metre transformers with 50 turns ; 600 metre with 100 turns. For longer waves in which the primary and secondary windings are all the same, we have 250, 400, 650 and 1,000 and 2,500 turns. That is all we have so far, but it is a simple matter to make more, and I propose to make some more and try some experiments with these. Mr. Coursey also asked about the troubles of oscillation due to stray capacities. As a matter of fact I have found much more difficulty in that respect when using a resistance amplifier. I find that with the resistance amplifier, if you use a high resistance telephone, moving about the room with the telephones on your head will alter all the effects, and it was necessary, therefore, to have a telephone transformer. With the transformer form of amplifier, however, I have not noticed that difficulty, and it does not seem to be affected, like the resistance coupled amplifier, by stray capacities. The difficulty of the continuous oscillations being set up and the whole apparatus screaming continuously is, I think, always present if you have many valves, but the potentiometer seems to be the means whereby you can get rid of it best.

I am afraid that I have made no measurements in microhenries of the inductance of the transformers. We have only gone by turns. My real object in bringing the matter to the notice of the Society is that I think it is essentially an arrangement suitable for amateurs to gain information and find out all about how to build apparatus themselves. As Mr. Coursey said, detailed information of the construction of apparatus is not at all easy to get. Either writers of text-books are not acquainted with it themselves or else they carefully conceal it. I think this information chiefly exists in the hands of people who have by their own experiments and perhaps also by past service with the Forces, gained their knowledge and are employing it for gain by selling apparatus at great expense. I think it is about time that that sort of thing was put an end to. I have every sympathy with a person who wishes to make a livelihood out of it, but I am looking at it from another point of view, and I think it is about time that the way in which these things are made should, as far as possible, be published. In the paper I have given more details with regard to dimensions which I have not given you verbally to-night, so that anybody who wishes to make apparatus like this can do so. I think people who wish to make their own apparatus should have the fullest possible information to enable them to make the things themselves instead of having to go and buy them.

Dr. J. Erskine-Murray (President) : Asking you to give formal thanks is hardly necessary after the way in which you have already shown your appreciation to Mr. Campbell Swinton.

I should like to mention that theoretically the design of this instrument is really better than the ordinary service commercial instruments for obvious practical reasons. It is theoretically better to have transformers small, but of course in practice you could not be juggling with sets of interchangeable transformers, and therefore, you have to employ a switch instead. Of course you can have a switch which cuts out the extra turns.

Will you give your thanks to Mr. Campbell Swinton in the ordinary way. (*Prolonged applause.*)

The next meeting of the Wireless Society of London will be held on Monday, June 27th, at 8 o'clock, at the Royal Society of Arts, when a Paper contributed by Lieut. Edes, relating to "Resistance-coupled Amplifiers," will be read before the Society.

WIRELESS CLUB REPORTS

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

The Editor will be pleased to consider for publication papers of unusual or special interest read before Societies.

The Wireless Society of London.

A meeting of the Wireless Society of London was held at the Royal Society of Arts, John Street, Adelphi, W.C.2, on Wednesday, June 1st, 1921.

The chair was taken by the President, Major J. Erskine Murray, D.Sc., at 8 p.m.

After the minutes of the previous meeting had been read and confirmed, the President called upon Mr. A. A. Campbell Swinton to give his paper, entitled "A Universal Amplifier for all Wave-lengths." (*For a full report of the paper see page 198 of this issue.*)

At the conclusion of the discussion (*see page 203 of this issue*), which followed the paper, the President, addressing the meeting said:

The candidates who were ballotted for during the meeting have been elected, *viz.*, MEMBERS: Lieut. Noel H. Edes, Léon Deloy; ASSOCIATE MEMBERS: De Lésle Carey, R. J. Reeves. The Birmingham Experimental Wireless Society has been approved for affiliation.

Lieut. Edes, who is at present serving in Egypt (he is among those elected this evening), has sent us a paper following up Mr. Maurice Child's paper on "Resistance Coupled Amplifiers." This paper will be read at the next meeting, and will be the final paper for this year.

Lastly, there is a proposal, in fact it is more than a proposal, to the effect that we should have something of a combination of business and pleasure, as was done last year, by a visit to a centre of wireless interest and combine it with some enjoyment after the fashion of the British Association. Major Binyon has kindly said that he will be able to show us some things at his station at Slough, and we propose to combine that with a motor ride out there. Details will be announced later. The date is Monday, June 27th, and Lieut. Edes' paper will be read on the same evening.

The meeting adjourned at 9.30 p.m.

Croydon Wireless and Physical Society.

At a meeting of the Croydon Wireless and Physical Society, held at the Central Polytechnic, Croydon, on June 4th, 1921, with Mr. H. T. P. Gee in the chair, Mr. W. R. H. Tingey gave a most interesting lecture on the principles to be observed in obtaining the best results from a single-valve receiver. The great advantages derivable from the use of a separate heterodyne, in place of an autodyne connection, were discussed and clearly demonstrated by Mr. Tingey, who had had the Polytechnic aerial placed at his disposal. A keen discussion followed the lecture, which was freely interspersed, at Mr. Tingey's request, with questions from members of the audience.

A very hearty vote of thanks was then accorded the lecturer.

The Chairman then read a letter from Mr. C. Harrison, in which he expressed his thanks for the gift which was presented to him by the Society on his relinquishing his position as Honorary Secretary prior to his departure abroad, and also his appreciation of the fact that the Society at the last meeting had unanimously elected him a Vice-President.

North Middlesex Wireless Club.

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

The 65th meeting of the North Middlesex Wireless Club was held at Shaftesbury Hall, Bowes Park, on May 18th, Mr. C. W. Beckman being in the chair. He called on Mr. L. C. Holton to give an address on "How to Receive C.W. without causing Interference." As all wireless men are aware, this has become an important matter, having regard to the number of amateurs now listening in. By means of a temporary aerial inside the hall, and two sets of instruments, Mr. Holton was able to demonstrate how an incorrectly adjusted receiver radiated waves which were made audible to the audience by means of the Club's amplifier. He explained how to avoid the trouble, and at the same time achieve the best results in receiving. At the close of the lecture the Chairman expressed the thanks of the meeting for a very interesting and instructive evening.

Those interested can obtain particulars of the Club from Mr. E. M. Savage, Hon. Secretary, Nithsdale, Eversley Park Rd., Winchmore Hill, N21.

Folkestone and District Wireless Society.

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

Thanks to the untiring work of the President and Vice-Chairmen, the Society have been fortunate in obtaining some suitable rooms for their permanent Headquarters. The rooms are situated in the building known as the Turkish Baths, Christchurch Road, Folkestone, and are quite central, and convenient for all members.

The Club-room will be open to members every evening from 6 p.m. to 10 p.m. Visitors, Sundays, 3 p.m. to 5 p.m.

The monthly general meeting was held at Headquarters, on Wednesday, May 4th, at 7.30 p.m., Mr. Arnold H. Ullyett, F.R.G.S., in the chair.

The minutes of the previous meeting were read and confirmed, after which the usual business of the Society was dealt with.

It was decided to form a Technical Advisory Committee for the purpose of installing and keeping in repair the Society's aerial and apparatus. The following gentlemen were elected to serve thereon:—Messrs. A. G. Mills, F. Mills, and H. A. S. Gothard.

Two gentlemen were elected to membership.

Notice to members:—The monthly general meetings are held on the first Wednesday in the month, at 7.30 p.m. All members are particularly requested to endeavour to be present at these meetings.

Buzzer practice:—Mr. A. G. Mills has kindly consented to give half-hour buzzer practice every Wednesday evening.

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

Leeds and District Wireless Society.

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

A general meeting of the above Society was held on Friday, May 27th. A set of rules was read over and adopted by the Society. The meeting then proceeded to discuss the course to be adopted during the summer months. It was finally decided to go into recess until September, and to begin the winter session with a general meeting. At the same time provision was made for certain enthusiastic beginners to be helped to start their stations. They have been arranged in groups of two, and each third Friday beginning on June 17th, every group will be shown over one or other of the stations already established. In addition they have been invited to submit any constructional problems by post to members of the Committee.

Wireless and Experimental Association.

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

On May 25th, buzzer practice 7.30 to 7.50. Mr. Horwood then described a method of calibrating the strength of signals. Mr. Goldsmith described his receiving circuit, and for the benefit of the elementary members, Mr. Voigt discussed the subject of spark and C.W. transmission and reception.

Messrs. Kloots, Voigt and Gosheran gave their opinion and experience of high and low frequency amplifiers, and Mr. Knight dealt at length with the recording of wireless signals.

At a meeting on June 1st a vote of thanks to the *South London Press* was passed for their kindness in giving such consistently good reports of our meetings.

Mr. Kloots then introduced the subject of sunspots and magnetic storms, and gave a startling thought in likening the sun to the incandescent filament of a thermionic valve emitting streams of electrons which fell on the plate of the earth when permitted by the grid of the ionized layer of the upper atmosphere.

A discussion was afterwards raised on the discovery of the rectifying properties of crystals.

Bradford Wireless Society.

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

A meeting of the above Society was held in the Club-room on Friday, June 3rd, at 7.45 p.m., with Mr. Ramshaw in the chair.

The minutes of the previous meeting were read and confirmed, following which two new members were elected.

A vote of thanks was proposed to Mr. Liardet by Mr. A. Bever and seconded by Mr. J. Bever, for the offer to present the Society with a receiving set. Mr. Liardet's kind offer was accepted, and the vote was carried unanimously. Mr. Liardet suitably replied, and Mr. Ramshaw, in a brief speech called attention to the numerous benefits conferred upon the Society by Mr. Liardet.

Arrangements were made to hold a special lantern lecture at the next meeting on June 17th, entitled, "The Commercial Development of Radiotelegraphy."

The meeting then adjourned to the Instrument Room where Mr. Eskdale showed his M 15 Receiving Set purchased from the Marconi Scientific Instrument Co. Exceedingly fine results were obtained, and the makers are to be congratulated upon this fine instrument.

Dartford and District Wireless Society.

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

An extremely interesting and instructive meeting of the above Society was held on Friday, June 3rd, 1921, at the Society's Headquarters, Dartford Grammar School.

There was a very good attendance of members, the occasion being a lecture by Mr. J. R. Smith, A.M.I.E.E., Vice-President of the Society, on "Early Wireless Telegraphy."

The lecturer illustrated by means of lantern slides the early experiments of Signor Marconi in connection with the transmission and reception of wireless signals, utilising the induction coil and coherer receiver. The various additional instruments brought into use from time to time and the improvements made on existing instruments were clearly explained by the lecturer, the diagrammatical slides shown being of great assistance to the members in following the lecturers remarks.

Some 40 slides were exhibited and explained, thereby giving the members some idea of the difficulties which had to be overcome before successful results were obtained. The lecturer had also arranged a large amount of apparatus for demonstration purposes, comprising a 12-in. induction coil, Leyden jars, and several Geissler fluorescent tubes. These were put in operation, the various scientific details appertaining to each being explained.

At the conclusion of the lecture, the President, Dr. L. J. Miskin, M.B., proposed a vote of thanks to the lecturer for his very interesting and instructive lecture, which proposition was seconded by the Hon. Secretary.

New members continue to be enrolled, and any person interested can obtain full particulars from the Hon. Secretary, Mr. E. C. Deavin, 84, Hawley Road, Dartford.

The Southport Wireless Society.

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

During the past few weeks the members of the above Society have been busily engaged in making and fixing instruments at their Headquarters. At present both transmission and reception are in working order, and steps are being made with regard to portable sets to use in conjunction with these. Tests have been made with the transmission set which have proved most successful.

The result of the "Derby" was received in Southport by a number of members. The telephony was quite distinct, and heard as if at close range to the speaker.

Meetings are held each Tuesday evening at 8 p.m., in the Society's Rooms.

Prospective members are invited, and particulars of membership will be forwarded on application to the Hon. Secretary, Mr. H. Sutton, 68b, Marshside Road, Southport.

Leicestershire Radio Society.

A monthly meeting was held on May 9th at the Vaughan Working Men's College, Leicester, Mr. Atkinson being in the chair.

It was the President's unfortunate duty to tender the resignations of Messrs. Dunt and Rowlatt from the Society.

The heavy claims on the time of the former made it impossible for him to take an active part

in the Society, while Mr. Rowlatt had to resign for similar personal reasons.

The meeting accorded that a letter of thanks be sent to the late Secretary for his services, and placed the members on the honorary list.

Mr. Pallet was appointed Secretary, which he accepted.

The financial report of the Exhibition was read, and showed a profit of almost £6. 500 people had visited the Exhibition.

Mr. Pallett was then called on to deliver his lantern lecture on "Spark Transmitters: Theory and Practice." As was anticipated, this subject was dealt with fully by the lecturer, and was illustrated by many very good slides. Details of all the usual sets from the ½ k.w. to Carnarvon's giant transmitter, were dealt with in a very able way and numerous interposed questions were answered satisfactorily. The Marconi call signal device was illustrated, and its uses explained. The 1½ k.w. set came in for the most discussion as this was the set the lecturer was most familiar with. Here rather heated and pertinent questions were put, and a lively debate followed. The biggest stumbling-block, however, appeared to be the series condenser, which, although in parallel with the A.T.I., was shown to be actually in series with the aerial, and could produce a shorter wave. This point although ably demonstrated by the lecturer on the blackboard, left a big doubt in many members' minds as it seemed so contradictory to practice, and the discussion would have been endless except for the fact that the caretaker had to close the place up for the night, it being well past the closing hour.

The Secretary wishes all members and intending members to note that his address is now—Mr. Pallet, Silver Street, Leicester.

Plymouth Wireless Society.

A meeting of the Plymouth Wireless Society was held on Friday, May 27th. Mr. W. J. Lewarn in the chair.

Mr. J. K. A. Nicholson, A.M.I.E.E., gave a further lecture on thermionic valves, being a continuation of the previous one on this subject, the particular subject being the Fleming valve with its advantages and disadvantages over crystal receivers, etc. These lectures are particularly beneficial to those members who are about to sit for the P.M.G. Certificate.

A vote of thanks was passed to Mr. Nicholson.

The Lowestoft and District Wireless Society.

On May 3rd a paper was given by Mr. H. C. Trent on "Wireless Terms and their Meaning," the lecturer illustrating his subject by numerous diagrams and apparatus.

The City of London School Wireless Society's Apparatus.

On May 10th Mr. O. G. Scarle gave a lecture on "Telephony," the lecturer describing the working and construction of the commercial telephone and different types of microphones used. Another lecture will be given on the above subject as applied to wireless at an early date.

Members who possess valves give good reports of results attained in telephony from the Hague, and enthusiasm is running high at the possibility of getting the results of the Derby from the R.33. Future meetings: Every Tuesday at the headquarters adjoining Oulton Broad Railway Station, at 7.30 p.m.

Full particulars of the Society are obtainable from the Secretary, "Gouzeacourt," Chestnut Avenue, Oulton Broad.

City of London School Wireless Society.

A meeting of the above Society was held on Tuesday, May 24th. When the business of the Society was concluded Mr. Babs gave the members a complete and instructive lecture on "Learning the Morse Code." Many interesting points were touched upon and the lecturer was accorded a hearty vote of thanks. On Saturday, May 21st, twenty members of the Society visited the Handley-Page Aerodrome at Cricklewood, and by kind permission of Messrs. Marconi's inspected the whole of the wireless apparatus installed there. It consists of a three-valve 100-watt transmitter and a seven-valve type 55D amplifier. A very pleasant morning was spent there, and when the two aeroplanes started for Paris they were conversed with by wireless telephone over a great part of their journey. Cordial thanks for their hospitality were extended to Messrs. Handley Page, and every member received a souvenir before leaving the aerodrome.

At the next general meeting of the Society Mr. Burroughs (by kind permission of the Marconi Company) will give "A Popular Lecture on Wireless." This lecture will be illustrated by a seven-valve amplifier type 55D, and lantern slides.

City of London School, Victoria Embankment, E.C.4.

Woolwich Radio Society.

The usual monthly general meeting of the above Society took place at Woolwich Polytechnic at 8 p.m. on Friday, May 27th. There was a very good attendance, and we were pleased to welcome several visitors from the Dartford Wireless Society.

Mr. W. L. McPherson, B.Sc., Vice-President, took the chair, and after the minutes of the last meeting had been read and confirmed, Mr. W. T. James was asked to read his paper on "Amplification: High Frequency and Low Frequency."

In his introductory remarks, Mr. James pointed out that efficient amplification on low wavelengths was the most difficult to obtain. He then went on to give the circuit of the three-valve amplifying set that he has made, and kindly loaned to the Society, and which is working at the Old Mill, Plumstead Common.

He then described several other forms of low frequency amplifiers and exhibited several for inspection. Mention was made of Latour, the French wireless expert, who used a special kind of iron for the transformers that he had designed, and which were remarkably efficient.

A low frequency resistance amplifier was then exhibited, which worked well on V24 valves.

Coming to high frequency resistance amplifiers, Mr. James pointed out that they had been tried some years ago and rejected, but were now again coming to the fore. He mentioned that he was now engaged on designing a high frequency resistance amplifier, which would be a great advance on any amplifier now in use, in that amplification was constant over all wavelengths. It embodied a new principle he was not at liberty to divulge at present, but he would give us the details some time later.

In the discussion that followed Mr. McPherson spoke of the advantage that H.F. amplification possesses over L.F. amplification, and he pointed out why it was necessary to put a condenser across the terminals of the first transformer primary.

A hearty vote of thanks was accorded to Mr. James for his lucid explanation, and particularly for his very clear diagrams of the various circuits discussed.

Weekly meetings of the Woolwich Radio Society take place at the Old Mill, Plumstead Common, every Thursday, at 7.30 p.m., the last week in the month excepted. During the last month 12 new members have joined, and the Hon. Secretary will be pleased to welcome any new members either then, or at his house—42, Greenvale Road, Eltham, S.E.9.

The Aldershot and District Wireless Society.

At the meeting of the above Society, held at the Wireless Station, Queen's Avenue, on May 23rd, the Secretary announced that Lieut.-General The Earl of Cavan, K.P., G.C.M.G., K.C.B., M.V.O., had very kindly consented to become patron of the Society. The announcement was warmly applauded by the members.

The Chairman, Mr. E. Lynam, then called on Lieut. D. A. Butler, Officer-in-Charge Wireless Station, for his lecture on "The Electron Theory."

The lecturer explained that to accept the electron theory it was necessary to have a thorough grasp of the "theory of relativity," to prepare our minds to deal with such minute quantities as the atom and electron. We, the human race, have the audacity to observe, measure and determine everything by our own standards. We say the earth is large because, compared to ourselves, it contains a vast amount more mass than we do, but there are worlds many times larger in relation to which our earth is minute. Again, the universe, as we know it, is tremendously larger even than these. Beyond the universe there must be something still larger.

Everything is set in its own sphere of "relativity," and has its own standards accordingly.

On the other hand, we say a gnat is small, but he knows something which is as small to him as he is to us, while at the same time he considers us as being a nation of giants. Of everything, there must always be something larger and something smaller.

We reach, finally, the smallest unit of matter from which all things are constructed, the atom.

In it we find the electron, revolving in the atom as the earth revolves round the sun.

The lecturer then explained that the electron was a piece of electricity, and how a drift of electrons constituted an electric current. A demonstration proved that the electron is material and electric. Further, all matter was composed of atoms and electrons built up into elements, molecules and compounds, bringing us to the fact that we are composed, fundamentally, of electricity.

Lieut. Butler then showed what he termed "the wily electron" at work. This was a demonstration with various vacuum tubes and other apparatus in a darkened room, the effects produced being very beautiful, spectacular and instructive. Experiments were also conducted with thermionic valves to show the effect of electron flow and its use in wireless transmission and reception.

After numerous questions had been answered, a hearty vote of thanks to Lieut. Butler concluded the meeting.

The Gravesend Wireless Experimental and Model Engineering Society.

A meeting was held at the Globe Hotel on Wednesday, May 11th, and it was unanimously decided to form a Society as above, in Gravesend. The following officers were elected :—

Chairman, Mr. Sleath; Hon. Secretary, Mr. Birchall; Treasurer, Mr. Bloxam; Committee, Messrs. Southgate, Grant, Futter, and Martin.

On Thursday, May 26th, a second meeting was held at the Globe Hotel. After the Chairman had read the minutes of the previous meeting, and the Rules which had been drawn up by the Committee, Mr. Wheatcroft gave a very interesting address on his early experiences in X-ray work, and some very humorous stories about the early power station at Bath, where Mr. Wheatcroft was at that time a pupil.

After a short discussion on some German field telephone apparatus, which Mr. Irwin kindly lent, and a short buzzer practice, a very successful meeting came to a close.

Full particulars may be obtained from Mr. W. Birchall, 29, Pier Road, Gravesend.

Hartlepools and District Wireless Society.

A meeting of wireless enthusiasts was held on May 31st, and it was decided to form the above named Society.

We hope shortly to have a permanent Club-room, and all are looking forward to some interesting evenings.

Will those interested please communicate with Mr. R. L. Howey, Hon. Secretary, 33, Grange Road, West Hartlepool.

Loughborough College Wireless Society.

The programme of the Society's arrangements was opened by a paper read by Mr. H. V. Field, Vice-President of the Society, on the Development of Wireless.

The chair was taken by Mr. J. S. Oswald, B.Sc.(Eng.).

The paper was illustrated by lantern slides and demonstrations given on high-frequency apparatus.

A large amount of wireless apparatus was also exhibited.

The first instructional lecture was given by Mr. P. H. Cook, on the "Construction of a Cheap and Efficient Valve Receiver."

Owing to the outdoor activities of the College, the series of lectures will be discontinued until next session.

Portsmouth and District Wireless Association.

At a general meeting held at the Club-room at the Pyle Rooms, it was decided to procure a room in Claremont Road permanently for the use of members.

It was proposed to instal the apparatus belonging to the Association for experimental purposes.

A series of lectures have been arranged on crystal and valve work.

The subscription was increased to 2s. 6d. per month, to meet the expenses of the new room.

The Wandsworth Common Wireless Club.

The above Club has held several meetings, and so far the attendances are encouraging. A lecture was given on May 20th by Mr. Thomas on Wireless in Aircraft during the War. This was well illustrated with photographs. A Club set is in course of construction, as is also the aerial. New members will be welcomed at the above address on Fridays or Wednesdays. A series of extremely helpful lecture-demonstrations has been arranged for.

Kensington Wireless Society.

At a meeting held on May 25th at 2, Penywern Road, S.W.5, the Kensington Wireless Society was formally inaugurated.

The following were elected officers :—

President, Captain de A. Donisthorpe; Chairman, Dr. A. Gordon Wilson, M.D.; Hon. Secretary, Mr. W. H. McMillan, 258, Earl's Court Road, S.W.5; Hon. Treasurer, Mr. J. H. Reeves, M.B.E.

The election of Committee and the adoption of a set of rules was postponed for consideration at a special general meeting to be held shortly.

A communication was received from the City and Guilds Wireless Society requesting some form of close working association with them. It was agreed that this proposal should receive favourable and early consideration.

An inspection was made of the room kindly offered for the use of the Society by Mr. J. H. Reeves, and a large assortment of high-class apparatus offered for the use of members.

The Society has the unique advantage of having the terminals of two G.P.O. aerials in different rooms under the same roof. It is hoped to be able shortly to obtain a transmission licence, when experimental work will be possible with minute power.

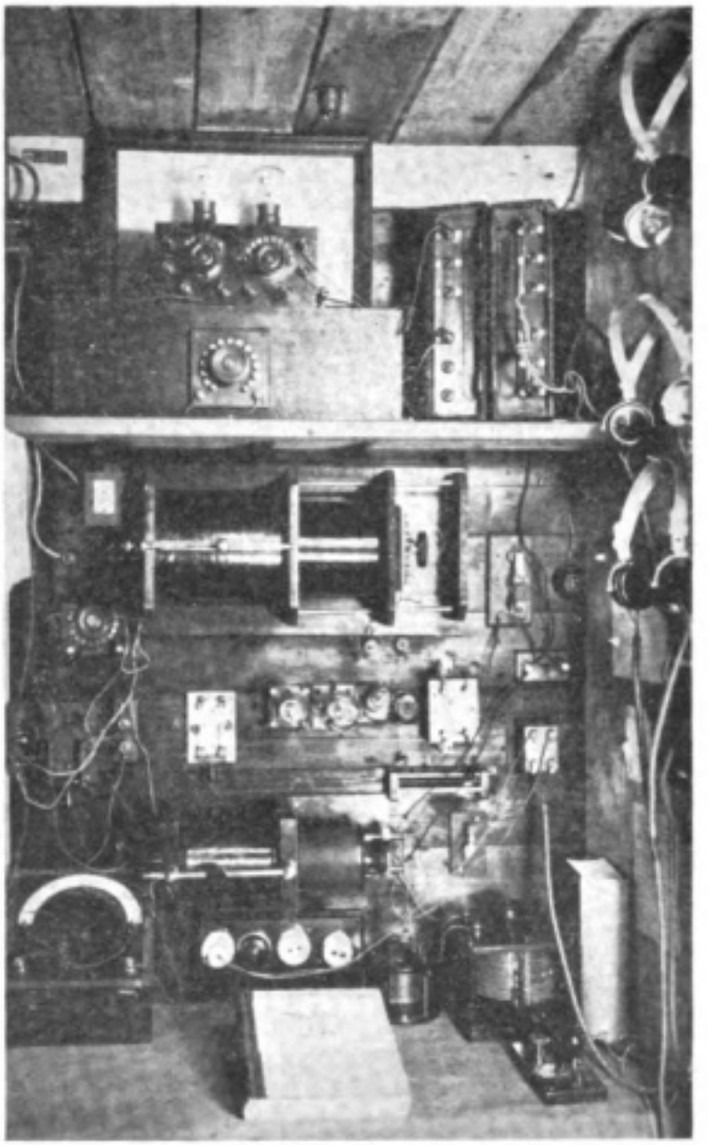
A demonstration was given by Mr. Reeves in recording signals on a dictaphone, and reproducing the same. The reproduced signals were clearly audible over a room 20 ft. by 18 ft. During the experiments improvements in the method used suggested themselves, so that full details of this method and the results obtained are held over for later publication.

A COMPACT RECEIVING SET

THE POST-WAR STATION OF A PRE-WAR AMATEUR

By W. Ison.

IN the October, 1914, number of *The Wireless World* a short article appeared, written by me, with a photograph of my station as it then was. When I look back on that and think of the struggles of those days, and then look at my station of to-day, I can appreciate the vast strides that wireless has made. To get such long-wave (!) stations as Clifden was thought to be something great in those days, and one had to be very quiet to hear signals assuming even that the detector was working. I thought, therefore, that possibly my present station might be of interest to other amateurs. It is by no means perfect, and is far from "finished." My aerial consists of a single wire slung from a 25 ft. steel mast on the roof across the garden to a chimney of a house in the next road. 90 ft. of this length forms the aerial, insulators being fixed at the proper distance. The lead-in is heavy rubber covered wire and the earth, wire netting buried under the aerial. I use two sets, one for long and one for short waves. The latter works on crystal and two-valve high-frequency amplifier (which I can make a low frequency at will). This gives me all the ship and shore stations. The larger set consists of loose coupler, loading coil, and two variable condensers. It works on either one or two valves, and I can also put in the amplifier giving four valves. Even with two the signals are very strong from Rome and Moscow. Horsea of course has to be toned down. I hear all the principal stations including America, and I can work up to 20,000 metres. At night when signals are strong all the principal stations are quite readable with the aerial entirely disconnected. I hope to commence making my transmitting set shortly, as the P.O. have offered me the usual 10 watt licence. I started wireless quite as an amateur in 1913, and it may interest some to know that it brought me during the war the position of wireless officer to an Army Corps in France.



The Wireless "Cabin." The picture will suggest to amateurs the advantage of panelling for convenience in arranging apparatus.

NOTES AND NEWS

Award to Dr. J. A. Fleming, F.R.S.

Professor J. A. Fleming, M.A., D.Sc., F.R.S., has, it is announced, been awarded the Albert Medal of the Royal Society of Arts for his work and services in electrical engineering. A pioneer in radio engineering, Professor Fleming, whose renown is world-wide as the inventor of the thermionic valve, which may be classed as the most important of his many inventions in wireless telegraphy, is the author of more contributions to radio literature than any other scientist.

Wireless Section Committee of the I.E.E.

The following members have been nominated to serve on the Wireless Section Committee of the Institution of Electrical Engineers for 1921-1922 :—Chairman, Dr. G. W. O. Howe. New nominations for membership of the Committee : Mr. B. Binyon, O.B.E., Dr. W. H. Eccles, Mr. G. H. Nash, C.B.E., and Mr. C. C. Paterson, O.B.E. The following will continue to serve as members of the Committee : Sir Charles Bright, F.R.S.E., Mr. R. C. Clinker, Prof. C. L. Fortescue, Mr. A. Gray, Admiral of the Fleet Sir H. B. Jackson, G.C.B., Capt. H. J. Round, M.C., Mr. A. A. C. Swinton, F.R.S., and Mr. L. B. Turner. Not later than 14 days after the publication of the Committee's list of nominations, any five members of the wireless section may nominate any other duly qualified person to fill any vacancy by delivering such nomination in writing to the Secretary of the Institution, together with the written consent of such person to accept office if elected, but each such nominator shall be debarred from nominating any other person for the same election.

Wireless Telephone Greetings to Gen. Smuts.

General Smuts, Premier of the Union of South Africa, whilst on his way to England to take part in the meetings of the Imperial Conference, was the recipient of greetings by wireless telephony from Sir Edgar Walton, High Commissioner of South Africa in London.

The message, which was telephoned through the Marconi station at Poldhu, contained a brief news summary and a personal welcome from Mr. Winston Churchill.

Ourselves as Others See Us.

An extract from the American magazine, "QST," on the subject of the Transatlantic Tests.

"Such reception is a new field for British experimenters, and they hardly can be expected to show the same performance as an American dyed-in-the-wool ham who has learned how to get amateur DX only after years of patient struggle. We have tested most of the circuits used by the Britishers, and find them one and all decidedly inferior to our standard American regenerative circuit using variometer tuning in secondary and tertiary circuits. We would bet our new spring hat that if a good U.S. amateur with such a set and an Armstrong Super could be sent to England, reception of U.S. amateurs would straightway become commonplace.

"We do not mean to deprecate the loyal co-operation shown by our English confrères, however. For the admirably complete way in which they go into a problem we have the greatest respect, and we are most sincerely grateful for their interest and enthusiastic co-operation in this, our first attempt to get overseas on schedule. We will all hope for better luck next time."

A Visit from Dutch Engineers.

Members of the Association of Electrical Engineers of Holland recently paid a visit to England, and the photograph shows a group taken at the home of Mr. W. J. Crampton, M.I.E.E., Huntington House, Weybridge, where they were entertained.

The Party at Huntington House.

An enjoyable hour was spent in Mr. Crampton's wireless room, and excellent signals were obtained, including telephony and music.

Mr. Crampton had previously arranged for speech to be transmitted in Dutch from The Hague, by the President of the Dutch Radio Institute, for the benefit of the visitors. A concert was also given from The Hague.

Mr. Crampton used only three valves in his receiving set instead of seven which he had previously been employing.

Wireless Concerts.

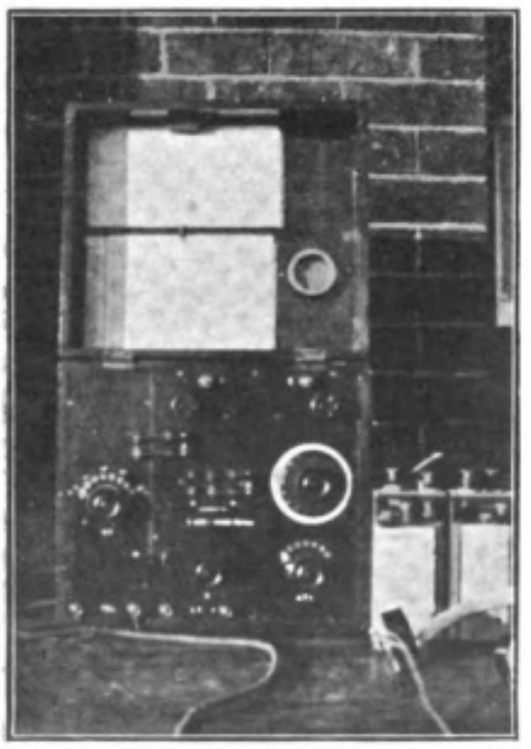
The Gravesend Wireless Experimental Society announces that at the Gravesend Hospital Fete, which H.R.H. Princess Mary has promised to visit on June 29th, Mr. W. R. Tingey has offered to give a wireless demonstration. There will be complete receiving and transmitting stations erected on the fête ground, and the demonstration will take the form of music and speech transmissions at every hour from 2 p.m. until 9 p.m. on a wavelength of 1,000 metres. The call letters 2NA will be sent three times before and after each transmission. There will also be spark transmissions at every half-hour on a wave of 130 metres.

CONVERTING A MARK III TUNER

By Captain E. J. Hobbs, M.C.

WITH the standard 100 ft. single-wire aerial allowed by the P.M.G. (approximate capacity 0·0002 to 0·0003 mfd.) and a Mark III Tuner converted as follows, excellent signals have been obtained from most home and continental stations on wavelengths between 600 and 8,000 metres. Although the author has frequently heard PCGG (the Dutch concert) on this set, the reader must not expect to pick up that station satisfactorily with a set of this type. A small indoor aerial about 15 ft. long has also given good results on Morse signals.

Comparatively little of the original "Tuner" is required, and extras have been reduced to a minimum. Parts left over may be sold or used to make other instruments —more of this, however, later.



The Converted Tuner.
Fig. 1.

From the original "Tuner" are required :—The box, 0·0015 mfd. variable condenser, A.T.I. ebonite former, two 8-point rotary switches (made from the 5-point and 19-point switches), two change-over switches, telephone condenser (0·006 mfd.), six terminals and potentiometer knob, spindle and bush.

Extras required :—One sheet 14 in. × 12 in. × $\frac{3}{8}$ in. ebonite sheet, one valve holder, one filament rheostat, 4-volt accumulator, about $\frac{1}{2}$ lb. No. 28 S.W.G. D.C.C. copper wire, and a piece of 2 in. diameter ebonite tube $\frac{3}{4}$ in. long.

To commence construction. First dismantle the set, select the components mentioned above and proceed as follows :—

The Box. Move the telephone partition half an inch inwards so that it will hold four 15-volt H.T. batteries. Any cabinet maker will do this for a small sum.

Ebonite Panel. Next cut and fit the ebonite for both battery and receiver portions. $\frac{1}{4}$ in. ebonite may be used instead of $\frac{3}{8}$ in., but will not be so mechanically strong.

H.T. Battery. Fit four 15-volt H.T. Units in the place formerly used as a space for the telephones, and in the centre of the panel above these batteries an 8-point rotary switch should be mounted. Stud 1 is the "off" position, studs 2, 4, 6 and 8 are for 15, 30, 45 and 60 volts respectively, and studs 3, 5 and 7 are "dead" (to prevent short-circuiting). The banks of the cells are connected as shown in Fig. 2. One

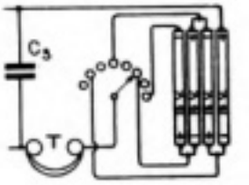


Fig. 2.

of the change-over switches is used as a double pole switch to carry the H.T. current across to the plate circuits, thus avoiding connections under the panels. (See photo, Fig. 1.)

Aerial Tuning Inductance. Strip the existing wire from the A.T.I. former (19 tappings), and remove the thread by turning

in a lathe, or fill up the grooves with cobbler's wax in order to present a smooth surface for the new winding. Next wind the tube with No. 28 D.C.C. copper wire in four layers bank winding (see *The Wireless World*, Vol. VIII, pages 463 and 464, September 18th issue, 1919), taking off the tappings at intervals of 0·85, 2·25, 3·75, 5·5, 7, 8 and 9·3 cms. from the commencement of the winding. Fit the finished coil to the underneath side of the panel by means of the brass brackets with which it was originally mounted in the tuner, and take the tappings to the 8 studs of the A.T.I. switch. The latter is made up from the 19-point A.T.I. switch.

Tuning Condenser. The fitting of this requires no comment except that the moving vanes should be connected to the earthed side of the circuit. By means of a change-over switch the condenser is placed in series or parallel with the aerial as shown in the diagram of connections (Fig. 3). For this purpose the crystal change-over switch can be utilised.

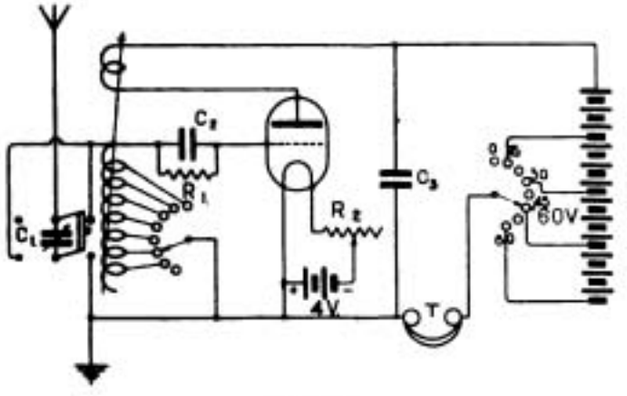


Fig. 3.

Reaction Coil. Mounted co-axially with the A.T.I. at the aerial end is a reaction coil capable of being rotated through an angle of 180 degrees. This coil consists of an ebonite tube 2 in. in diameter and ¾ in. long, wound with approximately 300 turns of No. 28 D.C.C. copper wire in honeycomb or "Burndept" style.* A gap must be left in the centre of this winding to allow the spindle to pass through. The spindle should be set about ¾ in. from the end of the A.T.I., and passes through a bush. A convenient knob, spindle and brush can be provided from the potentiometer. Flexible leads are now soldered to the ends of this coil and connected to plate and H.T. battery positive respectively.

Filament Rheostat. This should preferably be bought, but can be made from the details which appeared on page 860, Vol. VIII of *The Wireless World*, on March 19th, 1921.

Telephone Condenser (C3). A fixed value condenser of 0·003 mfd. capacity is shunted across both H.T. battery and telephones. For this, unscrew the brass binding plates of the 0·006 mfd. telephone condenser and divide into two parts each half having an equal number of plates. Reassemble one half between the brass clamping plates and mount in the set.

Grid Leak and Condenser (C2. R1.). These may be made or bought, and any of the usual values such as 0·0002 mfd. condenser 2 ohm leak will be satisfactory. A special combination condenser and leak for this set is sold by Messrs. Burnham & Co., Deptford, or the Amateur Supplies Association, Tooting (see advertisement pages), and is recommended for best results.

Telephones. If L.R. telephones are used,

WAVELENGTH METRES	1		2		3		4		5		6		7		8		STUD CONDENSER
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5000																	
5500																	
6000																	
6500																	
7000																	
7500																	
8000																	
8500																	
9000																	
9500																	
10000																	

S-Series P-Parallel

Fig. 4.

* See *The Wireless World* pp, 539, 540, 541, 635, 636 and 637, Vol. VIII.

a transformer will be required. 4,000 ohm telephones, however, may be used if desired.

Calibration Table. A chart similar to Fig. 4 will be found very useful to record the best tuning adjustment for various wavelengths.

General. A low-frequency amplifier can be added in the usual way, or extra valves may be fitted direct to the panel. In the finished set a large overlap in wavelength will be found between studs. This is due to the fact that one existing row of holes was used to take tappings through. In winding the inductance do not use more shellac varnish or paraffin wax than absolutely necessary to hold the turns in position.

When turning the thread off the A.T.I. former it is advisable to leave a small flange at each end (one thread will be sufficient), as this prevents end turns slipping.

From the surplus materials an excellent short wave reception and buzzer wavemeter can be made. The closed circuit inductance (C.C.I., 5 tappings) and condenser (0·0005 mfd.) are calibrated. By mounting these with the buzzer, Perikon detector and a few terminals a short wave crystal receiver or wavemeter is produced having a range about 100-700 metres.

The writer's condenser has been calibrated and the result given below may serve as an *approximate* guide to the capacity of an average Mark III Aerial Tuning Condenser.

Setting.	Capacity (mfds.)
0	0·00007
10	0·00014
20	0·00022
40	0·00038
60	0·00054
80	0·00071
100	0·00089
120	0·00106
140	0·00124
160	0·00141
170	0·00149
180	0·00155

EDITOR'S NOTE. — *We understand that Tuners are being converted to the above design by Messrs. Burnham & Co., and the Amateur Supplies Association.*

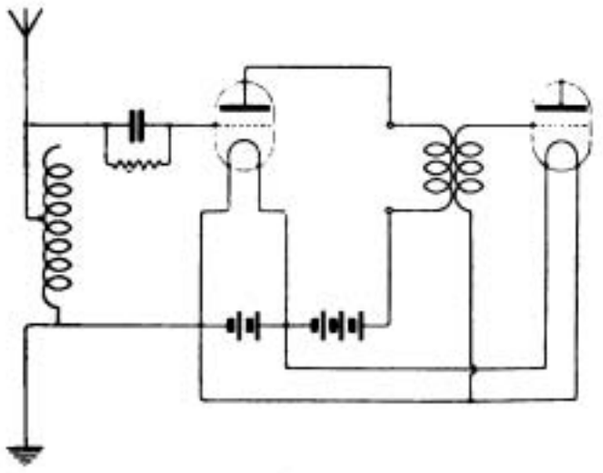
THE CONSTRUCTION OF LOW FREQUENCY AMPLIFIERS—Part II.

IN the preceding issue we discussed low frequency intervalve transformers and designed primary and secondary windings for a one to one ratio transformer. The usefulness of this transformer can be greatly increased if we add a third—or tertiary—winding so that signals may be taken from the first valve—by connecting the telephones to the third winding—or passed on to the next valve for further magnification. This winding may be wound over the secondary and should consist of 1,200 turns of No. 30 S.S.C. wire wound in 10 layers. For this 5 ounces of wire will be required. The final outside diameter will be approximately 1½ in. No thin paper need be put between the layers of the third winding, but four or five turns of paper should be placed round the outside of the winding. This winding will make the body of the transformer of larger diameter than the end washers, but it does not matter as the winding is not carried to the ends of the layers.

A good *telephone transformer* may be wound on a similar core to the above transformer with 3 ounces of No. 44 S.S.C. on the primary and 5 ounces No. 30 S.S.C. for the secondary.

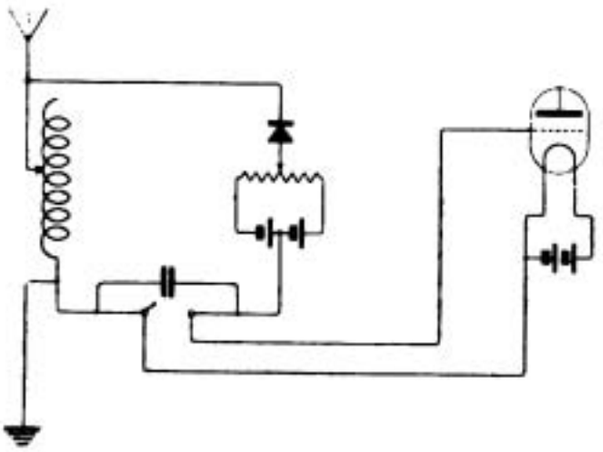
Note Magnifiers.—In making a note magnifier it should be remembered that the input circuit varies according to the receiver circuit to which connection is to be made. For instance, if the magnifier is to be connected to the anode circuit of a valve receiver, such as in

Fig. 4a, a transformer, or choke coil, must be used to complete the anode circuit of the receiver valve and to put the current changes in the anode on to the next grid in the form of voltage changes. A transformer is much better than a choke coil, and for this purpose



4a.

the above-mentioned intervalve transformer will be suitable. An ordinary telephone transformer will not do, as the secondary winding, which would be connected to the grid, has current changes in it, and not voltage changes which will vary the grid potential. Again with a crystal circuit as in Fig. 4b it is possible to connect the grid and filament directly on to the telephone terminals. With this arrangement violent howling is sometimes caused if working with a bad crystal and with the potentiometer adjustment off the sensitive point of the crystal.

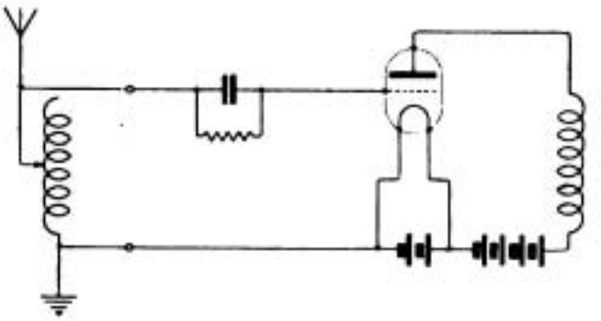


4b.

However, the arrangement can be made to work well. A third arrangement is for the first valve to be made a rectifier with grid condenser and leak, and other valves after it to magnify the rectified signals. This is shown in Fig. 4c.

Thus it will be seen that the input circuit can be made suitable for the individual need.

A three-valve low frequency amplifier is about the limit—with more than three valves a set becomes very noisy due to microphonic effects, and also has a very great tendency to "howl" or oscillate at an audible frequency. We propose to outline the arrangement of a three-valve low frequency amplifier embodying the methods of connection shown in Figs. 4a, b, and c. The individual can modify it according to his needs and purse. We suggest R type valves as they are at present the cheapest.



4c

Fig. 5 gives a circuit diagram. The terminals A B should be connected across the oscillating circuit, the currents in which are to be rectified and magnified.

If rectification is not desired leave A and B blank and connect C D in anode circuit of valve receiver or to telephone terminals of crystal receiver. If desired the transformer P may be omitted, if magnifier is going to be used with crystal set only, in which case the connections shown dotted should be made permanent.

Fig. 6 shows a suggested panel arrangement, the size of the panel being 10 ins. by 5 ins. It should be made of ebonite, or if too expensive, of hard dry wood—wood must be thoroughly dry.

For a complete three-valve amplifier, three

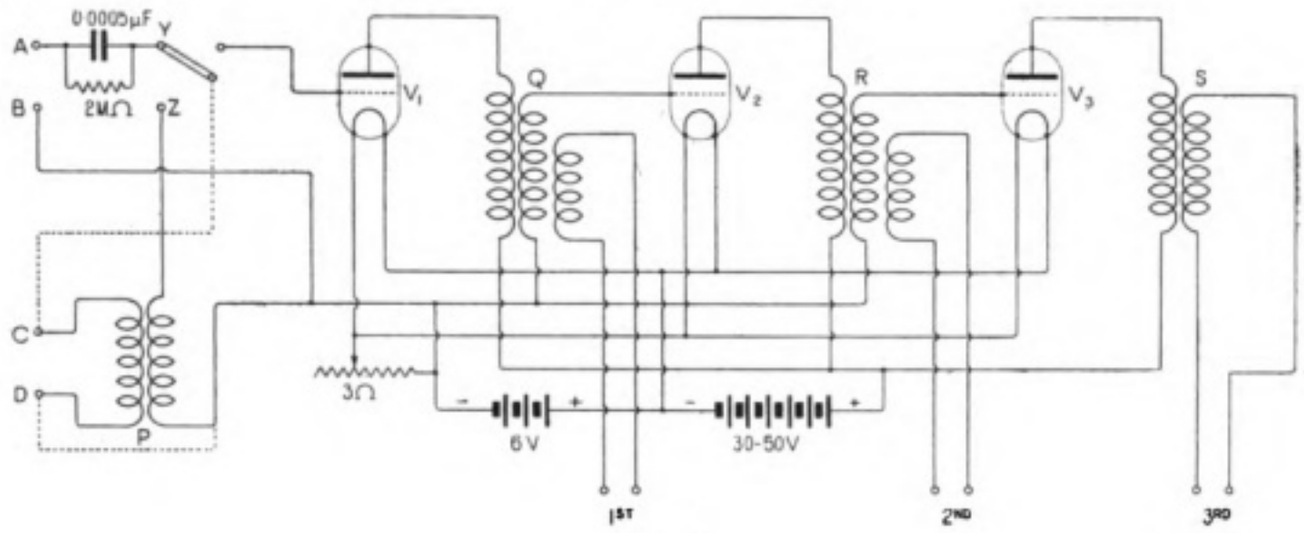


Fig. 5.

valve holders and three intervalve transformers, two with and one without telephone windings, will be required, and also one telephone transformer.

If only using two valves, omit intervalve transformer R and No. 2 valve holder, and the panel may be made 2 ins. shorter.

Thirteen terminals will be required and one two-contact switch, together with a 0·0005 mfd. condenser and a two-megohm grid leak (if it is desired to make the rectifier attachment). The filament resistance shown in Fig. 5 is omitted in Fig. 6 because most of the R valves on sale at the present time require only 4 volts on filament. If the valves obtained have filaments which require more than 4 volts an external resistance may be connected in circuit as shown in the diagram. Complete valve holders can be purchased or effective ones made up. A sample valve should be obtained before attempting to make holders.

The transformers may be fastened to the panel by means of two pieces of fibre—one at each end—passed round the transformer and held to the panel by a screw at each side.

When the magnifier is mounted and tested, it is possible that it will "howl." This is due to oscillations being generated at audible frequency and can usually be overcome by reversing one or two of the windings, which winding to reverse is determined experimentally.

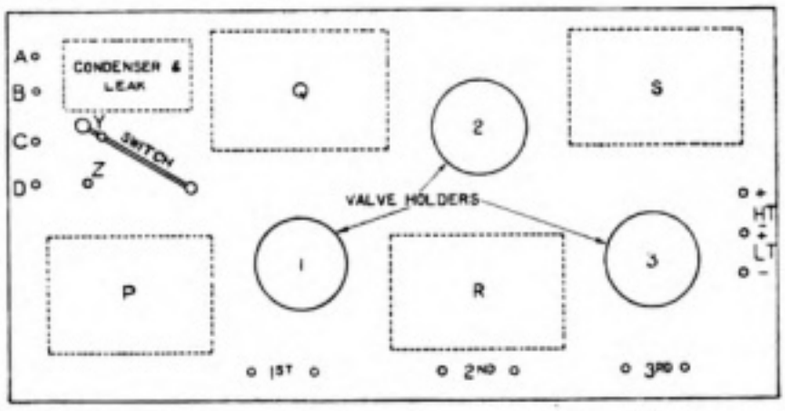


Fig. 6.

There is one thing which should be pointed out in this connection. It is obvious from Fig. 5 that a useful addition would be a change-over switch by means of which the telephones can be moved from one telephone winding to another without having to move them from terminal to terminal. To do this it is necessary to join the windings together, which straight way leads to howling owing to the coupling effect thus established. To do this a switch arrangement which cuts off the unused windings is needed.

QUESTIONS AND ANSWERS

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

RELAY (Bournemouth) *asks for a two-valve and crystal circuit, to use one stage of H.F. amplification, followed by crystal rectification and then L.F. amplification, see Fig.* 1.

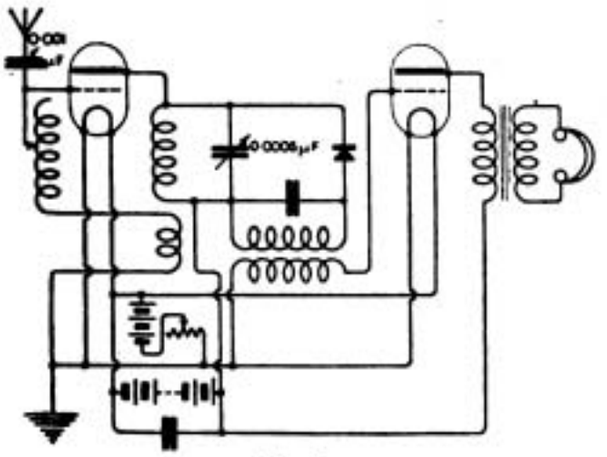


Fig. 1.

A.G. (Teddington).—(1) The value of this condenser is not critical, provided that it has a fairly big capacity—0·05 mfds. would be a good value.

(2) No.

(3) One "bfd." means one billifarad, and its value is one millionth of a microfarad.

(4) You can make a 10 megohm resistance in the form of a pencil line upon ebonite, adjusting to the best value under signal conditions. You may find it give a certain amount of trouble owing to the difficulty of making good contacts to it, and also its inconstancy. The best plan is to buy a carbon compound resistance from a firm dealing in wireless goods.

S.O.S. (New Southgate) *asks* (1) *For an opinion with regard to suggested aerial systems.* (2) *The effect of a piano adjacent to his instruments.* (3) *The effect of nearness of his aerial to the roof of his house.* (4) *For general criticism of a set.*

(1) You will get the best results with aerial No. 3. Can you not raise the height of the aerial by means of a pole at the end of the house. It would also stop the occasional sag you mention. The lead in should be taken from this end of the aerial, not from the mast end.

(2) We do not think it would have any detrimental effect at all.

(3) Yes, it reduces the effective height of the aerial, leading to a falling off in signal strength.

(4) There is no advantage gained by having two variable couplings at A—AR and B—BR. The maximum wavelength of the aerial circuit will be approximately 7,500 ms. Maximum wavelength of the secondary circuit is, approximately, 4,500 ms. Circuit will be improved by providing a series-parallel switch to connect the aerial condenser in series with the inductance for short waves.

G.M.R.G. (Marlborough College) *asks* (1) *For a book dealing with the construction of condensers.* (2) *Dimensions for an intervalve transformer for a certain set.* (3) *If note magnification is as good as H.F. magnification.* (4) *If it is possible to get burnt-out valves repaired.*

(1) We do not know of one. The constructional articles in the issues for August 7th and 21st will give you some assistance.

(2) These are H.F. transformers, which cannot be designed in these columns.

(3) Both types have their special uses, for which they are best. You will find L.F. easier to make and use.

(4) No.

H.E.C. (Sheffield) *asks* re *the "Single valve long range receiver"* (1) *What resistance telephones to use.* (2) *How to make a suitable telephone transformer.* (3) *If an R type valve can be used.* (4) *How to use a 110-volt lighting supply instead of H.T. batteries.*

(1) 120 ohm telephones.

(2) See *The Wireless World*, March, 1920 issue p. 699.

(3) Yes.

(4) Unless you can silence the commutator noises on the 110 vs. supply the results will probably be disappointing. Connect condensers and iron-cored chokes in the circuit as shown in Fig. 2

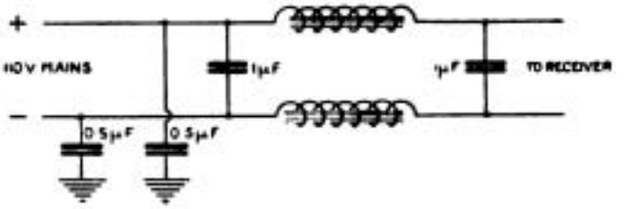


Fig. 2.

W.D.H. (Brighton).—Connect up as shown in Fig. 3, making sure that the positive of the supply is connected to the positive of the accumulator. Use one 50 candle-power 220-volt

carbon lamp in series with the accumulator. The charging current will then be about 1 amp. The charging time will depend on the state of the cells. Continue the charge until gassing freely.

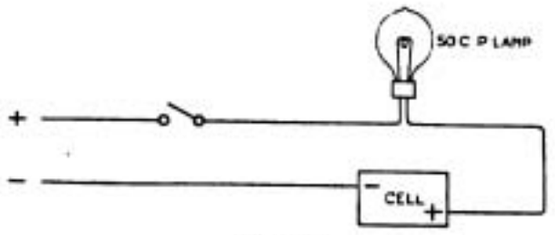


Fig. 3.

F.H.K. (Coventry) *asks, re single valve long-range receiver (1) What quantities of wire will be required. (2) If an R valve would be suitable.*

(1) For No. 1 unit, 4 oz. of No. 26 DWS, and 3 oz. of No. 32 DWS. For No. 2 unit, 12 oz. of No. 25 DWS.

(2) Yes.

"720" (South Shields).—(1) and (2) See February 5th, 1921, and succeeding issues.

(3) Yes, provided that you use a variable condenser of 0·0006 mfds. across the secondary (5") winding, and a 0·0005 mfds. variable condenser in parallel with the primary winding.

(4) A Marconi V 24 or French type, obtainable from any of the advertisers in this journal.

MUS. BAC. (Bletchley).—(1) The thickness should be 0·001" and 0·002", and not as stated in the article.

(2) This is obviously wrong. Put in two clamping screws, one each side of the condenser, in the middle of the clamp.

(3) It should be possible to obtain them from any of the advertisers.

G.H. (Ravenstall) *asks (1) For dimensions of primary and reaction coil together, with gauge of wire capable of tuning to 8,000 to 10,000 ms. (2) The capacity of his variable condenser of 11 fixed vanes 3" diameter and 10 movable vanes 2¼" diameter spaced ⅛" apart.*

(1) The primary to be used in parallel with a 0·0005 condenser, 8" diameter wound for 12" with No. 28 enamelled or silk-covered wire. Reaction coil, 6" diameter, wound for 10" with No. 28.

(2) Approximately 0·0005 mfds.

A.A.D. (Southend-on-Sea) *asks (1) For a diagram of a single valve receiver, using certain specified apparatus. (2) Is a telephone transformer necessary. If so, what ratio. (3) Is the aerial measured from spreader to spreader. (4) What is the best way to use slabs efficiently.*

(1) Connect up as in Fig. 4.

(2) Not for 8,000 ohm telephones. It is better to use L.R. 120 ohms telephones and telephone transformer for valve sets.

(3) From the far end of the spreader to the bottom of the down lead for a single wire. With a twin wire aerial both wires are counted in the P.O. estimation of length.

(4) Entirely disconnect the slabs which are not actually in use.

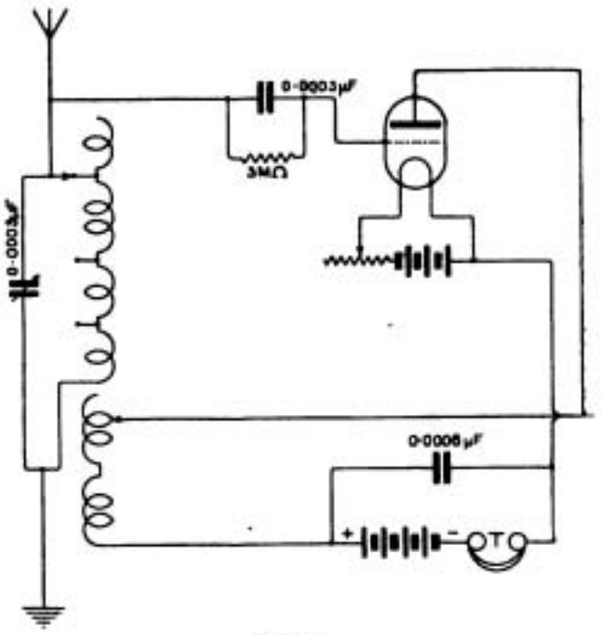


Fig. 4.

D.G.F. (Brixton Hill).—(1) Connect up circuit as in Fig. 5.

We do not advise more than 3,500 ms. with a crystal receiver. Make inductances 6" diameter and wind for 14" with No. 24 enamelled wire. Use only one condenser of 0·0003 mfds. Telephones should be 8,000 ohms or 120 ohms with telephone transformer (March, 1920, issue). Potentiometer resistance anything above 200 ohms. Blocking condenser across telephones 0·0015 mfds.

(3) Yes.

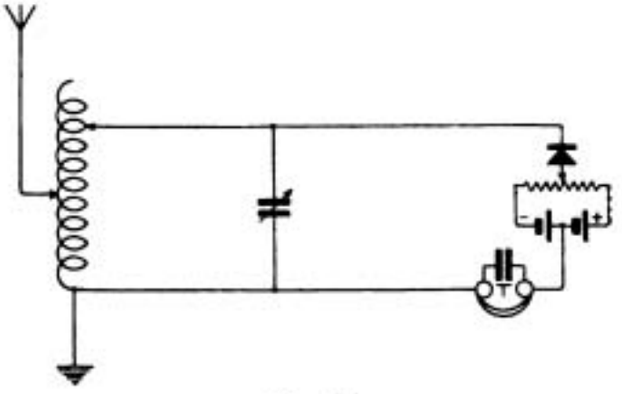


Fig. 5.

A.L.J. (Coventry).—(1) A condenser of 0·0003 mfds. capacity connected between the crystal slider and the earth will improve the set. You should get Nauen and Nantes and also ship stations. There are not many spark stations working on 3,000 ms.

(2) No.

(3) Results will be improved if the aerial is raised at the 20' end.

W.R. (Brixton).—(1) Condenser A = 0·0008 mfds. B = 0·00085 mfds. approximately.

(2) Six fixed and six moving.

(3) We know of no suitable book.

(4) No. Possibly you may be successful with a 3' frame wound with about 40 turns, but it is very doubtful.

S.J.H. (London).—(1) Telephone results are good. The reaction coil should couple into the secondary circuit, not into the primary. Connect the blocking condenser across the telephones and the H.T. battery.

(2) For L.F. transformers use 2 ozs. for the primary and 4 ozs. for the secondary, both No. 42 S.S.C. wound on a former ($\frac{1}{2}$") with soft iron core.

(3) Yes. The iron wire should be approximately No. 24 gauge.

(4) Probably due to too tight a reaction coupling; adjust it almost but not quite to the point of oscillation.

W.R. (London).—(1) Yes, if the reaction coil is connected in the anode circuit of No. 2 valve, and if the intervalve transformers, of which no mention is made, are suitable.

(2) No. It is a matter of experiment.

(3) Maximum wavelength will be about 3,500 ms.

(4) Try a 3" former wound with 4" of No. 28 enamelled wire.

F.U.H. (Aston).—(1) The inductance of the primary = 11,500 mhys., and the secondary 40,000 mhys. The capacity of the variable condenser cannot be estimated, as no dimensions are given—assumed to be 0·0003 mfds. Wavelength on 100' single wire aerial, primary circuit, maximum 3,000 ms.; secondary circuit with variable condenser across it, maximum 6,500 ms.

(2) and (3) The inductance of the loading coil is 22,000 mhys., which will increase the aerial wavelengths up to 5,000 ms. To increase the wavelength above this connect a small variable or fixed condenser of, approximately, 0·0003 mfds. in parallel with the loading coil and primary, which will bring the wavelength up to 6,500 ms.

(4) Yes; with good crystal adjustment and good aerial.

E.W. (Leeds).—(1) Use No. 18, 20 or 22 D.C.C. or bell wire, as you please. To estimate the number of turns and spacing we must have particulars of the loading inductance and tuning condenser.

(2) The frame aerial loading inductance and tuning condenser are all connected in series, with the detector across the condenser.

(3) For frame aerial reception a crystal is useless. At least two valves and a crystal are necessary. Carborundum invariably requires a potentiometer, but zincite-bornite or zincite-copper-pyrites give good results without one.

(4) You will do well to use an outside aerial, in which case you can make better earthing arrangements.

W.P.L. (Marlow).—(1) Approximate wavelength, —; aerial circuit, 1,200 ms.; secondary circuit, with 0·0005 mfd. condenser, 3,500 ms.

(2) Loading coil for 3,500 ms., 15 cms. diameter, wound with 28 cms. of No. 24 enamelled wire.

(3) and (4) See W. H. Nottage's book, "Measurement and Calculation of Inductance and Capacity," obtainable from our publishers.

W.C.B. (Gravesend).—(1) and (2) The design of a set of H.F. transformers for all wavelengths is outside the scope of these columns. For satisfactory results you will probably find the resistance type best. Wind with as fine resistance wire as you can get, and put both windings on the same former. We should prefer not to have tappings, but to have entirely separate transformers for the different ranges of wavelength.

(3) This is the Lafayette station near Bordeaux, built by French and Americans for war service, and now taken over by the French Government.

FAWLEY (Southampton).—(1) See many two-valve circuits recently given. In particular, see Fig. 1, page 790, February 5th issue, adding a reaction coil in the plate circuit of the first valve, and putting a small condenser across the primary of the first iron-cored transformer. A potentiometer is not needed with a grid condenser. Couple the reaction coil with the jigger secondary.

(2) You will need to considerably increase the inductance of both the aerial and closed circuits. The coils you mention will probably be suitable. You will also find it advantageous to put a small condenser in parallel with the A.T.I. for long waves, and also to increase the closed circuit capacity considerably.

(3) The reaction coil may be 6" × 3", wound with No. 30, with several tappings.

W.L. (Birkenhead).—(1) The circuit will not be satisfactory as it stands in your sketch. You have omitted the main condenser C shown in the diagram to which you refer. A Q valve is quite possible for low-power transmission, but we doubt if it will stand up to the power you require for the distance without softening.

(2) The set should do the distance with a suitable valve—say a Marconi-Osram B type. You might try the coherer, but you will probably find it rather unsatisfactory.

(3) Yes, approximately.

(4) Results will be little if any better on 1,000 ms., which wavelength you would probably not be allowed to use.

S.W.W. (Forest Hill).—(1) The amount of wire required will depend on the size of your aerial, about which you say nothing. Assuming it to be full-sized P.M.G., try baskets, diameter of whose outside windings = 12 cms., inside windings = 2 cms., wound with No. 24. A single basket will do for 400 ms.; to increase wavelength add more side by side in series, the windings being in the same sense on each. For 16,000 ms. you will probably require 16-20, using a 0·002 mfds. condenser in parallel with the complete coil. The reaction coil may be one or two baskets of similar size wound with No. 28.

(2) See Fig. 2, page 853, March 5th issue.

RADIO (Exeter).—The aerial should be satisfactory, except that it is undesirably small. The natural wavelength will probably be about 60 ms., and the capacity about 0·0001 mfds. The earth wire is considerably too long in proportion to the length of the aerial.

(2) Wind the large former with No. 22 and the smaller with No. 28. The reaction coil may be 6" × 4", wound with No. 28.

(3) The minimum is difficult to say, depending on the arrangement of tappings, etc. Maximum about 4,500 ms.

(4) 15,600 mhys.

H.W.A.B. (Kilbeggan).—(1) Either of your suggested valve arrangements should be very good. The first, with two stages of H.F. amplification, should give somewhat better results on weak signals, but will be somewhat more difficult to make and handle.

(2) There is very little difference in efficiency between any of the better hard valves. For general purposes a valve of French type, taking about 75 vs. on the plate, are very good, but lower voltage valves of the " V 24 " type are also quite good.

(3) The arrangements suggested are as good as any we know of.

S.G. (Seacombe).—(1) Certainly. See Fig. 2, page 662, December 11th issue, replacing the connection there shown to the top of the coil by a connection to one slider. If you do not wish to receive C.W. you may omit the reaction coil.

(2) Yes.

VALVITUS (Brondesbury).—(1) The diagram submitted is correct, except that you should put a small condenser across the H.T. battery and telephones.

(2) If you omit the reaction coil you will not be able to receive C.W.

(3) We do not know of any map other than those which appear in the " Year Book."

(4) Your wireless licence will certainly not authorise you to erect aerials from trees in parks, etc., without the permission of the owners, keepers, or other responsible authorities.

M.V.P. (Raynes Park).—A condenser with the dimensions you suggest will have a capacity of about 0·0045 mfds., which will be quite suitable for the wavemeter with a suitable set of coils. For a range of 300 ms. to 10,000 ms. you will require at least three, and preferably four coils.

W.E. (London).—(1) To link up a frame aerial to a receiver 20′ away we should recommend running a pair of bare copper leads in air, insulating them on porcelain at each end of the run.

(2) Across the receiver end of the leads put a loading coil in series with the condenser shown. Set will be inefficient at wavelengths longer than about 5,000 ms., and will want a loading coil of about 100,000 mhys. to reach 20,000 ms. (The H.T. battery leads are wrongly connected in the sketch sent.)

(3) The frame will receive best from either of the directions in its own plane.

(4) Either magnetic or capacitative reaction may be employed. If the latter is used the coupling condenser should be variable, and have a total capacity of about 0·00005 mfds.

P.S.N. (West Norwood).—(1) The circuit sent in is satisfactory, except that the series aerial condenser would not be required, except for very short wavelengths. In any case it would be better on the aerial side of the closed circuit. It may quite well be dispensed with.

(2) The series condenser, if used, should be about 0·005 mfds. Tuned circuit condenser should be about 0·0004 mfds.

(3) Results should be fair, but will be much better if you can get your aerial considerably more than 10 ft. above your instruments.

W.H.M. (Winchester).—(1) Yes.

(2) No; the reaction coil circuit is unsuited as a crystal set secondary circuit unless it is tuned by means of a variable condenser.

(3) This has been tried, but has not been found very beneficial.

(4) Impossible to say without further information. Trace out the wiring, and examine the circuit diagram so obtained.

G.A.E. (Lewisham).—The first effect showed the necessity of a grid leak across the grid condenser to adjust the grid potential to the best point for rectification. The second effect, joining grid and anode by a pencil, probably means that there was insufficient reaction coupling between the grid and anode circuits, and joining the two by means of a pencil line will give resistance coupling as well as magnetic coupling.

R.W.B. (Godalming).—(1) This probably refers to relays of the " Brown " type, which are not easily constructed.

(2) 3 ozs. of No. 44 S.S.C. will probably be sufficient. Yes, it will have to be abolished to rewind the main coil.

(3) Yes.

(4) There is no printing error. The figures in Table 2 are correct for a 10-turn per cm. winding, and these values should be multiplied by 4 to make them correct for a 20 turns per cm. winding, in addition to multiplying them by the " Relative Ind. Factor " (columns 4 and 7, Table 3).

T.G. (Manchester).—Use the circuit shown in Fig. 6. Additional apparatus:—Crystal potentiometer and reaction coil X. Separate the two coils of the loose coupler and make a coil X 4″ in diameter wound with 50 turns of No. 24 The frame aerial will not be required in conjunction with the outside aerial. Rewind the 6″ former with the No. 22 enamelled wire as 30 is too fine for the aerial circuit.

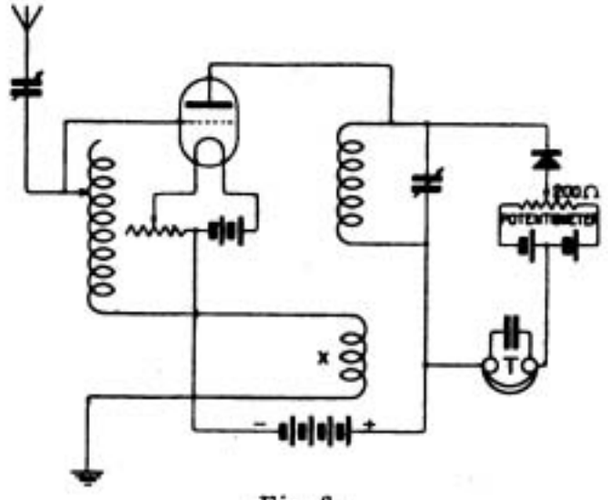


Fig. 6.

(2) At all hours of the day. No stated time. Speech will be weak for you.

(3) The range should be from about 300 to 3,000 ms.

QUESTIONS AND ANSWERS

NOVICE (Whitley Bay).—(1) Difficult to say; probably 8,000 ms. with all inductances in series and without the plug condensers. With the plug condensers in circuit the maximum wavelength will be well over 20,000 ms., but very inefficient.

(2) Very doubtful with an indoor aerial.

(3) Make a separate inductance 4" in diameter and wind with 6" of No. 24 with a few tappings. Use with variable condenser only in series, and disconnect the plug condensers and all other inductances.

(4) No. 26 wire is too fine for the aerial. Use a single No. 18 wire. Also No. 30 wire is too fine for aerial inductances. The smallest gauge should never go below No. 26 for aerial circuits. Otherwise the circuit is good.

J.C. (Rotherham).—(1) Diagram Fig. 7 gives the circuit of the Mark III* short wave tuner.

(2) You cannot expect results with six layers of wire on a 2" diameter former. Make a 6" diameter former and wind with 10" of No. 24 enamelled wire and provide with a sliding contact.

(3) 4 volts is too much for a crystal without a potentiometer.

(4) Yes, 2,000 ohm telephones will do.

W.A.F. (Ealing).—(1) Probably because you have about ten times too much inductance and also probably resistance in the circuit. Also bury the earth plate much deeper.

(2) For the best arrangement for a set of this type see Fig. 1, page 662, December 14th issue.

(3) (*a*) 80,000 mhys. (*b*) 850 mhys.

(4) You are very unlikely to get PCGG with a set of this type.

J.B.H. (West Hartlepool).—(1) Maximum wavelength approximately 5,000 ms. The minimum depends entirely on the arrangement of tappings on the coils.

(2) Impossible to say, as you do not state the size of the pancakes. The wavelength reached should, however, be quite high.

(3) This method of construction is fairly efficient if the pancakes are separated slightly, say $\frac{1}{8}$" from each other; but self capacity losses are serious if they are placed in contact.

(4) About 120 ms.

C.W.W. (Hornsey).—(1) The presence in a diagram of thin straight lines between the windings of a transformer indicates that they are to be wound on an iron-cored former, and the transformer is therefore for L.F. For the construction of such transformers see many recent replies and the current constructional article.

(2) L.F. transformers generally have multilayer windings on iron cores. H.F. transformers are wound on cores of some dielectric, the windings generally approximating to single layers.

(3) About 15,000 ms.

(4) For the addition of two additional valves to your set see Fig. 2, page 31, of the issue for April 2nd.

S.J.S. (Bourne End).—(1) *Refers to a valve transmitter shown in Fig. 1, page 866, March 19th issue, and asks for the size of the induction coil to supply the anode feed current.* (2) *He also asks for a rearrangement of the recently described single*

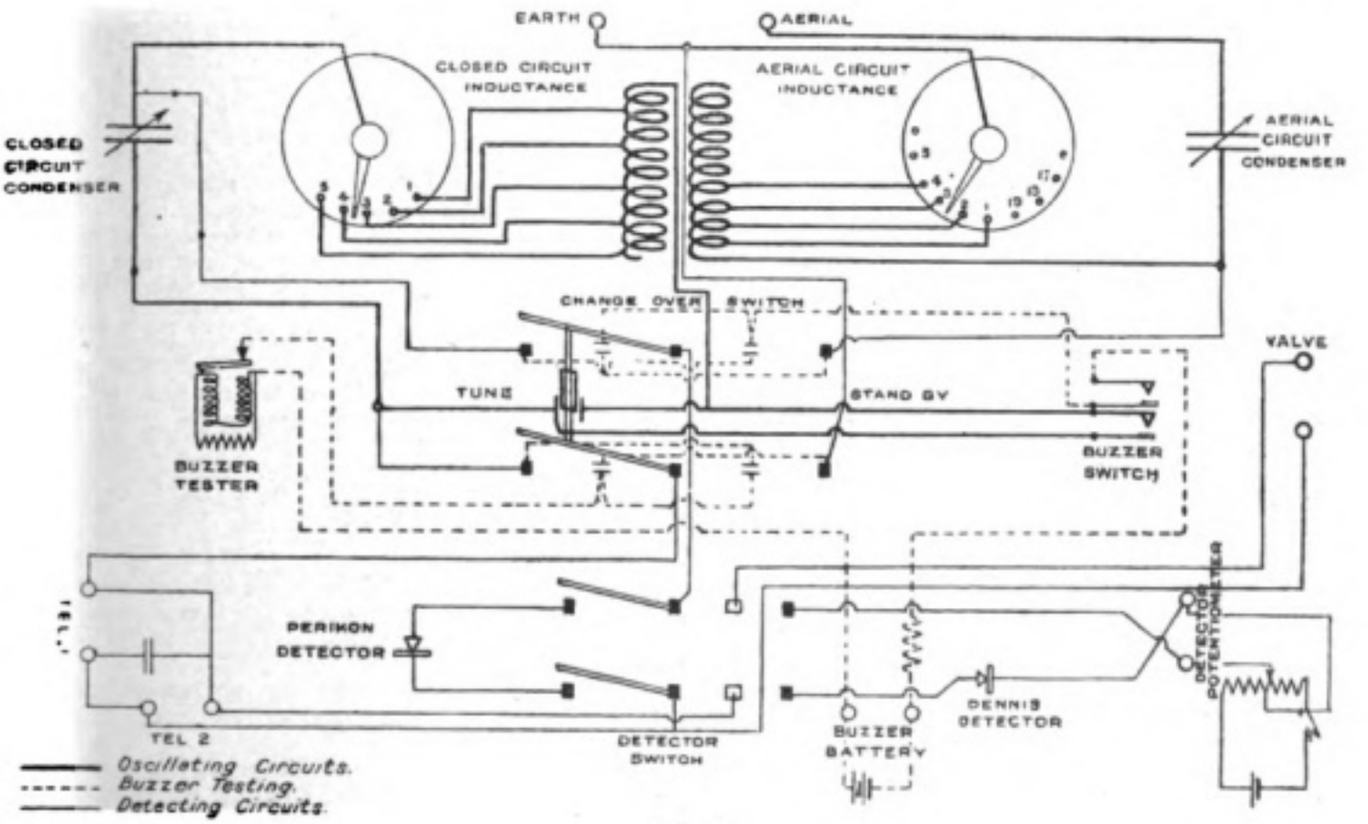


Fig. 7.

valve long range receiver to use three valves in certain specified ways. (3) *If the power of the set in* (1) *will be under* 10 *watts, and the probable maximum range.* (4) *He queries the dimensions* (2¼") *given in Fig.* 8, *pag* 878.

(1) This method is not particularly good, but may give fair results. Any size coil up to about 40 watts input may be used—the bigger the better. The secondary voltage is not important, as it may be brought to the desired value by altering the capacity of C3.

(2) We are unable to re-design sets in these columns to meet special requirements.

(3) You will not succeed in getting 10 watts through an R valve without spoiling it. In any case with a coil used as shown, the efficiency will be very poor, probably not more than 5 to 10 per cent. It is difficult to suggest a range, so much depending on local conditions, and the type of receiver used—possibly 5 to 10 miles.

(4) This should evidently be 8¼", as given in the letterpress.

"MINOR" (West Ealing).—The aerial and earth system appear to be as good as you can arrange, and should be satisfactory. The suggested gas pipe earth would not be likely to improve matters.

(2) The arrangement of the set will be correct if you connect the aerial to the slider, and the crystal to the top of the coil. The extra coil will not be of much use, but may be connected in series with the A.T.I. if desired.

(3) Maximum wavelength will be about 3,500 ms.

F.J.S. (Felstead).—(1) You require either a self-heterodyne receiver or a separate heterodyne. Try the latter method. (See the constructional articles in Nos. 5 and 6 of Vol. 8.)

(2) Poulsen tikkers can be made quite satisfactory, but require good driving mechanism in order to obtain a good note. A valve heterodyne set will be more suitable for your purpose.

(3) We do not know of any such publication apart from the Year Book.

RADIO (Tunbridge Wells).—(1) Wind the primary first, and then the secondary on a ¼" core, about 2" long. Stalloy is a special make of iron which gives low hysteresis losses. Ordinary soft iron wire is good enough for the transformer in question.

(2) For 85 mhys. make a coil 2 cms. inside and 8 cms. outside diameter, wound with No. 24. For 500 mhys. make coil 2 cms. inside, and 10 cms. outside diameter, wound with No. 28.

W.E.P. (Appledore).—(1) Connect by means of an iron-cored L.F. transformer, of dimensions as given frequently recently.

(2) This depends on the type of valve used, about 50 volts should be sufficient with an R type valve, and a suitable set.

(3) There are at least two tuners answering to this description. The best winding for a reaction coil can be fixed most easily by trial. Use about No. 28 wire, and try about 50 per cent. more turns than the coil to which you are coupling, to commence with. Reduce the number of turns if this gives too tight coupling.

W.R. (Lewisham).—(1) A.T.I. 8" in diameter, 14" long, wound full of No. 26 enamel wire, with a sliding contact.

(2) Use a 0·0005 mfds. condenser in the aerial circuit, with a series-parallel switch to connect it either in series or in parallel with the A.T.I. Make tappings on the secondary.

(3) The billi condenser on the No. 26 is approximately 0·0005 mfds. capacity.

(4) Yes.

R.W.B. (Godalming).—The Mark IV amplifier can be used entirely as an L.F. amplifier, or as a rectifier followed by two stages of L.F. amplification. The reason for your failure without a pair of telephones across the input terminals is that these terminals go to the grid and filament of the first valve, and therefore without some external connection across them, as by the telephones, you have no path for the D.C. anode current of your valve. You can get over this by coupling the receiver to the amplifier through an ordinary L.F. inter-valve transformer, but there should be such a transformer with appropriate terminals already fitted to the amplifier.

J.W.P. (Mansfield).—The circuit shown is approximately correct in arrangement. We should strongly advise you to insert the reaction coil in the plate circuit of the first valve, and not in that of the rectifying valve. This will probably account for poor C.W. reception. Lack of satisfactory amplification is almost certainly due to unsuitability of the H.F. transformer B as it stands. Try inserting variable condensers across one or both of its windings.

"ALPHA" (Highbury).—(1) On a standard P.M.G. aerial, 3,000 ms.

(2) 2½ lbs. approximately.

C.S.F. (Doncaster) *asks* (1) *what sort of aerial to use in an attic.* (2) *If it will be efficient with either crystal or valve for the reception of most English stations.*

(1) Almost the only type that will give results of any use will be a closed frame aerial.

(2) Such an aerial can be made to give good results with a circuit employing not less than about 3 valves. Results with a crystal would be nil.

J.K. (Leeds).—(1) The circuit will be all right if you connect the upper side of the 0·003 mfd. condenser to the other side of the reaction to that shown. No grid leak is necessary.

(2) A .. 10" × 8", of No. 22.
B .. 7" × 5", of No. 24.
C .. 4" × 3", of No. 28.
D .. 0·005 mfds.

"T.B." (Rotherham).—(1) We do not know whether amplifiers of this type are still being made, but numbers originally made for service use are being put upon the market. The amplifier is of quite good design.

(2) Any resistance telephones not greater than 1,000 ohms should be suitable, the nearer to this value the better.

(3) This would, of course, improve results, but would involve a certain amount of structural alteration to the set.

(4) The set is quite good as it stands, and we

do not think that you are likely to improve it much.

E.D. (Kennington).—(1) Your sketch shows no filament battery at all. What you call the filament potentiometer is the grid potentiometer, which should have a resistance of about 250 ohms. The circuit is rather a poor one.

(2) No leak is necessary.

(3) This depends entirely on the wavelength range required and the dimensions of the rest of the circuit, about neither of which you say anything.

(4) If the filament of a valve will not light, the valve is useless. If it will light the valve is **generally** all right, but not always so, as some derangement of the electrodes may prevent it functioning properly.

J.A.V. (Caversham).—(1) Quite correct.

(2) About 120 metres.

(3) 0·00038 mfds.

(4) Approximately 1,400 mhys.

R.A.W.J. (Lewisham).—(1) 0·00049 mfds.

(2) It is very little use for you to give us the thickness of a paper dielectric to the fifth decimal place of a centimeter before waxing if you say nothing about the thickness after waxing, which will probably be quite different. Assuming a thickness of 0·015 cms. after waxing, the total length of overlap will be about 25 cms.

E.W.L. (Birmingham) *asks how to calculate the currents in the following network, which he says does not appear amenable to treatment by Kirchoff and Ohm's laws.*

These laws will deal with every problem of this type. Assuming currents as in the diagram,

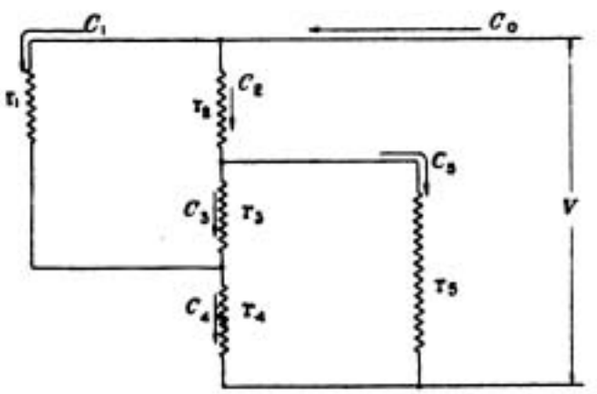


Fig. 8.

Fig. 8, they give the following equations, which are sufficiant to determine the required values.

$$C_0 - C_1 - C_2 = 0 \quad C_1 r_1 + C_4 r_4 = V$$
$$C_2 - C_3 - C_5 = 0 \quad C_1 r_1 - C_2 r_2 - C_3 r_3 = 0$$
$$C_5 + C_1 - C_4 = 0 \quad C_2 r_2 + C_4 r_4 - C_5 r_5 = 0$$

A.W.C. (Ewell) *asks* (1) *Whether 7/22 phosphor bronze wire will be good for an earth lead.* (2) *Whether the recently described single valve long range receiver is designed to give a minimum amount of radiation.* (3) *How to make a simple lightning arrester.*

(1) Yes.

(2) This set will give some radiation, but the amount will not be very serious. In order to decrease the amount of radiation further it would be necessary to complicate the circuit somewhat.

(3) Mount two brass plates close together on a block of some non-inflammable insulator such as slate, so that they have two edges parallel and almost touching. The space between them may be about 1/100". Connect the aerial and earth to these two plates.

W.F. (Burnley).—Thank you for your consideration in enclosing a copy of the diagram referred to, which has saved us the labour necessary to hunt up the reference. All your suggested values will be O.K., except that 6 volts would be better for the filament battery, and the variable condenser should preferably not be more than 0·0005 mfds. The tuning coil might be 10" × 6", wound with No. 22. Maximum wavelength will then be about 4,000 ms., which is enough for a set of this type.

W.N.G. (Dovercourt).—(1) The connections originally given are quite wrong. Your suggested rearrangement is correct. For satisfactory results you should increase the size of the aerial considerably, and also that of the A.T.I. Make the latter about 10" × 6" of No. 22. Possibly your earth also is poor.

(2) With present dimensions probably not more than 800 ms., if as much.

(3) Circuit is quite correct.

(4) A condenser is not necessary with such a small aerial as yours, but if used should have a capacity of about 0·005 mfds.

H.A.H. (Nunhead).—(1) Radiation would be considerable from this circuit. Radiation is not only a question of interfering with amateurs, but commercial and Government stations with sensitive amplifiers.

(2) and (3) Yes. If it receives spark signals it should receive telephony when there is any on. Listen on 900 ms. for aircraft working at the time the Paris and Brussels aeroplanes start. For the Dutch concerts you will require at least one note magnifier.

C.M.L. (Brighton).—(1) You cannot make a transformer out of two potentiometers. You could use a single one as a potentiometer for the purpose of stepping down volts if you wish, though the method would not be efficient. Resistance for 250 volts should certainly not be less than 1,000 ohms—2,000 would be better. The wire might be No. 38 Eureka.

(2) The circuit submitted should work as well with a valve as with a crystal.

(3) A condenser would improve results. Capacity should be about 0·0005 mfd.

(4) Signals would be weakened if leakage were bad. This should not be the case if the wood were hard and dry.—(Four questions only, please.)

E.H.L.C. (Leeds).—(1) and (2) A Tesla coil as usually constructed cannot be introduced into a spark transmitter to any advantage. On the other hand, the principle of action of a two-circuit inductively coupled spark transmitter does actually approximate fairly closely to that of the Tesla coil.

(3) We doubt if a quenched spark gap would operate very satisfactorily on a spark coil, owing to the irregularity of the discharges. On the other hand, with a suitably designed gap a certain amount of quenching action would probably be obtained.

(4) The windings for a loose coupler depend entirely on the purpose for which it is to be used. We cannot help you as you do not even say whether you mean to use it for transmission or reception.

F.E.C. (Windsor).—(1) The circuit will be correct if you connect up in the following order aerial, coupler, primary condenser, tapping to grid, A.T.I., and earth. A capacity of 0·0004 mfds. is too small for a series A.T.C.—see various other replies.

(2) The A.T.I. may be 6″ × 4″ wound with No. 22.

(3) Wind the primary with No. 22, and the secondary with No. 28 or No. 30.

(4) About 60 volts.

C.W. (Oldham).—(1) You should hear ships in the neighbourhood of Liverpool, very likely FL, and with careful tuning possibly stations such as Cullercoats and Cleethorpes.

(2) Yes.

(3) Yes, if connected to a large metal plate, buried in damp earth.

(4) There is no book published with this information except the Year Book.

G.A.H. (Farnborough).—(1) Secondary inside primary is generally most convenient.

(2) Primary should be wound with No. 24 and secondary with No. 26.

(3) There is little to choose between good makes of valves. R type is very good.

(4) You do not give us much clue to the cause of your howling. If you are using reaction the cause is almost always due to too tight reaction coupling.

INQUISITIVE (Gosport).—(1) The set should be all right as shown. The wire for the A.T.I. can be No. 24 D.W.S.

(2) About 0·002 mfds.

(3) Carborundum for a start. You can then try various other "fancy" combinations as you get more experienced.

(4) Certainly, as far as capacity is concerned. As you do not describe it we cannot say whether it is of good type or not.

S.R. (Gateshead).—(1) Suitable dimensions depend on other data for the circuit, about which you say nothing. However, with a P.M.G. aerial and a parallel A.T.C. of 0·0015 mfds., the tuned circuit condenser 0·001 mfds., the primary may be 16″ × 8″, wound with No. 26. The secondary, 12″ × 7″, wound with No. 34.

(2) This again depends entirely on the remaining constants of the circuits. The inductance of the inner coil is 21,000 mhys., of the outer coil $\frac{1}{3}$ 7,000 mhys.

(3) If the lines in your first sketch represent the aerial wires, the aerial will be of very little use; if they represent the former on which a frame aerial is to be wound, the aerial will be all right for valve work. In your second sketch the three inside wires can be omitted with practically no loss of signal strength, but an aerial only 25′ long will only give good results with a fairly high degree of amplification.

N.M. (London).—(1) The loading inductance as described and as shown at B in the diagram do not agree. Coil B wound in layers is very inefficient. If the coil described is used the wavelength of the circuit will be 5,000 ms., but it is not very efficient—the capacity is too great for short wavelengths.

(2) Try a 3″ diameter former wound with 4″ of No. 28.

(3) The earth is not too good. Try the water pipe. Increase height of aerial at 10′ end.

(4) Yes.

A CORRECTION.

EXPERIMENTAL WIRELESS TELEPHONY.

For Figures 11 and 13 appearing on pages 135 and 137 of the issue of May 28th the accompanying diagrams should be substituted.

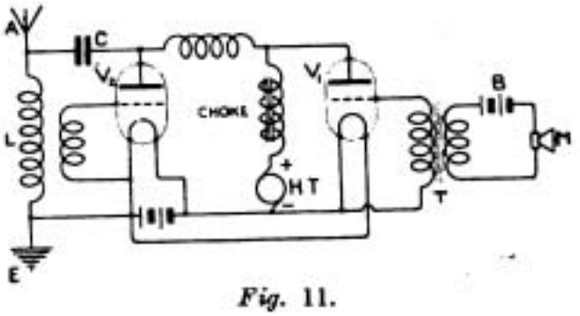


Fig. 11.

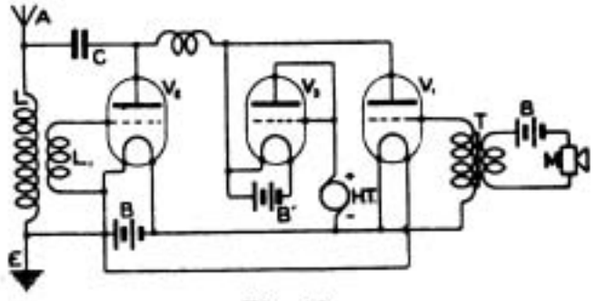


Fig. 13.

SHARE MARKET REPORT.

There has been practically no business done with Wireless Shares during the fortnight owing to the general commercial quietness.

Prices as we go to press, June 16th, are :—

Marconi Ordinary	£2	5	0
,, Preference	£2	5	0
,, Inter. Marine	£1	5	0
,, Canadian		7	9
Radio Corporation of America :—			
Ordinary		9	0
Preference		10	6