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Spark Interference on Broadcast Wavelengths.

It is necessary to seriously consider the difficulties experienced by listeners-in in coastal regions to short wave and broadcast telephony arising from interference by ship stations transmitting on flatly tuned spark systems.

Letters are continuously arriving drawing attention to the impossibility of receiving broadcasting with apparatus of the type usually sold for the purpose, and attention has frequently been drawn to the matter in the daily press. Complaints are also put forward by retailers of broadcast apparatus owing to their inability to guarantee that their apparatus will receive the broadcast transmissions in coastal towns without interference. Well modulated telephony and highly damped spark transmission, the former on a wavelength band of from 350 and 420 metres, and the latter on 600 metres, must certainly overlap when reception is arranged with a single circuit tuner, and interference must arise in view of the fact that ship stations usually employ a power of $1\frac{1}{2}$ kW.

Attention was drawn to this interference by Prof. Marchant in his recent paper before the Radio Society of Great Britain, in particular with regard to the difficulties experienced in the Liverpool district from approaching ships and a busy land station.

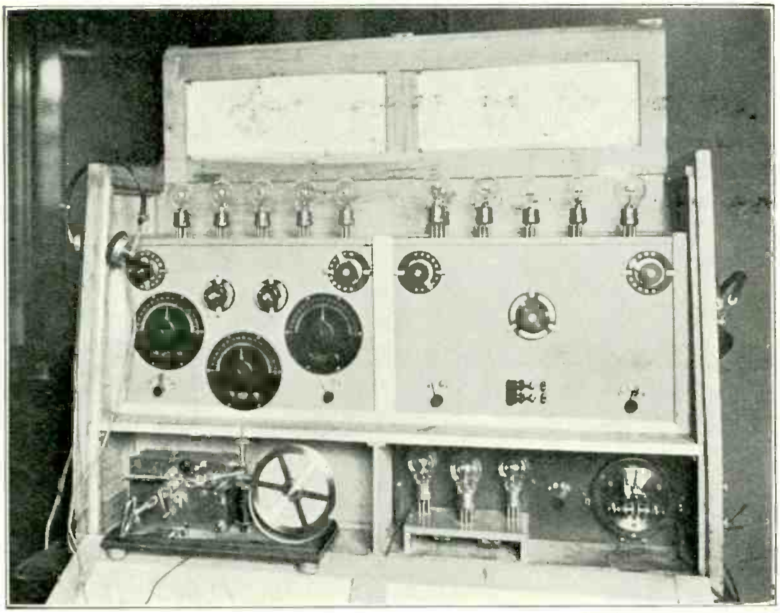
It is hard to suggest what should be done to remedy this trouble. It is quite obvious that it would be a very difficult matter to alter the wavelength band for ship working as the present equipments would not allow of any wide change from that at present allocated, whilst on the other hand there are so many broadcast receivers now in use designed for reception only on the existing broadcast band of wavelengths.

It would seem that the only solution would be to stipulate sharper tuning for the 600 metre spark transmitters. Looser coupling of these transmitters, and more care in tuning, might have the desired effect of reducing interference to a satisfactory extent. Ship stations are now usually equipped with either synchronous rotary or quenched gaps, which are specially designed for the purpose of reducing damping in the transmitting aerial circuit, but whether or not such apparatus is functioning efficiently and achieving the desired object, is a matter of conjecture.

If broadcast reception in coastal towns is to go ahead, something must be done, and possibly a way out of the difficulty may be found by the introduction of regulations defining the degree of damping to be used by ship transmitting stations and careful observation by the authorities as to transmitters emitting waves extending on either side of the specified wavelength band.

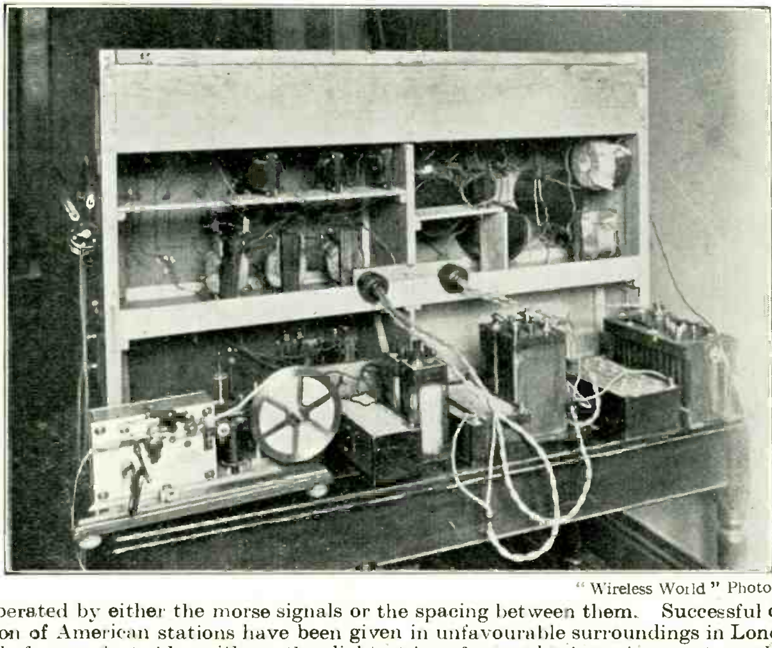
Development in Interference Elimination

The recent Invention by Mons. Y. Marrec.



"Wireless World" Photo.

The apparatus comprises high and low frequency amplifiers followed by a low frequency oscillator, which is employed to heterodyne the detected and amplified signals. The pitch of the resultant note is regulated to suit a number of low frequency narrowly tuned selector circuits.



"Wireless World" Photo.

An inker is operated by either the morse signals or the spacing between them. Successful demonstrations of the reception of American stations have been given in unfavourable surroundings in London on a frame aerial of seven foot sides without the slightest interference by jamming or atmospherics.

Graduating a Barometer in Millibars.

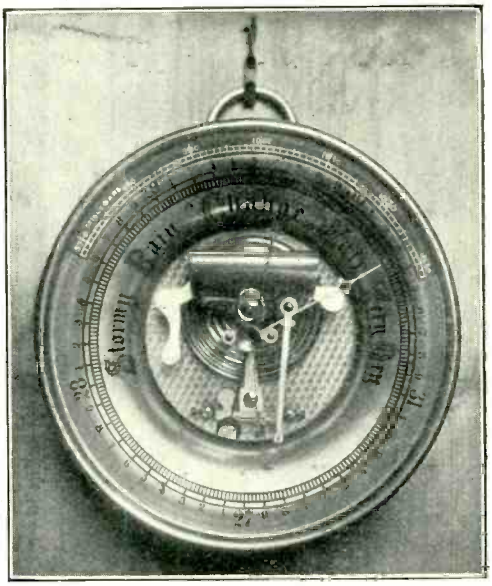
BY H. E. ADSHEAD, B.A.

IT has for some years now been the standard practice to give the atmospheric pressure in millibars instead of inches. As old barometric instruments do not contain this graduation, I hope the following article will induce some to add it to their aneroids, etc. One advantage in so doing is that the eye becomes accustomed to the look of the scale, and then the mind ceases to oppose a prejudice against what is a scientific improvement.

What are millibars? Those whose school days have gone a long way back may satisfy themselves by saying it is a "pounds-per-square-inch graduation in the metric system." Pressure is always given as the quotient of a force by an area; unit pressure is unit force on unit area. The metric force unit is a dyne, the area unit a square centimetre. This unit is very small, and a million such units are taken as the barometric unit and called a "bar," and this is about the average air pressure. To save decimals, we work in thousandths and say we have 970, 1,000, 1,050 millibars, as the case may be, rather than 0·970, 1·000, 1·050 bars. We are already accustomed to millimetres, milliamps, and so this should not be difficult of comprehension.

The scale may be either white lines on black film wrapping paper as in the photograph, or, for those who have no Chinese white paint, black lines on white. The former is the less obtrusive. The scale may be pasted on the outside of the glass if the pointer is not too far away. By the way, speaking of Chinese white, may I digress a moment. In a drawing intended for photographic reproduction, no attempt should be made to erase erroneous lines, they should be covered up with dabs of thick Chinese white, and the alteration will be invisible.

Returning to the main subject, we have these two facts to go upon. A length of $3\frac{1}{4}$ inches is equal to 110 millibars, and a pressure of 999·0 millibars is equivalent to 29·50 inches of mercury. Take therefore a sheet of paper and draw an arc having the same radius as that of the aneroid scale. Along this mark off a length corresponding to $3\frac{1}{4}$ of its inches, and divide this by trial and error into exactly eleven parts. It will not be necessary to employ such an extended scale as this, about six of these will cover most requirements. Draw a larger arc of such a radius that it will fit nicely on to the aneroid face and produce these six divisions outwards from the centre on to it. Each is then sub-divided into ten parts and the larger units numbered from 970 to 1,030. This scale is inked in and cut out and pasted on *so that the division* 999 *is opposite* 29·50 as in the photograph. Those who are not accurate draughtsmen may prefer to work on a circle of much larger radius and produce their lines inwards on to the correct arc. In either case a fine needle may be stuck through the centre and the set square swung round it in drawing the lines. If in the reader's aneroid the 29·5 does not occur at the top, one end of the scale, of course, will need to be extended so as to centre it.



An Aneroid barometer with the new scale fitted, by means of which it is possible to take readings direct in millibars.

I wonder if readers have noticed how very sensitive an aneroid is to changes of pressure. If the hand is very carefully set and the instrument taken upstairs to the next floor, a slight fall will be visible.

Improving Quality in Loud Speakers.

The Filter Feed Circuit and Construction of an Instrument for reducing distortion.

LOUD speakers, in common with other electro-magnetic reproducing devices, may be divided, according to the method of winding, into two classes, known respectively as high resistance and low resistance wound. The former are connected direct in the plate circuit of the last valve of the amplifier, and the windings consist of very many turns of wire, which is necessarily very fine owing to the small space available, the total resistance being generally 2,000, 4,000 or even 8,000 ohms. In the case of the low resistance type, the primary of a step-down low fequency (iron core) transformer is connected in the plate circuit and the loud speaker is connected across the secondary or low resistance winding of this transformer. The coils of the loud speaker are, in this case, wound with a fewer turns of larger diameter wire, the total resistance being usually 120 ohms. Neither type may be said to be the better, as each has both advantages and disadvantages. The high resistance type is slightly more expensive to wind and is less robust, and as the whole of the plate current of the last valve, which may be a power valve, is flowing continuously through the windings, there is a danger of the latter being overheated and "burnt out." In addition to this, if the plate current of the valve is large, and the magnetic system of the loud speaker is not very large there is a danger of the latter being magnetically saturated. This point is enlarged upon in a later paragraph.

In the case of the low resistance type, the dangers of overheating the winding and of magnetic saturation are avoided. A disadvantage is, however, incurred in that the speech is unavoidably distorted to some extent by the use of an iron-core transformer. Owing to the fact that the characteristic or permeability curve of iron is not a straight line, some distortion always occurs when speech currents are passed through an iron-core transformer.

The reason for this may be seen from the curve in Fig. 1, which gives the value of the magnetic field for different values of the magnetising force. It will be seen that the variation of magnetic field with the change of magnetising force is not uniform, so that the speech pulsations are not reproduced with absolute faithfulness. The distortion is, of course, a minimum when the transformer is operated on the straight part of the curve.

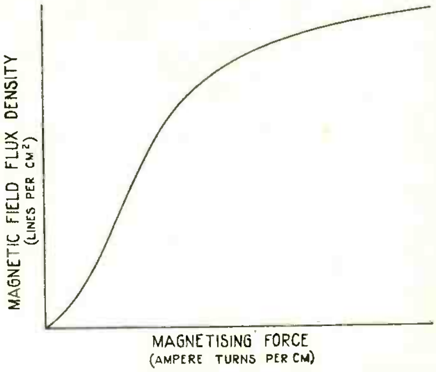


Fig. 1. Curve showing that the relationship between magnetising force and magnetic pull is not uniform. This is one of the contributory causes of distortion in amplifying apparatus having iron cores.

The phenomenon of hysteresis is also responsible for some distortion. It is thus clear that the addition of an extra iron-core transformer, after those used to couple the low-frequency amplifying valves, is detrimental to the purity of reproduction in the loud speaker.

The use of a filter circuit such as is described below ensures that the loud speaker windings shall not be damaged by excessive plate current, whilst at the same time avoiding the distortion introduced by the use of an iron-core transformer.

This very desirable double effect is produced by separating the speech pulsating currents from the steady plate current so that the former alone pass through the loud speaker windings, a shunt path being provided for the steady plate current. Fig. 2 is a diagrammatical representation of the plate current of a low frequency amplifying valve. OA represents the steady plate current which flows directly the filament is lighted, the super-imposed pulsations at audio frequency being produced by the varying potentials applied to the grid. Now the loud speaker is actuated solely by the pulsations, and the only effect of the steady plate current is to heat the windings of the loud speaker. The object of the filter is to enable the pulsations alone to pass through the loud speaker.

A circuit diagram of the device is given in

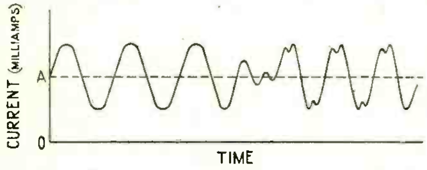


Fig. 2. Typical form of current fluctuations in the plate circuit of note magnifying valve.

Fig. 3. In series with the loud speaker is a large fixed condenser C, of 4 or 5 microfarads. This prevents the steady plate current from passing through the loud speaker, whilst offering a low impedance to the speech pulsations. The iron-core choke L is shunted across the loud speaker and condenser C together, and provides a path for the steady plate current, whilst at the same time its inductance is so large that it offers a very high impedance indeed to the speech pulsa-

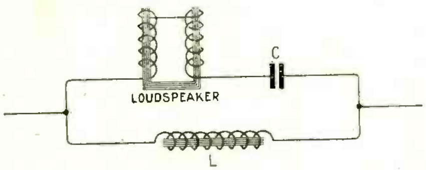


Fig. 3. An arrangement for preventing the steady plate current from passing through the windings of the Loud Speaker.

tions. The effect of the arrangement is that the steady plate current flows through the choke L and the speech pulsations pass through the condenser C and actuate the loud speaker. As the speech oscillations do not pass through the choke circuit, no distortion is introduced by this, and the desirable features of the low resistance winding are obtained without its disadvantages.

With regard to the actual details of a practical circuit, the construction of fixed condensers is too well known to need repetition. If it is intended, however, to purchase this item, condensers of the Mansbridge type are very suitable, a couple of 2 mfd. condensers of this type in parallel being quite satisfactory and not too expensive (Fig. 4). As to the choke, this, of course, must have a large induc-

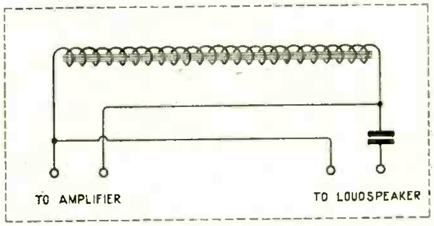


Fig. 4. Connections of an instrument for preventing the steady plate current from passing through the Loud Speaker winding. The fluctuating component of the plate current is fed through the condenser to the Loud Speaker.

tance, and should be of generous proportions. A closed iron circuit should be used, the cross-sectional area being not less than half a square inch. A suitable winding will be obtained by winding about 10 ozs. of No. 34 S.W.G. double silk covered copper wire on a cardboard former. The parts of the filter may if preferred be mounted on an ebonite deck in a box.

The method of connecting to the amplifier and loud speaker is shown in Fig. 5.

Apart from the safeguard against a "bu n-out," the device does not have a great effect on the quality of reproduction as obtained in an ordinary high-resistance loud speaker,

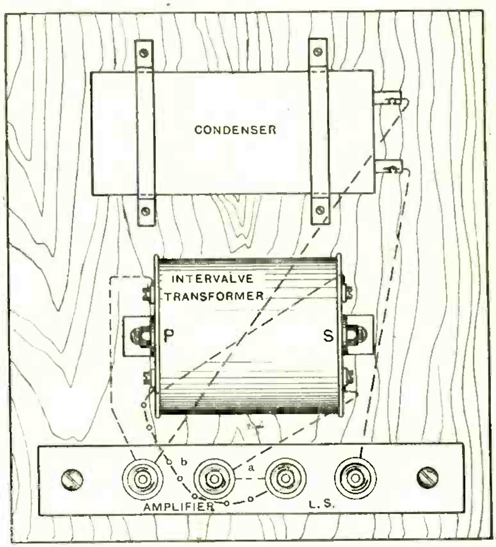


Fig. 5. Constructional details of an instrument for operating the Loud Speaker, embodying the principles described.

unless the latter is being used to give a volume of sound which is large relative to the size of the loud speaker. In cases, however, where a very large volume of sound is required, as, for example, when entertaining a large number of people in a hall, the device is extremely useful, the loud notes being kept much purer owing to the magnetic system of the loud speaker not becoming saturated. A further glance at Fig. 1 wi l make this clearer. It will be noticed that at higher values of the magnetising field, the curve flattens out, *i.e.*, a given fluctuation of magnetising current does not produce such a large fluctuation of magnetic field as is the case lower down the curve. The result is that the volume of sound is not so great and the reproduction becomes "fluffy." By the use of the filter circuit, however, this effect is entirely avoided. As pointed out above, the effect is more noticeable when a large volume of sound is required, as the plate current in a power amplifier may be of the order of 40 milliamperes or more.

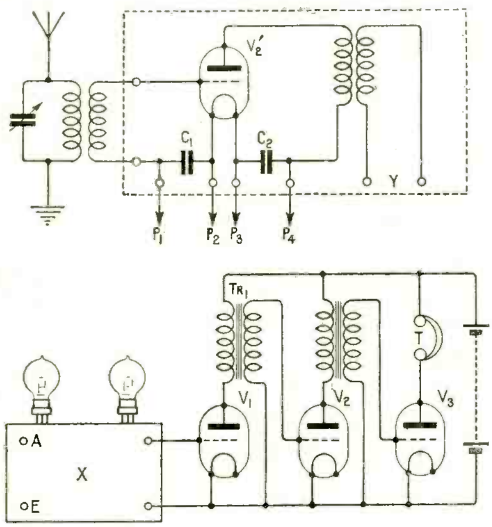
E. J. W.

Novel Ideas and Inventions.

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

AN ATTACHMENT FOR DUAL AMPLIFICATION.

THE advantages and utility of dual amplification—or reflex circuits as they are sometimes called—are to-day known to most experimenters, but not everyone has the inclination to build a special amplifier or receiving set for the purpose. It is, however, possible to obtain the advantages of such special apparatus by making but a trifling addition to any existing amplifying and receiving apparatus, without in any way interfering with its existing construction or wiring.* For instance, consider the case of a five-valve receiver sketched in outline in the figure consisting of a high frequency valve, a detector, and three L.F. valves. The H.F. valve and the detector valve are shown in outline only at X. The output from the detector valve is joined to the grid and filament of the first L.F. valve V_1, the subsequent L.F. valves being designated by V_2 and V_3, the plate circuit of the last valve including the telephone receivers T. Between the valves V_1 and V_2, and between V_2 and V_3 are the usual L.F. intervalve transformers. This or any similar arrangement may be converted so that one of the L.F. valves acts as a high-frequency amplifying valve as well by a simple addition such as is sketched in the upper part of this figure. This addition consists of a valve with input terminals to which the aerial circuit can be connected or coupled, instead of joining it directly to the A and E terminals of the two-valve unit X, and with a H.F. coupling (shown as a H.F. transformer in the diagram) in its output circuit. In the grid circuit of this valve is a bypass condenser C_1, connected across two leads P_1 P_2. In the plate circuit of this valve is a similar bypass condenser C_2, connected across two similar leads P_3 P_4. These four leads, P_1 P_2 P_3 P_4, can be plugged into the socket of say the valve V_2, so that the filament supply of the valve V_2 serves to light this extra valve V_2', while the lead P_1 plugs into the grid socket of the valve V_2, and P_4 into the plate socket. The two leads Y should also be joined to the A and E terminals of the first two-valve unit X. Thus when this is done the aerial circuit is first coupled to this valve V_2' (which is still really the middle valve of the L.F. amplifier, $V_1V_2V_3$), which acts as a high-frequency amplifying valve. The output of this valve,



Circuit and method of connecting component instruments for introducing dual amplification.

* See British Patent No. 194459, by P.G.A.H. Voigt.

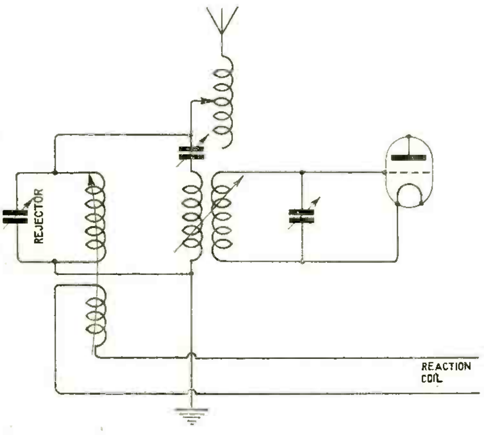
through the leads Y, passes to the first valve in the unit X (which may be a high-frequency valve), thence to the second valve, the detector, thence to the first L.F. valve V_1 in the normal manner. From the output of this valve V_1, the energy passes through the L.F. intervalve transformer T_1, thence out through the connecting leads P_1 P_2 to the outside valve V_2', which replaces the valve V_2, thence back into the L.F. amplifier again through the leads P_3 P_4.

Such an attachment, if properly arranged, may prove a useful addition to any existing receiving set.

A REJECTOR SYSTEM.*

It is well known that protection from a disturbing signal may be obtained by including in the tuning circuits a separate tuned circuit comprising a coil and condenser. One method of connection consists in joining the rejector circuit across the ordinary tuning circuit. Signals with the frequency of the aerial circuit will pass through the ordinary tuning device, and little will pass through the rejector. Signals of different frequency, however, will find an easier path through the rejector circuit, and only a small current will be sent through the ordinary tuned circuit.

The smaller the damping of the rejector circuit, the better will it perform, but it is difficult to construct coils and condensers with small losses without considerable expense, and without them having considerable dimensions. Thus, to reduce the coil losses, the coil is constructed with turns of large diameter of stranded wire, and with the turns spaced. The difficulty experienced is that the large coils themselves act as collectors of energy, and further, where several such rejectors are employed, it is difficult to so place them that they do not interact.



A simple rejector circuit. The reaction coil may be coupled with the coil of the rejector circuit to compensate for resistance losses.

It is known that a valve amplifier may be connected to an oscillatory circuit to reduce its damping. It can therefore be arranged that the rejector circuit may be connected so that the values used in the receiver may operate to reduce the damping. The rejector coil may therefore be constructed of fine wire, and further, no great precautions need be taken to keep the condenser losses low. The small size of the coil makes it easily possible to provide screens, such as metal boxes, which will serve to prevent interaction with other rejectors or other portions of the receiver.

Thus in a particular case, instead of employing a coil 100 millimetres in diameter by 9 millimetres long, a coil 10 millimetres internal diameter and 30 millimetres external diameter by 1·5 millimetres long is satisfactory.

THE GAUMONT LOUD SPEAKING TELEPHONE.

The essential feature of this loud speaker is the elimination of the ordinary rigid diaphragm which usually has a pronounced resonant property and causes distortion of the sounds emitted by the apparatus. Instead of an ordinary diaphragm either acted upon directly by the magnetic system, or indirectly by a reed or coil controlled by the magnetic system, the Gaumont loud speaker* has the movable coil forming part of the diaphragm itself. The coil, which is preferably constructed of aluminium wire, is formed in a cone shape, and either stuck on to or woven as part of a cotton or silk cloth to form a cone-shaped diaphragm. The poles of a powerful electro-magnet are shaped so that the magnetic field traverses the diaphragm and coil practically normal to the surface of the coil, so that the whole diaphragm is thrown into vibration by the action of telephone currents flowing through the coil. Owing to the shape given to the diaphragm, and to its not having any particular resonant period, the telephone can reproduce sounds without distorting, suppressing or accentuating the harmonics, so that a purer sound is produced.

* British Patent, April 27th, 1923 No. 174,636. Gesellschaft Für Drahtlose Telegraphie M.B.H.

* British Patent No. 193,339, by the Société des Etablissements Gaumont.

A PRACTICAL COURSE IN THE PRINCIPLES OF WIRELESS

EXPERIMENTS
FOR THE RADIO AMATEUR

By MAURICE CHILD.

Vice-Chairman of the Radio Society of Great Britain.

EXPERIMENT No. 10.

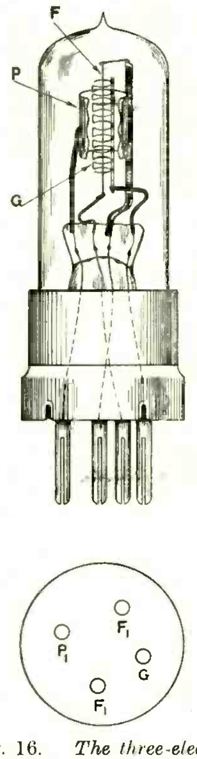
To obtain a knowledge of the way in which a thermionic valve operates.

The apparatus required is as follows :—

1 Hard " R " Valve.
1 Valve Holder.
1 8-10 Variable Resistance.
1 6-volt Accumulator Battery.
1 105-volt Dry Cell Battery tapped in divisions of 15 volts (approximately).
2 Single Pole Switches.
1 Milliamperemeter registering from 0 to 5 milliamperes.
1 Voltmeter, registering from 0 to 10 volts.
3 or 4 Dry Cells.
1 Potentiometer.

With the apparatus which he already has in his possession, the experimenter will have arrived at a stage when he can now receive radio signals. As to whether these signals will be strong or weak will depend on many factors, some of which are not immediately under his control, such as the distance separating him from the particular transmitting station whose signals he is receiving; the efficiency of his aerial to receive signals from the particular direction he requires them; and the unknown absorption of wave energy due to local surroundings, both at the receiving and transmitting stations. The main point, however, is that provided signals can be obtained, the experimenter will soon be able, with a little practice, to find on what stations he can rely for signals of a constant and useful strength for comparative purposes. Before he has been very long receiving, however, he will require to obtain the signals a good deal stronger or from greater distances, and therefore the author is of the opinion that it is important that any apparatus used for the strengthening of signals should be thoroughly understood, theoretically as well as practically.

It may be pointed out that the average experimenter at first desires to obtain very strong signals, and frequently wastes a great deal of time and money in employing apparatus or circuits which do not give the results he desires. If, however, he will follow out the next few experiments in detail, it is hoped that much time and expense will be saved.



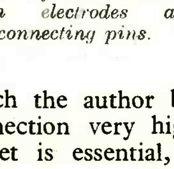


Fig. 16. The three-electrode valve, showing the method of connection between electrodes and connecting pins.

Fig. 16 shows a general sketch of the inside connections of a three-electrode valve, termed a "Triode.' The projection shows the relative position of the pin contacts at the base, and careful scrutiny will disclose where these pins are connected inside the valve itself. Thus F_1 and F_1 are connected to each side of the filament F. G is connected to the spiral G, known as the grid, and P_1 to the cylinder known as the plate.

The valve-holder should preferably be of a type where good quality ebonite is employed in encasing the sockets for the valve-pins. The majority of valve-holders on the market are of composition, some of which are good from an insulation point of view, but some of which the author believes are not. In this connection very high insulation of a valve socket is essential, as the slightest leakage from the grid pin to any of the other pins, is going to cause erratic results from time to time, and such irregularities in the valve's behaviour will be extremely difficult to trace.

As an alternative to encased valve holders, four separate brass sockets can be fixed to a flat sheet of good quality ebonite.

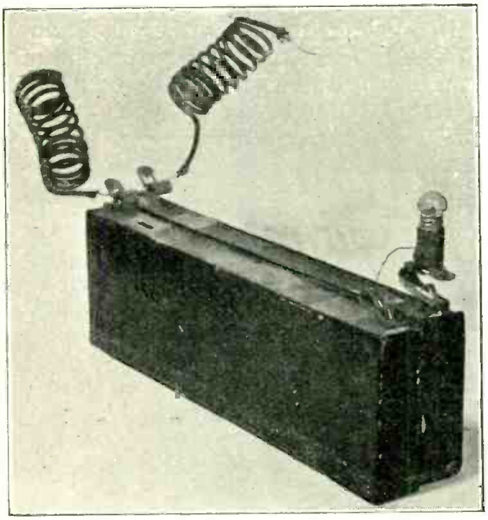


Fig. 17. The fitting of a small lamp in place of a connecting strap in the H.T. battery will protect it from damage by short circuit.

The milliamperemeter is an instrument which many experimenters will feel somewhat alarmed at the prospect of having to buy, as it is not a necessity for actually receiving signals. To the serious photographer the exposure meter is reckoned an essential thing, although in itself it does not actually take photographs, and in the same way the milliamperemeter is to the radio experimenter what the exposure meter is to the photographer. It enables him to know what he is about, and must therefore be part of his equipment.

With regard to the 100-volt battery, this has commonly become known as a high tension battery, in order to distinguish it from the accumulator or 6-volt battery used for lighting the filament of the valve. If the experimenter is prepared to put down two or three pounds in obtaining a really good battery to start with, it will pay him to set up a number of small Leclanché cells of the loose-liquid variety. The author has had such a battery in constant use for a period of eight months, and it is still giving exactly the same voltage across its terminals as when it was set up. The only trouble that has been experienced with it was due to two of the cells apparently getting short-circuited internally, although it was difficult to notice any particular cause for this. In any case the matter was quickly put right by two pairs of new elements replacing those worn out, at the cost of 1s. If the experimenter prefers it, however, a dry cell battery made up of units giving from 15 to 16 volts can be obtained, and in this case it will be found desirable to insert a small 3·5 volt lamp in series as indicated in the photograph, Fig. 17. In the event of a short circuit accidentally taking place between the positive and negative wires of this battery, the lamp will be fused. This will cost the experimenter 3d. or 4d. to renew, and therefore he will be careful not to short-circuit the battery subsequently. On the other hand, without the lamp, instead of the 3d. or 4d., the cost may be £1 to 25s. for a new battery. A short circuit lasting a few minutes would be sufficient to practically ruin a dry cell high tension battery.

With regard to the accumulator, there are many good makes of these on the market, and the author finds it difficult to recommend any particular types as being far superior to others.

And now as to the experiment itself. The apparatus must be joined up in the manner indicated in Fig. 18. The single pole switches are closed, while the filament resistance is adjusted to a position so that when the voltmeter is

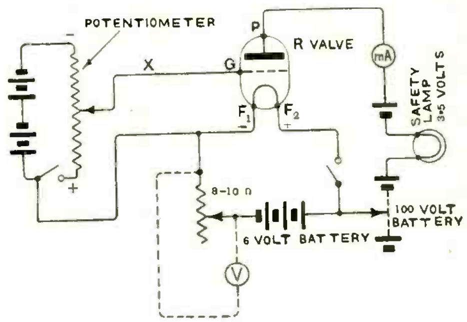


Fig. 18. Connections of apparatus for showing the effect of the potential of the grid on the current which flows in the H.T. battery circuit.

placed across it the voltage registered is 2. If the voltmeter is connected directly across the accumulator battery, it should register 6 volts when the battery is fully charged and the filament is alight. The *difference* between the reading of the voltmeter when placed on the filament resistance and when placed across the accumulator battery, is the voltage which is across the filament itself.

It is important that the experimenter should realise how the voltage of the accumulator battery is distributed around the filament circuit. In this way he will remember that when the resistance is placed in the position shown in the diagram, *i.e.*, between the negative terminal of the battery and the filament, there is a voltage drop across it, and that any point of the filament must be at a higher voltage than the negative terminal of the accumulator battery.

The high tension battery should be adjusted to give 30 volts, and the potentiometer slider should be at the positive end of the winding. In this case the grid of the valve will have exactly the same voltage as the negative end of the filament.

This can be proved by taking the wire marked " X " from the potentiometer slider and connecting it directly to the negative terminal of the filament itself. It will be observed that the milliamperemetre reading is the same in each case. This reading should be noted for future reference. The wire marked " X " should now be placed *on the negative terminal of the accumulator battery.* The grid will now be at a negative voltage in relation to the negative end of the filament, and if the voltage drop on the resistance is 2 volts, we should say that the grid is 2 volts negative. The milliamperemeter will now register the plate circuit current, and the reading should be noted. If, now, the wire " X " is reconnected to the potentiometer, and the slider is moved towards the top, a position can be found where the milliamperemeter registers the same current as when the wire " X " was joined to the negative terminal of the battery. The slider at this point will therefore indicate – 2 volts in relation to the negative end of the filament. If the slider is moved up still further a position may be found where the plate circuit current is reduced to zero. The grid voltage values for the above result will vary, of course, with different types of valves, and it is for this reason that it is necessary for the experimenter to fix up the apparatus suggested in this experiment in order that he may not be working in the dark.

The experiment may be extended by reversing the battery on the potentiometer, in which case it will be found that the plate circuit current as indicated by the milliamperemeter rises as the potential on the grid is increased in a positive sense in relation to the negative end of the filament.

If it is desired to know the voltage applied between the grid and the negative end of the filament, the voltmeter may be used for this

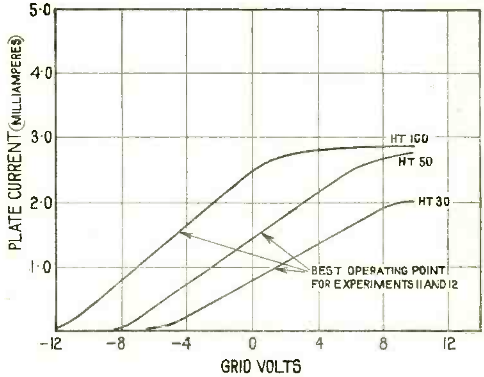


Fig. 19. Curves plotted from the results obtained in this experiment, showing the relationship between grid potential and plate current.

purpose, in which case the wire shown from the voltmeter to the negative terminal of the 6-volt battery will be permanently connected to " G." By taking careful readings both of the voltmeter and the milliamperemeter, it will be possible to plot a series of curves on squared paper, somewhat similar to those shown in Fig. 19. It will be noted that these curves vary in length according to the value of the high tension battery voltage. It is important that the experimenter should thoroughly grasp the meaning of these curves so that at any future time he will know exactly what is the normal plate circuit current with any given voltage applied to the grid, either in a positive or negative sense. For these tests it is necessary that the filament resistance is kept at a constant value, or, putting it another way, the filament current should be constant.

HERTZITE

Broadcasting, whilst stimulating interest in the design of multivalve amplifiers, has revived the use of the crystal detector, and this revival has given rise to the introduction of a variety of crystals. Most of these crystals are however similar to Hertzite in a more or less degree in composition and action. This article describing the introduction of Hertzite is of special interest to users of this well-known crystal.

By W. J. FRY.

IN the year 1913 I was the first maker in this country of the crystal known as "Hertzite," and which name was given it by me. The crystal was made for Messrs. Russell & Shaw, and as far as I know, I do not think that the process of treatment is known by anyone else in this country. The greatest difficulty in producing Hertzite is that of obtaining suitable minerals, as generally speaking these are scarce, as the generality of minerals are unfit for the necessary chemical treatment. Any mineral which shows the slightest signs of natural radio sensitivity is practically useless, as this feature, instead of being improved by treatment, is practically destroyed. Certain crystals which are quite insensitive are often capable of being made to reach maximum sensitivity. A crystal that is naturally friable, usually becomes very hard after treatment, and loses its crumbly nature. What change is imparted to the crystal subjected to the process is hard to discover, but the fact remains that all naturally hard crystals are much more sensitive than soft ones, and this fact may have something to do with the phenomenon.

In the original treatment a large percentage of tellurium was fused into the crystal. In this process only six pieces could be treated at a time, with a loss sometimes of four of them. After considerable research I have now evolved a process by which the use of tellurium is unnecessary, and fifty or sixty pieces can be produced by one treatment practically without loss, which is a complete revolution of the older method. It is not generally known that Hertzite can be produced in three forms. Firstly, the generally known species of fine or coarse granular formation; secondly, a striated form; and thirdly, in a form which is practically the prototype of bornite in colour and appearance. Most people presumably are of the opinion that only the very bright silvery granular crystal is of any use, but this is for want of better knowledge, as some of the dull grey specimens are of great sensitivity, for "all is not gold that glitters."

To-day, many different crystals purporting to be Hertzite are on the market, some of them being practically useless. Hertzite should retain its sensitivity after fracturing, whereas the so-called specimens on the market are not only friable, but not uni-sensitive, and some very insensitive. A knowledge of the proper way to use Hertzite is of great importance. The best results are obtained by mounting the crystals in a cup with either Wood's metal or blowpipe solder. Screw contacts are not always satisfactory as they tend to fracture the crystal and hold it only in a few positions, which may not present the most suitable faces. The "cat's whisker" contact should be made by using about four pieces of not larger than No. 40 S.W.G. copper wire pulled down straight and arranged to make a micrometer contact, fixed in a horizontal lever which should have a spring of some sort. A small Grover washer is good for providing side pressure to the arm and damp any lash. The use of the commonly used stiff spiral single pointed brass contact is very detrimental to the functioning of the crystal, and gives too heavy a contact, which causes a breaking up of the mineral. I have seen many instances of detectors failing to work on this account, the bases of the detectors glistening with minute particles of disintegrated crystal. I have even known of knitting needles being used for point contact, which is an absurdity, while the users pronounce Hertzite as being useless.

Crystals are often mounted within glass tubes, and when this is done provision should be made for ventilation, otherwise condensation will occur at times in the tube, moistening the mineral and rendering it insensitive. If Hertzite is properly treated and not fingered it will maintain its sensitivity practically indefinitely. I have specimens which I made twelve years ago which have been lying about quite unprotected, and still give signals of maximum strength. Some of these were taken to the White Sea in 1914, and signals obtained there which were inaudible with any other crystal.

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2TB	H. W. Sellers, 18, Edgerton Grove Road, Huddersfield.
2TC	H. W. Sellers, 18, Edgerton Grove Road, Huddersfield.
2TF	Edinburgh and District Radio Society. Hon. Secretary, W. Winkler, 9, Ettrick Road, Edinburgh.
2TG	Dr. T. F. Wall, Dept. of Applied Science, The University, St. George's Square, Sheffield.
2TH	Dr. T. F. Wall, Dept. of Applied Science, The University, St. George's Square, Sheffield.
2TI	H. Bevan Swift, 49, Kingsmead Road, Tulse Hill, S.W.2.
2TM	L. H. Mansell, "Woodfield," Madresfield Road, Malvern.
2TN	C. E. Stuart, Lyndon Lodge, Polesworth, Tamworth.
2TO	F. Townsend, 46, Grove Lane, Ipswich.
2TP	C. W. Andrews, "Radioville," 26, Melody Road, Wandsworth Common, S.W.18.
2TQ	T. C. Macnamara, "Clontarf," 31, Rollscourt Avenue, Herne Hill, S.E.24.
2TR	F. O. Sparrow, 8, North Drive, Swinton, Manchester.
2TV	E. W. Wood, 79, Colwyn Road, Northampton.
2TW	E. W. Wood, 79, Colwyn Road, Northampton.
2TX	A. R. C. Johnston, 87, Twyford Avenue, Acton, W.3.
2TY	Sydney Scott, Field Villa, Norton, Malton.
2TZ	Ernest Jones, "Newholme," Hempshaw Lane, Offerton, Stockport.
2UA	S. B. P. Barnes, 38, Avenue Road, Highgate, N.6.
2UC	E. J. Winstone, 53a, Gunterstone Road, W. Kensington, W.14.
2UD	Ernest W. Smith, 77, Grove Lane, Camberwell, S.E.5.
2UG	W. Humphreys Burton, 103, Portland Road, Nottingham.
2UI	A. R. Ogston, 41, Broomfield Avenue, N.13.
2UJ	L. R. Richards, "Mona," 25, Cholmeley Park, Highgate, N.6.
2UK	Cotteridge Day Continuation School, King's Norton, Birmingham.
2UM	H. Lloyd, 3, Ventnor Place, Sheffield.
2UN	14th Cardiff Lord Mayor's Own Troop of B.P. Scouts, Y.M.C.A., Boys' Dept., Cardiff.
2US	The Radio Society of Highgate, Highgate 1919 Club, South Grove, Highgate, N.6.
2UV	W. Corsham, 104, Harlesden Gardens, N.W.10.
2UX	A. T. Headley, 255, Galton Road, Warley, Birmingham.
2UY	W. Fenn. Holly Cottage, Polesworth, Tamworth.
2UZ	C. V. Stead, 29, Sholebroke View, Chapeltown, Leeds.
2VC	A. S. Gosling, 63, North Road, West Bridgford, Nottingham.
2VF	H. A. Blackwell, Whyte House, Bispham, Blackpool.
2VH	S. E. Payne, Bush Hill Park, Enfield.
2VI	H. Curtis, 26, Upper Hall Lane, Walsall.
2VJ	B. J. Axten, "Ravenscourt," 78, Ealing Road, Wembley, Middlesex.
2VK	Burndept, Ltd., Aerial Works, Blackheath, S.E.3.
2VM	J. Lipowsky, 614, Old Ford Road, Bow, E.3.
2VN	M. H. Drury-Lavin, Old House, Sonning, Berks.
2VO	Alan C. Holmes, 60, Aire View, Cononley, Keighley, Yorks.
2VP	P. G. A. H. Voigt, "Bowdon Mount," 121, Honor Oak Park, S.E.23.
2VQ	H. B. Old, 10, St. Jude's Avenue, Mapperley, Nottingham.
2VR	H. J. Jackson, 8th Walthamstow Boy Scouts,
2VS	W. K. Hill, 79, Beulah Hill, London, S.E.19.
2VT	W. K. Hill, 79, Beulah Hill, London, S.E.19.
2VW	E. H. Robinson, 125c, Adelaide Road, N.W.3.
2VX	H. H. Thompson, 44, Northumberland Road, Coventry.
2WA	J. Pigott, Manor Farm, Wolvercote, Oxford.
2WB	G. W. Jones, 8, Rosebery Street, Wolverhampton.
2WD	C. W. Clarabut, Bedford Physical and Radio Society, "Beechcroft," Beverley Crescent, Bedford.
2WJ	R. L. Royle, "Southwold," Alderman's Hill, Palmer's Green, N.13.
2WK	G. R. Lewis, 10, Lansdowne Road, Ashton-on-Mersey, Manchester.
2WL	F. J. Cripwell, Lonk Hill, Thorpe, Tamworth.
2WM	J. W. Pallett, 111, Ruby Street, Leicester.
2WN	A. H. Wilson, 67, Broad Street, Hanley, Stoke-on-Trent.
2WO	J. H. Brown, "Redbrook," Baguley, Cheshire.
2WQ	Colin H. Gardner, Amblecote House, Brierley Hill, Staffs.
2WR	L. W. Burcham, "Gauzecourt," Chestnut Avenue, Oulton Broad, Norfolk.
2WS	H. Squelch, Jnr., 35, Crown Lane, Bromley Common, Kent.
2WT	H. Chadwick, 9, Raimond Street, Halliwell, Bolton.

2WZ Captain A. H. Hobson, 32, Wilbury Road, Hove, Sussex.
2XA Rev. C. H. Townson, Wilts Farm School, Warminster.
2XB S. Z. Auckland & Sons, 35, Douglas Road, Highbury, N.6.
2XC H. Johnson, "Avondale," Chestnut Walk, Worcester.
2XD H. R. Gladwell, London Road, Abridge, Essex.
2XF E. T. Chapman, "Hillmorton," Ringwood Road, Newtown, Dorset.
2XI R. H. Wagner, 6, Maresfield Gardens, N.W.3.
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2XK Sheffield and District Wireless Society. Hon. Sec., L. H. Crowther, 18, Linden Avenue, Sheffield.
2XL Captain Edward Davis, "Pavilion," 222, Lavender Hill, Clapham Junction, S.W.11.
2XM P. H. Dorte, Downside Wireless Society, Downside School, Stratton-on-the-Fosse, Nr. Bath.
2XN P. H. Dorte, Downside Wireless Society, Downside School, Stratton-on-the-Fosse, Nr. Bath.
2XP J. F. Payne, 22, Shakespeare Crescent, Manor Park, E.12.
2XR J. F. Haines, 36, Zetland Street, E.14.
2XW H. A. Woodyer, 118, Buckingham Road, Heaton Moor, Nr. Stockport.
2XX D. F. Young, 23, Holcombe Road, Ilford, Essex.
2XZ Lewis T. Dixon, "Strathspey," 4, Haythorp Street, Southfields, S.W.18.
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2YF James R. Clay, Upper Longbottom, Luddendenfoot, Yorks.
2YG L. G. Boomer, 42nd Camberwell Troop, B.P. Scouts, 51, Brook Street, S.E.1.
2YH G. E. Duveen, 40, Park Lane, W.1.
2YI W. J. Hewitt, 83, Reddings Road, Moseley, Birmingham.
2YJ Wireless Equipment, Ltd., 90, Charing Cross Road, W.C.2.
2YK T. M. Ovenden, 12a, Elgin Court, Elgin Avenue, Hampstead.
2YM Rolfe W. Piper, "Elmhurst," 62, Chiltern View Road, Uxbridge.
2YN A. W. Thompson, 32, St. Nicholas Street, Scarborough.
2YQ W. P. Wilson, 1, Highland Road, Gipsy Hill, S.E.19.
2YR A. R. Pike, 17, Avonwick Road, Heston, Hounslow.
2YU G. W. Hale and R. Lyle, 36, Dagnall Park, S. Norwood, S.E.25.
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2YW J. Harold F. Town, 4, Eversley Mount, Halifax.
2YX F. E. B. Jones, "Hill Crest," Jockey Hill, Birmingham Road, Wylde Green, Birmingham.
2YY O. H. Patterson, 26, Allerton Road, Stoke Newington, N.16.
2ZB C. R. Small, "Broadhurst," Skelmersdale Road, Clacton-on-Sea.
2ZC General Radio Co., Transmitting Station, Twyford Abbey Works, Acton Lane, Harlesden, N.W.10.
2ZD A. Woodcock, 1, Montagu Road, Handsworth, Birmingham.
2ZK W. L. Turner, Purley, Caldy, West Kirby.
2ZL H. W. Gee, 44, Gordon Street, Gainsborough, Lincs.
2ZM T. H. Isted, Terling, Witham, Essex.
2ZO L. H. Soundy, 60, Bellevue Road, Ealing.
2ZP G. F. Forwood, West Chart, Limpsfield, Surrey.
2ZQ H. W. Nunn, 49, Leigh Road, Highbury Park, N.5.
2ZS F. J. Dinsdale, 14, Highfield View, Stonycroft, Liverpool.
2ZT Benham, Woodbury Road, New Malden, Surrey.
2ZU T. Eccles, 30, Thackeray Street, Liverpool.
2ZV E. T. Smith, Rutlands, Felsted.
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5AI A. H. Sheffield, 139, Wallwood Road, Leytonstone, E.11
5AJ Walter C. Barraclough, 9, Rutland Avenue, Withington, Manchester.
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5BL Arthur E. Vick, 19, Gresham Road, Hall Green, Birmingham.
5BM J. T. Quick, 164, Portland Road, Edgbaston, Birmingham.
5BT L. V. Clark, 4, Compton Crescent, Grove Park.
5BV Hugh N. Ryan, 88, Home Park Road, Wimbledon Park, S.W.19.
5BW A. De Villiers, 161, Westminster Bridge Road, S.E.1.
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5CS G. R. Garratt, 35, Abbey Road, St. John's Wood, N.W.8.
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5CY L. Gordon, 133, Old Street, Ashton-under-Lyne, Lancs.
5DA G. Gore, 24, Brucegate, Berwick-on-Tweed.
5DB C. H. P. Nutter, 243a, Selhurst Road, S.E.25.
5DC W. T. Aked, "Kasauli," Devonshire Road, St. Annes-on-Sea.
5DG C. H. Stephenson, Penn Manor, Wolverhampton.
5DM A. N. Jackson Ley, Grove House, Albert Grove, Nottingham.
5DN Captain L. A. K. Halcomb, "South Dene," 106, Millhouses Lane, Sheffield.
5DO E. J. Watts, 6, Ashley Road, Salisbury.
5DP Sea Scouts' Headquarters, Clacton Troop, Clacton-on-Sea.
5DS A. W. Fittian, 51, St. James' Road, S.W.17.
5DT Hutchinson & Co. (F. Pinkerton), 101, Dartmouth Road, Forest Hill, S.E.23.
5DV D. Whittaker, 56, Park Road, St. Annes-on-Sea.
5DY Chelmsford Radio Engineering Co., Ramsford End, Chelmsford, Essex.
5FH L. H. Lee, 155, Rosefield Road, Smethwick, Staffs.
5FL T. W. Pevensey, Lewisham, S.E.
5FR J. L. Jeffree, 191, St. James Road, Croydon.
5FS W. A. Andrews, 1, Balmoral Mansions, St. Andrew's Park, Bristol.
5FZ Lincoln Wireless Society. Sec., J. T. James, 126, West Parade, Lincoln.
5GB L. Humphries, L. Humphries & Co., 61, Geraint Street, Prince's Park, Liverpool.
5GF H. Stopher, 14, Johnston Terrace, Cricklewood, N.W.2.
5GI R. Horrocks, 65, Leander Road, Thornton Heath.
5GJ James Bevis, 4, Somerset Road, Linford Estate, Mucking Ford, Nr. Stanford-le-Hope, Essex.
5GL N. G. Baguley (Hon. Sec.), Newark and District Wireless Society, The Park, Newark.
5GP J. E. Simpson, "Baskerville," Epsom Road, Guildford.
5GQ F. W. Nightingale, Pikford Schools, Northampton.
5GT E. S. Dobson, "Lorne House," Richmond Place, Ilkley, Yorks.
5HA R. Watson, 35, Fairview Road, Oxton, Birkenhead.
5HC J. A. Beveridge, "Dunelm," 8, Cluny Drive, Edinburgh

5HD Henry St. John Ward, N.E. Coast W. Co., Ltd., Blenheim Chamber, 1, Crowtree Road, Sunderland.
5HI L. W. Birch, 30, Limesford Road, Waverley Park, S.E.15.
5HL G. E. Vowles, St. Leonards, Hooley Street, Sherwood, Nottingham.
5HQ E. A. Pollard, Spring Bank, Limefield, Blackburn.
5HW The National Physical Laboratory, Teddington.
5HX C. H. Gardner, Electrical Disposals Syndicate, 6, Market Place, Oxford Circus, W.1.
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5HZ C. A. Carpenter, 10, Crossley Street, Sherwood, Nottingham.
5IC F. E. Harvey, "Fairmead, Sunset Avenue, Woodford Green, Essex.
5ID P. D. Coates, 55, Ennismore Street, Burnley.
5IF H. Featherstone, 3, Cumberland Gardens, Tunbridge Wells.
5IG J. E. Sheldrick, "The Brambles," Third Avenue, Denville, Havant, Hants.
5IK B. L. Stephenson, 12, Sheringham Road, Withington, Manchester.
5IO Wireless Equipment, Ltd. (Test Station), R. H. Brown, 10, Coverdale Road, Shepherd's Bush, W.12.
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5JZ H. J. Cheney, 263, Thimble Mill Lane, Nechells, Birmingham.
5KA G. C. Beddington, "Stagsden," West Cliff Road, Bournemouth.
5KB F. Westrup Coomber, Electrical Engineer, 58, The Tything, Worcester.
5KL G. M. Wood, 60, Pikes Lane, Glossop, Manchester.
5KN J. Earnshaw, 95, Mayfield Road, Sanderstead.
5KO I. W. Higgs, and J. S. Hobbs, 45, Howard Road, Westbury Park, Bristol.
5KP A. T. Wallace, "Brettenham," Hedge Lane, Palmer's Green, N.13.
5KY E. E. G. Allsopp, Ingle Nook, Wigginton Road, Tamworth.
5LA L. H. Soundy, 60, Bellevue Road, Ealing.
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5LP L. W. Pullman, 213, Golder's Green Road, N.W.11.
5LV N. Willson, "Claremont," Tenbury Road, Kings Heath, Birmingham.
5LZ A. G. S. Gwinn, 61, Carnarvon Road, Stratford, E.15.
5MA R. Munday, 17, Malden Road, New Malden, Surrey.
5MD R. W. Hardisty, 5, Ethelbert Road, Canterbury.
5MJ C. F. Howes, Enfield.
5MO W. Guthrie Dixon, "Dipwood." Rowlands Gill, Newcastle-on-Tyne.
5MP Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.
5MS Manchester Wireless Society, Houldsworth Hall, Deansgate, Manchester.
5MT Manchester Wireless Society, Houldsworth Hall, Deansgate, Manchester.
5MY W. G. Wyatt-Ingram, 41, Lambeth Road, Brixton Hill, S.W.2.
5ND J. H. Taylor, & Co. Electrical Engineers, Macaulay Street, Huddersfield.
5NF R. W. Galpin, Bank House, Herne Bay, Kent.
5NH A. C. Hulme, 39, Poplar Avenue, Edgbaston, Birmingham.
5NN J. H. R. Ridley, "Studley," 106, Woodside Green, S. Norwood, S.E.25.
5NO The British Broadcasting Co., Newcastle.
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5OC Col. E. C. Jennings, Gelli Deg, Kidwelly, Carmarthenshire, S. Wales.
5OD Ralph Bates, "Holmeside," St. Catherines, Lincoln.
5OL John F. Cullen, 68, Queen's Drive, West Derby, Liverpool.
5OT F. J. Wood, "Belmont," Upper Colwyn Bay, North Wales.
5OX C. H. F. Hubbard, 196, Putney Bridge Road, S.W.15.
5OY Belvedere and District Radio and Scientific Society, Erith Technical Institute.
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5PR C. Ratcliffe, 68a, Dewsbury Road, Leeds.
5PS J. E. Clatt, "Melrose," Alexandria Road, Farnboro', Hants.
5PU T. Allison, 33, Wilton Grove, Merton Park, S.W.
5PV R. G. Templar, 52, Alderville Road, Hurlingham.
5QB A. G. Bainton, 8, Palace Road, Streatham Hill, S.W.2.
5QD G. H. Wray, 19b, Church Gate, Loughborough, Leicestershire.
5QI D. G. Bird, 8, Osborne Terrace, South Shields.
5QM V. R. Mills, 122, Hughenden Road, Hastings.
5QV F. L. Stollery, "Fairmead," Vista Road, Clacton-on-Sea.
5QX Holt & Dedman, Radio Engineers, 6, Raby Road, New Malden, Surrey.
5RC W. Brierley, 59, Gayner Park, Filton, Bristol.
5RF L. F. Hunter, 18, Tannsfield Road, Sydenham, S.E.26.
5RL John A. Sang, 22, Stranmillis Gardens, Belfast.
5RP Capt. H. I. Hughes (Hughes & Watts, Ltd.), Engineers, Oxton, Birkenhead.
5RZ A. G. Wood, 93, Upper Tulse Hill, S.W.2.
5SA The Mercian Radio Co., Radio Works, Hinckley.
5SC The British Broadcasting Co., Glasgow.
5SD John Turner, Barwythe, Nr. Dunstable, Beds.
5SF J. K. Wilkie, "Avondale," Knowsley Road, Cressington Park, Liverpool.
5SI C. L. Naylor, 43, Hill Crescent, Longdon Road, Shrewsbury.
5ST Robert R. Morrison, Spring Grove, Kilbarchan, Renfrewshire.
5SU Capt. Ian Fraser, St John's Lodge, Inner Circle, Regents Park, N.W.1.
5SW C. Bedford, Turton Hall, Gildersome, Nr. Leeds.
5SZ J. W. Riddiough, Lawnside, Sandals Road, Baildon.
5TA Vernon J. N. Williams, "Merok," Lees Road, Bramhall, Cheshire.
5TF Percy A. Gooding, 16, Cambridge Road, Hammersmith, W.6.
5TG F. R. W. Strafford, 3, Lee Road, Dovercourt.
5TH A. G. Suthers, "Tilmore," Petersfield, Hants.
5TI J. Bonnett, 159a, Turner's Hill, Cheshunt, Herts.
5TL E. D'Eresby Moss, 4, St. George's Terrace, Regent's Park, N.W.
5TQ H. Rayner, 32, Grange Road, Cleckheaton, Yorks.
5TR Ashton J. Cooper, 8, Cowley Road, Ilford, Essex.
5TS W. Dean, "Bankleigh," Ramsgreave, Nr. Blackburn.
5TV Lieut. W. H. Lloyd, 27, Copthall Gardens, Twickenham.
5TW Capt. R. Stanton Baugh, "Longfield," Wake Green Road, Moseley, Birmingham.
5TX Capt. R. Stanton Baugh, "Longfield," Wake Green Road, Moseley, Birmingham.
5UA A. Barber, 15, Harrington Terrace, Ledget Green, Bradford.
5UC J. Gardener, Lewis Road, Sutton, Surrey.
5UM H. Alchin, 78, Chester Road, Forest Gate, E.7.
5UQ T. C. Lloyd Edwards, Trevor Hall, Ruabon, N. Wales.
5US J. Croysdale, 5, Elm Grove, Burley-in-Wharfedale, Leeds.
5UV L. A. Jeffreys, 90, Harringay Road, Green Lanes, N.15.
5UY D. B. Fry, "The Laurels," Mayfield, Sussex.
5VD F. J. Wakefield, 31, Station Road, Church End, Finchley, N.13.
5VK Bernard Caldwell, Caverswall, Lower Walton, Nr. Warrington.
5VP G. F. Kitchen, 10, Beech Road, Epsom, Surrey.
5VT G. C. Webb, 10, Osborne Road, Stroud Green, N.4.
5VU S. W. Butters, 51, Clarendon Road, W. Croydon, Surrey.
5VX J. H. Ives, 49, Acme Road, Watford, Herts.
5WA The British Broadcasting Co., Cardiff.
5WF Dallas G. Bower, Van Buren, Upper Richmond, Putney, S.W.15.
5WM J. B. Renshaw, "Wireless House," Old Chapel Street, Blackburn.
5WR C. E. Morriss, "Southernbay," Heron Hill, Belvedere, Kent.
5WU R. B. Cross, 9, Ormsby Avenue, Gorton Mount Estate, Gorton, Manchester.

5WZ E. Wyndham Hettich, 1, King Street, Jersey.
5XR F. A. Tuck, 87, Mayo Road, N.W.10.
5XS F. B. Thomas, 7, Mornington Villas, Wanstead, E.11.
5XT P. B. Thompson, Ichose Side Place, Enfield Town, Middlesex.
5XU Thos. N. Lord, 6, Trafalgar Terrace, West Park Street, Dewsbury.
5XY J. C. Harrison, 10, Lake Road, Fairhaven, Lytham, Lancs.
5YM Captain E. H. Robinson, Langmead, Pirbright, Surrey.
5ZH T. Allison, The Cromwell Engineering Co., 127, Fulham Road, S.W.
5ZO W. F. Mills, 11, Stoney Hey Road, New Brighton, Cheshire.
5ZR F. H. Austin, 52, Church Street, St. Peters, Broadstairs.
5ZY L. Headlan, Stakesby Road, Whitby, Yorks.
6AA Durham and Northumberland Collieries Fire and Rescue Brigade, The Rescue Station, 854, Scotswood Road, Newcastle-on-Tyne. (Frederick P. Mills).
6AB Durham and Northumberland Collieries Fire and Rescue Brigade, The Rescue Station, 854, Scotswood Road, Newcastle-on-Tyne. (Frederick P. Mills).
6AF Robert H. Rice, 7c, Seaside, Eastbourne.
6AJ G. Ensoll, 25, Victoria Road, Dukinfield, Cheshire.
6AL James Parker Morter, 49, Westow Hill, Upper Norwood, S.E.
6AO A. Ruddlesden, 24, Wakefield Road, Dewsbury.
6AW E. J. Jarvis, Naseby Cottage, High Road, Waltham Cross.
6BC W. Douglas Clague, White House, High Heworth, Gateshead.
6BQ J. L. Cannon, 14, Woodcroft Avenue, Broomhill, Glasgow, W.
6BR G. H. Ramsden, "Overdale," Ilkley, Yorks.
6BW John C. Mason, 8, Westmoreland Road, New Brighton, Cheshire.
6CF Wm. C. Lingard, Bridgeholme Green, Chapel-en-le-Frith, Derbyshire.
6CG A. W. Eagle, 42, Park Lane, Tottenham, N.17.
6CI C. E. Tilley, 10, Guthlaxton Street, Highfields, Leicester.
6CW David Burne-Jones, "Gwalier," Rustic Avenue, Streatham, S.W.16.
6DJ A. C. Copsey, 27, Sutherland Road, Tottenham, N.17.
6DU E. J. Newton, 1, Jerningham Road, New Cross, S.E.14.
6DZ Captain L. A. K. Halcomb, "South Dene," 106, Mill-houses Lane, Sheffield.
6FQ A. B. Richardson, 9, Quarry Road, Hastings.
6FV W. H. Taylor, 37, Bridge Street, Warrington.
6GC H. H. Burbury, Crigglestone, Nr. Wakefield, Yorks.
6GM E. A. Wilson, "Roxburgh," 42, Heber Road, Cricklewood, N.W.2.
6GO L. A. Sayce, 5, Toward Terrace, Sunderland.
6GW P. Brian, 79, Lakey Lane, Hall Green, Birmingham.
6GZ R. E. Neale, Farnborough Road, Farnborough, Hants.
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6HF Yorkshire.
6HK J. W. F. Cardell, "Tretherras," Newquay, Cornwall.
6HR W. D. Keiller, 51, Highworth Road, New Southgate, London, N. 11.
6HS H. Saville, 1, Delamore Avenue, Stretford, Nr. Manchester.
6HV W. J. Butler, 15, Algernon Road, Edgbaston, Birmingham.
6HX C. H. Nokes, "Misidia," Ripley, Surrey.
6IC A. Jowett, 310, Hopwood Lane, West End, Halifax.
6ID F. Wheatley, Jnr., 24, Radnor Road, Handsworth, Birmingham.
6IG E. Brady, 6, Coltesgate Hill, Ripon, Yorks.
6IM Highgate.
6IX W. G. Fudger, "Brora," Priorswood Road, Nr. Godalming.
6JB Wimbledon Radio Society, Red Cross Hall, Church Road, Wimbledon, S.W.19
6JL — Edgeleigh, Warwick Avenue, Coventry.
6JS P. R. Solder, 76, Albert Road, Alexandra Park, N.W.22.
6JV Capt. H. J. B. Hampson, 477, Earlham Rise, Norwich.
6JX R. J. W. Lankester, "Wanderings Farm," Kingston Road, Kingston-on-Thames.
6KF Worcester Cadet Signal Co. (R. C. of S.), Junior Technical School, Sansome Walk, Worcester.
6LB L. J. Fuller, Glenburn, Seagry Road, Wanstead, Essex.
6LJ S. K. Lewer, London, N.W.6.
6LW R. C. Davies, "Sunnyside," 22, Graingers Lane, Cradley Heath, Stafford.
6MG B. W. D. Lacey, 33, Woodbridge Road, Moseley, Birmingham.
KCLX Professor Wilson, University of London, King's College, Strand, W.C.2.
BXH Capt. C. H. Bailey, "Gliffaes," Crickhowell, Abergavenny.
8AA A. Riss, 38 bis, Boulevard Sainte-Beuve, Boulogne-sur-Mer, Pas de Calais.
8AB Léon Deloy, 55, Boulevard Mont-Boron, à Nice, Alpes Maritimes, France.
8AC Achille Fabre, Rue du Roc, à Albi, Tarn, France.
8AD J. Roussel, 12, Rue Hoche, à Juvisy-sur-Orge, Seine-et-Oise.
8AE Dr. Pierre Corret, 97, Rue Royale, Versailles, Seine-et-Oise.
8AE La T.S.F. Moderne, 11, Avenue de Saxe, Paris.
8AF Radio Club de France, 95, Rue de Monceau, Paris.
8AG Colmant, 16, Avenue de Robinson, à Chatenay par Sceaux, Seine-et-Oise.
8AH Marcel Coze, 7, Rue Lalo, Paris, 16e.
8AN Charles Biemans, 167, Boulevard du Montparnasse, Paris, 6e.
8AO Lardry, Radio Club de l'Ouest, Boulevard Négrier, Le Mans, Sarthe.
8AP J. J. Peugot, Sous Roche, Par Audincourt, Doubs, France.
8AQ Sassi, Arpajon, Seine-et-Oise.
8AR Le Saulnier, Boisguillaume par Rouen, Seine Inférieure.
8AS Paul Coisy, 76 bis, Avenue du Chemin de Fer, Rueil, Seine-et-Oise.
8AU Barrelier, Le Mans, Sarthe.
8AV Yvan Voos, (Radio Club de Reims), 20, Rue Worle, Reims.
8AY G. Thuillier, 11, Rue d'Ornan, à Alger, France.
8AZ M. Borne, Place du Val, à Vanves, Seine.
8BB J. Laborie, 3, Rue du Midi à Neuilly, Seine, Paris.
8BC N. Druelle, 6, Rue des Domeliers, à Compiegne, Oise, France. (President de Radio Association Comp.).
8BF Pierre Louis, 8, Rue de la Mouillère, Orleans, France.
8BD Dubois, 211, Boulevard Saint Germain, Paris, France.
8BG Nuisement-sur-Coole, Marne, France.
8BK André Voisembert, 27, Rue Jean Binet, à Colombes, Seine.
8BM R. Dupont, à La Briquette, près Valenciennes, Nord.
8BN Berché, Villa Marie Thérèse, Avenue des Coteaux, à Garches. (Seine-et-Oise.)
8BQ Félix Gavaudan, 22, Boulevard de la République, Marseille.
8BS Pierre Delaunay, 1, Rue d'Astorg, Paris.
8BT Rédier, 9, Rue du Cherche-Midi, Paris.
8BV G. Perroux, 96, Boulevard du Montparnasse, Paris.
8BY Seksik, 47, Rue Reinard, Marseille.
8CB Dussagey, 29, Place du Marché, St. Honoré, à Paris.
8CC Henri Suquet, 18, Avenue Kléber, à Paris.

Holders of Transmitting Licences are requested to keep the Editor advised of any changes in the above particulars that may be necessary, in order that corrections can appear in subsequent lists of additions and amendments.

Operators of Receiving Stations can materially help holders of Experimental Transmitting Licences who carry out tests from time to time, by forwarding to the addresses given above, reports concerning transmissions heard.

HIGH-SPEED TRANSMISSION

MEMBERS OF PARLIAMENT VISIT ONGAR AND BRENTFORD.

OCCUPYING twenty-five Daimler cars, a hundred members of the Industrial Group of the House of Commons left Palace Yard, Westminster, on the morning of Wednesday, June 27th. The object of the expedition, organised by Marconi's Wireless Telegraph Company, Limited, was to enable the members to see the latest commercial wireless practice in actual operation.

The party first visited Radio House, the Company's London control office for the whole system of communications at the English end. The elaborate and efficient system of dealing with the large volume of traffic was here inspected, and the visitors took advantage of the facilities offered by sending a souvenir marconigram to the Ministers of Commerce of each of the countries served, viz., United States, Canada, France, Switzerland and Spain. In every case an appreciative reply was received in a very short time.

On leaving Radio House, the party proceeded to the Company's transmitting system at Ongar. Actually there are three separate transmitting stations, one for communication with France, another with Spain and Switzerland, and a third with Canada. The members were particularly impressed by the simplicity of operation, each transmitting plant being under the control of one man only. The transmitting plant is actuated by high speed signalling keys, which are controlled direct from London. The receiving station at Brentford was finally visited. Before returning to the House, the members lunched at Brentford, and in response to a toast to his health, Senatore Marconi prophesied great improvements in long-distance radio communication.

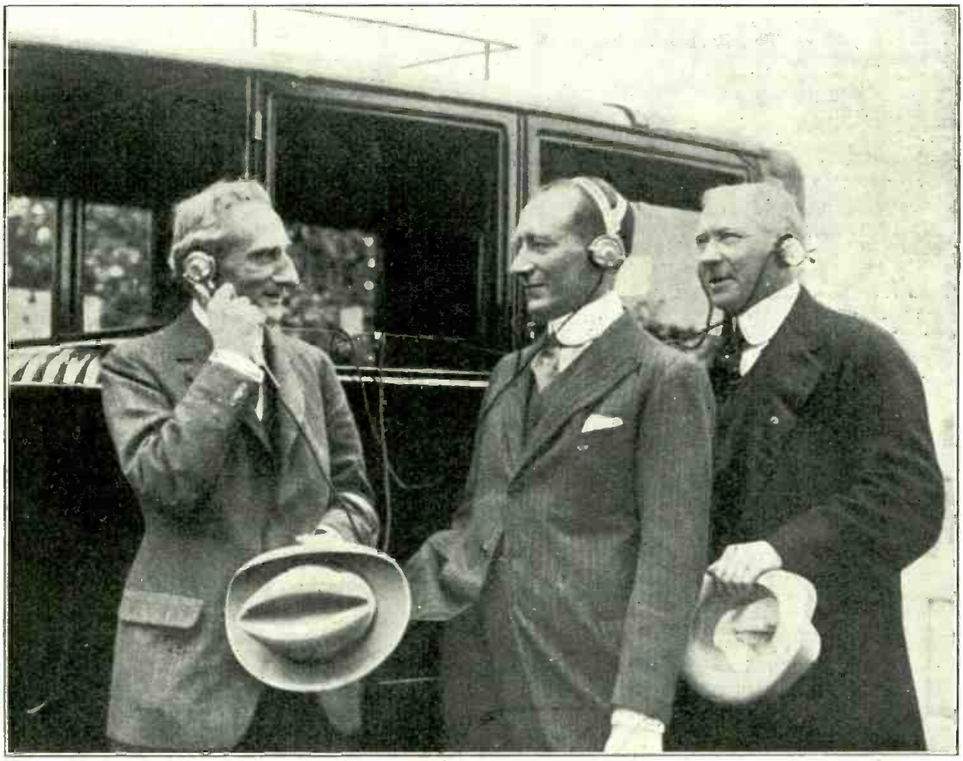
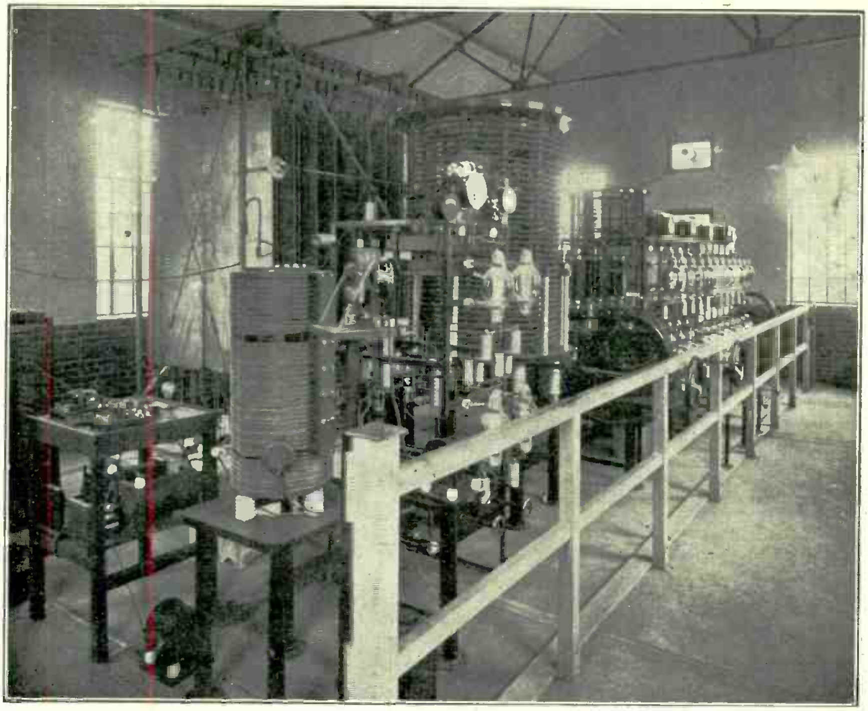
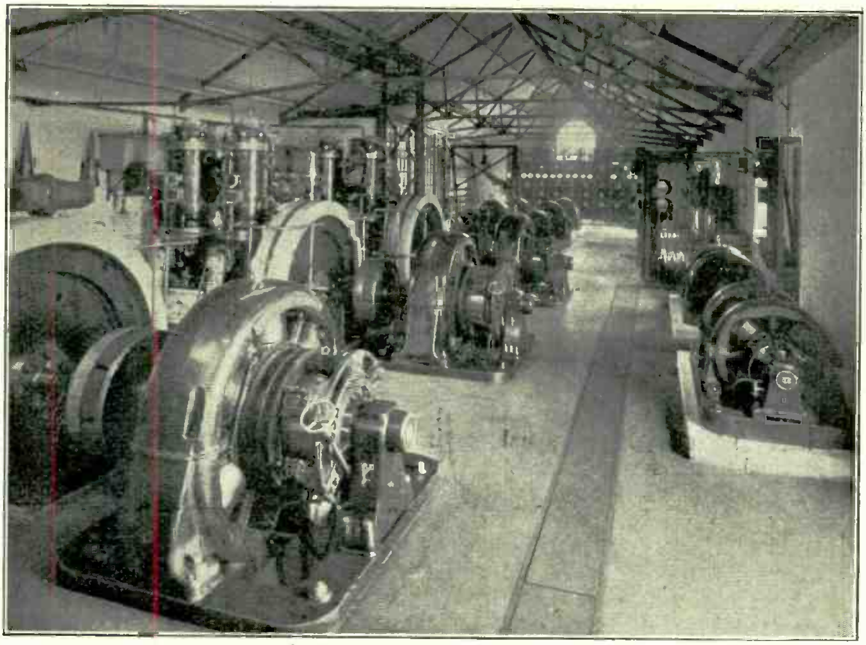


Photo : Barratts.

One hundred members of the Industrial group of the House of Commons last week visited the Marconi high-speed stations at Ongar and Brentford. Our photo shows Senatore Marconi with Mr. Godfrey C. Isaacs and Mr. Grattan Doyle, M.P. (on right), listening-in at Brentford.



The valve transmitter at the Ongar Station. It is interesting to note the handles for remote control and the compact layout of the apparatus.



The central power house at Ongar station showing the generators.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XIV.

The series has been specially arranged so that the reader who follows each section as it appears will have obtained a complete wireless education with a minimum of time and trouble, and he will be in a position to successfully design his own wireless equipment.

The last sections deal with series and parallel resonance, the study of which is so important to those who desire a clear understanding of wireless.

By W. James.

32.—Oscillatory Circuits.

Having now dealt with the properties of series and parallel circuits (to which we shall return later in connection with radio circuits), it will be interesting to look into the action of oscillatory and coupled circuits.

Suppose we have capacity, inductance and resistance connected as in Fig. 68 with switch S and battery H.T. When switch S makes contact at A, the condenser is charged up. The charging current which flows into the condenser passes through R, and energy is wasted in heat. The loss is equal to I^2R watts where I is the current. When, however, the condenser is fully charged, its back pressure is equal to that of the battery, *i.e.*, there is now no charging current. While the current is flowing, a magnetic field is generated around the wires and the coil L. The field falls to zero with the charging current. It will be noticed the potential of the battery E is equal to the sum of the potentials across C, L and R at all instants during charging.

When the condenser is fully charged we have Q, the charge in coulombs is equal to $E \times C$, — the pressure times the capacity, and the energy stored in the condenser is $\frac{1}{2}CE^2$ joules. Now if the switch is moved to B the condenser will discharge, and in so doing a magnetic field is set up in the circuit, principally around L. Remembering that the current flow from a condenser is greatest when the pressure is smallest, it will be realised that when the potential difference across the condenser has fallen to zero the current at that instant is a maximum; therefore the intensity of the magnetic field is a maximum. With *no resistance, and no losses* due to energy leaving the circuit through radiation, the energy stored in the circuit in the form of magnetic energy is equal to $\frac{1}{2}LI^2$ joules. Obviously $\frac{1}{2}LI^2 = \frac{1}{2}CE^2$ since we have assumed no losses. But now the pressure across the condenser has reached zero; therefore the magnetic field is collapsing, and, cutting the turns of coil L, is producing a voltage and returning energy to the circuit, which is charging up the condenser in an opposite direction. That is, the plates which were originally negative are now receiving a positive charge. When the whole of the energy associated with the inductance is stored as electrostatic energy in the condenser once more, the current has fallen to zero, the pressure across the coil is zero, and the condenser commences to discharge. The whole cycle, charging and discharging of the condenser,

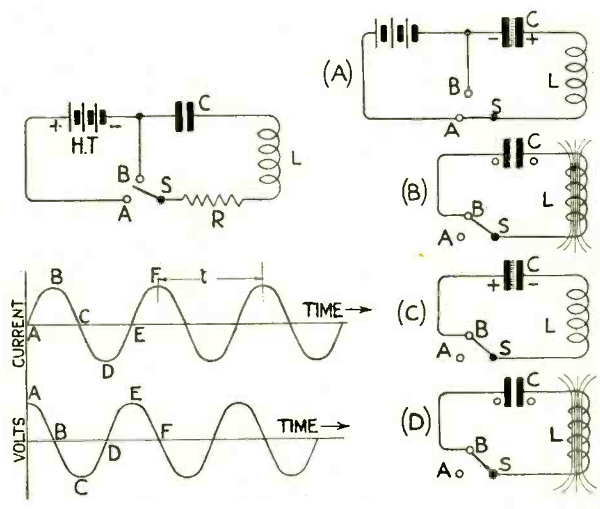


Fig. 68. Showing the various conditions in an oscillatory circuit during the generation of oscillations.

is repeated, and we have an oscillatory current in the circuit, the *frequency* of the currents being equal to $\frac{1}{2\pi\sqrt{L \times C}}$ where L is the inductance in henries and C the capacity in farads. To fix the idea of an oscillating current the operation is as follows :—

(A) Condenser charged and switch S moved to contact B. Considering the curves of Fig. 68, the pressure across the condenser is at this instant a maximum, and the current flowing is zero, as shown at point A. The condenser commences discharging and the current increases until at point B the voltage across the condenser is zero and the current is a maximum (B). The energy is now stored in the magnetic field. At point C the condenser voltage is at maximum once more, but in an opposite direction, and the current is zero (C). The condenser discharges, and at point D the pressure across the condenser is zero again, and the current is a maximum (D).

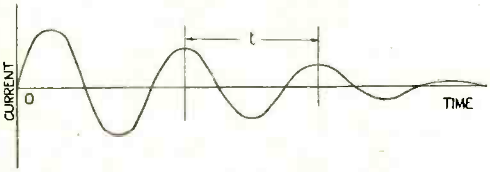


Fig. 69. The curve represents the current flow in an oscillatory circuit possessing resistance. The greater the resistance the quicker will oscillations cease. The time between any two successive crests or troughs, as at t, is called the periodic time.

In actual circuits, of course, resistance is present, and energy is lost, so that the amplitude of the current decreases gradually to zero (see Fig. 69). In the former case we have a continuous wave, in the latter a damped wave. If the circuit is connected to a source of pressure, such as a high frequency alternator or a valve oscillator, the oscillations will still be continuous, the losses being made good from the source of energy.

The presence of resistance affects the natural frequency of the circuit. Thus

$$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

If the quantity $\frac{R^2}{4L^2}$ is equal to or greater than the quantity $\frac{1}{LC}$, the circuit will not generate free oscillations. In the case of Fig. 68, the initial condenser discharge would be in one direction only. That is, the whole of the energy stored in the condenser is dissipated through the resistance of the circuit. The circuit is said to be *aperiodic*. Sometimes a portion of a wireless circuit is made aperiodic or "semi-aperiodic," as in the case of high-frequency transformers used to couple valves, which are wound with resistance wire. Generally, however, the resistance is negligible, and the frequency of the circuit is sensibly equal to $\frac{1}{2\pi}\sqrt{\frac{1}{LC}}$. The quantity *LC is called the oscillation constant.*

Writing this in another way $2\pi f = \frac{1}{\sqrt{LC}}$

$$\text{or } \omega = \frac{1}{\sqrt{LC}}$$

which is the same equation as that for the resonant frequency of a circuit dealt with earlier. In connection with Figs. 68 and 69, it will be observed that the periodic time in seconds, t, is the same irrespective of the amplitude of the current.

Example.—

Suppose $C = 0{\cdot}001\ \mu F$ and $L = 200\ \mu H$, and resistance is negligible. What is the natural frequency of the circuit.

$$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$$

$\pi = 3{\cdot}14 \quad \therefore 2\pi = 6{\cdot}28$. And $\frac{1}{2\pi} = 0{\cdot}16$.

$$L = 200\ \mu H = 0{\cdot}0002 \text{ henry.}$$

$$C = 0{\cdot}001\ \mu F = 1 \times 10^{-9} \text{ farad.}$$

$$LC = 2 \times 10^{-13}.$$

$$\frac{1}{LC} = 5 \times 10^{12}.$$

$$\sqrt{\frac{1}{LC}} = 2{\cdot}24 \times 10^6$$

$$f = 0{\cdot}16 \times 2{\cdot}24 \times 10^6$$

$$= 358{,}400 \text{ cycles per second,}$$

corresponding to a wavelength of about 845 metres.

If now the losses in the circuit are equivalent to a resistance of 1,000 ohms will the circuit oscillate ?

If the circuit will oscillate the quantity $\frac{R^2}{4L^2}$ must be less than $\frac{1}{LC}$. The circuit will just *not* oscillate when $\frac{R^2}{4L^2} = \frac{1}{LC}$ or when

$$R = 2\sqrt{\frac{L}{C}}$$

In the above case $R = 1{,}000$

$L = 0{\cdot}0002$ henry and

$C = 1 \times 10^{-9}$ farad.

$$\therefore 2\sqrt{\frac{L}{C}} = 2\sqrt{2 \times 10^5}$$

or 894

Thus R is larger than $2\sqrt{\frac{L}{C}}$ and the circuit will not oscillate. If R is 500 ohms the circuit will oscillate, and the natural frequency will be

$$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$ which works out at 297,000 cycles, or a wavelength of nearly 1,010 metres.

If the losses are equivalent to a resistance of 10 ohms, the effect upon the frequency is negligible. However, the resistance in radio circuits is often 20 or 30 ohms.

It is well-known that the velocity of an electromagnetic wave is 300 million metres, or roughly 186,000 miles per second. Therefore the frequency of oscillation being known, we may easily find the *wavelength* or distance between the crests of an electromagnetic wave.

We may write

velocity = frequency × wavelength,

and wavelength $(\lambda) = \frac{\text{velocity}}{\text{frequency}}$.

When R is negligible

$\lambda = 3 \times 10^8 \times 2\pi\sqrt{LC}$ metres

$= 1{,}884\sqrt{LC}$ metres where

L = inductance in μH

C = capacity in μF.

Thus if $L = 200\mu H$. $C = 0{\cdot}001\ \mu F$.

$\lambda = 1{,}884\sqrt{200 \times 0{\cdot}001}$

$= 1{,}884\sqrt{0{\cdot}2}$

$= 842$ metres.

It will be noticed that the wavelength remains constant for any values of L or C provided their product remains constant. Tables may therefore be worked out showing the wavelength and frequency corresponding with given values of LC. When either L or C is known, or settled upon for use in a circuit, the remaining quantity may be easily and quickly found. Such a table with examples was given on pages 350 and 351, June 16th issue.

The reader will realise the number of oscillations produced through charging the condenser and allowing it to discharge through the resistance, and inductance is determined by the value of the resistance. The larger the condenser the greater the amplitude of the oscillatory current. The smaller the inductance the quicker will oscillations cease, and in this respect inductance and resistance together decide the number of oscillations.

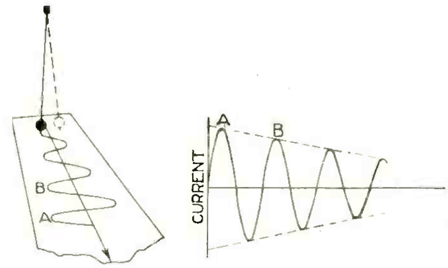


Fig. 70. Here we have a portion of a slightly damped wave such as would be produced in an oscillatory circuit with a little resistance. To the left is represented a pendulum which may swing so that as the paper moves at a uniform speed in the direction of the arrow a curve is traced. If the pendulum is moved to one side (charged as it were) and is then released, it will swing to and fro with decreasing amplitude according to the resistance which hinders its motion. The movement is damped, and a damped wave is traced out.

It may be shown that the amplitude of successive crests decreases uniformly according to a ratio. Thus if the amplitude of the second crest, Fig. 70, is 0·8 that of the first, the amplitude of the fourth will be 0·8 that of the third, and so on.

We may write

$$\frac{A}{B} = \epsilon^{\delta}$$

where A = the amplitude of one crest

B = the amplitude of the next crest

ϵ = the base of the Naperian system of logarithms

δ = a constant called the logarithmic decrement.

Then $\delta = \log_\epsilon \frac{A}{B}$

or $\delta = 2{\cdot}303 \log \frac{A}{B}$, since the Naperian logarithm of a number is 2·303 times the common logarithm. The above equations mean, the decrement (short for logarithmic decrement) is equal to the 2·303 the common log of the ratio of the amplitude of one crest to the next. If the decrement is 0·2, the ratio of $\frac{A}{B}$ is about 1.2 (*i.e.*, $2{\cdot}303 \log 1{\cdot}2 = 0{\cdot}2$).

When the resistance of the circuit is not large, the decrement $\delta = \pi\left(\frac{R}{\omega L}\right)$ which may be rewritten $\delta = \pi\omega CR$ since $\omega L = \frac{1}{\omega C}$ (or $\delta = \frac{R}{2fL} = 2fCR$, since $\omega = 2\pi f$).

It will be noticed the decrement increases with the resistance and inversely as the inductance.

The number of oscillations per discharge may now be readily found. It is generally assumed the oscillations cease when the amplitude of the last oscillation is 0·01 of the first oscillation. The natural logarithm of 100 is 4·606 or say 4·6

Then the natural number of oscillations is equal to $\frac{4 \cdot 6 + \delta}{\delta}$

Thus if $\delta = 0 \cdot 2$

$$N = \frac{4 \cdot 6 + 0 \cdot 2}{0 \cdot 2} = 24.$$

In the case of a spark transmitter, such as represented in Fig. 71, if the decrement of the oscillatory circuit LCG is 0·2, there will be 24 complete oscillations for every spark discharge at the gap. The number of spark

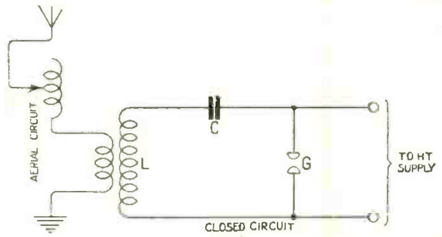
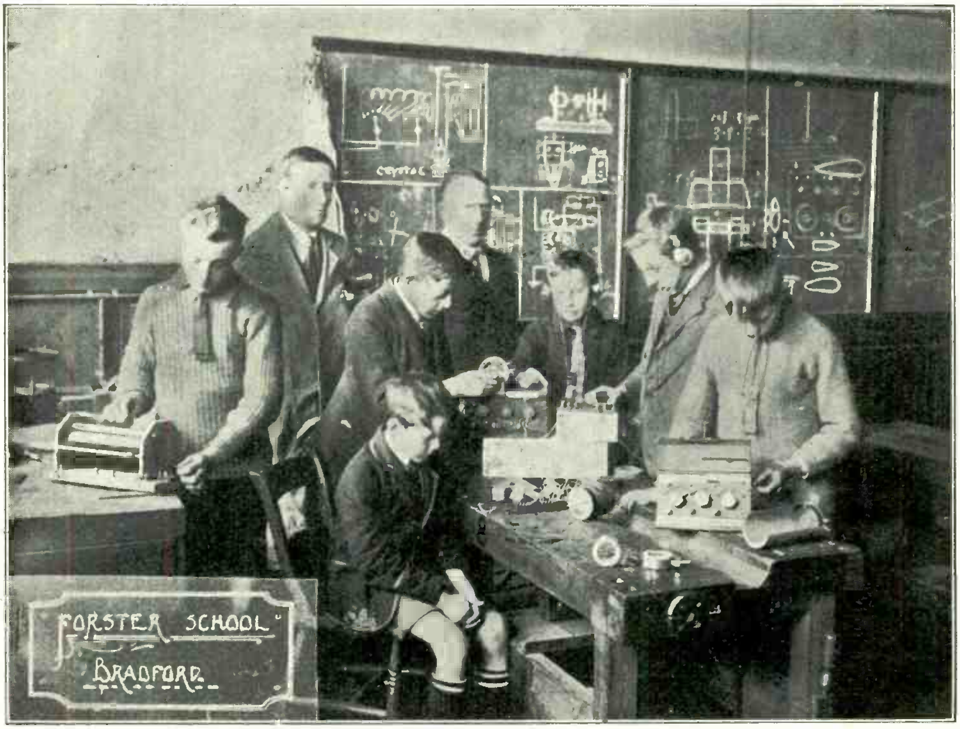


Fig. 71. Portion of a spark transmitter. The closed oscillatory circuit consists of L, C and G.

discharges per second will depend upon the frequency of the alternator, or the rate of vibration of the armature of the induction coil which is used to supply the power for sending. The only portion of the transmitter which concerns us here is the closed circuit *i.e.*, LCG. The remainder will be briefly referred to later.



The Forster School at Bradford possesses a five-valve receiver constructed by the boys. Our illustration shows a corner of the workroom with some of the boys constructing further sets.

Notes and News

A Wireless Club has been started at Watford Grammar School.

* * * *

Several pleasure steamers on the Clyde are now fitted with broadcast receivers.

* * * *

The desirability of equipping Darlington fire engines with wireless sets is being considered by the County Council. It is urged that such a step would effect a great saving over the ordinary fire alarm system.

* * * *

A recommendation has been forwarded to the French Government from Algiers advertising the establishment of a radio system in that country to supplement the cables to France.

* * * *

2 ZY to Move.

The Manchester Broadcasting Station, it is announced, will be removed, during the first week in August, from Trafford Park to Dickinson Street. The change has been desired for some considerable time, and the removal to the new site, in the centre of the city, will be much appreciated by artistes.

Amateur Wireless Between Australia and New Zealand.

Reports have been received from an experimental wireless station in Waihemo, Otago, New Zealand, that messages from experimental transmitting stations in Melbourne, Australia, have been received without a break, except when strong local nterference affected the signals. The distance is approximately 1,500 miles, and the power used by the Melbourne stations was in each case less than 10 watts input. Transmissions from the New Zealand station and another amateur station have been received in Melbourne.

Photo: "Photopress."

Senatore Marconi (on right) with Members of Parliament at Radio House, where the party inspected the operation of high-speed wireless on June 27th.

The motor cruiser "Ness," owned by Mr. Almand Halzy, on the Norfolk Broads. Useful experiments have been carried out on board with a Burndept Ethophone V.

Retirement of Prof. Magnus Maclean.

The announcement is made of the retirement of Prof. Magnus Maclean, M.A., D.Sc., from the Chair of Electrical Engineering at Glasgow University.

Prof. Maclean has had a distinguished career in the sphere of electrical science, and has produced a number of standard works on the subject. In addition, he has contributed many papers on physics and electrical engineering to the Royal Institutions of London and Edinburgh, and to the Institution of Electrical Engineers. It is interesting to note that he was chief official assistant to Lord Kelvin for 15 years.

Unknown Call Signs.

Reception of the following stations is reported from Ponders End, Middlesex :—
5 CY, 5 IW, or **5 OW, 5 NX, 5 IP, 6 AK.**

We should be interested to know the location of these stations.

A Belfast Radio Exhibition.

It may not be generally known in Great Britain that wireless now has a considerable following of amateurs in northern Ireland. Proof of this was demonstrated in Belfast on Wednesday, June 20th, when a highly successful wireless exhibition, organised by the Northern Radio Association (Ireland), was held at Ye Olde Castle Restaurant in that city.

The proceedings were opened by the Lord Mayor of Belfast, who remarked on the pleasure it gave him to open the exhibition—the first of its kind in Ulster. A photograph of the Lord Mayor and company appears on page 467. The exhibition had two objects, firstly, to guide members in the choice of apparatus, and second, to stimulate interest in the new science. A comprehensive range of crystal and valve sets was on view, and a feature of the exhibition was the absence of trade propaganda, rendering it possible for visitors to inspect the apparatus without being solicited to buy.

The entire arrangements were in the hands of an organising committee, under the direction of Captain J. Norman Inglis, President of the Association.

The Northern Radio Association (Ireland) is a comparatively young body, having been founded in October of last year, and already the membership amounts to 200. The amateurs of Great Britain will watch with interest the activities of their brethren in the Emerald Isle.

The Hon. Secretary of the Association is Mr. W. R. Hallanby, Inverary Drive, Sydenham, Belfast.

Telephony from Denmark ?

The regular transmission of speech and music from Lingby, near Copenhagen, referred to in our issue of June 16th, has apparently been received by a northern experimenter, Mr. R. Dundas Duncan, B.Sc., of Edinburgh, while searching recently for FL. He states that he heard speech on a slightly higher wavelength, about 2,700 metres. At first Mr. Dundas supposed it to be of German origin, but the occurrence of the word "Copenhagen," and the realisation that the words were obviously not German, led him to suppose that he was listening to Danish telephony. The speech was quite clear when using a detector and L.F. valve. Have any other experimenters heard this transmission ?

FORTHCOMING EVENTS.

THURSDAY, JULY 5th.

Dewsbury and District Wireless Society. General Meeting.

Wimbledon Radio Society. At 8 p.m. At Red Cross Hall, 59, Church Road. General Meeting.

Thornton Heath Radio Society. At 8 p.m. At the Polytechnic, High Street. General Meeting with Lecture.

St. Pancras Radio Society. At 8.30 p.m. At the Working Men's College, Crowndale Road, N.W. Inaugural Meeting.

FRIDAY, JULY 6th.

Leeds and District Wireless Society. Lecture by Mr. H. F. Yardley, M.I.R.E.

Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove. Lecture by Mr. J. Steell.

SATURDAY, JULY 7th.

Ipswich and District Radio Society. Field Day at Hadleigh. Conducted by Mr. Barnard Smith.

MONDAY, JULY 9th.

The North London Wireless Association. At 8.30 p.m. Lecture: "Radio Metal Craft," by Mr. W. L. Johnson.

The Hornsey and District Wireless Society. Lecture: "Faults in Valve Circuits," by Mr. J. R. Hunting.

TUESDAY, JULY 10th.

Battersea and District Radio Society. At 8 p.m. At the Latchmere Road Baths. Lecture: "Fundamentals of Radio Work," by Mr. H. Bevan Swift, A.M.I.E.E.

WEDNESDAY, JULY 11th.

Portsmouth and District Wireless Association. Lecture: "Generators," by Mr. C. H. Warren, M.M.

THURSDAY, JULY 12th.

Liverpool Wireless Society. At 7.30 p.m. At the Liverpool Royal Institution, Colquitt Street. Lecture: "Control of Intrinsic Reaction," by Dr. Richardson, A.R.C.Sc.

Winchester Wireless Society. Demonstration at Boy Scouts' Rally.

Ilford and District Radio Society. Visit to Ilford Power Station.

Stoke-on-Trent Wireless and Experimental Society. Lecture: "The Measurement of Electrical Quantities," by Mr. R. W. Steel (Asst. Hon. Secretary).

The S.O.S. Call.

A highly important circular touching the transmission of the distress call (S.O.S.) has been issued by the Mercantile Marine Department of the Board of Trade.

Experience has shown that the signal, if sent at the ordinary speed, may fail to arrest the attention of watchers (1) in congested areas, (2) at very long ranges on the high seas, and (3) when atmospherics are causing interference.

It has been found, however, that the signal is distinctive under these circumstances if special stress is given to the three long dashes, and the call is sent slowly, at the rate of eight repetitions a minute. The circular emphasises on operators the importance of using the utmost discretion and brevity when replying to distress calls.

A Home-Made A.C. Rectifier.

In view of the special interest now being shown in alternating current rectifiers, readers of *The Wireless World and Radio Review* may be glad to learn that an article dealing with an efficient model rectifier appeared in the issue of our contemporary, *The Model Engineer*, for November 29th, 1917. The construction of the instrument, which is of the rotary type, is fully described by Mr. E. Fowler Clark, and the article is illustrated with photographs and diagrams. We understand that a limited number of copies of the issue referred to can still be obtained from the publishers, Messrs. Percival Marshall & Co., 66, Farringdon Street, London, E.C.4, price 5d. post free.

Wireless on Trains.

The Paris-Bordeaux express is now fitted with wireless, and passengers, peacefully reclining in the smoking saloon, are able to hear the dulcet tones of Eiffel Tower and Radiola while *en route*. Four loud speakers, two at each end, are installed in the coach.

Many experiments had first to be made to overcome the numerous difficulties encountered, but the apparatus will now successfully withstand the severest tests, reception being unmarred by tunnels and bridges. The aerials consist of a series of wires running parallel along the whole length of the car.

Lectures by Dr. G. W. O. Howe.

The governors of the Technical College, Glasgow, have invited Professor G. W. O. Howe, D.Sc., to give a course of ten evening lectures at the college on Wireless Telegraphy and Telephony. The lectures will be given weekly from September to December next, the proposed fee to students being ten shillings.

MAKING A TWO-VALVE RECEIVER

SIMPLE DESIGN OF HIGH FREQUENCY AND DETECTOR VALVE SET.

IF long range is aimed at, such as reception from all the British Broadcasting Stations, high frequency amplification is essential. An instrument consisting of a high frequency amplifier and valve detector is usually regarded as the most useful arrangement for providing selective and efficient reception, and permitting of the employment of a circuit arrangement approved by the Post Office for use on broadcasting wavelengths.

Two valve holders with two 4BA screws for holding down.

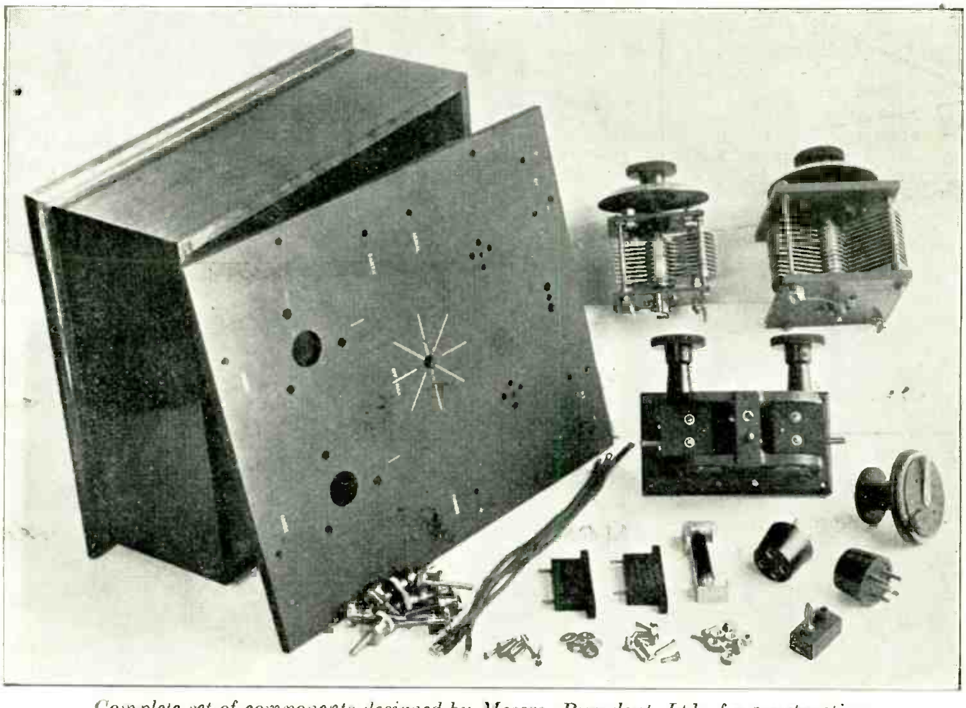
Filament resistance (3 ohms) complete with fixing screws.

Two variable condensers, 0·00075 mfds. and 0·00025 mfds., with dials and fixing screws.

Single coil holder plug.

Two fixed condensers, 0·00025 mfds. and 0·003 mfds.

Grid leak, 2 megohms, with clips and screws.



Complete set of components designed by Messrs. Burndept, Ltd., for constructing the reacting H.F. and detector valve receiver.

The design given is drawn up in order that the experimenter may build an instrument from standard component parts, which are :—

Ebonite panel, 10 ins. by 12 ins. by 5/16 in.

Polished box, $9\frac{1}{2}$ ins. by $11\frac{1}{2}$ ins. by 4 ins. deep inside.

Three-coil coil holder.

Eight substantial lacquered terminals with back nuts and washers.

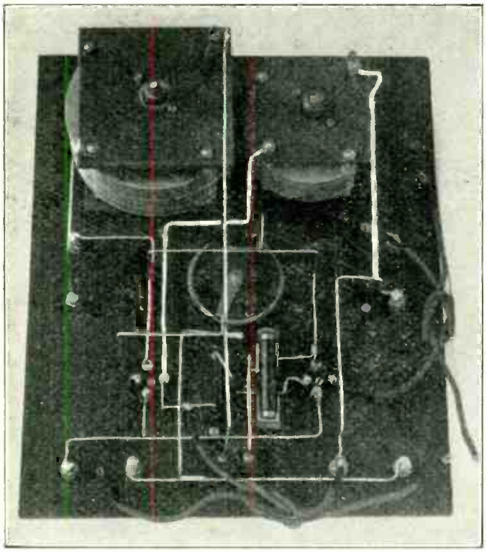
Screws, four No. 4 by $\frac{1}{2}$ in. wood, for securing coil holder to box, eight No. 4 by $\frac{3}{4}$ in. wood, for holding down panel with raised or counter-sunk heads, four 5 BA by $\frac{1}{4}$ in. cheesehead for attaching fixed condensers to panel.

3 ounces, or 12 ft. of No. 16 S.W.G. tinned copper wire.

"Fluxite" and solder, or resin-cored solder.

Two yards of single flex.

The assembling of the components on the panel only requires ability in the use of the screwdriver and little explanation is needed. Mention might be made, however, of the necessity to exercise care in driving screws home into blind holes in the under side of the panel, for should these holes not be sufficiently deep there is a danger of producing small bumps on the face of the panel, or even of breaking a portion of the surface away. Terminal nuts must be run down tightly so that there is not the slightest chance of them revolving.

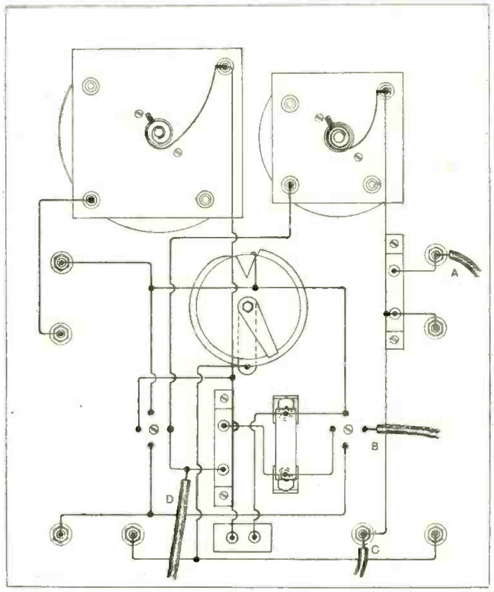


Underside of panel showing method of wiring.

The No. 16 wire will be found stiff to work, and every piece must be carefully bent, cut to size, and fitted before it is soldered into position. Where connections are made to terminals the wires should be bent round the stems so that they remain in position prior to soldering. If the loop of wire round the stem is made flush with the end of the thread, it is easy to make the solder run to produce a solid joint. This applies equally to the connections made to the valve holders. It is important for the soldering iron to be really hot, not red hot, of course, when soldering wires to small brass parts held in ebonite, and it is essential that the solder should run almost as soon as the iron is applied, or otherwise the whole of the metal will become heated, and the ebonite burnt. The necessity for using a clean, well-tinned iron cannot be over emphasised. Be careful, when soldering connections to the fixed condensers, not to over heat the tags. The ends of the flexible wires must be tinned before an attempt is made to attach them.

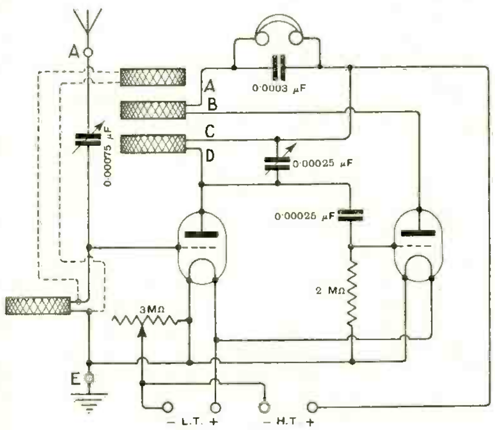
The circuit employed is a well-known one, and is arranged to produce maximum signal strength. Greater stability with regard to the tendency to self-oscillate may be obtained by connecting the aerial tuning condenser in parallel with the aerial inductance, with, perhaps, a slight loss in signal strength on the shorter wavelengths. To reduce still further the chances of energising the aerial circuit, the lead between filament and earth terminal may go to the positive instead of the negative side, as shown.

The reaction inductance, which is in the plate circuit of the second valve, should be the centre one in the coil holder, and on one side of it the tuned anode inductance and the connections to the holder on the other side may be paralleled across to the terminals of the holder arranged on the panel to take the aerial tuning inductance. This permits of reacting directly on to the aerial circuit, if so desired, when receiving on other than broadcasting wavelengths, it only being necessary to transfer the aerial inductance from the panel



Practical wiring diagram.

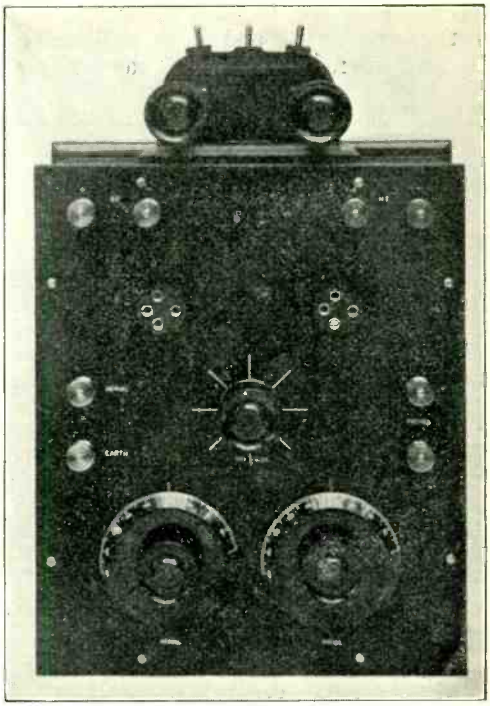
to the three-coil holder and swing the tuned anode inductance away to the position of



The principle of this circuit is the usual arrangement of reacting on to the tuned anode inductance.

partial or minimum coupling. Before finally making off the pairs of flexible lead connections on the coilholder, tests should be made to determine the arrangement which gives the best results.

In a receiver of this type, "R" valves of reliable make should be employed, as not only is this always essential for high frequency amplification, but also in order that both valves may operate uniformly with a common filament resistance and high tension battery.



The Completed Receiver.

EXPERIMENTAL STATIONS HEARD.

Denmark.

Mr. James Steffensen, of Ehlersvej, 8, Hellerup, near Copenhagen, whose report of reception of British and French amateurs appeared in our issue of May 19th, has forwarded a further list of stations since heard working.

These are as follows :—

Call Sign.	Date.	Wave-length.	Strength.
2 KF	May 16th	210	R 5
	June 3rd		
2 GG	May 27th	145	R 2
8 BM	May 27th	215	R 6
	June 3rd		
5 KO	May 27th	195	R 4
	June 3rd		R 6
2 VT	May 27th	200	R 5
	June 3rd		R 6
2 CN (?)	May 27th		R 3
2 WF (?)	May 31st	200	R 3
2 WK (?)	May 31st	200	R 5
2 WJ	June 3rd	200	R 5
2 NM	June 3rd	200	R 5
2 DF	June 3rd		R 5

Our correspondent would be pleased to hear from any English experimenter who would care to arrange a transmission test on a Sunday evening.

In Essex.

We have received a comprehensive list of call signs of stations heard by Mr. J. Bevis **(5 GJ)**, of 4, Somerset Road, Linford Estate, Nr. Stanford-le-Hope, Essex. With the use of two or three valves, Mr. Bevis has heard the following :—

2 DF	2 MK	2 MF	5 WR	5 TR
2 XR	2 LZ	2 QN	5 CX	5 LP
2 TV	2 ON	2 CO	5 BW	5 MX
2 JZ	2 OM	2 XB	5 TR	5 NN
2 NM	2 KT	2 RB	5 QV	5 IS
2 KF	2 FG	2 XS	5 DT	5 DP
2 OD	2 FQ	2 VJ	5 JT	5 LZ
0 GS	0 MX	0 XL	0 SA	5 MF
8 BC	8 BM	8 AQ	5 QJ	5 HY
5 MS				

Standard circuits were used for reception and the aerial was a five-wire cage, 30 ft. long and 30 ft. high.

Methods of Reducing Interference in Wireless Receiving Sets.

By Prof. E. W. MARCHANT.

(*Continued from page* 431 *of previous issue.*)

DISCUSSION.

Mr. Philip R. Coursey.

There are one or two points which were raised by Professor Marchant which might, perhaps, be referred to with advantage. Apart altogether from the illustrations he has given us of the different methods which have been proposed for eliminating atmospheric and other troubles, one point seems to me to be that, in some cases of interference, particularly interference arising from a powerful station emitting modulated continuous waves, receiving antennæ near to that station may have set up in them forced oscillations which will not necessarily be entirely confined to the wavelength of the interfering station. If the antenna be not tuned to the interfering signal, there is still in it, when near to the interfering station, a very considerable E.M.F., which it is very difficult to get rid of, and it seems that the antenna may be forced to oscillate at whatever frequency it is tuned to (provided, of course, it is somewhere near the interfering frequency). Therefore, all methods depending on selectivity due to circuits which are slightly detuned from the interfering signal will not be entirely effective in getting rid of the trouble. The effect is one which probably most of us have experienced in trying to work anywhere near a powerful broadcasting station, and detuning of the receiving aerial, even with loose coupled circuits, does not altogether eliminate the interference that one experiences.

The extra selectivity that can be obtained by employing reaction, as mentioned by the lecturer, of course lessens the trouble to some extent, but I should like to ask Professor Marchant whether, in discussing that extra selectivity, if he has also taken into account the fact that the employment of reaction is, at the same time, making the detector more sensitive, and is making a better amplifier of it, and is, therefore, making it more sensitive to the interference, whilst at the same time making the circuits more selective. Professor Marchant mentioned that atmospherics are worse when the humidity is high, *i.e.*, in damp weather, and that with a high barometer and dry weather, atmospherics are less. It may, perhaps, be of interest to mention that similar effects have been repeatedly observed in long distance short wave reception, and in these cases it has been found over and over again, in this country at all events, that, when the weather is damp, short wave signals, on the average, are good over long distances, during the winter time, and that a dry, fine night is often accompanied by a very marked drop in the strength of such signals from long distances. These effects were shown very markedly in the tests conducted last December across the Atlantic, and it rather shows that, if the same phenomena always occur with atmospherics, it is due to a pronounced change in the transmission qualities of the atmosphere with meteorological conditions, and that, therefore, probably these atmospherics have their source at considerable distances—very considerable distances—from the receiving stations.

It also, perhaps, raises the point as to whether the same effects are also experienced under the same conditions in different localities on the earth's surface. One is rather led by reports to think that such is not always the case. In America, for instance, one has records of short wave communications which rather lead one to the conclusion that in winter time the best transmission takes place when the night is fine. It seems to me that by such tests some useful information might be gathered in finding out the sources of some of these atmospheric troubles.

Mr. Maurice Child.

Professor Marchant has interested me very much this evening in mentioning local disturbances due to machinery. I have been troubled for many many years in that same respect, and it might, perhaps, be of a little assistance if I just mention the particular conditions under which the signals at the college at which I am engaged are received. The building in which we actually do the reception is a small cabin about 30 or 40 feet away from the main building, in which latter are situated a very large number of telegraphic instruments. These telegraphic instruments are all shunted, and sparking is reduced to a minimum. The wireless cabin has a separate earth from that of the other apparatus, which is earthed in the main building. The resistance of the earth in the wireless cabin, we find, varies from about 10 ohms in wet weather to something like 20 or 25 ohms in dry weather, so that it is not altogether very satisfactory. At the same time it is the best that can be done with the particular material which the local authority put down when they set up the district in which we are obliged to live. What we find is this: when the earth resistance is very high we get a good deal of disturbance from all the telegraphic instruments at work in the main building. Conversely, when the earth resistance is low the amount of disturbance we get is so small that there is no particular difficulty in receiving weak signals. It does not make much difference what arrangement of tuning we adopt on the wireless apparatus. That is to say, of course, if we use more selective circuits, or use a number of the selective circuits that Professor Marchant has mentioned. The disturbances from the telegraphic instruments are very much less, but, at the same time, the signal strength is reduced. The whole thing seems to depend, as far as I can tell, entirely on the value of the earth resistance, and I should very much like to hear whether Professor Marchant could give me any theory for, or can confirm by any experience of a similar character, these results which I have noticed.

Mr. R. E. H. Carpenter.

There are one or two points to which I should like to draw attention. The differential atmospheric eliminator which Prof. Marchant has shown us—which I think is due to Fessenden—seems to fail in practice for this reason. It is necessary in order to balance out the voltages induced in the secondary coils of the differential device, to get the currents in these circuits equal at every instant in amplitude and in phaso; this involves also equality of frequency and decrement, and if you have two circuits with de-tuning, that cannot be done. I should like to know how Prof. Marchant arrived at that figure of 800 ohms necessary to make a P.M.G. aerial aperiodic. Would not that depend upon the amount of loading inductance at the foot of the antenna which is needed to tune it to any particular wavelength? With regard to the figure showing the balanced valve device, am I not right in thinking that the balanced valve or balanced crystal devices are in no sense atmospheric eliminators but rather limiters? In the tropics an operator may be almost deafened by atmospherics and the jambing produced by atmospherics may last, for physiological reasons, very much longer than the atmospheric itself. In these circumstances, some method of limiting the intensity of the sound produced by an atmospheric is certainly very valuable and well worth having. Weagant's circuits are extremely ingenious. I have had no experience with them, but they have two rather serious drawbacks. One is the enormous amount of space which is necessary, quite obviously, for using some of these circuits, particularly on longer wavelengths, and the other point, which I do not think Prof. Marchant touched upon, is the necessity for balancing the phases of the currents in the various circuits. In Weagant's original papers he shows various combinations of resistance and capacity for getting coincidence of phase between his various circuits and his methods in general seem very much to depend on the manipulation of phases of radio frequency currents, which is a matter of some difficulty, requiring considerable skill on the part of the operator.

Mr. H. R. Rivers Moore.

There are one or two small points I should like to mention. I must say that I was rather interested to hear Prof. Marchant suggest that Liverpool is a place where interference is very bad. I was there last week, and coming from the South coast I regarded Liverpool as a perfect haven of peace. I was on a ship with only a crystal set and after listening for some time I heard Seaforth speak to one ship and the ship replied and then there was perfect peace for half-an-hour, and I had no difficulty in hearing Manchester's children's hour with a crystal set in the afternoon, although we were quite close to the big coast station. Down in Sussex I have worked a good deal with ordinary broadcast receiving apparatus—the regular standard types, and there is no difficulty in selecting two broadcasting stations even within 15 metres of one another, but when it comes to a ship station or a French coast station, nominally working on 300 or 450 metres, it will come crashing through. With regard to the Hinton rejector circuit, that strikes me as being very useful. In the diagram it is shown as a loose-coupled circuit. You have your aerial circuit and a loose-coupled circuit and then the Hinton rejector. Most of us are chiefly interested at the present time in broadcast receiving apparatus and I should like to know if the Hinton rejector is equally effective when applied direct to the aerial circuit without the loose coupling. I wish more had been said on the subject of getting rid of the interference from local sources. I was up against the problem only the other day. In this case they had got interference from local generators in a big institution, where there was a direct current lighting plant. I do not think there is usually much trouble with A.C. machines, but with D.C. machines you always have very minute sparking at the brushes, and my impression is that the greater part of the interference is due to that. In this case the charging station was 200 yards at least from the building and I was asked to see if I could do anything to eliminate the trouble. Someone had been there before and had put the operator and the apparatus in a cage of wire netting. I did not start in that direction as I did not think it would be effective. My own impression was that the interference was due to the little sparks which set up a high frequency on the leads all through the building, which was probably picked up by the aerial. Therefore, as you cannot screen your aerial, there is no possible chance of getting rid of it by screening your apparatus, so I did not attempt to do anything of that sort. My efforts, therefore, were directed to shunting off the ripple right at the start by means of condensers, but it was not effective. The best thing would have been to have screened the whole of the wiring in the building but I was told that certain portions of the wiring were in wood casing and other portions in steel tubing. The probable cure would have been to have a really efficient separate earth, but at the time I was there, there was no possibility of arranging that. I should very much like to hear of any similar experience of interference of that kind.

Mr. J. H. Reeves.

It is exactly a year ago since I read a paper before this Society—at the May meeting last year—which dealt with the relationship between static coupling and electro-magnetic coupling between the two coils, the ordinary A.T.I. and the secondary, and I showed that under certain circumstances the electro-magnetic and the electrostatic couplings helped one another, and in certain other circumstances they opposed one another. Supposing that we get a condition when the two are in opposition to one another, the electro-magnetic coupling was shown to be a function, mainly, of the distance apart of the coils; and if the coils themselves had been wound to have as little self capacity as possible, and their active ends were joined through a condenser, or, as I called it, a static coupler, then that coupling was not a function of the distance but a function of the periodicity. Hence, with any one particular wavelength, say 600 metres, you could find the position when the magnetic coupling was exactly equal to the contrary electrostatic coupling. With the coils, A.T.I. and secondary in this position, if a signal came through with a considerably higher periodicity, you then get the signals from that station owing to the excess of the electrostatic coupling; and contrariwise, if you get signals of a longer wavelength, you get them through by excess of electro-magnetic coupling. I have been working on that system ever since then, and it is only of a limited use, but I suggest that some of those gentlemen who have spoken of jamming by 600-metre ships in their immediate neighbourhood should look back to my paper, which was published in the Journal of this Society a year ago. I will just add to it this little much, that I was then winding both the primary and the secondary with quite fine wires; I have since found out that the A.T.I. can with advantage be quite stout, but the windings of the secondary may be of fine wire, say 36 S.W.G. well spaced. Then, using reaction on the secondary, which more or less wipes out the ohmic damping, I have found that quite reasonably strong signals can be obtained, with the almost complete elimination of any one strong local station.

Mr. L. F. Fogarty.

I have been very interested in Professor Marchant's reference to some recent experiments, whereby it has been possible to determine the actual wave shape of the interfering atmospherics. I should like to ask whether Professor Marchant can give us the method which has been used to make a record of it, or to render visible the shape of the curve in the oscillograph tube. It occurred to me that these atmospherics would be of a transient nature, and would not be regularly repeated, and therefore, some special method, probably photographic, would have to be adopted actually to delineate the shape of the curve.

Mr. G. G. Blake.

I wish Professor Marchant had told us more as to the elimination of noises due to machinery in the vicinity of a receiving station. I have very great difficulty in my own station, because there is a butcher's shop very close where they work a sausage machine, and when it is going it is absolutely impossible to receive signals at all. I have tried the experiment of turning off the main switch, as I thought the disturbance might probably be due to some sort of high frequency effect in the wiring of the town, and that the commutator of the motor of the machine was setting up ripples along the mains, and I was getting the effect of that on my aerial, but I found that turning off the electric light "main-switch" made no difference whatever. It was quite impossible to work while that sausage machine was going. With regard to the use of reaction, Professor Marchant has told us that the use of reaction sharpens the tuning very considerably. Of course, we have all come across that for ourselves while experimenting, but I think we are particularly pleased to be told this, but whether it will please the Post Office to the same extent I do not know.

Mr. E. Cuddon.

It may be of interest to mention a circuit due, I believe, to Captain Eric Hoghton, of Hove, which he recently demonstrated to me. He employs a separate heterodyne oscillator directly coupled to the aerial circuit, and the usual loosely coupled secondary circuit connected to a high frequency amplifier. In the anode circuit of this he has a loosely coupled oscillation transformer, the primary and secondary of which are tuned, not to the frequency of the received signal, but to the beat frequency. He experiences considerable interference from ships, and also from the lifts of a near-by hotel, and finds this an extremely satisfactory method of cutting out this interference.

Mr. Everest.

Mr. Child spoke of the variation of the resistance in the earth. It would be interesting to know what method Mr. Child employs for measuring the resistance of his earth connection.

Mr. Child.

The earth resistance was measured many years ago by the introduction of a third earth connection, and using the Wheatstone Bridge method. I know this is not a very accurate method when dealing with high frequency current, but it gave a useful measure at the time, and it was sufficiently accurate for the particular purpose. It was done by three earth connections and the use of a Wheatstone Bridge.

Mr. Read.

I should like to ask Professor Marchant two questions. I think he knows me fairly well from the old days, as I was at college under him for a long time. I should like to know if he has studied a question which I think has not been touched on, and that is the trouble experienced from arc stations. I do not know whether many members have experienced much trouble in that line, but I believe in certain districts it is very bad. The second point I should be glad to have some information on is the question of screening sets. I have not had much experience with screening, but I should think it would do quite a lot for the elimination of external noises, because, quite apart from reception in one's aerial, especially with high amplification circuits, one is apt to get quite strong signals without an aerial. I would like to know if Professor Marchant has had any experience of screening the whole set, or individual units in particular.

Mr. Lawes.

May I ask Professor Marchant if, in order to avoid trouble from local disturbances, he has tried, not connecting the aerial to earth, but to a metallic netting insulated from the earth? In that connection I should like to mention a very curious incident. I was testing groups of magnetos during the war. They were bolted to cast-iron blocks fixed on to an earthed angle-iron frame, the whole thing being metallically joined together, and very solid. When the magnetos were running, by taking a wire 2 ft. long, and attaching one end to the frame, you could get a small spark between the other end of the wire and any portion of the iron frame. That seems to show how difficult it may be to eliminate the trouble from local disturbing commutator machines.

(To be concluded).

Wireless Club Reports.

Contributions to this section are welcomed. Reports should be as concise as possible and should record the most interesting features of each meeting. The Editor reserves the right to edit the reports when necessary. **Papers read before Societies will receive special consideration with a view to publication.**

An Asterisk denotes affiliation with the Radio Society of Great Britain.

Tottenham Wireless Society.*

An instructive lecture on "Grid Leaks, Fixed Condensers and Coils," was given by Mr. T. Vickery, on Wednesday, June 20th. The lecturer demonstrated several types of leak, testing their resistances on his megger, and proceeded to show the method of constructing condensers. He concluded with detailed instructions in coil winding.

On Saturday, June 23rd, a number of the members visited a ship station, the operator kindly explaining the operation of his set—a ½kW. rotary spark transmitter and crystal receiver.

There still remains plenty of room for new members, and all interested should apply for particulars to the Hon. Sec., S. J. Glyde, 137, Winchelsea Road, Tottenham, N.17.

Members of the Walthamstow Amateur Radio Society who visited High Beech on June 16th, and conducted many interesting experiments.

The Halifax Wireless Club.*

At the June meeting of the above Society a discussion was held on the respective merits of the Neutrodyne, the Flewelling, and a certain recently widely advertised circuit, the S.T.100.

The Secretary opened with a description of a three-valve Neutrodyne, which he had combined with a reflex circuit, obtaining approximately a six-valve effect with three valves. The circuit was fully explained and the theory discussed.

Several members having tried the S.T.100, this circuit was the subject of lively discussion, but as the members are unfortunately (?) not within 15 miles of **2 LO** no experimenter could say if the results claimed for the circuit could be justified. Certainly no record-breaking claims were established, though it was agreed that the circuit could be made very stable, and the music received was very sweet and pure.

With regard to the Flewelling circuit, this had only been experimented with four days prior to the meeting, but it was reported that on one valve **2 ZY** (Manchester), 30 miles away, was audible on an Amplion at reasonable strength, and **PGCC** (300 miles). All the British broadcasting stations, and **FL** music (500 miles), were plainly audible in the telephones at normal three-valve strength.

A demonstration was given of the Flewelling circuit roughly constructed for the discussion, and **2 ZY** (30 miles) was plainly audible to all in the room on one valve. Members were also able to hear **2 LO** (200 miles) on the headphones. The ease of manipulation of the circuit was apparent and the results equal to any one-valve Armstrong.

In the circuit demonstrated, which departed very slightly from the published description in *The Wireless World and Radio Review*, an ordinary "R" valve was used, and there was no trace of any whistle such as is experienced in the Armstrong circuit. The demonstration showed that it was quite a simple matter to tune in any station without allowing the set to oscillate.

Hon. Sec., c/o Y.M.C.A., Clare Hall, Halifax.

Dewsbury and District Wireless Society.*

Members of the Society spent a very interesting evening on Thursday, June 14th, when they were permitted to view the interior of the local telephone exchange. The authorities had kindly arranged for an engineer to explain the various circuits and other intricacies connected with the system. As a result the members left with a good understanding of the telephone system and, it is believed, with good intentions for the future treatment of operators.

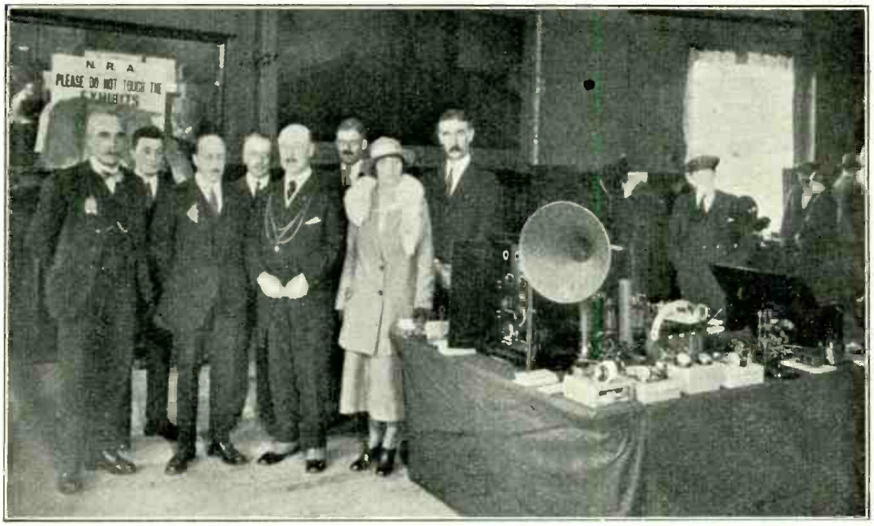
Hon. Sec., Fred Gomershall, A.S.A.S., 1, Ashworth Terrace, Dewsbury.

It is hoped that through the generosity of the President, Mr. Palmer, the Club will, in a few weeks' time, be in possession of an elaborate receiving set.

Application has been made for affiliation with the Radio Society of Great Britain.

There are several vacancies for new members, and any experimenters wishing to join are requested to communicate with the Hon. Sec., either personally or by letter.

Hon. Sec., J. C. Percy, 185, Broadway, Cricklewood.



A very successful wireless exhibition was held in Belfast on June 20th, under the auspices of the Northern Radio Association (Ireland). Our photo shows the Lord Mayor and company at the opening ceremony.

Battersea and District Radio Society.*

An enjoyable evening was spent on Wednesday, May 30th, when a number of the members gave a concert at the Latchmere Road Baths.

A lecture on "Accumulators" was given by Mr. G. E. Reeves on Tuesday, June 12th, and proved of great interest.

The Society is now affiliated with the Radio Society of Great Britain, and it is hoped that the club's activities will thus be extended.

More members—both ladies and gentlemen—are wanted. Full particulars can be obtained from the Hon. Sec., A. E. P. Walters, 31, Holden Street, Lavender Hill, S.W.11.

Ilford and District Radio Society.*

An interesting talk on the "Ilford Generating Station" was given by Mr. Gregory on June 14th. By the kindness of this gentleman the Society will visit the station on July 12th.

The Hon. Secretaryship of the Society has now changed hands, and the position is held by Mr. N. Vizard, 12, Seymour Gardens, Ilford.

Cricklewood Radio Club.

Four very successful experimental outings have taken place, and the Committee have arranged a number of others to be held during the summer months.

The Beckenham and District Radio Society.

General appreciation of the new headquarters was expressed by the members on June 7th.

The subject under consideration was how to obtain filament and high tension current from the house supply (A.C.), and the speaker, Mr. Knight, A.M.I.E.E., A.M.I.R.E., was highly successful in communicating his views on the subject.

The meeting closed with the presentation of competition awards.

Hon. Sec., J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

Smethwick Wireless Society.

An interesting lecture on "Batteries for Receiving Apparatus" was recently given by the Hon. Asst. Secretary, Mr. L. Lee (5 FH). The members afterwards experimented with the Society's apparatus.

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

Oldham Amateur Radio Society.

"Gadgets Night" was held on June 1st, when one member demonstrated a neat little panel for switching telephones in series to a receiving set. Another member produced a variable condenser of novel and economical design. The material and design for the Club's portable three-valve receiving set were discussed, and an interesting debate followed on the subject of "Double Reaction."

On June 8th, the members considered the suitability of various proposed sites for the future headquarters of the Club.

The transmission from 2 ZY was then received on a four-valve set and on the Armstrong super-regenerative circuit, using one valve and a frame aerial.

Hon. Sec., W. Schofield, 92, Sharples Hall Street, Oldham.

Raymald Wireless Club.

"Loss of Insulation on Aerials" was the subject of a lecture delivered by Mr. G. H. Brown on June 6th. Much useful information was imparted concerning the relative advantages of the different types of insulators, and the lecturer gave some helpful hints for the protection of aerials and insulators.

Hon. Sec., F. E. Baker, 28a, Estella Avenue, New Malden.

Book Reviews

Radio-Schnell-Telegraphie (High-Speed Radio Telegraphy) by Dr. Eugen Nesper; pp. XI. + 120, with 108 figs. Julius Springer, Berlin, 1922.

This book of 120 pages is devoted entirely to the methods of transmission and reception in high speed radiotelegraphy. As the author points out in the preface, the commercial success of long distance communication is only possible by the use of high-speed operation in combination with a highly developed administrative organisation. The characteristic properties of submarine cables limit the speed of working to about 35 words per minute, but there is no such limit in radio communication, and the author regards 150 words per minute as a reasonable aim. The author regards the high-frequency alternator as the only commercial type of transmitter for this class of service at the present time, as although the problem can be solved equally well by means of thermionic valves, they cannot at present compete economically with the high-frequency alternator.

After a general review of the subject the various sources of radio-frequency current are described—Poulsen arcs, valves, H.F. alternators, and frequency transformers. The author then discusses the methods of keying these various types of generator, and describes the Wheatstone automatic transmitter and its modifications. The reception of high-speed signals is then considered, and over 20 pages are devoted to the all-important subject of selectivity and freedom from interference. Various high-speed inkers are then described, including one by Huth, based on the Johnsen-Rahbek principle. Then follows a description of the phonographic and telegraphonic methods of reception, and of the Baudot and Hughes printing telegraphs. A chapter is devoted to the general lay-out of transmitting and receiving stations, and their connection with the central operating office. Not the least valuable feature of the book is the classified, alphabetical bibliography, which should prove extremely useful to those interested in the subject.

The book is well printed and illustrated in the style associated with Springer, and although it contains little that is new, it can be thoroughly recommended to anyone interested in the subject and wanting a concise review of the present state of development. G. W. O. H.

"Radio" (Zeitschrift für das Gesamte Radiowesen). A trade paper for the wireless industry. (Berlin: Rothgiesser and Diesing Aktiengesellschaft, Prinzenstrasse 98, S.42. Published on 10th and 25th of each month. Annual subscription for England and colonies, 12s. 6d.).

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LONDON 2 LO, 369 metres; **MANCHESTER, 2 ZY,** 385 metres; **BIRMINGHAM, 5 IT,** 420 metres; **CARDIFF, 5 WA,** 353 metres; **NEWCASTLE, 5 NO,** 400 metres; **GLASGOW, 5 SC,** 415 metres. Regular morning and evening programmes, particulars of which appear in the daily press, are conducted from these stations by the British Broadcasting Company. The usual times of transmission are:—Weekdays, 11.30 a.m. to 12.30 p.m. (**2 LO** only), 3.30 to 4.30 p.m., 5.30 to 11 p.m. Sundays, 3 p.m. (**2 LO** only), 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), **FL,** 2,600 metres. Daily, 7.40 a.m., Meteorological Forecast; 12.15 p.m., Meteorological Report and Forecast; 3.30 p.m., Financial Bulletin (Paris Bourse); 6.10 p.m., Concert and Meteorological Forecast; 11.15 p.m., Meteorological Report and Forecast. Sundays, 6.10 p.m., Concert and Meteorological Report.

LEVALLOIS-PERRET (Radiola), **SFR,** 1,780 metres. Sundays, 2 to 3 p.m., 9 to 10.30 p.m., Concert. Weekdays, 12.40 p.m., Concert, 5.5 p.m., Financial Bulletin; 5.15 to 6.15 p.m., Instrumental Music; 8.45 p.m., Miscellaneous News; 9 to 10 p.m., Concert. Thursdays, 9.45 p.m. to 10.30 p.m., Dance Music.

ECOLE SUPÉRIEURE des Postes et Télégraphes, 450 metres. Tuesday and Thursday, 8.30 p.m., Concert. Saturday, 2.30 to 7.30 p.m., Concert.

LYONS, YN, 3,100 metres. Weekdays, 10.45 to 11.15 a.m. Gramophone records.

HOLLAND.

THE HAGUE, PCGG, 1,050 metres. Sunday, 3 to 5 p.m. Concert. Monday and Thursday, 8.40 to 9.40 p.m., Concert.

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

THE HAGUE (Velthuyzen), PCKK, 1,050 metres. Friday, 8.40 to 9.40 p.m., Miscellaneous.

IJMUIDEN, PCMM, 1,050 metres. Saturday, 8.40 to 9.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres. Wednesday, 8.10 to 9.10 p.m., Concert and News.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. Working days, 12 noon. Meteorological Bulletin. Daily, 4.50 p.m., Meteorological Bulletin. Tuesday and Thursday, 9 p.m., Concert. Sunday, 6 p.m., Concert.

GERMANY.

BERLIN (Kœnigswusterhausen), **LP,** 4,000 metres. Daily, 7 to 8 a.m., Financial and other news; 12 to 1.30 p.m., Financial and other news; 5 to 6.30 p.m., Financial and other news.

EBERSWALDE (2,950 metres). Tuesday and Saturday, 6.30 to 7.30 p.m. Concert.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres, 8 a.m., 12 noon and 4 p.m. Meteorological Bulletin and News. 4,500 metres, 10 a.m., 3 p.m. and 10 p.m., Concert.

SWITZERLAND.

GENEVA, HB 1, 900 metres. Daily, 6 to 8.30 p.m. Concert ("Utilitas").

LAUSANNE, HB 2, 1,350 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

QUESTIONS AND ANSWERS

"H.K." (Dorset) *asks for a diagram of a three-valve circuit employing one H.F. transformer coupled amplifying valve, detector, and one L.F. amplifier, with switches to enable any combination of the three valves to be used.*

The diagram is given in Fig. 1.

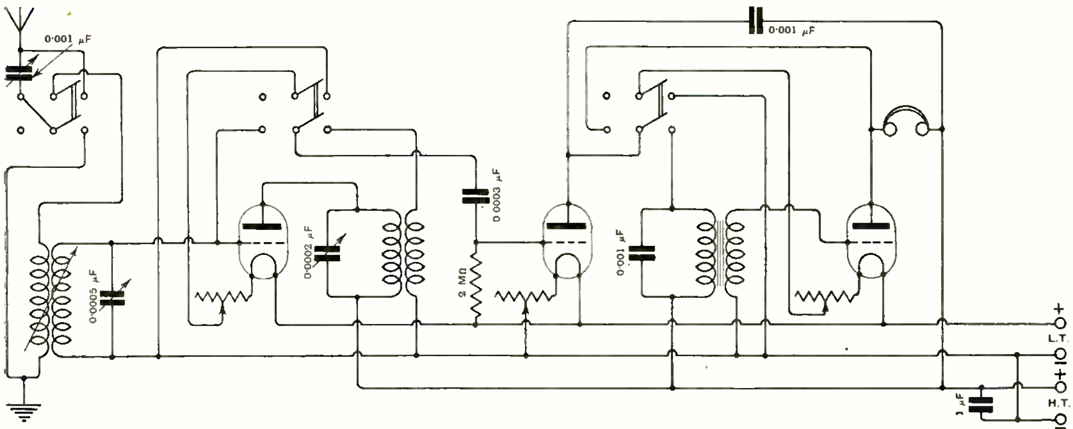

Fig. 1. **"H.K." (Dorset).** *Receiver with H.F., valve rectifier and note magnifier with switches to switch the H.F. or L.F. valve circuits.*

"PERPLEX" (Highbury, N.5) *submits a diagram of a two-valve set, one H.F. amplifier and detector, with which he gets poor results. He asks (1) For criticism of the circuit. (2) What is the function of the series-parallel switch. (3) For the windings of a H.F. plug-in transformer to cover the wavelengths of the Hague and Paris stations. (4) For the name of any publication we recommend dealing with the theory of the crystal detector.*

(1) The circuit diagram is correct. We think that your inability to tune out **2 LO** is principally due to the use of a single circuit tuner, and your receiver is therefore not sufficiently selective. From your description of this set, it is unlikely that any of the trouble is attributable to the A.T.C. (2) The purpose of the series-parallel switch is to connect the aerial tuning condenser in series with the aerial inductance for short wavelengths such as those in use by the British broadcasting station, and in parallel for the longer wavelengths. (3) For the transmissions from the Hague, we suggest you wind 1,300 turns of No. 40 S.S.C. wire for both primary and secondary windings on an ebonite disc former, $2\frac{1}{4}''$ in diameter, having a groove $\frac{1}{8}''$ wide and $\frac{1}{2}''$ deep. For the transmissions from the French Radiola Station, use a former $2\frac{1}{2}''$ in diameter, with a groove $\frac{1}{4}''$ wide, and $\frac{1}{4}''$ deep. Wind 800 turns each for primary and secondary of No. 40 S.S.C. wire. For the Eiffel Tower transmissions on 2,600 metres, use a former similar to the second one mentioned above. Wind 1,000 turns of No. 40 S.S.C. wire for both primary and secondary. (4) The crystal detector is dealt with in most publications dealing with wireless telegraphy and telephony.

"S.B.H." (Sidcup) *asks (1) In what way may a variocoupler be used in a valve circuit. (2) How a variometer may be connected in a valve circuit to give reaction. (3) If a variometer, when used to supply reaction in a circuit, is as efficient as a coil coupled to the secondary or to the tuned anode coil. (4) If the "permanent" type of crystal detector is more sensitive than other types.*

(1) A variocoupler may certainly be used as a tuner in a valve circuit. (2) The method of using a variometer to give reaction in a valve circuit

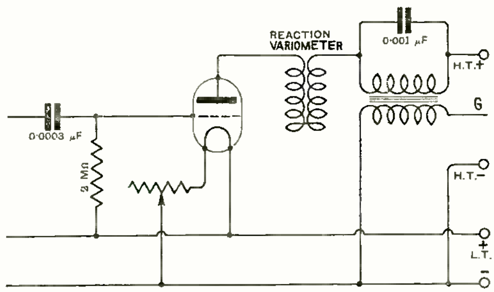

Fig. 2. **"S.B.H." (Sidcup).** *Method of connecting variometer to secure reaction effects.*

is indicated in Fig. 2. (3) There is not much to choose between them. (4) The "permanent" type of crystal rectifier is satisfactory, but not necessarily more sensitive than other types.

"J.H." (Sheffield) *submits a diagram of a two-valve set and asks* (1) *For criticism.* (2) *If a set made up from this diagram would give satisfactory reception using a frame aerial, and if so, what would be the probable effective range.* (3) *For the maximum and minimum wavelengths of a coil 3″ diameter by 10″ of No. 22 enamelled copper wire.*

(1) When receiving short wavelength signals, use the tuning condenser in series with the tuning coil. For longer wavelengths, connect the condenser in parallel with the coil. (2) Using a frame aerial the set should give satisfactory reception up to approximately 50 miles, but a great deal naturally depends on the power of the transmitting stations. (3) The range of the tuner is from 250 to 2,500 metres.

"T.A.L.D." (Woking) *asks* (1) *If a potentiometer of 500 ohms resistance could be used with a crystal detector.* (2) *What is a suitable winding.*

(1) A resistance of 500 ohms is a very suitable value for use with a crystal detector. (2) On a 1″ diameter former, wind about 4 ins. No. 36 S.W.G. Eureka resistance wire.

"T.A.L.D." (Woking) *asks* (1) *For particulars of the windings of a loose coupled tuner to cover the range of wavelengths from 300 to 500 metres.* (2) *The identity of* **5 AQ.**

(1) We suggest that you wind the loose coupler from the following particulars:—Primary coil 4″ diameter, former wound with 90 turns of No. 20 D.C.C. copper wire with six taps. Use a 0·001 mfd. variable condenser in series. Secondary coil, 3″ diameter former wound with 100 turns of No. 26 D.C.C. copper wire. Use a 0·0005 mfd. variable condenser in parallel. (2) Particulars of this station are given in the issue of May 5th. D. Douet, 10, Ruvigny Gardens, Putney, S.W.15. Power, 10 watts.

"H.F." (Oldham) *requires a circuit diagram of a four-valve receiver employing three H.F. amplifying valves and detector, using the tuned anode method of H.F. coupling, the circuit to be conveniently arranged for coupling to the two-valve note magnifier circuit given in reply to* **"R.I.R.D." (Derby)** *in the issue of March 17th.*

The diagram is given in Fig. 3.

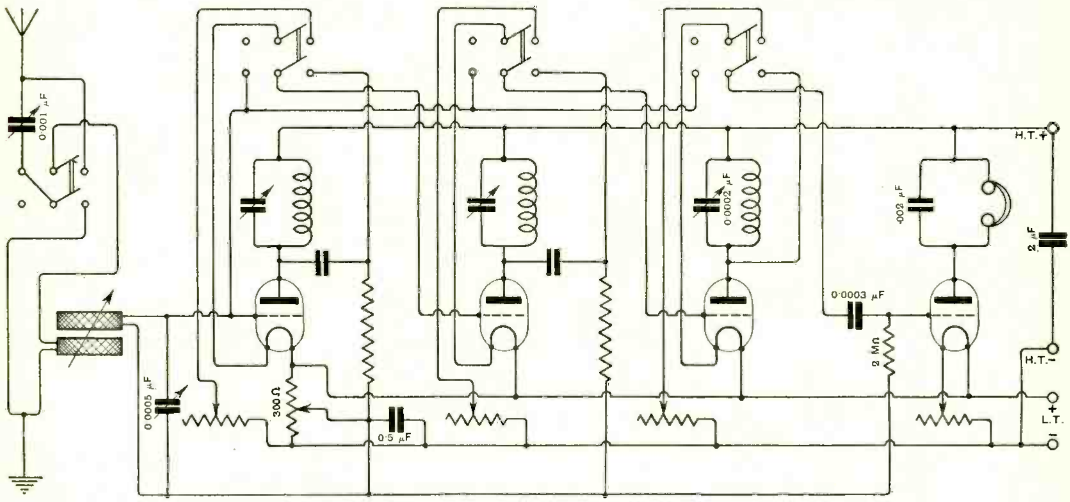

Fig. 3. **"H.F." (Oldham).** *This diagram shows the method of connecting three stages of H.F. amplification with a valve rectifier.*

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* **The Wireless World and Radio Review**, 12/13, *Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*

THE WIRELESS WORLD AND RADIO REVIEW

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A 10th Anniversary.

Thursday, July 5th, was a day to be remembered in the history of amateur wireless, and particularly in the history of the Radio Society of Great Britain, since it was on that date just ten years ago that the first meeting of a little group of wireless enthusiasts was called together, out of which has grown up the present organisation of the Radio Society of Great Britain and affiliated societies, with Royal patronage. The work which this Society has done, backed by all associated Societies and the amateurs of the country generally, is too well known to require any comment here. This may be an occasion, however, to remind anyone who is interested in the past history of the Society, or who has interested friends, that a pamphlet was prepared some time ago giving the history of the Society from its earliest days up to recent months. This history is available free to anyone who cares to apply for it, either to the Hon. Secretary, at 32, Quex Road, West Hampstead, N.W.6, or from the Editorial offices of this Journal. Those who have not already made the acquaintance of this little history will find it full of interesting information regarding the progress of amateur development in this country.

Calls Heard.

At irregular intervals recently, we have published some lists of amateur calls heard by stations listening-in in different parts of the country. Judging by the number of letters which have been received, this appears to be a very popular feature. We, therefore, propose to devote more space to this in the future, and would like to receive for publication, lists of calls heard. The name and address (or at least sufficient address to give the location of the receiving station) should be given, followed by a list of the calls heard, and, in certain cases, the dates. No other information is required at present, as the idea will be to put those who are interested in each other's transmissions directly in touch with one another. Of course the lists of calls heard should be confined as far as possible to amateur transmitting stations at some considerable distance. Unidentified stations should be given in a separate list when sending in this information.

Talking of matters which interest holders of experimental transmitting licences reminds us that we hear that a meeting of transmitters in the London area is to be held on Friday, July 20th, at King's College, Strand, W.C.2, at 6 p.m., with a view to the formation of a Society of transmitting amateurs in the London area. They will thus be able to keep in touch with one another by holding meetings at which they can discuss points of mutual interest. We hope to have an opportunity of saying more about this shortly.

B

A READY RECKONER FOR WAVE-LENGTH, INDUCTANCE & CAPACITY

From the tables and graphs given it is quite easy to determine the number of turns of wire on a certain former necessary to produce a desired inductance or to give a particular wavelength with a condenser of given value. Any combination of the relationship of inductance and capacity to wavelength can be read off, together with the necessary practical data.

By E. J. HOBBS, M.C., Associate Member I.R.E.

TABLE II accompanying these notes has been prepared by the writer as a supplement to Table I on page 431, *The Wireless World*, September 4th, 1920, Vol. VIII.

A simple example is given below merely to indicate the broad principle for using these tables. Assume :—

(*a*) Maximum wavelength desired = 3,000 metres.

(*b*) A standard Post Office aerial has a capacity of 0·0003 mfd. (neglect the inductance) and

(*c*) Maximum capacity of variable condenser to be used in parallel = 0·0005 mfd.

(*b*) and (*c*) together will have a total capacity of 0·0008 mfd., and from Table II, 3,167 mhys. is stated to be suitable for 3,000 metres, with a parallel capacity of 0·0008 mfd.

In Table I the dimensions of coils approximating 3,167 mhys. are :—

	Diam.	Length.	Inductance.
1.	12 cms.	9 cms.	3,200 mhys.
2.	8 cms.	16 cms.	3,300 mhys.
3.	10 cms.	12 cms.	3,440 mhys.

[N.B.—The inductance next above that required is selected to ensure that ample inductance is provided.]

As the inductances in Table I are provided for coils wound with No. 26 single silk covered wire a table of correction factors for normal gauges of wire is given in Table III.

Example :—

If coil 3 is wound with No. 24 D.S.C. wire its inductance will be—

$$3{,}400 \times 0{\cdot}62 = 2{,}132 \text{ mhys.}$$

or with No. 28 D.C.C. wire—

$$3{,}440 \times 0{\cdot}63 = 2{,}167 \text{ mhys.}$$

TABLE I.

Inductance of a solenoid wound 20 turns per cm. Inductances in microhenries.
Diameters of solenoid in cms.

Length cms.	Diameter of Solenoid.									
	4	5	6	7	8	9	10	12	14	16	18
1	23	32	41	50	60	70	80	—	—	—	—
2	66	93	122	155	185	218	253	324	399	478	559
3	118	169	224	283	346	389	480	623	784	932	1095
4	174	252	338	432	531	636	745	974	1221	1480	1745
5	232	340	460	590	719	881	1040	1370	1725	2095	2482
6	292	430	587	761	945	1201	1350	1790	2270	2795	3300
7	351	523	717	932	1165	1415	1680	2240	2850	3490	4180
8	413	617	850	1109	1390	1695	2016	2710	3454	4250	5110
9	474	711	985	1291	1624	1980	2360	3200	4080	5025	6050
10	537	807	1120	1472	1858	2275	2720	3680	4725	5857	7050
12	666	997	1395	1842	2345	2870	3440	4700	6074	7546	9130
14	786	1193	1673	2216	2810	3475	4185	5740	7450	9310	11290
16	911	1390	1951	2593	3300	4090	4940	6800	8880	11140	13600
18	1037	1583	2231	2972	3800	4711	5700	7880	10310	12980	15850
20	1162	1779	2512	3352	4290	5330	6460	8970	11780	14860	18190
22	1287	1975	2794	3734	4820	5960	7230	10060	13250	16750	20560
24	1414	2170	3005	4115	5290	6590	8000	11160	14730	18670	22940
26	1536	2370	3357	4502	5790	7380	8780	12270	16230	20610	25370
28	1666	2565	3642	4883	6290	7840	9680	13390	17730	22550	27810
30	1792	2761	3922	5264	6790	8480	10330	14500	19230	24500	30260
32	1920	2958	4207	5652	7290	9110	11100	15620	20750	26460	32730
34	2044	3155	4490	6040	7800	9519	11930	16730	22260	28650	35200

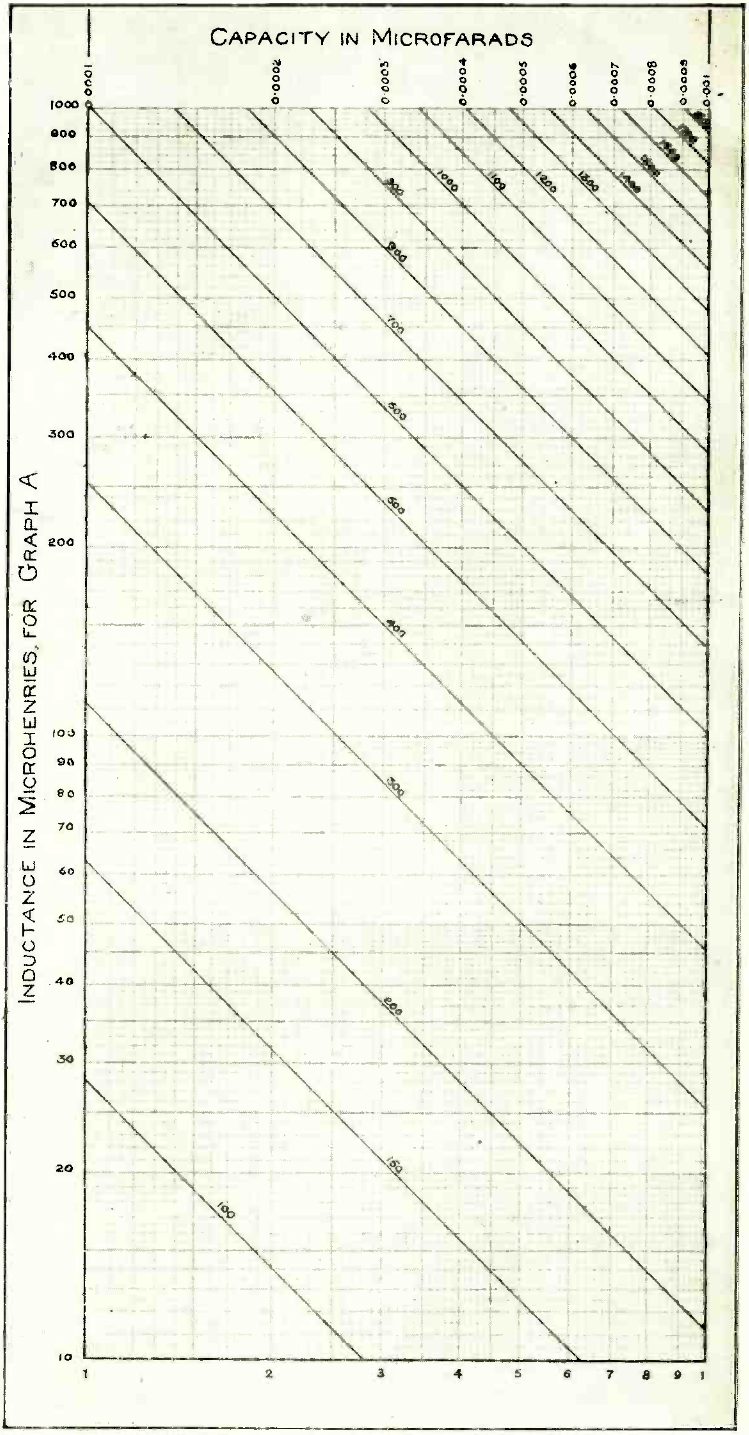
Tables I and II may also be used to locate suitable points for tappings. An inductance of 3,167 mhys. will tune to 3,000 metres with a capacity of 0·0008 mfd., *i.e.*, when the condenser is adjusted to its maximum capacity. If, however, it is reduced to its lowest capacity (zero scale reading) the total capacity in parallel with the A.T.I. will be that of the antenna alone—approximately 0·0003 mfd. (assuming, of course, the condenser has a negligible capacity at zero scale reading). 3,167 mhys. will tune to roughly 1,900 metres (see Table II) with 0·0003 mfd.; tuning to 1,900 metres can also be obtained with 1,270

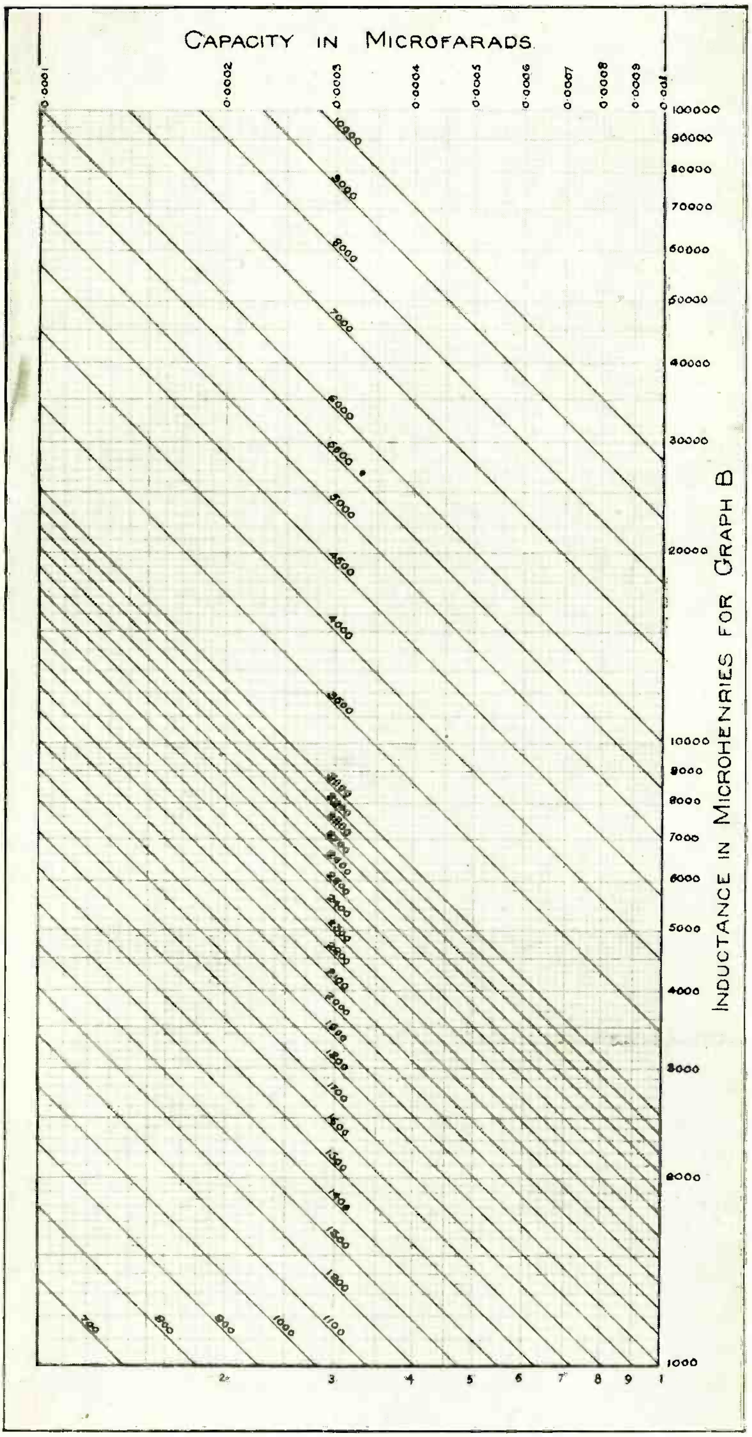
TABLE II.

INDUCTANCE IN MICROHENRIES—CAPACITY IN MICROFARADS.

λ	λ^2											
Metres	λ^2	$\log_{10}$	0·0001	0·0002	0·0003	0·0004	0·0005	0·0006	0·0007	0·0008	0·0009	0·001
100	10000	4·0000	28·2	14·1	9·38	7·04	5·63	4·69	4·02	3·52	3·12	2·82
150	22500	4·3522	63·3	31·7	21·1	15·8	12·7	10·6	9·00	7·90	7·04	6·33
200	40000	4·6021	112·6	56·3	37·5	28·1	22·5	18·8	16·1	14·1	12·5	11·26
300	90000	4·9542	253·4	126·7	84·5	63·3	50·7	42·2	36·2	31·7	28·1	25·3
350	122500	5·0881	345	172	115	86·2	69·0	57·4	49·3	43·1	38·3	34·5
400	160000	5·2041	450	225	150	112	90·1	75·1	64·4	56·3	50·0	45·0
440	193600	5·2869	545	272	182	136	109	90·8	77·9	68·1	60·6	54·5
500	250000	5·3979	704	352	235	176	141	117	101	88·0	78·2	70·4
600	360000	5·5563	1014	507	338	253	203	169	145	127	113	101
700	490000	5·6902	1379	689	460	345	276	230	197	172	153	138
800	640000	5·8062	1802	900	600	451	360	300	257	225	200	180
900	810000	5·9085	2281	1140	760	570	456	380	326	285	253	228
1000	1000000	6·0000	2816	1408	939	704	563	469	402	352	312	282
1100	1210000	6·0828	3407	1704	1136	852	681	568	487	426	379	341
1200	1440000	6·1584	4054	2027	1351	1013	810	676	579	507	450	405
1300	1690000	6·2279	4758	2379	1586	1190	952	795	680	595	529	476
1400	1960000	6·2923	5518	2759	1839	1380	1104	920	788	690	613	552
1500	2250000	6·3522	6334	3167	2111	1584	1267	1056	905	792	704	633
1600	2560000	6·4082	7207	3604	2402	1802	1441	1201	1030	901	801	721
1700	2890000	6·4609	8136	4068	2712	2034	1627	1356	1162	1017	904	814
1800	3240000	6·5105	9122	4561	3040	2280	1824	1520	1303	1140	1013	912
1900	3610000	6·5575	10163	5081	3388	2541	2033	1694	1452	1270	1129	1016
2000	4000000	6·6021	11262	5631	3754	2815	2252	1877	1609	1408	1251	1126
2100	4410000	6·6444	12416	6208	4139	3104	2483	2069	1774	1552	1380	1242
2200	4840000	6·6848	13626	6813	4542	3406	2725	2271	1947	1703	1514	1363
2300	5290000	6·7236	14894	7447	4965	3723	2979	2482	2128	1862	1655	1489
2400	5760000	6·7604	16216	8108	5405	4054	3243	2703	2316	2027	1802	1621
2500	6250000	6·7959	17595	8797	5865	4399	3519	2933	2514	2199	1955	1759
2600	6760000	6·8299	19032	9516	6344	4758	3806	3172	2719	2379	2115	1903
2700	7290000	6·8627	20524	10262	6841	5131	4105	3421	2932	2565	2280	2052
2800	7840000	6·8943	22072	11036	7357	5518	4414	3679	3153	2759	2452	2207
2900	8410000	6·9248	23677	11838	7892	5919	4735	3946	3382	2959	2631	2368
3000	9000000	6·9542	25340	12670	8447	6335	5068	4223	3620	3167	2815	2534
3500	12250000	7·0881	34487	17243	11496	8622	6897	5748	4927	4311	3832	3449
4000	16000000	7·2041	45045	22522	15015	11261	9009	7507	6435	5631	5005	4504
4500	20250000	7·3065	57008	28504	19003	14252	11402	9501	8144	7126	6334	5701
5000	25000000	7·3979	70383	35191	23461	17596	14077	11731	10055	8798	7820	7038
5500	30250000	7·4807	85166	42583	28389	21292	17033	14194	12167	10647	9463	8517
6000	36000000	7·5563	101360	50680	33787	25340	20272	16893	14480	12670	11262	10136
6500	42250000	7·6258	118940	59470	39647	29735	23788	19823	16991	14867	13215	11894
7000	49000000	7·6902	137950	68975	45983	34487	27590	22991	19707	17244	15328	13795
7500	56250000	7·7501	158360	79180	52787	39590	31672	26393	22623	19795	17595	15836
8000	64000000	7·8062	180180	90090	60060	45045	36036	30030	25740	22522	20020	18018
8500	72250000	7·8588	203410	101705	67803	50852	40682	33902	29058	25426	22601	20341
9000	81000000	7·9085	228030	114015	76010	57007	45606	38005	32576	28504	25340	22803
9500	90250000	7·9554	254090	127045	84696	63512	50818	42348	36298	31761	28232	25409
10000	100000000	8·0000	281510	140755	93836	70377	56302	46918	40215	35188	31279	28151
11000	121000000	8·0828	340660	170330	113553	85165	68132	56776	48665	42582	37851	34066
12000	144000000	8·1584	405400	202700	135133	101350	81080	57566	57914	50675	45044	40540
13000	169000000	6·2279	475800	237900	158600	118950	95160	79300	67971	59475	52866	47580
14000	196000000	8·2923	551820	275910	183940	137955	110364	91970	78831	68977	61313	55182
15000	225000000	8·3522	633450	316725	211150	158362	126690	105575	90493	79181	70383	63345
16000	256000000	8·4082	720720	360360	240240	180180	144144	120120	102960	90090	80080	72072
17000	289000000	8·4609	813650	406825	271216	203412	162730	135608	116235	101706	90405	81365
18000	324000000	8·5105	912160	456080	304053	228040	183432	152026	130308	114020	101351	91216
19000	361000000	8·5575	1016300	508150	338766	254075	203260	169384	145185	127037	112922	101630
20000	400000000	8·6021	1126200	563100	375400	281550	225240	187700	160885	140775	125133	112620

Graph A.
To obtain the inductance value of a coil necessary to produce a given wavelength with a given condenser find the point on the wavelength line (transverse line) where it intersects the capacity value (vertical line) and read off the inductance value (horizontal line). Particulars for winding coils to given inductance values with No. 26 single silk covered wire will be found in Table I.





Graph B.
This graph is similar to that given on the adjoining page, but provision is made for higher wavelengths.

mhys. and 0·0008 mfd. (Table II). If, therefore, a tapping is taken 5 cms. from the beginning of the winding (coil 1), 1,370 mhys, it will be suitable; the other tappings may be similarly determined, after which intermediate tappings may be added, if desired, according to the taste of the experimenter.

TABLE III.

S.W.G.	S.S.C.	D.S.C	D.C.C.
20	0·27	0·24	0·18
22	0·43	0·41	0·29
24	0.69	0·62	0·38
26	1·00	0·87	0·50
28	1·43	1·22	0·63
30	1·99	1·63	0·77
32	2·56	2·19	0·99
34	3·39	2·82	1·31
36	4·69	4·00	1·59

Some measurements of the capacity, inductance and natural wavelength of a standard Post Office aerial are given as a guide. It will be apparent that except in the case of short wave reception (below, say, 300 or 400 metres), the inductance of the antenna system may generally be neglected for experimental work.

Height =25 ft.
Length =75 ft. double wire spaced 6 ft.
Wavelength=97 metres.
Inductance =12·6 mhys.
Capacity =0·00021 mfd.

The preceding notes are intended for beginners, but advanced experimenters should find the following more useful.

The whole of this article is based on the formula for inductance, viz.:—

$$L = \frac{\lambda^2}{KC}$$

where

L = Inductance
λ = Wavelength.
K = A constant.
C = Capacity.

Wavelength is usually measured in metres and capacity in microfarads. If L is required in centimetres $K = 3{,}552$; if L is to be microhenries $K = 1885^2$. For each value of C we may have a constant for KC.

Curves may be drawn on squared paper so that intermediate values of L or C can be read, but errors cannot easily be detected. If, however, we plot our curves on logarithmic daper a straight line should result, and consequently an error will be immediately seen. Intermediate values may also be more accurately read.

The two graphs " A " and " B " are based on this assumption, and cover the range of wavelengths 100 to 10,000 metres, inductances for wavelengths in graph " A " being read off direct from the left-hand scale, and for graph " B " on the right-hand scale. The notations on the graphs are self explanatory. If wavelengths occurring in graph " A " are multiplied by 10, L should be read off the right-hand scale; if wavelengths in graph " B " are multiplied by 10^{-1}, L should be read on the left-hand scale.

To find the inductance for any wavelength above the range given divide the wavelength by 10 or 10^2, and with the wavelength obtained read L from the graph, and multiply the answer by 10^2 or 10^4; lower wavelengths may also be dealt with in the reverse manner.

Examples:—

1. Find L when $\lambda = 100$ metres, and $C = 0{\cdot}00055$ mfd.
   We find in this case it cannot be read off direct owing to the limitations of the paper, so read the inductance for 1,000 metres with a capacity of 0·00055 mfd. = approx. 620 mhys. But as we *multiplied* the wavelength by 10 we must *divide* the inductance by 10^2, which gives us 6·2, the required answer.
2. Find L when $\lambda = 18{,}000$ metres and $C = 0.00035$ mfd.
   $18{,}000 \div 10 = 1{,}800$. On the 1,800 metre graph, therefore, we find $L = 2{,}600$. In this case we *divided* the wavelength by 10, so the answer must be *multiplied* by 10^2. Answer = 260,000 mhys.
3. Find L when $\lambda = 30{,}000$ metres and $C = 0{\cdot}001$ mfd.
   $300{,}000 \div 10 = 3{,}000$. From the 3,000 graph L is found to be 2,534. Answer $= 2{,}534 \times 10^2 = 253{,}400$ mhys.

We have available, therefore, in Fig. 4 sufficient data to obtain any LC value for any wavelength from 10 to 100,000 metres.

It will also be apparent that the lower or higher values of C, *i.e.*, any capacity between 0·00001 and 0·01 mfd. may be used as desired. If the capacity is divided by 10 the inductance must be multiplied by 10 and *vice versa*.

The writer wishes to acknowledge the assistance given by Capt. J. H. Warr, B.Sc, in checking Table II, and H. A. Talbot in the preparation of the graphs.

ON CRYSTAL DETECTORS.

By H. E. ADSHEAD, B.A.

MANY readers have no doubt constructed crystal receivers, either according to their own design or from those published in *The Wireless World and Radio Review*. However well the receiver may otherwise be made, the results will be marred if the detector is a bad one. In particular it is a very great nuisance if the crystal is always going out of adjustment. The point I wish to emphasise in this article is the value of *rigidity*. If the component parts of the detector will not move either by vibration or temperature changes, then the adjustment will remain correct for years. This is a very useful feature in the stand-by or comparison detector, for all operators should have two detectors on their instrument. I have tried Hertzite and other galenas, and I acknowledge that they produce very loud signals, but the cat whisker does not stop any stiller than its counterpart on the hearthrug! But favour whatever crystal you may, it is essential that the detector be as small as it can be made.

To illustrate this point, Fig. 1 is a photograph of two silicon and gold point detectors. The type on the left is very bad, and will not stand the least vibration and needs frequent setting, while that on the right never varies. It even fell out of the pliers on to the floor while I was preparing to photograph it, and yet it remained in adjustment. It is out of a German war receiver (Lorenz), and the penny and the dimensioned drawings (Fig. 2) will show how small are its component parts. These dimensions are given in millimetres, but readers who are unfamiliar with this system can take two-thirds of each and call them sixteenths of an inch. There is a tight-fitting cover to exclude air and dust, and the

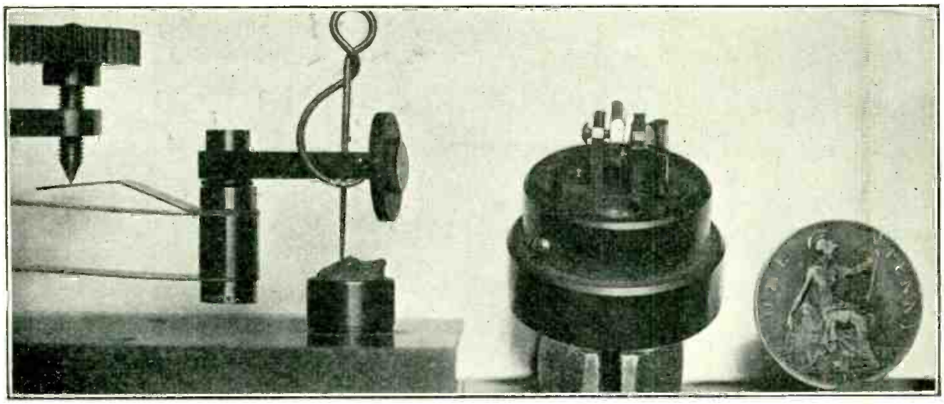


Fig. 1. The relative dimensions of the two types of crystal detectors are shown in comparison with the size of a penny.

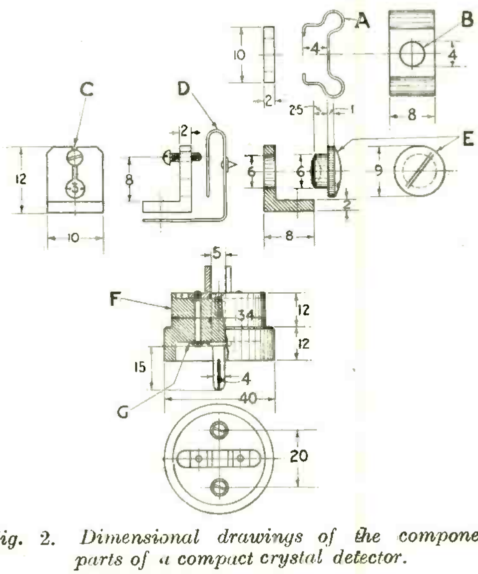


Fig. 2. Dimensional drawings of the component parts of a compact crystal detector.

components appear to be of dull-nickelled brass. The point on the spring contact is placed eccentrically on both centre lines and thus passes over a circle when the crystal is turned. The shallow screw-headed cup has a thin flake of the desired crystal set in Wood's metal. Originally it had a piece of pyrites, but I changed this for a piece of silicon off the same crystal as is used in the large detector. The wonderful permanency of this detector has convinced me that there is nothing unreliable about silicon, it is the detector designs which are faulty. It is true that the available searching surface is reduced to one line circle, but one cannot have everything, and if it unfortunately happened that it did not contain a sensitive point, the crystal could be melted out and moved a bit. It might be noted that the plug distance of 2 cm. seems to be a standard on the continent, and most plug fittings conform to it.

It may be of interest to recall here a list of crystal combinations given in *The Wireless World* of May, 1914, and slightly amended.

Silicon—Gold point, Steel, Antimony, Bismuth.

Galena—Steel point, Graphite, Tellurium.

Zincite (Zn O)—Bornite ($Cu_3\ Fe\ S_3$), Calcopyrite ($Cu\ Fe\ S_2$), Tellurium.

Iron pyrites ($Fe\ S_2$)—Metal point.

Carborundum (Si C)—Steel.

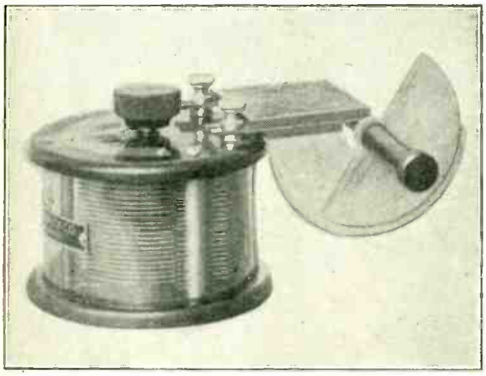
Molybdenite ($Mo\ S_2$) in metal clips.

The virtue of gold is probably that it does not oxidize like copper.

A Useful Condenser Attachment.

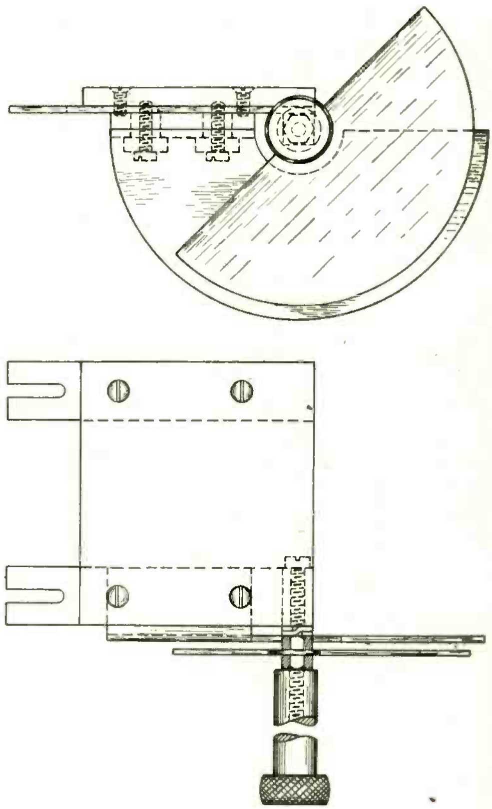
By CYRIL T. ATKINSON.

THE advent of short wave experimental transmissions and broadcasting has rendered the use of a vernier control in connection with the tuning condenser almost a necessity, and as there are no doubt many others who, like the writer, are in possession of good quality condensers not containing this refinement, it is thought that the following description of a fitment designed to be added to these units will be welcomed.



Variable Condenser with simple Vernier attachment.

When the primary considerations were reviewed it was decided that the vernier must be capable of attachment without structural alteration to the condenser concerned and



Constructional details of Vernier condenser design for fitting across the terminals of a variable.

also that it should be self-contained, and arranged so as to be easily transferred from one to another.

The final arrangement is as depicted in the illustrations, from which it will be seen to consist essentially of two specially shaped plates, one moving and one fixed, supported by an ebonite platform and arranged in such a manner as to allow of the rotation of one in the conventional manner.

The ebonite platform should first be constructed, the dimensions being determined by the distance between the condenser terminals, the two metal lugs, attached one at each end, being attached by two 6 BA × 3/16 in. countersunk brass screws. The front lug after being properly located, is removed, and the long front bearing "sweated" to it, care being taken to get this quite true and square.

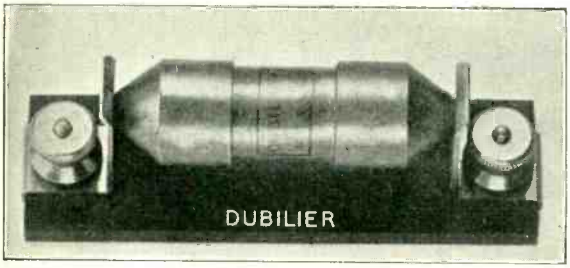
The fixed plate may now be attached, great care being taken to insulate it from the lug. This is done by the insertion of an ebonite distance piece and by carefully bushing the fixing screws by means of ebonite tube. As the drawings are clear it would be somewhat superfluous to give exact written details of every part, and in any case many of these are appreciably flexible to suit varying conditions. Special note is, however, called to the spring washer which serves to render the connection of the moving vane, via the spindle and bearing, more certain and also introduces sufficient friction to prevent unstability at any given setting. The long ebonite handle enables the hand to be kept at a reasonable distance when operating and minimises to a large extent any capacity effects which would otherwise result.

The pleasure derived from the use of such a vernier, with the added efficiency in accurate tuning, far exceeds the slight cost and will well repay any time which may have been spent in its construction.

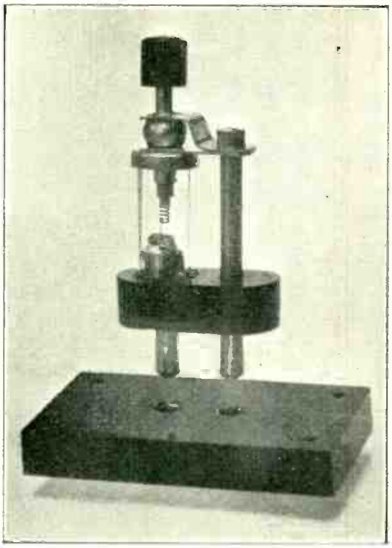
New Instruments and Components.

A New Dubilier Resistance.

Those who have experimented with resistance capacity amplification have no doubt experienced difficulty in obtaining suitable plate circuit resistances. The usual type of high resistance cannot be relied upon to pass currents of 2 or 3 milliamperes without developing changes in resistance value with the production of noises in the amplifying apparatus. The new resistance has been specially designed for this purpose and is capable of passing large currents, while it can be relied upon to give constant results when passing currents such as are met with in the plate circuits of low frequency resistance-coupled amplifiers.



The Dubilier Resistance.



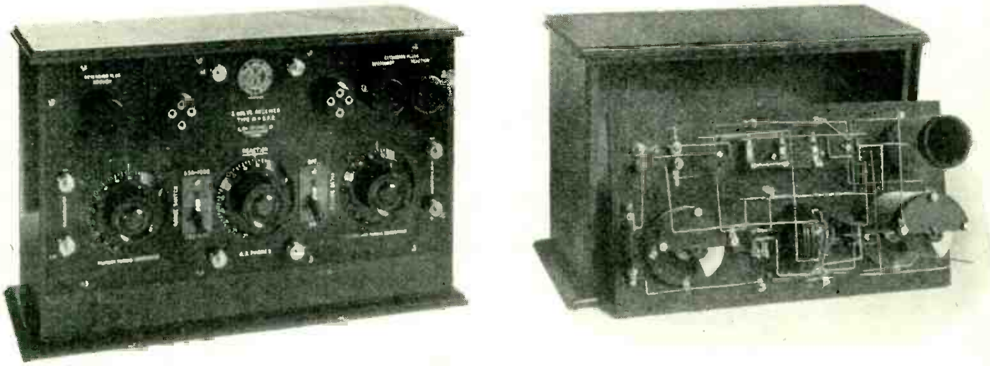
Detachable crystal detector.

A Useful Crystal Detector.

This detector, manufactured by S. A. Cutters, of 15, Red Lion Square, W.C.1, is designed to provide critical adjustment, and by means of a two-pin socket can be reversed or withdrawn from the circuit. The design is the outcome of the progress made in the production of crystal detectors since the advent of broadcasting.

Receiving Equipment of Messrs. L. McMichael, Ltd.

The main difficulty in the design of a receiver embodying high frequency amplification is that of simultaneously tuning a number of circuits. It is this difficulty which is often the cause of condemnation of a particular type of receiver, though the trouble is none other than the complication of making a number of tuning adjustments. In the M.H.B.R.2 two-valve receiver the wavelength range is covered without the necessity of making changes in the inductance values other than as provided by a two-way key switch, both positions of which are suitably calibrated. The instrument when supplied is accompanied by a table showing the settings of the secondary tuning condenser for bringing in the various British broadcasting stations, and so it only becomes necessary when tuning to make one adjustment to receive the required signal, after which it can be brought to maximum strength by regulating the reaction coupling as provided by the centre knob and dial. Provision is made for long wave tuning by the removal of the three plugs seen near the valve holders in the photograph and the substitution of plug-in coils of suitable size. The wiring of the apparatus and internal arrangements are very creditable, and it will be observed than when wavelength changes are made by means of the key switch the ratio of inductance to capacity and the circuit arrangements are suitably changed to produce the most efficient working. The cleanness of the design, and the high quality finish is at once appreciated by all those interested in the technicalities of instrument manufacture.



The M.H.B.R.2 Receiver.

Radio Society of Great Britain.

An ordinary general meeting of the Society was held on Wednesday, June 27th, at 6 p.m., at the Institution of Electrical Engineers.

The Chairman (Admiral of the Fleet Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S., D.Sc., M.I.E.E.) presided.

The minutes of the previous meeting were read and confirmed.

Mr. R. Watson Watt then read a valuable paper on "The Elimination of Atmospherics," based on his work on the Radio Research Board extending over a number of years. An interesting discussion followed.

The Chairman announced that the following members and associate members had been elected :

Members : Lt. Col. W. L. Palmer, C.M.G., J. H. Deakin, P. C. King, G. H. Daly, E. Saunders, J. C. Mason, A. J. Rolfe, B. H. Thomson, H. J. Pack-Beresford.

Associate Members : F. A. Nutter, P. A. Florence, Major H. A. P. Littledale, G. H. Barrett.

The following Societies were also accepted for affiliation :—

Ladies' Lyceum Club Radio Circle, Midhurst and District Radio Society, Hendon Radio Society, Bexley Heath and Welling Radio Society, Eccles and District Radio Society and the Radio Section of the Peek Frean Social and Sports Club.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XV.

The series has been specially arranged so that the reader who follows each section as it appears will have obtained a complete wireless education with a minimum of time and trouble, and he will be in a position to successfully design his own wireless equipment.

The last sections deal with series and parallel resonance, the study of which is so important to those who desire a clear understanding of wireless.

By W. James.

33.—Effect of Damping.

THE effect of damping upon tuning should be noted. When a spark transmitter is highly damped, the number of oscillations per spark discharge is small, therefore a large proportion of the total energy per spark transmitted is contained is the first oscillation. This large first oscillation striking a receiving aerial will cause a current to flow in the receiver largely through shock; that is, the large impulse is picked up by the receiving aerial, and so long as the receiver is tuned somewhere near the wavelength of the spark transmitter, the receiving circuits will be affected. The receiver, aerial circuit will oscillate at the wavelength to which it happens to be tuned. It will be seen that highly damped spark signals are a source of annoyance in that it is difficult to tune them out. The lower the damping, the sharper will we be able to tune the receiver, until when continuous waves are being received, tuning is very sharp indeed. In the latter case each oscillation represents equal amounts of energy, and at the receiver the circuits must be tuned to the same wavelength as the transmitter, otherwise the receiver will not receive sufficient energy to operate the telephone receivers.

Perhaps the following illustration will help to fix our ideas. Suppose we have a pendulum at rest. It will have a natural frequency depending upon its dimensions. We may set it swinging at its natural frequency by a number of small impulses timed so that the frequency of the blows agrees exactly with the natural frequency. The amplitude of the swing will grow gradually to a maximum, and the amplitude will be maintained so long as the feeble blows are maintained at their proper frequency.

If on the other hand we strike the pendulum one hard blow, the pendulum will jump about for a moment or two and then will eventually swing at its natural frequency.

The latter condition is analogous to the case of a highly damped wave such as obtained from a spark transmitter.

It does not matter to what frequency the receiver is tuned, if the spark transmitter is sufficiently damped, *i.e.*, if its decrement is high, it will cause a disturbance at the receiver. In practice the transmitter is not so highly damped that the effect is analogous to one blow of the pendulum, but spark signals do affect the receiver when the latter is tuned to a frequency considerably different to the supposed frequency of the transmitter.

An atmospheric produces results similar to the large blow of the pendulum. Some atmospherics consist of a single pulse—and therefore are similar to a very highly damped spark signal. They cannot ordinarily be dealt with at the receiver without a good deal of trouble.

The former condition is analogous to the effect of continuous waves. The receiver will only respond when it is sharply tuned to the frequency of the continuous wave signals. Each tiny impulse which is received by the receiving aerial, helps to build up the amplitude of the oscillations which finally operate the receivers. If the receiver is out of tune, there will be no response; consequently, the aim is to produce signals with the smallest possible decrement. In the case of spark transmission, the energy sent out must always be damped—with some systems more than others. When however valves, arcs, or high frequency alternators are employed for transmission, the signals are undamped.

Modulated continuous waves, such as produced by a wireless telephone transmitter may, however, cause effects at the receiver which are similar to the effects of a highly damped spark transmitter. A telephone transmitter radiates not a single frequency, but a band of frequencies. In other words communication takes place through a channel of frequencies. With most systems, if we assume the central wave—the carrier wave—to have a frequency of F cycles, the width of the channel occupied will be $(F + f) - (F - f)$ where f is the range of modulating frequencies. The frequencies generated by an orchestra may be from 200 to 5,000. If then the frequency of the carrier wave is 300,000 (corresponding to a wavelength of 1,000 metres), the frequency channel occupied will be from 295,000 cycles to 305,000 cycles, or a range of wavelengths of 34 metres. The shorter the wavelength, the less likely is interference to be produced. At the longer wavelengths telephony becomes impossible from the point of view of the range of wavelengths occupied. Interference is experienced, especially by those located near a telephony transmitting station.

34.—Choke Coils and Transformers.

Magnetisation of Iron.—When dealing with inductance, section 16, it was mentioned that the number of magnetic lines of force generated by a current flowing through a coil may be greatly increased by fitting an iron core. If we call the total number of lines of force F, the flux density, B, is evidently equal to $\frac{F}{A}$ where A is the area of the coil cross section. The flux density when the core is air is generally represented by H. This quantity is also known as the magnetising force. If now an iron core is fitted to the coil, the flux density increases from H to B, and the ratio $\frac{B}{H}$ is known as the permeability of the iron, represented by μ. It is evident the effect of introducing an iron core has been to increase the flux density μ times. For example, let the magnetising force H be equal to 100, and the flux density 100 lines when the core is air. If an iron core is fitted, and the permeability of the iron is 800, the flux density will be increased to 100×800 or 80,000 lines.

Different grades of iron and other magnetic materials vary considerably in their magnetic properties. If we plot curves (Fig. 72) showing the relation between flux density, B, and magnetising force H when the magnetic material is annealed sheet iron (curve Y) and cast steel (curve Z) we find that for a given magnetising force the flux density produced is different in the two cases. That produced in annealed sheet iron is greater. Another point to notice is the general shape of the curves. Starting from zero magnetising force, where the flux density is also zero, a small increment of H produces a large increase in B, until point A is reached. Here the curve is bending over, and for a given increase in B a much larger relative increase in H is

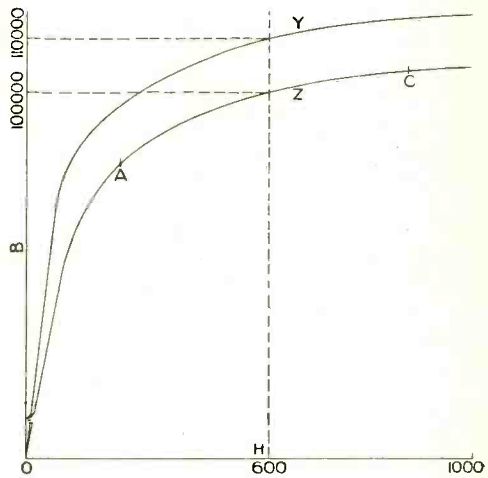


Fig. 72. Magnetisation curves of specimens of annealed sheet iron (curve Y) and cast steel (curve Z). The curves are the result of plotting the flux density B in lines per square inch against the magnetising force H. The curves are known as B—H curves.

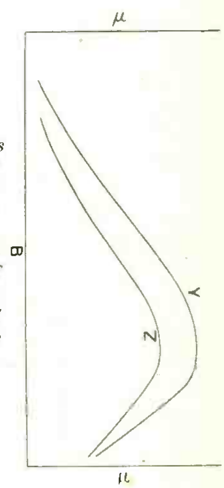


Fig. 73. The ratio B/H is known as the permeability of the magnetic material, and the curves show the permeability μ plotted against B. It will be noticed the permeability is high for small values of B. At the higher flux densities the value of μ is lower until when the iron or steel is practically saturated, μ is very small indeed.

required until, as higher values of H are reached, only a small response is secured by an increase in H. At this point (say point C) we have reached magnetic saturation, that is, the iron is saturated. Since the ratio $\frac{B}{H}$ is the permeability, μ, it follows that the permeability is a varying quantity. In Fig. 73 we have permeability curves for the annealed sheet iron (curve Y), and the sheet steel (curve Z). As we expect from the curves of Fig. 72, the permeability of annealed sheet iron at all flux densities is higher than that of the specimen of sheet steel.

When iron is subjected to a varying magnetising force, such as when an alternating current flows in the winding, power is lost in the iron due to hysteresis and eddy currents. The lost power appears as heat.

Hysteresis may be explained as follows :— Suppose we have a coil of wire wrapped round an iron core, and subject the iron to a complete cycle of magnetisation. In other words, starting from zero current we gradually increase the current to a certain value, then gradually decrease it to zero ; increase it again in an opposite direction and then decrease it to zero. It will be found the relationship between flux density and magnetising force is as shown in Fig. 74. Taking things step by step ; with zero value of H, B

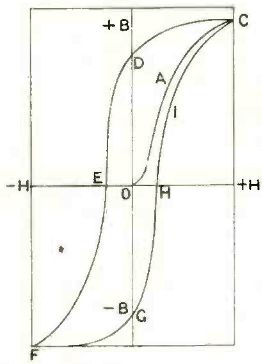


Fig. 74. The curves show the relationship between B and H when a specimen of iron is subject to a complete cycle of magnetisation. The magnetism lags behind the magnetising force which is known as hysteresis. The curve is a hysteresis curve.

is zero. As H is increased (by increasing the current), B increases as in the curve OAC. When point C is reached, and the current is reduced, the value of B falls as shown by CDE. But the value of B does not fall so rapidly as it increased, and, it will be noticed, when H is reduced to zero, the value of B is still considerable, as represented by OD. The amount OD, represents the residual magnetism. To reduce it to zero we require a reverse magnetising force equal to OE. The reverse magnetising force necessary to reduce the residual magnetism to zero is called the coercive force. If the value of H is further increased we obtain the curve EF, and by reducing H the value of B falls to G. If the current is now reversed, B may be reduced to zero again. This lagging of the magnetism behind the magnetising force is known as magnetic hysteresis. To produce a complete cycle of magnetisation the current must be reversed twice. The total amount of electrical energy lost in hysteresis is proportional to the area enclosed by the complete loop, $HICDEFGH$. The energy lost depends upon the quality of the iron, the volume of the iron, the number of magnetic cycles passed through per second, and the maximum flux density or $W_h = \frac{kVB^{1.6}f}{10^7}$

where W_h = watts lost in hysteresis
k = a constant which depends upon the quality of the iron.
V = volume of iron in cubic cms.
B = maximum flux density, lines per square cm.
f = number of cycles per second.

A few values of k are as follows :—

Stalloy (silicon iron) ..	0·0007
Transformer iron ..	0·0009
Soft iron wire	0·002
Good sheet iron	0·003

To keep hysteresis losses low, therefore, the flux density ought to be low, a good quality of iron used, and no more iron than is necessary. The frequency is usually determined by other considerations.

The other loss referred to, the eddy current loss, is explained as follows : Iron is a conductor of electricity—not so good as copper, of course, but still is a fairly good conductor.

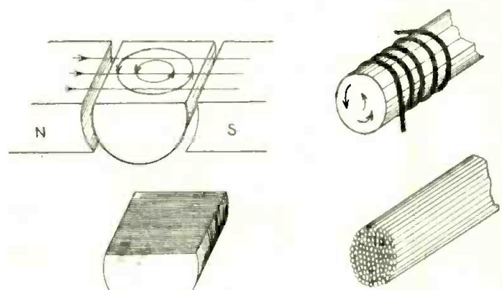


Fig. 75. A varying flux produces circulating currents in the core. The core is therefore split up or laminated so that there is considerable opposition to current flow. The arrows show the direction of the induced (eddy) currents, and the lower figures the method of reducing the magnitude of the currents by building the core of laminations or a bundle of iron wires.

It has been explained (section 18) how a voltage may be produced in a conductor by moving that conductor through a magnetic field, or, alternatively, by holding the conductor stationary and varying the strength of the field. Since in the above case the iron is cut by the lines of force as they increase and decrease through the rise and fall of the current in the coil, a pressure is induced, and currents circulate in the iron. The current which flows depends upon the specific resistance of the iron and the area. They tend to circulate in a plane at right angles to the magnetic field, as shown in Fig. 75. The remedy is to use an alloyed iron with a high specific resistance, and to laminate the core, that is build it up of thin sheets, and in some cases of fine iron wire. The sheets are often insulated with paper or varnish, one from the other. The effect is to provide a high resistance to the flow of current, without altering the magnetic properties greatly. Of course the volume of iron is now only perhaps 90% of the total core volume, the remaining 10 per cent. being insulation. This should be allowed for.

The eddy current loss $W_e = \frac{kVt^2f^2B^2}{10^{12}}$

where k = a constant (40·64 for sheet iron).
V = volume of iron in cubic inches
t = thickness of iron sheets in inches.
f = frequency.
B = flux density in lines per square inch

The points to notice here are that the loss may be reduced by reducing the flux density, the thickness of the iron laminations, and by using iron with a high specific resistance which varies the value of K. Laminations are usually 6 to 12 mils. thick. The volume and frequency are usually decided by other considerations.

It is evident that care must be taken to properly insulate the laminations. Bolts used to hold them together should be fitted in an insulating bush to prevent short-circuiting them, and the position of the bolts and their size should be carefully seen to. The edges of the laminations ought to be smooth, and we should not file them up when assembled, otherwise the effect of providing insulation is nullified.

Experimental Stations Heard.

The following is a list of amateurs' calls logged by Mr. H. L. Holt, of 25, Lamb Street, Longsight, Manchester, during the last six months on short wavelengths (180 to 240 metres).

Mr. Holt used an indoor aerial and two valves (detector and L.F., and occasionally H.F. and detector).

2 AW, 2 AX, 2 DX, 2 FP, 2 DF, 2 GW, 2 IN, 2 JF, 2 JO, 2 KF, 2 KT, 2 JZ, 2 KA, 2 LF, 2 LG, 2 MK, 2 NM, 2 NO, 2 OD, 2 ON, 2 KW, 2 OM, 2 UF, 2 VP, 2 VW, 2 VF, 2 VO, 2 VS, 2 VT, 2 WU, 2 XR, 2 SA, 2 TA, 2 TB, 2 QK, 2 YQ, 2 TX, 2 ZS, 2 VM, 2 WK, 2 KN, 2 XJ, 2 IT, 2 SP, 2 FN, 2 GG, 2 YT, 2 IJ, 2 PX, 2 TB, 2 WJ, 2 KX, 2 XR, 2 RP, 5 LJ, 5 CX, 5 GL, 5 MS, 5 MT, 5 LC, 5 DT, 5 LZ, 5 KO, 5 IC, 5 HI, 5 ZK, 5 NN, 5 BV, 5 WR, 5 RI, 5 DN, 5 IK, 5 OH, 5 HI, 5 IV, 5 FD, 5 BH, 5 GS, 5 MU, 5 XC, 5 CY, 5 FS, 5 QM, 5 ZU, 0 AA, 0 BQ, 0 DV, 0 MX, 0 NM, 0 NY, 0 YS, 0 FN, 0 YY, 0 XL, PCII, 8 AB, 8 AH, 8 AY, 8 AA, 8 AG, 8 ARA, 8 BM, 8 BF, 8 BJ, 8 BC, 8 BV, 8 CK, 8 CS, 8 CF, 8 BQ, 8 DP, 8 LBC, 8 XY, 8 TS.

Where are they ?

Experimenters who have heard the following calls would be glad to learn of the locality of the transmitters :—

5 IP, 5 GS, 5 ZV, 2 UF, 5 OW, 5 VM.

Reception in Scotland.

The following experimental transmitters have been heard at Port Seton, Scotland, by Capt. E. A. Anson :—

5 ST	Morse	April 29th	8.15 p.m.
5 IP	,,	May 27th	7 to 7.30 p.m.
5 WR	,,	June 16th	11 to 12.30 p.m.
5 GS	,,	June 17th	9 to 9.30 p.m.
8 BM	,,	June 24th	9 to 9.30 p.m.
8 AA	,,	Regularly.	

Unknown Calls with the Flewelling Circuit.

Mr. Louis J. Wood, Hon. Secretary of the Halifax Wireless Club, states that while experimenting late on the night of June 27th with a Flewelling circuit, using a transformer-coupled H.F. valve and reaction on to primary to avoid radiation, he heard **5 OW** and **2 UF** at loud speaker strength. **2 UF** stated that his radiation was 0·14 amps and that he was using grid control, and speech was good in both cases. It would be interesting to know the locality of these stations.

Using two H.F. valves and ordinary rectifier, states Mr. Wood, the signals were just audible in the telephones.

Further Notes on the Armstrong Super

To those who have experienced difficulty in the setting up of the Armstrong super-regenerative receiver, these notes compiled after considerable experimental work should prove most helpful.

By F. L. HOGG.

SOME time back some notes were published in the *Wireless World and Radio Review* on the Armstrong super by the writer, and as interest was shown, particularly in the single valve circuit, it was thought that further details might be of interest.

Experiments since conducted seem to show that the single valve circuit is the most satisfactory for all-round purposes. This circuit is shown in Fig. 1. The first point to note is that for satisfactory work a quenching frequency of not more than 15,000 cycles should be used, *i.e.*, well within audibility. This is a most important point with this circuit. Coil should be a 1,500 turn honeycomb and coil should have about 1,250 turns. The condensers across them should be of approximately 0·004 mfd. and 0·002 mfd. respectively. It has been found best to have variable coupling between the coils, and to not connect a condenser across their ends.

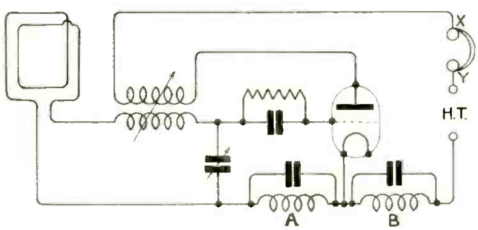


Fig. 1. Simple super-regenerative arrangement without filter circuit.

Some laboratory tests have shown that the secrets of the Armstrong are firstly, to obtain the correct grid voltage peak value from the oscillator coils, and secondly, to operate the valve at exactly the centre of its characteristic curve. The oscillator grid voltage, *i.e.*, the peak voltage impressed on the grid by the L.F. oscillator coils, is critical within very small limits, about 5 per cent. variation being sufficient to introduce distortion and loss of amplification. The valve must operate about its characteristic centre, as it is acting as an amplifier, and if it is used operating near a bend on the curve, it is obvious that distortion will occur. This means that a grid leak and condenser must be used, and that the H.T. battery must not be of too low a value. An H.T. voltage of 70 on an ordinary receiving valve is the minimum, and better results will be obtained from a purity point of view, on higher values, when of course the volume of sound is increased as well.

Having set up a super, generally the first thing the experimenter does is to try and get his nearest telephony station on his frame. This seems to be the easiest thing to do, but at short ranges from high power stations the Armstrong does not "super" except when very accurately adjusted. It is better to try on weaker amateur transmissions on 200 metres. On this wavelength the amplification is greater by about four times than on 400 metres, and is very much more easy to operate and to make work. A curve has been plotted showing the relation between amplification and signal strength, and it was found to be nearly a rectangular hyperbola.

The best way to get results is to tune in some weak telephony, and then start the large coils oscillating, and altering reaction coupling until some amplification is obtained. Then alter reaction coupling and oscillator coils simultaneously, increasing both until the best results are obtained, after which the grid leak should be adjusted. The correct value of the reaction coil is important. If, on altering the reaction coupling the H.F. oscillations stop and the L.F. oscillations begin with a click the reaction is too small. There should be a small band between the two forms of oscillations where a very loud roar is heard. If possible, a leak adjustable by means of a switch arm, such as can now be bought, should be used. This will be found to bring up the purity of the signal and improve amplification very much. With 70 volts H.T. on an "Ora," "AR," or "R" valve a grid leak value of ¾ to 1 megohm is about right. With 240 volts about 3-5 megohms are suitable.

Having adjusted the various controls, experiments may be tried with different filament currents and H.T. voltages, but long before this is reached, the experimenter will have, or should if the set is O.K., a bad headache, and a filter should be fitted. If the set works to its full capacity, a filter is an absolute necessity. For a really perfect filter the following parts are necessary: 2 variable condensers about 0·003 mfd. capacity (two 0·0015 mfd. variables and two 0·0015 mfd. fixed will do), two 10,000 ohm non-inductive resistances, and a small iron core choke. The method of connection is shown in Fig. 2. The filter is applied at the points X and Y instead of

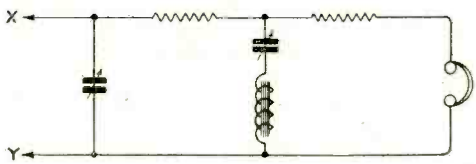


Fig. 2. Filter circuit for connection between telephones and telephone terminals.

the phones. By careful adjustment, the oscillator hum can be completely cut out. This filter will not affect the quality of signals received at all, and makes the set much more comfortable to work. Simpler filters can be made simply from a single condenser and choke, but these are not so effective, although they are quite useful. The successful operation of the super is about 20 per cent. common sense and 80 per cent. patience. It sounds fairly easy, but it takes a great deal of practice to operate it really well.

A great deal has been said about the super being unselective, but if it is really correctly adjusted the tuning is exceedingly sharp, being equal in selective properties to a single valve without super on a frame.

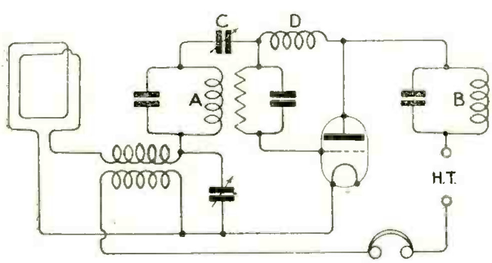


Fig. 3. An elaborated and particularly good super-regenerative circuit.

As would be expected, a large number of more or less freakish circuits have appeared. The now well-known Flewelling circuit is merely a single valve Armstrong using an "Eaton" oscillator consisting of condensers and resistances, instead of coils. Fig. 3 gives an excellent circuit due to Paul Godley of Ardrossan fame. Condenser C is about 0·002 mfd. maximum variable and coil D is a small radio frequency choke. The other components are of standard sizes. Coils A and B, the oscillators, are not coupled.

Fig. 4 at first sight looks rather unusual in arrangement. It consists of a regenerative detector and one-valve audio amplifier connected through a filter, the oscillator being replaced by a high-pitched buzzer or chopper giving a note of 5,000 cycles frequency. The coil A is coupled to the grid coil, and W is approximately tuned to the received wavelength, to function as a rejector to prevent absorption. The resistances are to govern the strength of the "oscillations." The chopper can be made from a high-speed

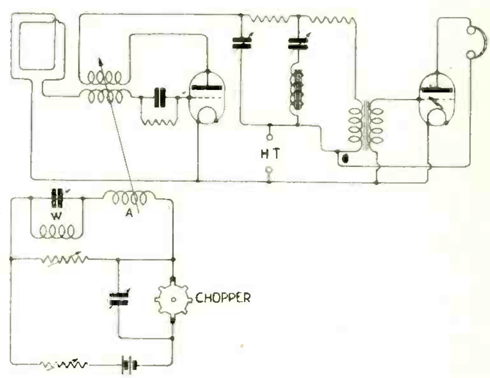


Fig. 4. In this circuit, damping is produced by a coupled circuit and interrupter.

motor with a disc having a very large number of sections, to interrupt the circuit. It might be mentioned that this circuit really does work.

Fig. 5 shows another very good type of circuit which uses a separate detector valve. The inductances A and B are wound on one tube 5 ins. diameter of 16 and 40 turns respectively. The condenser across A is 0·0003 mfd. C and D are the usual oscillator coils. The inductances A and B may be replaced by a high frequency transformer of the usual type. This circuit is fairly simple to handle

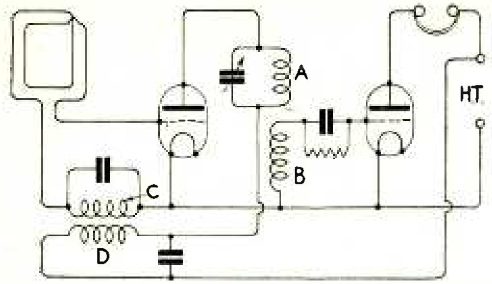


Fig. 5. Another circuit arrangement by which super-regenerative effects may be obtained.

and is worth while trying. Sometimes it is necessary to introduce a small coupling coil in the grid first valve circuit, to couple to the coil A, to produce extra reaction.

Fig. 6 gives an entirely new circuit. The inductances A and B are the oscillator coils and C is a "pick-up" coil of similar size. The inductances F and G are the two halves of a frame aerial. The fixed condensers in the frame circuit are 0·002 mfd. each. The procedure is as follows. The filament of the oscillator is extinguished and the H.T. on the detector reduced by the potentiometer to a suitable value. Signals are then tuned in, and the oscillator switched on. The H.T. is then increased until the signal is heard again, and adjustments are then made in the usual way. This circuit has many obvious advantages, besides being much more kind to the ears. The potentiometer across the H.T. should be of about 20,000 ohms resistance.

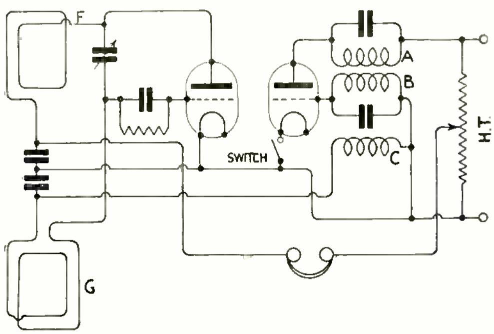


Fig. 6. An improved circuit embodying the super-regenerative principle.

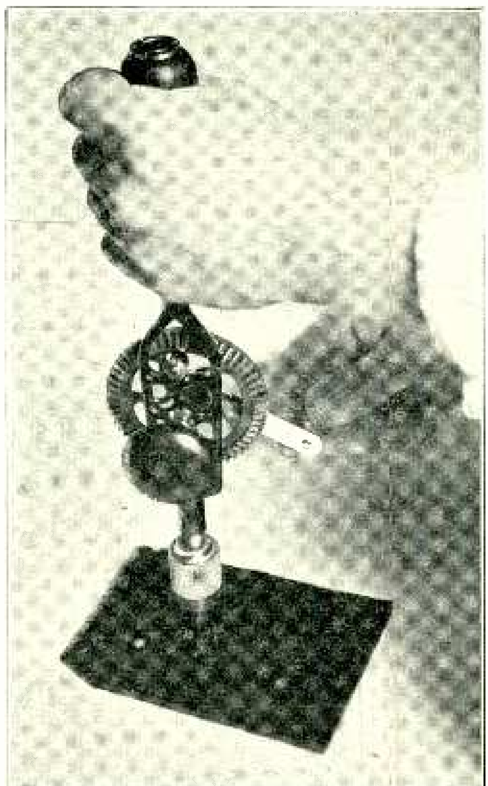
Any readers who try the Armstrong super will be assured of something to interest them for a considerable period, for the super-regenerative arrangement is a marvellous circuit when properly tamed.

In conclusion, I should like to acknowledge my indebtedness to Mr. H. Andrewes for some useful laboratory figures and data.

A Workshop Tip.

The difficulty of drilling vertically may be easily overcome by fitting to the top of the hand-brace a small circular pattern spirit-level of the type used in photographic work. As shown in the illustration, the level is attached to the top of the brace so that when the handle is grasped the bubble can be watched and maintained in the central position.

The importance of vertical drilling is very soon realised by the experimenter who attempts to make his own instrument panel,



Hand-brace fitted with spirit-level.

and unless one has a good deal of experience it is extremely difficult to be sure that the hole is entering correctly.

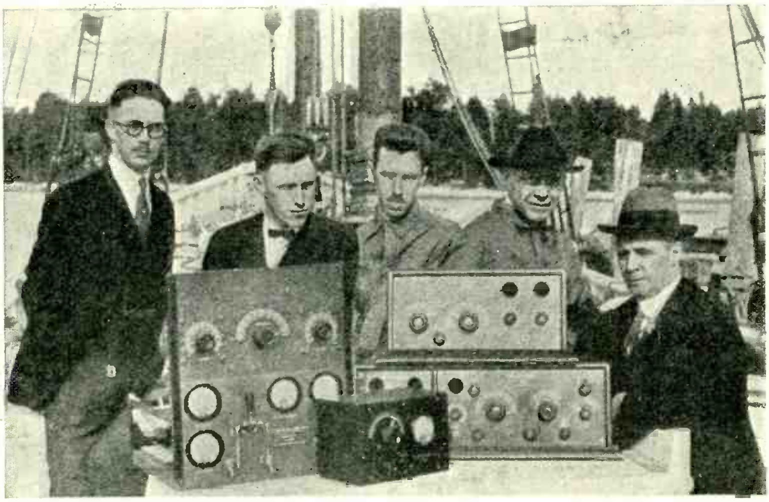
With this arrangement it will be found quite easy to watch the bubble while drilling the hole, and provided the material being drilled is lying on a horizontal surface, one can be certain that all holes are at true right angles to the face of the work.

Amateur Wireless in Polar Regions

An Opportunity for Long-Distance Reception.

FROM August 15th onwards British amateurs may have an opportunity of receiving wireless from the North Polar regions.

On June 23rd, an exploration party, under the direction of Dr. Donald B. McMillan, left Wiscasset, Maine, on a fourteen months' trip to the northern icefields, with the object of studying the flora and fauna in Ellesmere Land. Probably wireless amateurs will be more interested to know that the exploration ship, the *Bowdoin*, will endeavour to maintain wireless touch with civilisation. This attempt is being furthered by the American Radio Relay League, of which the operator, Mr. Donald H. Mix, is a member.



On board the "Bowdoin," which will send radio messages to members of the American Radio Relay League during the coming winter from Ellesmere Land, in the North Polar Regions. Left to right: Messrs. F. H. Schnell (Traffic Manager of A.R.R.L.), D. H. Mix (the ship's operator), K.B. Warner (Editor of "Q.S.T."), M. B. West (designer of the "Zenith" installation), and Dr. MacMillan (leader of the expedition).

Of great significance to experimenters in this country is the fact that the *Bowdoin* will be operating at a spot which is considerably closer to England than to an average point in the United States. There should thus be no more difficulty in receiving from the expedition ship in this country than in America.

After skirting the west shore of Greenland, the *Bowdoin* will proceed across Baffin Bay to Cape Sabine, and near here, at Flagler Bay, the ship will seek safe harbour, awaiting the long Arctic night when she will be frozen in for some nine months.

The expedition hopes to reach this spot by August 15th, and it is from here that Operator Mix, using the call sign **WNP**, will endeavour to communicate with members of the American Radio Relay League. Wavelengths of 185, 220 and 300 metres will be employed, the 220 metre wave probably being most used.

A weekly story of the expedition, about 500 words in length, will be sent from the ship to the North American Newspaper Alliance, the time of transmission being one o'clock every Monday morning (6 a.m. G.M.T.). Special efforts will be made by the A.R.R.L. to copy these messages, which may be in code or plain English. In return for the League's services, Dr. McMillan will permit operator Mix to communicate with amateurs, and to log the calls of all stations he hears during the trip. Each week **WNP** will send a list of calls heard to the A.R.R.L. Headquarters.

Mr. L. B. Warner, Secretary-Editor of *Q.S.T.*, the organ of the American Radio Relay League, suggests that "a pretty possibility exists for an international amateur relay *via* this station." The distance from the ship to either America or Great Britain is considerably less than the distance between those countries, and "we may have the privilege," says Mr. Warner, "of pulling off a relay stunt that will make the world sit up and take notice."

A PRACTICAL COURSE IN THE PRINCIPLES OF WIRELESS

EXPERIMENTS
FOR THE RADIO AMATEUR

By MAURICE CHILD.

Vice-Chairman of the Radio Society of Great Britain.

EXPERIMENT No. 11.

To utilise the valve as a low-frequency amplifier for increasing the strength of signals detected by the crystal.

The apparatus required will be as follows :—

3-contact tuner.
Carborundum crystal detector.
0.001 mfd. fixed condenser.
" R " valve.
6-volt battery.
60-volt battery.
Telephone transformer.
Intervalve transformer.
Pair 120 ohm telephones.
Filament resistance.
Potentiometer.
Four dry cells.
Two single pole switches.

The apparatus must be connected as shown in Fig. 20, by means of the sparking buzzer and the crystal adjusted as already mentioned in Experiment 9. When this has been done the valve may be switched on by closing the single-pole switch in the filament circuit.

The tuner may be adjusted as already indicated, by means of the wavemeter, and incoming signals will be heard with increased strength. The experimenter should take this opportunity of connecting the wire marked "X" to either the negative terminal of the accumulator battery or to the negative terminal of the filament. It will probably be found that if the signals received are weak, that 30 volts on the high tension battery with the wire marked "X" joined to the filament direct, will give as strong signals as when a 60 volt battery is employed.

With the latter voltage, however, it will generally be found that a considerable increase of strength is produced when the wire "X" is connected to the negative of the 6-volt battery. In order to understand exactly why this is so, the experimenter should refer to the curves which he should have plotted for his valve (Experiment 10).

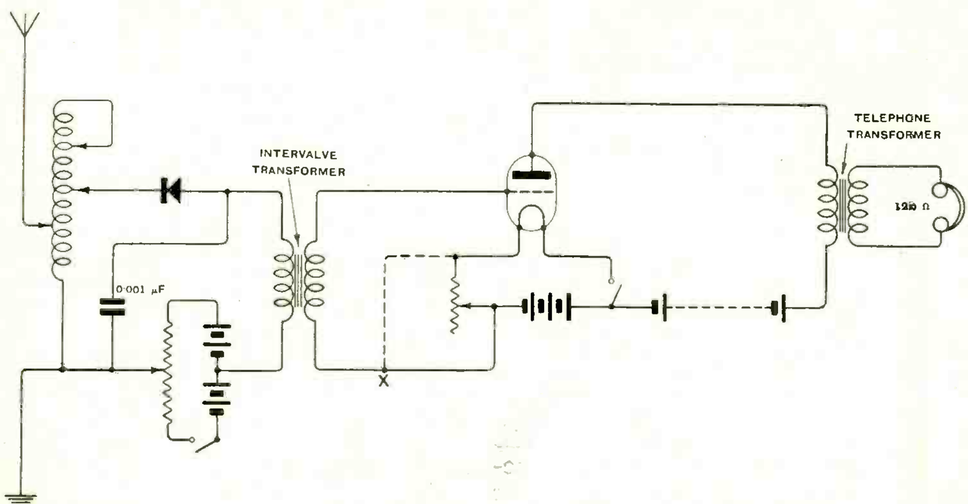


Fig. 20. Experimental circuit for demonstrating the action of a valve as a low frequency amplifier.

With regard to the intervalve transformer, the same remarks hold good for this as those given already in relation to the telephone transformer in Experiment 9. The primary has the fewer turns, and is included in the crystal circuit. The experimenter should try out the four possible ways of joining in the terminals of this transformer and give the benefit of his experience in this respect to the members of his society.

EXPERIMENT NO. 12.

To utilise the valve as an amplifier for high frequency currents before detection by the crystal.

The apparatus required is as follows :—

3-contact tuner.
"R" valve.
Filament resistance.
6-volt battery.
60-volt battery.
3 or 4 different sized fixed inductance coils.
0.0005 mfd. variable condenser.
0.001 mfd. fixed condenser.
0.006 fixed condenser.
0.5 mfd. fixed condenser.
Carborundum crystal detector.
Telephone transformer.
Potentiometer.
Two single-pole switches.
Four dry cells.

The apparatus must be joined up as in Fig. 21. It will be noted that the plate circuit of the valve includes an inductance with a variable condenser across it. The size of this inductance will be determined by the wave range over which it is desired to receive.

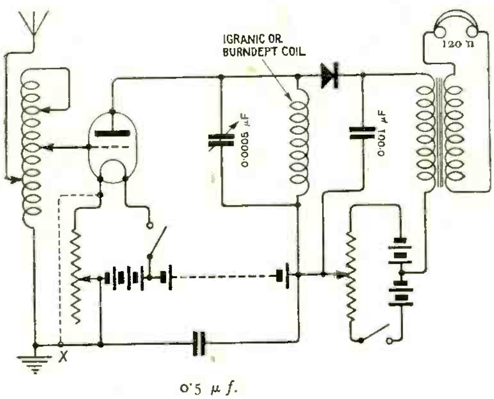


Fig. 21. This circuit is employed to amplify the oscillations prior to detection by the crystal.

The experimenter should have no difficulty in selecting suitable coils as he has already used these in previous experiments. The coil selected should be such that when one-third to two-thirds of the variable condenser is employed, the circuit will be tuned to the wavelength desired. In any case, he can easily test the wavelength to which the plate circuit will respond, by means of the wavemeter placed in close proximity to the inductance coil in question. The potentiometer is used for adjusting the crystal to its optimum sensitiveness.

Having determined the wavelength it is desired to receive, the wavemeter is set accordingly, and the 0·0005 mfds. variable condenser is varied until the maximum strength from the wavemeter buzzer results. The valve is now switched on, and the three slider tuner is adjusted until maximum strength is again obtained from the wavemeter, being placed close up to the tuner itself. A slight final adjustment of the 0·0005 mfds. condenser will be found necessary for maximum strength.

The success of this experiment depends very greatly on the general lay-out of the various pieces of apparatus.

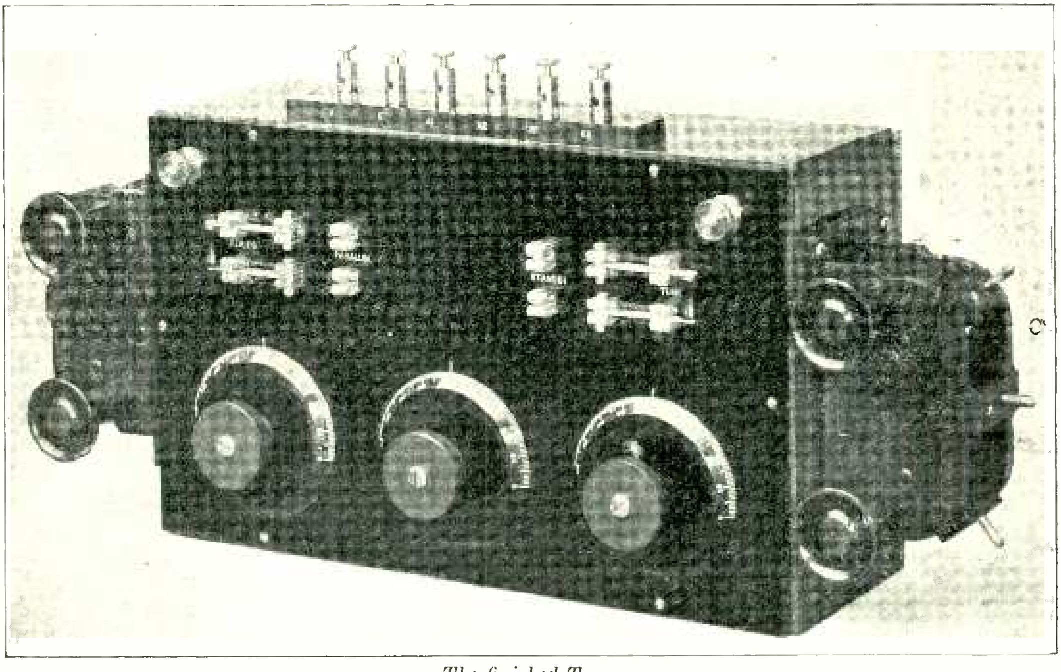
It is important that the tuner is kept at least one to two feet away from the plate circuit coil. This coil should be set up so that its plane is at right angles to that of the tuner inductance. Care must also be taken that the potentiometer, with its dry cell battery, crystal detector and telephone transformer, stands on some good insulation such as a board with small ebonite feet to support it an inch or two off the table. The apparatus joined in the manner described is extremely efficient for the reception of very weak signals. The experimenter will find that with strong signals the arrangement of Experiment 11 will produce louder results, but with this circuit it should be possible for him to hear signals which would otherwise be quite inaudible with the arrangement of apparatus in the previous experiment. The wire marked "X" may be tried connected to the negative end of the filament itself, if only 30 volts or so are employed from the high tension battery, but attention is here directed to the remarks made towards the end of the previous experiment. The position of "X" for best results varies for different valves and the H.T. volts employed with them.

THE TUNER

AN INSTRUMENT FOR TUNING AERIAL, CLOSED, AND HIGH FREQUENCY CIRCUITS.

By F. H. HAYNES.

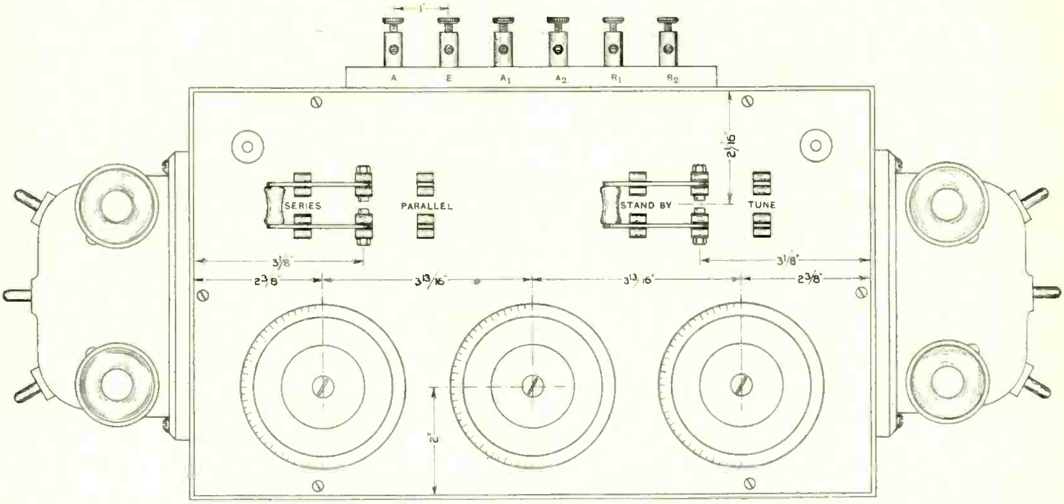
ONE of the most valuable instruments that the experimenter can possess is a tuner arranged to cover the whole wavelength range efficiently, and designed so that the operation of tuning a number of circuits simultaneously is a simple process by virtue of the disposition of the components on the panel. Whatever circuit principle is embodied in the detecting or amplifying apparatus, a tuner built on the lines of standard practice is needed, and the one described below is arranged so that it can form part of almost any receiving system. Details are given not with the idea of introducing anything new or novel, but to provide the reader with an instrument of well-tried design and simple construction.



The finished Tuner.

The adoption of a closed circuit coupled to the aerial circuit is essential, and by its use advantages such as increased signal strength, considerably improved selectivity and better operation of the high frequency amplifying circuit, if used, are obtained. Many experimenters hesitate to make use of a tuned closed circuit, but it must soon be realised that a single circuit tuner is only employed to make adjustment easy in the hands of a beginner. Unless both the aerial and closed circuits are in tune with the incoming signals, nothing will be received, and thus it becomes necessary for the two circuits to be adjusted to corresponding wavelengths simultaneously. To simplify this operation the instrument is fitted with a double pole two-position switch, which, when on the left-hand side, labelled " stand-by," throws the closed circuit out of action so that the aerial circuit alone can be adjusted to produce maximum signal strength. The closed circuit can then be introduced by moving the switch to the " tune " position, and the closed circuit condenser adjusted with the closed circuit inductance close up to aerial inductance. Improved selectivity is obtained by moving the two inductances apart, and slightly readjusting the setting of the condensers.

and the front one for the reaction inductance, so that reaction can be made use of when in the "stand-by" position. The coil holder on the right-hand end is provided to carry



The Tuner.

Scale drawing showing the relative positions of the components. The wood is cut away at the top to give clearance for the nuts and stems of the terminals, and the coil holders are screwed to the ends of the box.

If the tuner is to be used with a crystal detector the latter will be connected in series with telephone receivers bridged with a 0·001 mfd. condenser, and connected across terminals A and E, and only two coils, for the aerial and closed circuits, will need to be inserted in the left-hand coil holder. The centre socket of this holder is for the aerial inductance, the rear one for the closed circuit, the tuned anode inductance of a high frequency amplifying circuit, so that the reaction coil can be coupled to it. This is done by wiring the front socket across to the corresponding socket on the other holder in order that the inductance can be transferred from one side to the other, according to whether it is desired to react on to the aerial circuit or the tuned anode inductance, the latter

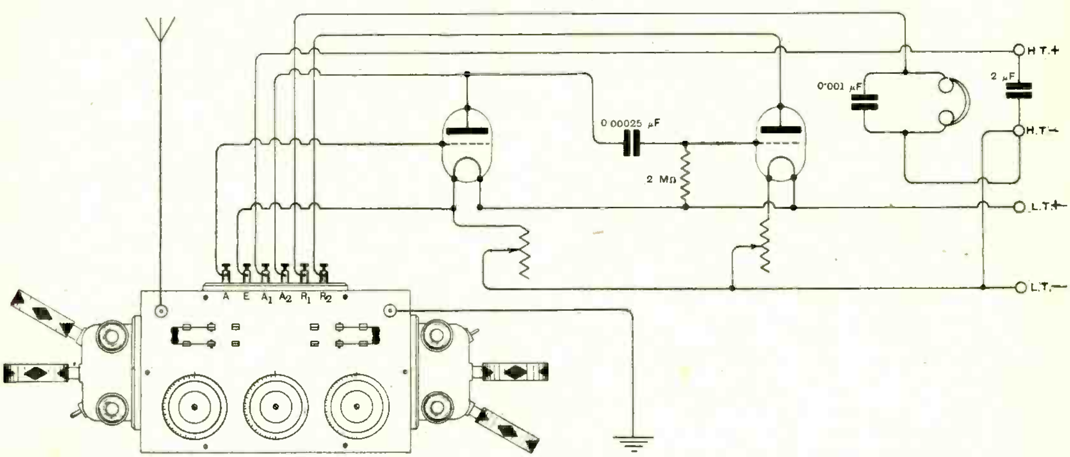
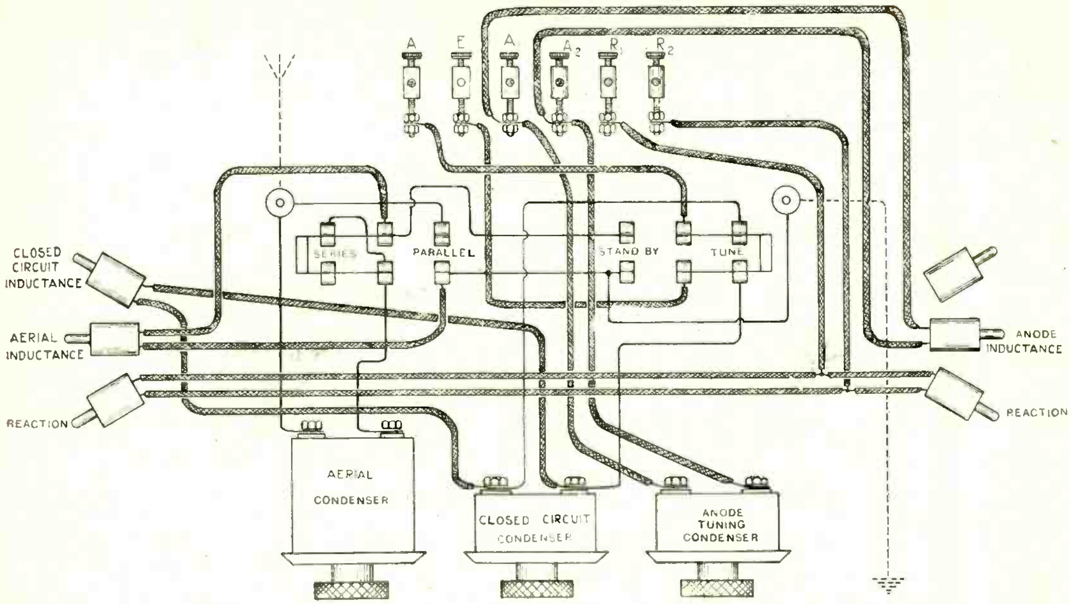


Diagram showing the method of connecting the tuner in circuit with a high frequency amplifier and detector valve set.

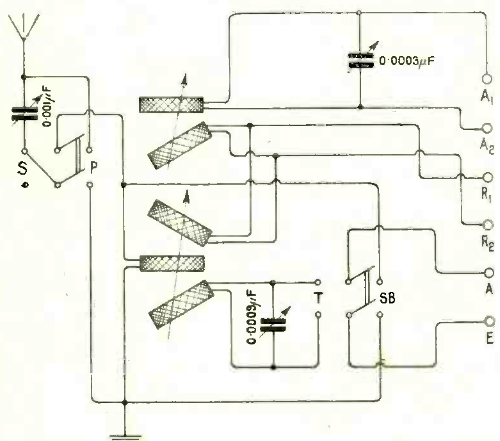


Wiring Diagram. Wiring up is carried out with flexible wire between terminals and coil holders and No. 16 S.W.G. tinned copper wire between condensers and switches. Tests must be made to determine the correct direction for connecting up the leads to the reaction coil sockets.

being accommodated in the centre socket of the right-hand coil holder.

The closed circuit and anode tuning inductances are arranged next to one another as it is necessary to tune the two circuits at the same time. If equal inductance coils are used in both these circuits and the condensers are well matched, their settings should be approximately equal in all positions.

Mention might be made of the left-hand switch, which is for the purpose of connecting the aerial tuning condenser in series or parallel with the aerial inductance, the former position being generally used for tuning to short wavelengths.



Circuit diagram from which the principles can be readily seen.

Regular Transmissions.

Our readers will no doubt be interested to know that we are about to re-introduce as a feature in this journal information regarding regular transmissions likely to be of general interest. Taking the regular transmissions sheet published in our issue of June 16th as a basis, the supplements will give additions and corrections from time to time, so that those who desire to keep this information complete will be supplied regularly with new information and additions which can be incorporated.

For the benefit of those who may not have already started to employ a card index for this purpose, it may be pointed out how very convenient a method it is for keeping a list up-to-date.

Transatlantic Amateur Transmissions.

A statement appeared in our Editorial in the issue of June 30th, where reference was made to the British transmissions during the Transatlantic tests, which is perhaps misleading. As a matter of fact, the stations which worked around 400 metres were not successful in transmitting across the Atlantic, and those which did succeed were working more nearly on 200 metres. The successful transmissions by the station **5 WS** were made on 215 metres. Mr. Coursey expressed the opinion at the time of the tests that the problem of transmission on small power across the Atlantic was probably simpler on 200 metres than on **440.**

Notes and News

The largest broadcasting station in the world, it is stated, is being erected at the Ford motor car works.

* * * *

Wireless sets attached to guide books, for the reception of bulletins on the state of the roads, was a suggestion made at a recent meeting of the Automobile Association.

* * * *

What is stated to be the largest frame aerial in existence has just been erected at the United States Shipping Board Headquarters at Bush House, Strand, London.

* * * *

Sir L. Worthington Evans, replying to Sir H. Brittain in the House of Commons on July 3rd, said he had received very few complaints as to the efficiency of the present system of broadcasting.

* * * *

Of Importance to Transmitting Licence Holders.

A meeting of transmitting licence holders is to be held on Friday, July 20th, at 6 p.m., at King's College, Strand, London, W.C.2, with a view to the formation of a Society of Experimental Transmitters in the London area.

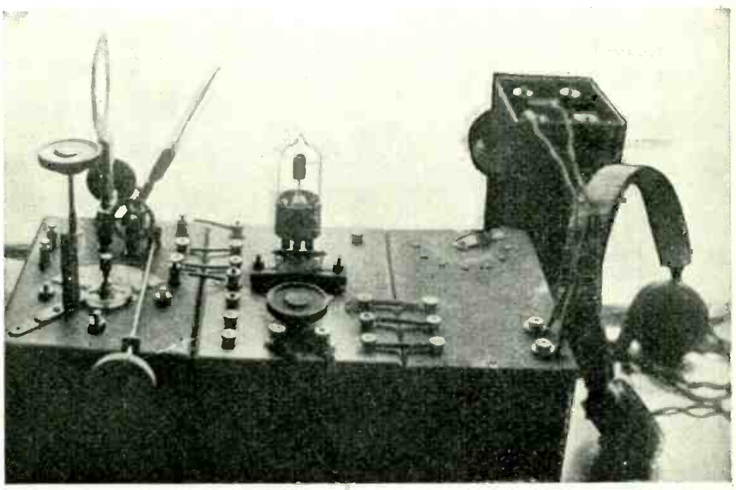
That Dangerous Aerial.

The Urban District Councils Association of England and Wales is considerably perturbed, if not alarmed, at the rapid increase in the number of private aerials. All kinds of dangers are portended from their widespread use, and one cannot but admire the mental resource of those who make if their business to decry what is new. Damage by fire, insecurity, masts in dangerous proximity to public roads, and fences and chimneys becoming dangerous through attachments of aerial apparatus, are among the horrors enumerated by Mr. A. Partington, of Ilford, who spoke at the Association's Conference at Llandudno on June 30th. Mr. Partington appears to have forgotton the peril of tripping over slack aerials in the dark, and even of strangulation from the same cause. If we had time we might invent a few more.

American Broadcasting on Single Valve.

The reception in England, with a single detector valve, of the American broadcasting station WGY, (Schenectady, New York), is the achievement of Mr. J. H. Brittain, of Patricroft, near Manchester. Our photograph shows Mr. Brittain's set, as used on the occasion referred to, when WGY announced the transmission of a drama entitled "Secret Service." The play, which our correspondent describes as "real American hot stuff," was received perfectly.

The aerial, of the single wire type, was approximately 65 feet long and 30 feet high, and the lead in, after entering the house, was 34 feet in length—hardly conforming to the best accepted practice. Earth connection was made with the gas pipe near the meter. Basket coils, seen on the left of the photograph, were employed, and the valve was of Dutch make, taking 40 volts on the plate. Mr. Brittain would like to know if any other experimenter has received American broadcasting on "such a ragtime set" as his.



A single-valve set which received American broadcasting in England. The owner is Mr. J. H. Brittain, of Patricroft, near Manchester.

B.B.C. Congratulates the Radio Society.

An interesting announcement was made from 2 LO, the London Broadcasting Station, on Monday, July 5th, when Mr. A. R. Burrows spoke as follows :—

"We understand that to-night is the tenth anniversary of the foundation of the Radio Society of Great Britain, originally known as the Wireless Society of London, which institution is now the parent of close on two hundred Radio Societies throughout the provinces.

"Three of the original officers of the Committee, Messrs. L. MacMichael, R. H. Clyne, and L. F. Fogarty, have held office for the whole period of ten years.

"It is interesting to note that the First General Meeting of this Society was held at the Institution of Electrical Engineers, which is almost directly beneath the present studio of the London station and at that meeting General Ferrié sent a special message of congratulation, which was received on a crystal set and projected by an inking device and lantern on a screen in the hall.

"To-night, it is with pleasure that we project in quite a different manner another message of hearty congratulation to this Society and to the thousands of experimenters affiliated to it."

Amateur Call Signs.

It is regretted that an error occurred in the Directory of Experimental Transmitting Stations, published in our last issue. The call sign **5 DT** is not as stated, allocated to the station of Messrs. Hutchinson, of Forest Hill. **5 DT** is, nevertheless, situated in the Forest Hill district.

Broadcasting from Koenigswusterhausen.

We are informed by a northern correspondent that the following particulars of transmission are stated in a letter he has received from the Director of the above station :—

From 7 a.m. to 10 p.m. news is broadcast practically continuously on a wavelength of 4,000 metres. No regular times have been arranged for concerts, but, until further notice, it is probable that a concert will be broadcast on Sundays from 11 a.m. to 1 p.m. on wavelengths of 2,700 and 4,000 metres.

FORTHCOMING EVENTS.

FRIDAY, JULY 13th.

Leeds and District Amateur Wireless Society. Lecture: "The Propagation of Aether Waves," by Mr. W. G. Marshall.

The Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove. Lecture and demonstration on "Direction Finding," by Messrs. H. Andrewes and F. G. S. Wise.

SATURDAY, JULY 14th.

Sydenham and Forest Hill Radio Society. At 3 p.m. Visit to **5DT** transmitting station.

Plymouth Wireless and Scientific Society. Visit to "Galva," near Plympton, by kind invitation of Capt. Silverlock (meet at Plympton at 2.45 p.m.).

SUNDAY, JULY 15th.

Radio Society of Highgate. At 11 a.m. Direction finding competition.

MONDAY, JULY 16th.

The North London Wireless Association. At 8.30 p.m. Lecture: "Manufacture of Radio Sets," by Mr. E. E. Wright.

Ipswich and District Radio Society. At 55, Fonnereau Road, Ordinary Meeting.

Hornsey and District Wireless Society. Lecture: "Tuned Anode and Other Methods," by Mr. J. A. Price.

TUESDAY, JULY 17th.

Plymouth Wireless and Scientific Society. At 7.30 p.m. At the Y.M.C.A. Building, Old Town Street. Buzzer practice. At 8 p.m., General Discussion.

WEDNESDAY, JULY 18th.

Radio Society of Great Britain. Visit to G.P.O. Wireless Station at Northolt and G.E.C. Laboratories, Wembley.

THURSDAY, JULY 19th.

Hackney and District Radio Society. At the Y.M.C.A., Mare Street. Chat on Building and Working of Variometers.

Lewisham and Catford Radio Society. At 136, Bromley Road, Catford, S.E.6. Lecture: "Aether Waves and How they are Produced," by Mr. H. M. Stanley.

RADIO SOCIETY OF GREAT BRITAIN.

On Wednesday, 18th July, members of the Radio Society of Great Britain will visit the Post Office Wireless Station at Northolt and the Laboratories of the General Electric Company at Wembley. The party will leave Kingsway by motor charabancs at 2.15 p.m. Arrangements will be made for tea during the afternoon. Notices are being circulated to all members.

The next ordinary general meeting of the Society will take place on Wednesday, July 25th, at 6 p.m. (tea at 5.30), at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, when Mr. Philip R. Coursey, B.Sc., F.Inst.P., will deliver a lecture entitled "Resistance - Coupled Amplifiers."

The Schools Radio Society.

Rapid steps are being made towards the formation of the Schools Radio Society, the particulars and aims of which were set forth in our issue of May 26th. The following is a list of schools known to possess wireless sets, and those marked with an asterisk have already expressed their desire to join the organisation :—

Bradford—Hanson School.*
Bishop's Stortford—The College.
Bushey—Royal Masonic School.
Brighton—Central Boys' School.*
Beddington—Bandon Hill School.*
Cheltenham—The College.
Dover—County School.
Durham—Fence Houses, New Lambton School.*
Edinburgh—Pettes College.
Ealing (Little)—Llamas School.*
Exeter—Grammar School.*
Godalming—Charterhouse.
Guildford—Grammar School.
Guildford—Technical School.
Haslemere—Grayswood School.*
Halifax—Holy Trinity School.*
Harrow—Harrow School.
Harrogate—Grammar School.*
Harlesden, N.W.—Acton Lane School.*
Jersey—St. Heliers Boys' School.*
Limpsfield—Hazelwood School.*
London—Mill Hill School.*
London—Beaufoy Institute.*
London—St. Olave's School, S.E.
London—William Ellis Endowed School.
Littleborough—Central School.*
Lowestoft—Central School.*
Lowestoft—Secondary School.
Merton, S.W.—Rutlish School.*
Newton-le-Willows (Yorks)—Aysgarth School.*
Oundle—Oundle School.*
Peterborough—Kings' School.
Pangbourne—Nautical College.
Rochdale—Greenbank Council School.*
Rotherham—Wickersley School.*
Silsden (Keighley)—Hothfield School.*
Sherbourne—Sherbourne College.*
Sittingbourne—Council School.*
Stamford—Grammar School.*
Tranent—H. G. School.*
Wakefield—Grammar School.*
Wakefield—St. Catherine's School*
Widnes—Central School.*
Winchester—The College.
Wimbledon—Wimbledon College.*
York—Bootham School.*
Additional—25 L.C.C. Schools.

Correspondence regarding the proposed Society should be addressed to R. J. Hibberd, Organising Secretary, Schools Radio Society, c/o *The Wireless World and Radio Review*, 12/13, Henrietta Street, W.C.2.

Methods of Reducing Interference in Wireless Receiving Sets.

By Prof. E. W. MARCHANT.

(Discussion continued from previous issue.)

A Member.

As the question of local interference, due to machines running in the same building or in a neighbouring building, has been mentioned by two or three speakers this evening, I might add a brief note to the same effect. I have been working for years in a building which is simply a cage of wires, some of which are connected to the 220-volt local supply, some to our own 100-volt supply, and so on, and we get an enormous amount of disturbance, which I have always put down to commutator ripples and sparking produced at the commutators. In fact, during working hours there is certain to be at least one motor running in the building, and almost the only chance of getting any really quiet reception is in the evening, or occasionally on a Wednesday afternoon half-holiday. I have used an ordinary earth, a water-pipe earth, a copper netting in the basement, and a small frame aerial—2 ft.—with no earth, but the disturbance is much the same, and it seems to be equally strong whatever you do with any of these arrangements. With a loop aerial—quite a small aerial—I can almost cut out the disturbance in a certain direction, or, at any rate, reduce it to a minimum. If I want to listen to signals on the loop aerial, there is one position in which I can turn the loop aerial at which the disturbance from these motors is a minimum, but the rather odd thing about it is that if I change the wavelength and try to listen to other signals I have got to change the position of the loop aerial again to get the minimum disturbance. That is simply a mystery to me at present, and perhaps some others who have had experience will be able to suggest a reason for it.

Mr. A. J. Bull.

With reference to machinery noises mentioned by several speakers, I have had experience with that at a land station at Parkeston Quay, which station is situated quite near a power house; in fact, it is adjoining the power house. For some time we have had a little trouble with the 600-metre wavelength, due to machinery noises, and I traced the trouble to a D.C. motor which was fed by a 220-volt D.C. supply. I took the

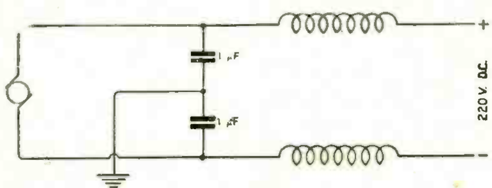


Fig. A.

trouble to take a wavemeter and place it near the motor leads, and I was able to pick up 600 metres on the wavemeter easily, but when I altered the length of the motor leads I lost the 600 metres. I should like to show you the method I adopted which eventually got rid of that interference. (See figure A).

The motor is fed with 220-volt supply. I tried to alter the length of the leads as they happened to send out a wavelength of 600 metres, owing to their length and to the sparking at the commutator. Two condensers of 1 microfarad each were placed across the leads and the centre earthed, but that only minimised the interference. I then thought that if I placed a large inductance in the leads (see figure) I should still further reduce a lot of the interference. The inductance was a temporary one, and consisted of two hanks of 7/22 copper wire, and that considerably decreased the interference. In fact, we were no longer troubled with it.

The President.

The text this evening has been the search for peace or tranquillity, but in wireless we can no more find it than in politics. Probably the most peaceful place on earth is in the middle of the Pacific Ocean, where there are very few machinery noises, very few atmospherics, and no broadcasting stations. The North Pole would be better still, because there would probably be no lightning or thunderstorms there; but that, again, is remote. Here we shall always have these troubles of interference from natural and artificial sources. The last method of prevention illustrated on the board reminds me of similar attempts at that kind of solution where machines were concerned, and one I have seen used on ships consisted of condensers such as shown in Mr. Bull's sketch, with resistances in series, so as to damp any oscillatory current that went through the condensers. The device of putting an inductance in is no doubt useful. With regard to atmospheric and similar disturbances, however, probably the very best solution that has been arrived at as a general solution is the use of directive methods of reception. If you can use a loop, as one of the speakers said, you can usually cut out a great deal of the nuisance, whether it is natural or whether it is artificial. The natural disturbances, the atmospherics, that are most easily cut out are those that come from long distances. The natural atmospheric disturbances not easily cut out are those that come from local storms. The weather within 100 or 200 miles always contributes a few strays to every station, and what the meteorologists call convective weather, *i.e.*, weather in which the atmosphere is rising or falling in large masses over large areas, which produces rain or other changes, such as lightning storms, always produces these strays or atmospherics even when it is 100 or 200 miles away. As we cannot abolish weather, we shall never abolish atmospherics, and the cure, as I say, for these local atmospherics has not yet been found. The only general deduction one can draw from all the things that have been tried during the last 25 years seems to me to suggest successive applications of dilution and filtration as the best remedy. By the use of a loose coupling we dilute the mixture of strays and signals; then use sharp tuning in order to exalt the signal relative to the atmospherics. Then amplify the result and apply another loose coupling, *i.e.*, dilute the mixture again. Use resonance in the next circuit to exalt once more the signal. Then magnify again, dilute by another loose coupling, and proceed as before as many times as desired. The Hinton circuit, for instance, is applying the principle of using very fine tuning in a circuit which is very slightly damped, that is highly resonant. I will now ask Professor Marchant to reply, if he wishes, to some of the questions.

Prof. E. W. Marchant (in reply).

Mr. Coursey has referred to the difficulty that may arise when receiving signals from a near-by station due to the antenna being set in oscillation at its natural wavelength. The most effective way of getting rid of this difficulty is, I think, to insert a resistance in the aerial circuit. As I have said in my paper, with an ordinary P.M.G. aerial tuned to about 400 metres, and assuming the effective capacity to be 500 micromicrofarads, the resistance necessary to make the aerial aperiodic is about 800 ohms. If the aerial is aperiodic it cannot be set in oscillation, and if the secondary circuits are screened from influences other than those coming from the aerial, there ought to be an almost entire elimination of disturbance. We have tried resistances up to 2,000 ohms in our circuit here with great success. The signal strength is not cut down as one would have anticipated with such high resistance, and the interference has been greatly reduced. Mr. Coursey has referred to the use of reaction. I think the amount of selectivity that is gained by using reaction is much greater than the increase in noise heard in the receiver due to its being more sensitive to interference. I was very interested in Mr. Coursey's observations as to the effect of weather on signals. His result, that when the weather is damp signals are good over long distances, is in agreement with what we have found in tests made here many years ago.

Mr. Child has referred to the interference due to telegraph instruments working in a building 30 or 40 feet away from the cabin in which he was receiving signals. At first sight it seems remarkable that the disturbance should be greatest when the apparent resistance of the earth is high. I think the cause of this must be that when the earth resistance is high, the earth currents due to telegraph apparatus must be transmitted to a greater extent to the earth lead which is used in connection with the wireless receiver. The change in disturbance cannot, I think, be due to the change in the resistance of the earth circuit of the wireless receiver alone, since an increase of resistance in this earth would tend to reduce the disturbance rather than to increase it.

Mr. Carpenter has referred to the differential atmospheric eliminator which I mentioned. As I said in my lecture, I have had no experience with this eliminator, but I think it should work quite successfully if resistance is put in the aerial circuit, so that there is no possibility of the aerial being set in oscillation at its natural frequency by the disturbing signal. In order to get balance between the effects produced in the two circuits, it is not necessary that the frequency, amplitude and phase of the currents produced in the two secondaries should be the same. The transformer is a low frequency transformer, and only carries the rectified current produced when the signals are rectified by the valves. Provided, therefore, the two currents produced in the secondaries are about the same strength and the decrement of the two circuits is about the same, there should be a good balance for a disturbance which has a frequency very different to that to which either of the two circuits is tuned. Of course, if the disturbing signal is of a frequency closely approximating to that of the two circuits, it will not be blotted out, since one of the circuits will respond very much more strongly to the interference than the other. I have already referred to the calculation of the resistance in the aerial necessary to make it aperiodic. As Mr. Carpenter says, the devices designed by Weagant take up a great deal of room, the control of the circuits is, I understand, effected by installing telephones to communicate with operators placed at different parts of the system in order to get proper control. I do not think that it will be necessary to use anything so elaborate to get rid of disturbance for receiving ordinary broadcasted messages. The methods used by Mr. Weagant are interesting, and may perhaps be modified in some cases for practical short wave reception.

With regard to Mr. Rivers Moore's question, I have not applied the Hinton rejector circuit direct to the aerial. It gives equally good effects, I believe, in this way, but, of course, it is a circuit with reaction, and there is always the risk of oscillations being produced by it, so that I do not think it will be safe to use it on an ordinary receiving aerial.

With regard to the problem of getting rid of local interference, Mr. Rivers Moore, I think, is right in thinking that it is very largely due to sparking at commutators, and it also is due to arcs. We have almost got rid of it in our receiving set in Liverpool except for one machine, which appears to produce a wave near to 400 metres. The only way to cure the disturbance due to this machine will be, I think, to shunt it by a shunt tuned for 400 metres wavelength. Resistance in the aerial circuit is a very great help in reducing disturbance.

Mr. Reeves refers to the electrostatic coupling which takes place as well as the electromagnetic coupling. I think most workers in wireless will have noticed the effect of static coupling. We found the other day, when trying a rejector circuit, that we could tune it by moving one reaction coil in relation to the main coil, although the reaction coil was disconnected from the circuit. This effect of electrostatic coupling can, of course, be calculated from the dimensions of the circuit.

Mr. Fogarty asks about the methods which have been used in making records with the Cathode Ray Oscillograph. I understand that the curves traced out by the cathode rays were sketches by hand, two observers making similar observations. If the observers agreed in their opinion as to the shape of the curve, then the record was taken as good. The actual time the trace lasts is longer than that taken by the atmospheric discharge to make it, since there is a certain amount of phosphorescence on the screen.

With regard to Mr. Blake's difficulty, I should think he could get over it by arranging for a special shunt to be attached to the motor which is giving him so much trouble in order that the wavelength for which his aerial is tuned may be eliminated from the disturbing motor circuit. This could be done quite easily by using a condenser and inductance so adjusted that they are tuned for the wavelength that he wishes to receive. Reaction, of course, must not be used on the aerial circuit, but if it is used on one of the circuits far away from the aerial, the Post Office regulations allow it.

Mr. Cudden has referred to the use of a separate heterodyne oscillator for reducing disturbance, the circuits being tuned to the beat frequency. I believe this method has been used by Dr. Nicholls and others in connection with experiments made last February by the Western Electric Co.

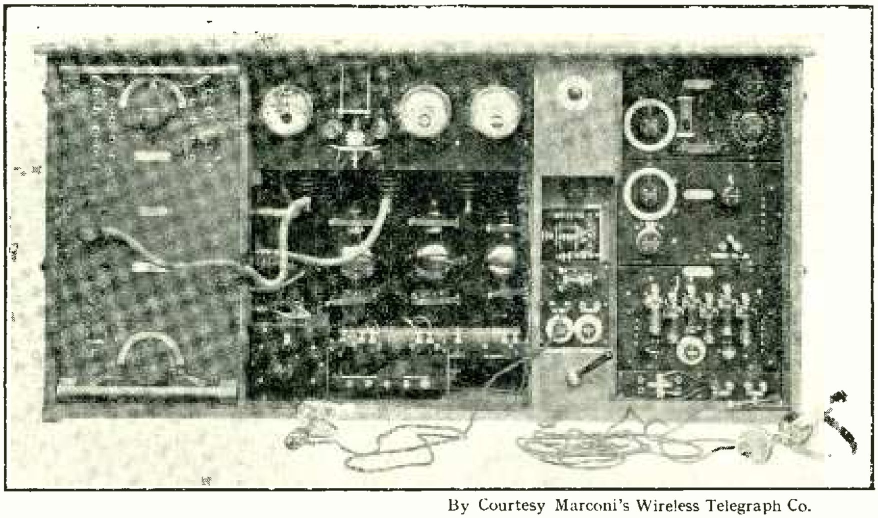
Mr. Read asks whether there has been any serious disturbance with arc stations. The wavelength of the arc stations is usually too far away from that of a set which is used for listening in that they do not cause any great trouble. We have found, however, considerable disturbance from arc circuits. I noticed this only the other day when using our short wave set for receiving broadcasted messages. There is a high frequency variation in the current coming to the arc which causes noises in the wireless receiver. Resistance in the aerial circuit seems as effective as any method for reducing this disturbance. We did not find that the screening of sets did very much to diminish interference, but I think if suitable precautions were taken, the screening of the separate units of the receiving circuit from each other and from the aerial should have a very beneficial effect. Magnetos, of course, produce high frequency currents at the spark gaps. One of the greatest troubles in connection with aircraft wireless has been the elimination of these disturbances, and I understand it has been necessary to encase the whole of the wiring going to the sparking plugs.

Another member refers to the directional method of getting rid of disturbances. This was mentioned by Captain Round in his paper on "Direction Finding," read before the Institution about three years ago, and has, I believe, been extremely effective.

It is difficult to explain the reason for the disturbance being less when the loop is turned in a certain direction for one wavelength and in another direction for another wavelength. He has also mentioned the possibility of using copper netting laid on the ground for his earth connection. I think a good deal depends on getting a good earth connection, if one is to avoid the possibility of earth currents which may be flowing in the ground, coming into the receiving circuit. I have referred to this in my reply to Mr. Child's observations. In one case which I came across recently of a receiving set close to a tramway route, disturbance due to the passing of tramcars was almost entirely overcome by digging well down into the ground and burying an earth plate so as to make sure of getting a good earth connection. Previous to this, connection had been made to a water pipe which was not a very good electrical connection with the ground.

The method described by Mr. Bull for getting rid of disturbances due to commutator currents is interesting. I have used a very similar arrangement for getting rid of ripples in voltage curves quite recently, though the actual connection of my circuit is rather different to that shown by Mr. Bull. I think he would find it would give a better result if some of the inductance he used was put between the machine and the condenser.

Dr. Eccles has referred to the use of a directive method of reducing disturbance and the advantages there are to be gained by loose coupling and sharp tuning. The rejector circuit is of special value in this direction, and, personally, I attach great importance to the use of resistance in the antenna so as to avoid its being set in oscillation at its natural frequency. If this is not done, disturbances will occur even though a large number of filters and tuning circuits are used.



By Courtesy Marconi's Wireless Telegraph Co.

Portable telephony, tonic train and C.W. transmitting and receiving equipment. Most of the components can be identified.

Wireless Club Reports.

Contributions to this section are welcomed. Reports should be as concise as possible and should record the most interesting features of each meeting. The Editor reserves the right to edit the reports when necessary. **Papers read before Societies will receive special consideration with a view to publication.**

An Asterisk denotes affiliation with the Radio Society of Great Britain.

The West London Wireless and Experimental Association.*

On Tuesday, June 12th, Mr. C. J. Rees, of the London Radio College, gave a lecture entitled "A Popular Two-Valve Set." The instrument under review was a H.F. amplifier and the second valve a detector. Either H.F. circuit or tuned anode circuit could be used as desired, and one prominent feature in the diagram was the connecting of the H.T. and L.T. batteries in series. After the lecture Mr. Rees demonstrated the circuits with apparatus brought along by himself.

The committee have a summer programme under consideration. The Secretary will be pleased to reply to all applicants desiring particulars of membership.

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

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

Grimsby and District Radio Society.*

At the meeting on Tuesday, June 19th, various pieces of apparatus were exhibited. Mr. Wood outlined the circuit of a rejector set which had been specially built to cut out local interference, which is generally very prominent in this district. The arrangement was one in which reaction can be used on either the second or third transformer, with a tapped reaction coil to work on the rejector circuit.

Hon. Sec., M. M. Bennett, c/o Club-room, Wellowgate, Grimsby.

The Stoke-on-Trent Wireless and Experimental Society.*

Over 30 members and friends attended a recent field day in the Cheadle district, the party being conveyed to Freehay by special 'bus. Portable sets were erected, and some interesting experimental work was carried out. An enjoyable time was spent, and tea was provided at the local farm.

Hon. Sec., F. J. Goodson, B.Sc., G.I.Mech.E., Tontine Square, Hanley.

The Hornsey and District Wireless Society.*

A general meeting was held at headquarters, the Queen's Hotel, Broadway, Crouch End, on June 11th. Messrs. W. L. Carter and H. Hyams were re-elected Chairman and Hon. Secretary respectively. Mr. H. Blaiklock was elected Hon. Treasurer, and Messrs. W. Trotman, J. A. Price, J. R. Hunting, H. Davy and C. P. Varnam, were elected to serve on the committee. The Hon. Secretary gave a short résumé of the club's activities during the past twelve months, and reported that since the club moved to the present headquarters in January last, nearly 40 new members had joined.

An interesting programme of forthcoming events has been arranged, a copy of which, together with further particulars, will be forwarded to prospective members upon application to the Hon. Sec., H. Hyams, 188, Nelson Road, Hornsey, N.8.

Clapham Park Wireless Society.*

The Society has been very active of late and the following is a résumé of recent proceedings.

On April 11th, Mr. H. V. Hodgson continued his interesting lecture on "Thorium," a lively discussion following his remarks. The subject demonstrated the versatility of the Society, the members of which are prepared to consider all branches of science.

An allusion was made to the remarkable reception of Mr. W. P. A. Emuss, who with a crystal set and regulation single wire aerial at Crawley, had tuned in the Glasgow, Manchester, Birmingham and Cardiff broadcasting stations. No valves were employed.

On April 18th, Mr. A. J. Maitland, of Messrs. Leslie McMichael, Ltd., gave an interesting description of some of the Company's apparatus.

The Lead Hydrate battery formed the subject, on April 25th, of some instructive remarks by Mr. T. J. Bulley, of the Lead Hydrate Battery Company. The lecturer demonstrated with a specimen battery. A good display of members' apparatus was on view on May 2nd, each member giving a brief description of his set.

On May 9th, Mr. J. G. Hurst was unanimously elected Chairman. Appreciation was expressed of the newly-printed rules of the Society, which reflected great credit on the printer. A reference library was started, and a nucleus was formed with three standard books, viz., Stanley's "Wireless Telegraphy," Parts I and II, and the Wireless Year Book.

Mr. Beedle interested the members on May 16th, with a demonstration of his "Wayward Set," on which he had finally achieved success. Attention was then given to Mr. Scott-Taggart's No. 14 circuit from "Wireless Valves Simply Explained," and comment, both favourable and unfavourable, was aroused. Several types of pancake coils were discussed, modelled on the lines recommended by Mr. F. H. Haynes on a recent visit.

On May 23rd it was agreed to purchase an "Amplion" loud speaker for the Society's use.

Mr. A. E. Manners demonstrated his admirable home-made set on May 30th, employing a Peto Pan loud speaker. The meeting concluded with an instructive discussion on the relative merits of different types of valve. The election of an Assistant Hon. Secretary took place on June 13th, when Mr. R. H. J. Cue, of 50, Cloudesdale Road, S.W.17, was appointed to the position. The Chairman drew attention to the very able manner in which the Hon. Secretary had conducted the Society through the major portion of the first year.

Hon. Sec., J. C. Elvy, A.M.I.E.E., 12, Tavistock Street, Strand, W.C.2.

The North London Wireless Association.*

Mr. F. S. Angel for his ninth paper on "Elementary Principles," chose the subject of L.F. Amplification. The best method of employing the valve for this purpose were clearly explained and the lecturer referred to the introduction of the dry cell and potentiometer.

Applications for membership should be addressed to the Hon. Sec., J. C. Lane, Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.

Ilkley and District Wireless Society.*

"Wireless in the R.A.F. during the War," was the subject of an interesting paper read by Mr. Francis Law on June 4th.

On June 18th an instructive lecture was given by Mr. E. Shackleton, who spoke on numerous types of circuits, including super-regenerative and freak varieties.

Hon. Sec., L. E. Overington, 11, Wilmot Road, Ilkley, Yorks.

Sutton and District Wireless Society.*

On June 27th, Mr. Norvill gave a successful demonstration of broadcast reception, illustrating the use of the new three-electrode variable condenser produced by Messrs. Autoveyors, Ltd.

The membership of the Society is steadily increasing, and is now approaching 50. Meetings are held at 8 p.m. on the second and fourth Wednesdays in the month at the adult school, Benhill Avenue, Sutton. It is hoped to arrange several visits of interest in the near future, with possibly a Field Day.

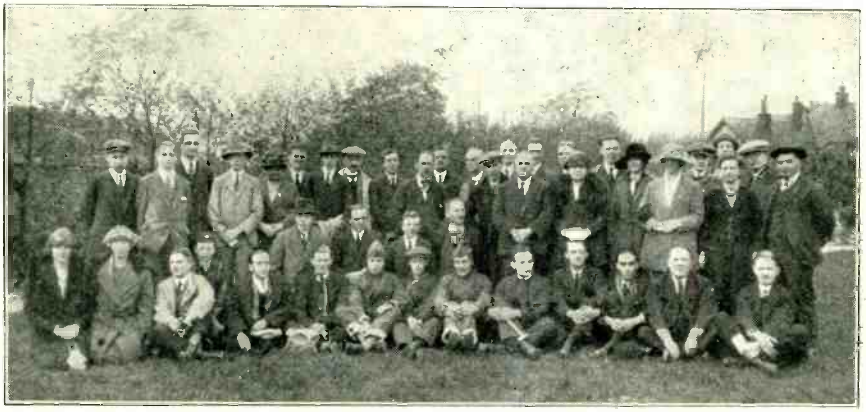
Particulars of membership will be gladly furnished by the Hon. Sec., E. A. Pywell, "Stanley Lodge," Rosebery Road, Cheam, Surrey.

The Wireless and Experimental Association.*

On June 10th, Mr. Voigt gave a lucid address on the saturation limits of the tail end valves of a fixed reaction set, the circuit of which had been drawn on the board by the Chairman. The meeting then discussed the factors governing the use of the loud speaker and the Secretary described an easily-made hornless instrument which had stood the test of prolonged use.

Ten representatives of the Society, chosen by ballot, visited the London Broadcasting Station on June 23rd, and were particularly impressed by the workmanlike appearance of all they saw. They did not expect to see lacquered brass and a glass finish, nor did they see it, but they went away convinced that "finish," though it may sell a set, does not facilitate its operation so much as sound, honest construction.

Hon. Sec., Geo. Sutton, 18, Melford Road, S.E.22.



Members and friends of the Sheffield and District Wireless Society photographed recently at Castleton, Derbyshire, where successful radio experiments were conducted in a coal mine.

The Southampton and District Radio Society.*

On June 14th, Mr. Bateman lectured before a large assembly of members on the "Flewelling Super Regenerative Circuit," dealing with the subject in his usual very able manner. He afterwards gave a demonstration of the circuit (which uses only one valve), and was successful in receiving broadcasting on an indoor aerial.

Dr. McDougall opened an interesting discussion on the persistent crackling disturbances which for some weeks have been seriously interfering with the reception of broadcasting about the time of sunset, and Dr. Norman Aldridge also gave his experiences of this annoyance. Mr. Birkett stated it might possibly be caused by the magnetic influences set up by the aurora borealis, whilst Mr. Bateman suggested the distortion of the surface of the Heaviside Layer, caused by the setting sun, as the possible explanation.

By kind permission of P. E. Curry, Esq., Local Manager of the White Star Line, a party of members recently visited the R.M.S. "Majestic," and spent a very interesting time inspecting the wireless equipment.

Hon. Sec., P. Sawyer, 55, Waterloo Road Southampton.

Leeds and District Amateur Wireless Society.*

At a recent instructional meeting the Secretary lectured on "The Elementary Principles of Transmission," dealing with the theory of damped wave transmission. Continuous wave working will be dealt with at a later date. The lecturer explained the principles of "plain aerial" and "tuned" sets, as extensively used in early days, and compared their performance with that of more modern equipment employing improved discharging and aerial exciting systems with rotary, quenched and other sparking devices.

At the 37th general meeting, Mr. H. F. Yardley, M.I.R.E. (Vice-President), lectured upon "Some Experiences with Non-Radiating Receivers." Mr. Yardley referred to the difficulties that beset manufacturers of broadcasting sets and the stringent tests conducted by the G.P.O. regarding aerial excitation in autodyne receivers. Speaking of broadcast reception, the lecturer stated that it was generally agreed that Leeds was "in clover," there being very little jamming and little difficulty in tuning in any of the broadcasting stations with two or three valve sets.

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

Ipswich and District Radio Society.*

By the courtesy of the Ipswich Postmaster, members of the Society were enabled to spend a very interesting and instructive afternoon on Saturday, June 23rd, in inspecting the Ipswich Telephone Exchange. The party was conducted by the Society's Hon. Sec., Mr. H. E. Barbrook, and special interest was taken in the new apparatus in the test room, where acquaintance was made with a new mounting of instruments.

Apart from the regular meetings for lectures and practical work, arrangements have been made for visits to Pulham Aerodrome and the Parkeston Wireless Station. Several field days are to be held in the district.

Hon. Sec., H. E. Barbrook, 46, Foundation Street, Ipswich.

Walthamstow Amateur Radio Society.*

On Saturday, June 16th, the club held the first field day of the season. Although the weather was dull, the rain held off.

A very useful aerial was erected in a quiet spot, without damage either to person or property, and after an interval for tea, experiments were the order of the evening. Several sets and arrangements of circuits were tried, ranging from well made and efficient pocket crystal sets to the club's multi-valve set. Crystal-valve circuits were included. The experimenters found themselves handicapped by lack of efficient "earthing" plant, the loose, well-drained soil of the high ground proving a poor conductor under the circumstances.

It is hoped to repeat the tests at an early date, making use of the knowledge gained. It is also proposed to include the use of kite aerials in future proceedings.

Hon. Sec., H. J. Sarson, Belle Vue House, Beaconstree Avenue, Walthamstow, E.17.

North Middlesex Wireless Club.*

"Wireless Sets *and* Wireless Sets," was the title of an interesting lecture given by Mr. A. J. Dixon, at the Shaftesbury Hall, Bowes Park, on June 27th. By way of contrast the lecturer demonstrated first with a "Matchbox Set," and then with a sensitive and selective receiver with high frequency amplification. Mr. Dixon then dealt with his early mistakes in high frequency work due to stray capacities in the circuit.

A profitable discussion followed, and several members gave their personal experiences with ingenious modifications of standard circuits.

Particulars regarding membership will be gladly supplied on application (by postcard) to the Hon. Sec., H. A. Green, 100, Pellatt Road, Wood Green, N.22.

The Radio Society of Highgate.*

The first of two lectures on "Amplification" was given by Mr. G. A. V. Sowter, B.Sc., on Friday, June 8th. In this lecture high frequency amplification was dealt with, and the theory and construction of H.F. amplifiers were lucidly explained. After dealing with the question of resonance, Mr. Sowter carefully explained the theory of the tuned anode method of intervalve coupling.

On Friday, June 15th, Mr. Sowter dealt with low frequency amplification. The principle of the transformer was dealt with, and the uses of transformers in wireless circuits were explained.

On Friday, June 22nd, a lecture entitled "Why Oscillatory Circuits Oscillate" was given by Mr. J. F. Stanley, B.Sc., A.C.G.I. By means of various mechanical analogies it was shown that the properties of inertia and elasticity are essential for the production of any kind of oscillatory or wave motion. The meaning of these two properties was carefully explained in a simple manner, and mathematics were studiously avoided.

Some unusually interesting features appear in the Society's programme for the next few months, full particulars of which can be obtained from the Hon. Sec., J. F. Stanley, B.Sc., A.C.G.I., 49, Cholmeley Park, Highgate, N.6.

South Norwood and District Radio Association.

On Thursday, June 14th, the Chairman, Mr. Percy Nutter, announced that Lt.-Col. G. K. M. Mason, D.S.O., M.P., had accepted the Presidency of the branch, and had become a member. He reported further that the authorities of the Stanley Hall (headquarters of the branch) had been approached with a view to the erection of an aerial for experimental work. "Photographs by Wireless" was the subject of a short lecture by Lt.-Col. Malone, who spoke on the possibilities of television, and referred to the recent transmission of the king's portrait from **2 LO**.

Prof. P. M. Baker then gave an instructive blackboard lecture on elementary inductance and capacity measurements.

Hon. Sec., C. H. P. Nutter (**5 DB**), Radio Corner, 243a, Selhurst Road, Norwood Junction, S.E.25.

Guildford and District Wireless Society.

On Wednesday, June 13th, the members paid an interesting visit to London, visiting the London Broadcasting Station, **2 LO**. Arriving at the station just before 11.30 a.m., the party were able to witness the broadcasting of the morning concert, an extremely interesting experience. After lunch, kindly provided at a restaurant by the Chairman, Alderman W. T. Patrick, J.P., the party visited the Marconi-Osram Valve Works, where the many wonderful processes of valve manufacture were studied.

Further visits to places of wireless interest are to be arranged.

Full particulars of membership can be obtained from the Hon. Sec., Rowland T. Bailey, 148, High Street, Guildford.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Now that Annapolis transmits time signals at 0855 G.M.T., the final dash at 0900 coincides with the first dot of the time signals sent out by Lyons, and it is very interesting to note the slight lag of **NSS** due to its much greater distance from the receiver.

Using one stage of H.F. with detector, and tuning for the most distant station, both are then comfortably audible despite the difference in their respective wavelengths.

When we consider that the lag of Annapolis cannot be much more than 1/70th of a second, it is rather surprising that the human ear and brain are able to detect such a small difference in time. I have observed these transmissions on several occasions during the past fortnight, and there is no doubt whatever about the discrepancy being apparent.

I should be interested to know through your valued journal whether any other of your readers have noticed this.

THOMAS BURT TROTT.

Plymouth, *June 22nd*, 1923.

The "E.J.C." Circuit

Readers' Reports.

The description in a recent issue* of an interesting single-valve circuit has brought comment from a large number of readers. It is impossible to give publication to all of the letters received, though the suggestions as to the methods by which the circuit was arrived at are identical in every case. "E.J.H." was probably making use of a circuit embodying a tuned anode high frequency amplifier, fitted with a switch for cutting out the H.F. circuit. On switching off the filament current of the H.F. valve he found that signals still persisted, and of good strength. An analysis of the circuit conditions led him to design the new circuit. Many readers claim to have had the circuit in use for some time, and in most cases attention is drawn to the superior results obtained.

The Editor appreciates reports giving practical details of readers' experience with circuits and apparatus described in the journal.

Book Review

The Practical Electrician's Pocket Book, 1923. (*S. Rentell & Co., Ltd.* 3s. net.)

This is the twenty-fifth annual issue of this red-coated manual, and the Editor appears to have celebrated the quarter century by making the book, if possible, more valuable than ever to its numerous readers. Various sections have been most carefully re-written, and an entirely new chapter has been added on Wireless Broadcasting. Absolute reliability is essential in any work which gains a place in the City and Guilds list of "Works of Reference," as has been done by this hardy annual. The book is compact and well printed, and covers a very wide ground in a concise and practical way which should ensure it an ever-increasing sale throughout the whole electrical profession.

* Page 239, May 26th, 1923.

Books and Catalogues Received.

"Comparison of Principal Points of Standards for Electrical Machinery" (Rotating Machines and Transformers). By Frederick Nettel. (Berlin: Julius Springer, Linkstr, 23-24, W.9. 42 pages. Price 2s. 6d., post free 3s. 2d.)

British Radio Sales Co., Ltd. (8-9, Stephens Buildings, Gresse Street, Rathbone Place, Oxford Street, W.1.). Catalogue of Wireless Repeating Gramophones. (16 pages.)

C. F. Elwell, Ltd. (Craven House, Kingsway, W.C.2.). "The Elwell Book of Diagrams." Embodying diagrams to show how Elwell Rectifying and Amplifying Units can be connected up to form complete receiving sets. (21 pages. Price 1s.).

C. F. Elwell, Ltd. (Craven House, Kingsway, W.C.2). Aristophone Catalogue, 1923, 55 pages illustrating and describing Elwell sets and components.

Broadcasting.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS* :—

GREAT BRITAIN.

LONDON 2 LO, 369 metres; **MANCHESTER, 2 ZY,** 385 metres; **BIRMINGHAM, 5 IT,** 420 metres; **CARDIFF, 5 WA,** 353 metres; **NEWCASTLE, 5 NO,** 400 metres; **GLASGOW, 5 SC,** 415 metres. Regular morning and evening programmes, particulars of which appear in the daily press, are conducted from these stations by the British Broadcasting Company. The usual times of transmission are:—Weekdays, 11.30 a.m. to 12.30 p.m. (**2 LO** only), 3.30 to 4.30 p.m., 5.30 to 11 p.m. Sundays, 3 p.m. (**2 LO** only), 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), **FL,** 2,600 metres. Daily, 7.40 a.m., Meteorological Forecast; 12.15 p.m., Meterological Report and Forecast; 3.30 p.m., Financial Bulletin (Paris Bourse); 6.10 p.m., Concert and Meteorological Forecast; 11.15 p.m., Meteorological Report and Forecast. Sundays, 6.10 p.m., Concert and Meteorological Report.

LEVALLOIS-PERRET (Radiola), **SFR,** 1,780 metres. Sundays 2 to 3 p.m., 9 to 10.30 p.m., Concert. Weekdays, 12.40 p.m. Concert, 5.5 p.m., Financial Bulletin; 5.15 to 6.15 p.m., Instrumental Music; 8.45 p.m., Miscellaneous News; 9 to 10 p.m., Concert. Thursdays, 9.45 to 10.30 p.m., Dance Music.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres, Tuesday and Thursday, 8.30 p.m., Concert. Saturday, 2.30 to 7.30 p.m., Concert.

LYONS, YN, 3,100 metres. Weekdays, 10.45 to 11.15 a.m., Gramophone records.

HOLLAND.

THE HAGUE, PCGG, 1,050 metres. Sunday, 3 to 5 p.m., Concert. Monday and Thursday, 8.40 to 9.40 p.m., Concert.

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

THE HAGUE (Velthuyzen), **PCKK,** 1,050 metres. Friday. 8.40 to 9.40 p.m., Miscellaneous.

IJMUIDEN, PCMM, 1,050 metres. Saturday, 8.40 to 9.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres. Wednesday, 8.10 to 9.10 p.m., Concert and News.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. Working days, 12 noon. Meteorological Bulletin. Daily, 4.50 p.m., Meteorological Bulletin, Tuesday and Thursday, 9 p.m., Concert. Sunday, 6 p.m., Concert.

GERMANY.

BERLIN (Koenigswusterhausen), **LP,** Sunday, 2,700 metres, 11 a.m. to 12 noon, music and speech; 4,000 metres, 12 noon to 1 p.m., music and speech; Daily, 4,000 metres, 7 to 8 a.m., 12 to 1.30 p.m., 5 to 6.30 p.m., Financial and other news.

EBERSWALDE (2,950 metres), Daily, 1 to 2 p.m., 8 to 9 p.m. Tuesday and Saturday, 6.30 to 7.30 p.m., Concert.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres, 8 a.m., 12 noon and 4 p.m., Meteorological Bulletin and News. 4,500 metres, 10 a.m., 3 p.m. and 10 p.m., Concert.

SWITZERLAND.

GENEVA, HB 1, 900 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

LAUSANNE, HB 2, 1,350 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

* (British Summer Time is given in each case.)

QUESTIONS AND ANSWERS

"H.W." (Brixton) *asks* (1) *For a diagram of a two-valve H.F. amplifying panel, with the wiring arranged so that one valve may be cut out when desired. Tuned anode H.F. intervalve coupling to be used, and to be capable of tuning to* 2,600 *metres.* (2) *If the proposed addition to the set will necessitate alterations to the two terminals provided on the detector panel for a loading coil.*

(1) A suitable diagram is given in Fig. 1. Plug-in honeycomb type coils may be used for the anode inductances, and each is tuned with a 0·0002 mfd. variable condenser. (2) The two terminals should be permanently short-circuited when the H.F. panel is added. Two new terminals for the loading coil are provided, which will be short-circuited, of course, when no loading coil is in use.

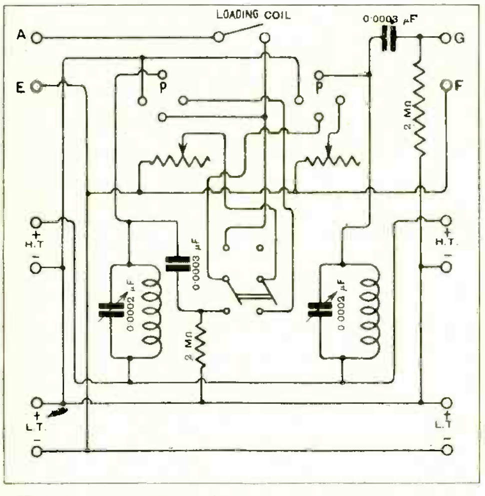


Fig. 1. **"H.W." (Brixton).** *Diagram of a two-valve H.F. panel* (2—0—0).

"G.A.W." (Hanwell) *submits particulars of a five-valve receiver he proposes to construct, using two H.F. valves with tuned anode coupling, detector, and two L.F. valves, and asks* (1) *If a* 0·0005 *mfd. variable condenser would be satisfactory for tuning each anode inductance.* (2) *If the basket coils which were described in the reply to* **"MANTOLA SUBSCRIBER"** *in the issue of March 17th would be suitable for use as anode inductances.* (3) *For the circuit diagram referred to in the reply mentioned in Question* (2).

(1) We suggest that 0·0002 mfd. is a much more suitable capacity. (2) Basket coils are quite suitable for use as anode inductances. As you do not state the wavelengths on which you wish to receive, we cannot advise you on the size of coils to use. The value of the inductance in the anode circuit should be slightly higher than that of the closed circuit coil in the tuner. (3) Diagrams of circuits employing tuned anode H.F. coupling are given in practically every issue of this journal. We would also refer you to "The Amateurs' Book of Wireless Circuits," by F. H. Haynes, The Wireless Press, Ltd., 2s. 6d. nett.

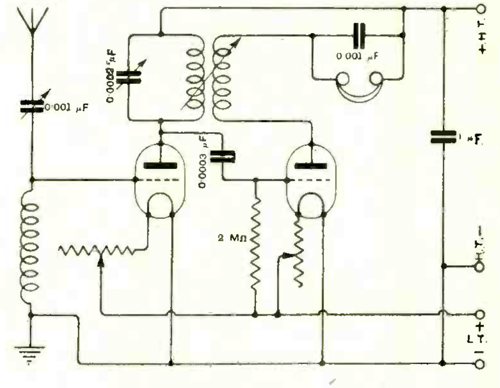


Fig. 2. **"IND" (Manchester).** *Receiver with one stage of H.F. amplification with valve rectifier* (1—*v*—0).

"IND" (Manchester) *submits a circuit diagram of a two-valve set, H.F. and detector, with reaction coupled to the anode inductance. He gets no results, and asks* (1) *For advice and suggestions.* (2) *If the coils in use in the circuit, particulars of which he gives, have suitable windings.*

(1) We have examined the diagram submitted, and it is not correct. A correct diagram is given in Fig. 2. (2) The coils you describe should be quite satisfactory for reception on the short wavelengths of British broadcast stations.

"R.S.T." (Derbyshire) *submits a sketch of an electrolytic rectifier, and asks if a rectifier constructed according to the sketch could be used for accumulator charging from A.C. mains of* 220 *volts.*

A rectifier of the type indicated would be quite suitable for the purpose of accumulator charging. You should also investigate the Tungar rectifier. See January 20th issue of this journal.

"F.T.C." (R.A.C.) *asks for the most suitable circuit employing a three-coil holder and honeycomb plug-in type coils, to receive on all wavelengths from* 600 *to* 23,000 *metres inclusive, the set to be used on the Mediterranean.*

We would refer you to "The Amateurs' Book of Wireless Circuits." Also Fig. 3, page 63, April 14th issue of this journal. Two H.F. valves should be used.

"DONEGAL" (Ireland) *asks* (1) *For a diagram of a receiving circuit employing two H.F. valves with crystal rectification, and reaction on to the aerial circuit.*

(1) The required diagram is given in Fig. 3.

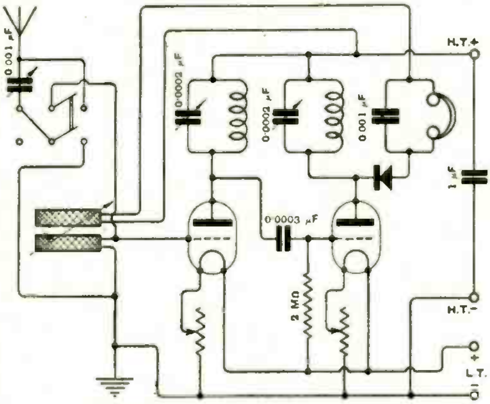


Fig. 3. **"DONEGAL" (Ireland).** *The diagram shows the method of connecting a high frequency amplifier and a crystal rectifier* (2—c—0). *The two valves have tuned anode circuits.*

"A.G.B." (Essex) *asks* (1) *and* (2) *For a diagram of a five-valve receiver employing one H.F., detector, and three L.F. valves, with switches for each L.F. valve, and a switch to enable the tuned anode or transformer method of H.F. coupling to be employed at will. A single tuning coil is to be used, and reaction is required on to the tuned anode.* (3) *If a six-volt accumulator should be used.* (4) *Whether he should change the iron boxes now enclosing his L.F. transformers, for brass ones.*

(1) and (2) The diagram is given in Fig. 4. (3) A six-volt accumulator is recommended. (4) The iron boxes for the L.F. transformers could not be improved upon.

"F.E.S." (Manchester) *asks* (1) *In connection with the reply to* **"T.A.T." (Acton, W.),** *in our issue of April 7th last, concerning the six-valve receiver, what would be the most suitable values of "Igranic" coils for use in aerial, secondary, anode and reactance circuits for the reception of British broadcasting, and for the Hague and Paris concerts.* (2) *Would a 12-volt car starting battery be suitable for use with this circuit, by running the three H.F. valves off one 6-volt section and the other three valves off the other half of the battery, as in diagram submitted.* (3) *If the 12-volt battery could be utilised for a three-valve broadcast receiver (one H.F., detector and one L.F. valves) by connecting the valve filaments in series, and using a single series resistance for controlling them.*

(1) For British broadcasting, if the aerial tuning condenser is in parallel with the aerial tuning inductance, the coils will be as follows: aerial No. 35; secondary, No. 50; anode, No. 75; reactance, No. 100. For the Eiffel Tower concerts, 2,600 metres, the following coils will answer: aerial, No. 300; secondary, No. 400; anode, No. 500; reactance, No. 600. For the Hague concerts, 1,050 metres, aerial, No. 100; secondary, No. 150; anode, No. 200; reactance, No. 250. (2) It would be better to break the coupling between the two 6-volt sections and wire these in parallel. The filament circuit would then not require alteration. (3) We do not recommend the arrangement.

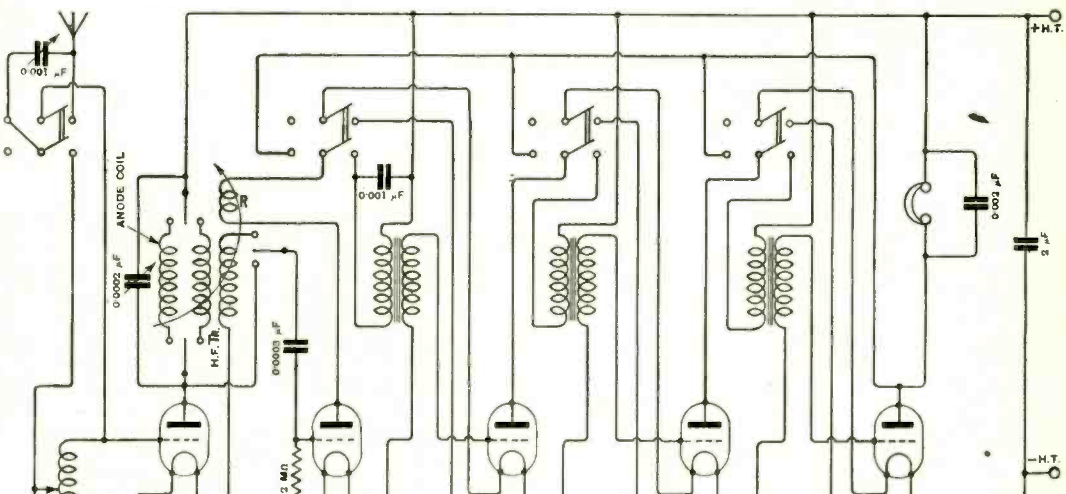


Fig. 4. **"A.G.B." (Essex).** *This receiver has one stage of H.F. amplification, rectifier, and three stages of note magnification* (1—v—3). *Switches are provided to vary the number of valves in circuit. The tuned anode or the transformer method of coupling the H.F. valve may be used.*

"L.S.S." (Greenhithe) *asks* (1) *For particulars of the A.T.I. in Fig. 1, p. 750, of the issue of March 3rd, 1923.* (2) *For particulars of a reaction coil to couple with the high frequency transformer.* (3) *If two 6 volt 60 a.h. (ignition rating) accumulators, joined in parallel, would be suitable for operating five "ORA" type valves.*

(1) The A.T.I. in this circuit should be a No. 75 plug-in type coil, with the aerial tuning condenser in series, for the reception of British broadcast transmissions. (2) When pin-type plug-in high frequency transformers are used, the most suitable form of reaction coil to couple with these would be a winding of approximately 100 turns of No. 36 S.S.C. copper wire on a bobbin of similar dimensions to those of the high frequency transformers. This coil should be arranged to swing over the high frequency transformer. Full details of a method by which this may be carried out are given in the issues of this journal of September 2nd and 16th, 1922. Also see June 9th issue. (3) The accumulator should give satisfactory service operating under the conditions mentioned. You should obtain approximately 16 hours' service on a continuous discharge.

"FREDUS" (London) *asks for the circuit given in reply to "ATOM" in the issue of May 19th to be repeated with the following modifications. The two high frequency valves to be tuned anode coupled, with switches provided to cut out any valve in the circuit.*

The modified diagram is given in Fig. 5.

(1) The oscillator coils should be 1,250 turn coils, and the condenser which bridges the ends of the two inductance coils should have a capacity of approximately 0·004 mfd. (2) For full particulars of the Tungar bulbs we would refer you to the article entitled "The Tungar Rectifier," page 540, January 20th issue of this journal. The manufacturers of these rectifiers are the British Thomson-Houston Co., Ltd.

"G.J." (Highgate, N.19) *asks the following questions with reference to circuit No. 105, in "The Amateur's Book of Wireless Circuits," by F. H. Haynes.* (1) *The windings of the microphone transformer, the winding of the L.F. choke coil, the winding of the H.F. choke coil.* (2) *The value of the resistance in series with the tapping key.* (3) *If two formers 6″ in diameter, wound with ¼″ wide copper strip could be used for the tuning arrangements.*

(1) The microphone transformer may consist of an iron wire core ½″ in diameter and 4″ long, the core being left open, with a primary winding of 200 turns of No. 22 S.S.C. copper wire, and a secondary of 10,000 turns of No. 36 S.S.C. wire. The low frequency choke coil may consist of 3,000 turns of No. 36 S.S.C. wire on an iron wire core ½″ in diameter and 4″ long. The high frequency choke coil may be a winding of No. 36 S.S.C. wire on an ebonite former 1″ in diameter and 4″ long. (2) The resistance to which you refer is the grid leak of the first valve, and the resistance value is 10,000 ohms as given in the description accompanying the circuit diagram. (3) One of the formers might be suitably employed as the aerial tuning inductance. Provision should be made by means of clips for tapping the inductance at any point. The grid circuit coil may be a winding of No. 20 D.C.C. wire on a former 4″ in diameter, to couple with the aerial tuning inductance.

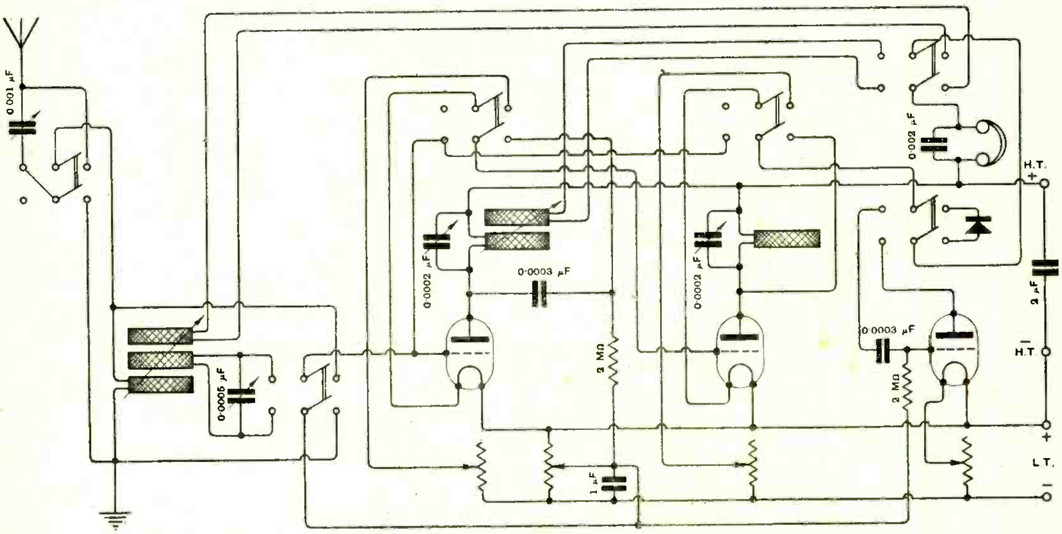


Fig. 5. **"FREDUS" (London).** *Diagram of a receiver with two H.F. and valve or crystal rectifier.*

"V.H.W." (Worcs.) *asks* (1) *For values of the coils and condensers comprising the single-valve super-regenerative circuit in the article by F. S. Hogg, which appeared in the issue of this journal of March 10th, 1923.* (2) *For the values of the filament voltage of the 3 to 5 and 12 ampere Tungar rectifier bulbs.*

"T.H." (Birmingham) *asks* (1) *What is the difference in the operation, of a switch for earthing the aerial, and a vacuum lightning protector.* (2) *The inductance of a coil* $4\frac{3}{8}''$ *diameter and* $1''$ *long wound with* 61 *layers of eight turns each of No.* 32 *D.S.C.* (3) *Whether the proposed aerial switching arrangement is satisfactory.*

"A.H." (Sweden) *asks* (1) *For a diagram of a seven-valve receiver using three high-frequency valves, semi-aperiodic transformer coupling, detector, and three low-frequency valves.* (2) *If we think that the circuit given in Fig.* 1, *page* 601, *of the issue of February* 3rd, 1923, *is a suitable one to adopt in a set to be built for the reception of American telephony.*

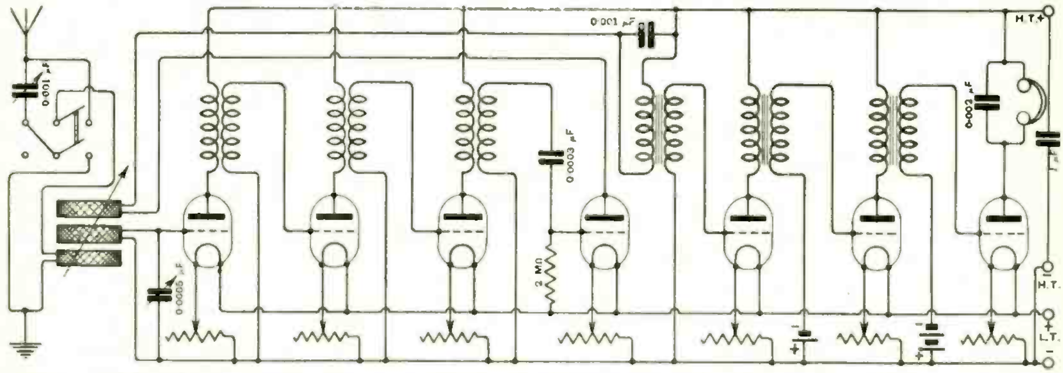


Fig. 6. **"A.H." (Sweden).** *Connections of a* 7-*valve receiver with three stages of H.F. amplification, valve rectifier and three stages of note magnification* (3—*v*—3).

(1) When a switch is used, with the switch in one position, so that the aerial is connected with the receivers, there is no protection against lightning. When the aerial and earth are joined with the switch, a lightning discharge would pass direct to earth, the instrument being disconnected from the aerial. The vacuum lightning protector should be considered as an additional protective device. If the aerial is struck by lightning when the set is in operation, the discharge will pass to earth across the small air gap of the protector. (2) The approximate inductance is 15,000 μH. We cannot say exactly from the particulars supplied. (3) The arrangement is satisfactory.

"J.Y.H." (Middlesex) *asks if reactance may be applied to the anode inductance as well as to the closed circuit inductance with advantage.*

We do not recommend the use of several reaction coils. It will be found that one, properly used, is sufficient.

"PUZZLED" (Cheshire) *submits a diagram of a three-valve receiver, and asks* (1) *For criticism.* (2) *Why the set does not give satisfactory reception without the use of reaction.* (3) *If the substitution of the tuned anode method of high frequency coupling for the high frequency transformer would effect any improvement.* (4) *Whether the wiring of the series parallel switch is correct for the type of switch indicated.*

(1) and (2) We have examined the diagram submitted, and the circuit is correct. We suggest, however, that with the type of valve employed, a high tension supply of 45 volts as a minimum value would give much more satisfactory results. (3) Provided that the high frequency transformer is of a good make, this method of H.F. coupling gives excellent results, but may not be so efficient as the tuned anode method. (4) The wiring of the series-parallel switch is correct.

(3) *If we think that the set would be improved by the addition of three low frequency amplifying valves.*

(1) A suitable diagram is given in Fig. 6. (2) The circuit is suitable, but whether or not you will receive American telephony depends upon a number of factors over which you have no control. (3) The addition of L.F. amplification will make no appreciable difference to the receptive range of the set.

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules*:—(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* **The Wireless World and Radio Review,** 12/13, *Henrietta Street, London, W.C.*2. *Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*

THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GT. BRITAIN

No. 205 [No. 16 Vol. XII.] JULY 21st, 1923. WEEKLY

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Questions and Answers Department: Under the supervision of W. JAMES.

Aerials and Lightning.

Many wireless enthusiasts received with mixed feelings the recent lightning display. The natural feeling is that an aerial wire being a good conductor is likely to receive charges which will pass through to the instrument room. It may be said at once if the aerial and earth are connected to the receiver during the storm, lightning discharges will damage the receiver. If the aerial condenser is in series with the aerial the condenser may have its insulation broken down. In those cases where the telephones are joined with the aerial circuits such as in the case of a crystal receiver it is by no means unusual for the telephones to be destroyed.

Fortunately it is a very simple matter to protect the apparatus. Obviously we may remove the aerial and earth connections from the receiver, and for this purpose it is recommended that a throw-over switch is joined in circuit so that with the switch in one position the aerial and earth are joined to the instrument, while with the switch in its other position the aerial and earth are connected together, with the instrument disconnected. It is good practice to provide this switch and it should be located close to the lead-in tube. It is not considered satisfactory to simply take the aerial and earth wires from the instrument and twist them together. It may so happen that a discharge will take place through the experimenter's body if he should be holding the aerial wire, with unfortunate consequences. It should be considered the provision of an aerial earth switch is as necessary as any other portion of the receiver. Obviously the instrument is completely protected so long as the aerial and earth are connected together.

To take care of the receiver through the aerial becoming charged while in use it is advisable to connect a protector of some sort. A simple yet quite easily constructed protector consists of two brass plates mounted so that they are nearly touching, the aerial being joined with one plate and the earth with the other. Special protectors may be purchased for a small sum and are very effective in protecting the apparatus from injury through the aerial receiving a charge while the receiver is in use.

It is good practice to use both protective arrangements. Incidentally, in installing protective devices, we also provide an excellent lightning conductor which will reduce the likelihood of damage to premises, so that the fact that an aerial is erected on a house-top should be regarded, especially by insurance companies, as a protective device rather than the contrary. We believe many of those who had tried to put about a scare in regard to the additional fire risks involved must have been sadly disappointed at the lack of evidence in support of their case.

MACHINE FOR WINDING WAVE-WOUND OR LATTICE INDUCTANCE COILS

Unless coil winding machines are rigidly built it cannot be hoped to construct mechanically strong coils of reasonable diameter. The design given is as simple as is permissible for winding substantial coils, whilst novel features are introduced, based on the author's experience.

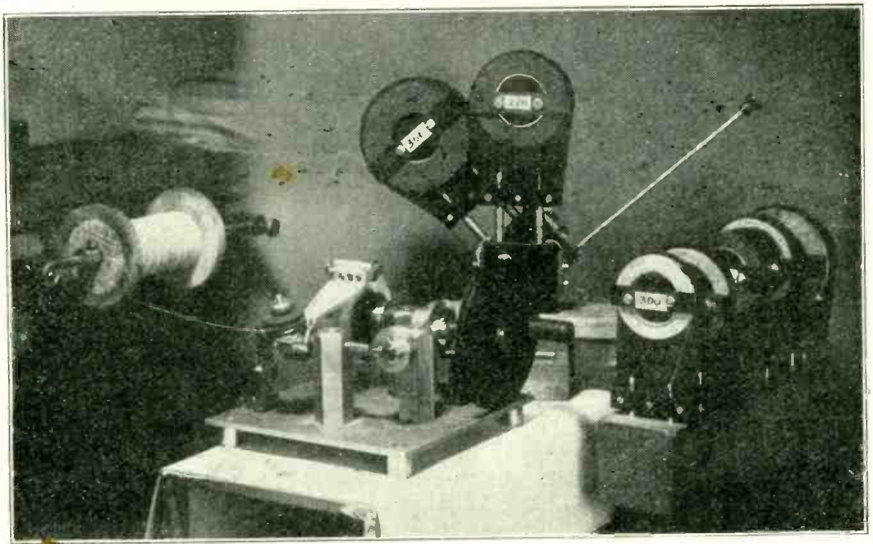
By MAURICE CHILD.

THE following details of a machine for winding small coils may be of interest to many readers desiring to make inductances for any particular experiments they may have in view. For example, small inductances of fine wire can be usefully employed as high frequency transformers with varying coupling between the primary and secondary, or again they may be required to build up various circuits in a multi-stage amplifier.

When it is required to try out circuits involving approximate or accurate tuning of many stages of amplification, the expense of purchasing a large number of coils is very considerable and they may not be of the dimensions required for experimental work. It therefore pays to construct a machine on the lines to be described.

In the first place the writer feels he must emphasise the necessity for a rigid type of construction, that is to say, good mechanical workmanship is essential, as any appreciable shake in the bearings or "back lash" and side play will be likely to cause difficulty in obtaining a rigid and neat coil.

The base of the machine (a photograph of which is given here) is of $\frac{1}{8}$ in. brass or zinc. Zinc was chosen in the present instance because, when purchased, it is usually quite flat, and does not require machining, whereas it is frequently difficult to obtain a perfectly flat sheet of brass. The main bearings, as can be seen, are hexagonal brass rod, the sides of which should be trued up carefully before marking the positions for the holes, which must, of course, be accurately drilled at right angles. The spindles are of silver steel. The bracket containing the guide roller, in the groove of which the wire passes on to the split ebonite drum, is of aluminium which is screwed to brass angle pieces, and to a machine bearing of brass which can move vertically on the slide bar, but is prevented



Fi[illegible]. The coil winder in operation showing a number of completed coils supported in suitable mountings.

from lateral movement by two machined brass collars which are held in position by set-screws. The cog-wheels were the only things purchased and can be obtained from Messrs. Cotton & Johnston, Gerrard Street, W.

As to the method of winding, it will be seen from the photograph that the wire (which can be of any gauge from No. 30 to 40), passes from the bobbin round the "V" grooved ebonite pulley between the spring guide bars into the slot on the brass roller immediately above the drum. It is found in practice that the machine can be worked in either direction. If the pulley wheel is revolved in a clock-wise direction, the wire should pass under the guide wheel. If the operation of the pulley wheel is reversed, the wire must now pass over the top.

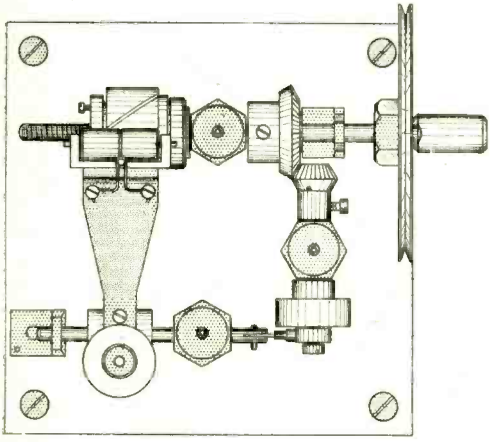


Fig. 2. Plan (drawn to scale). The dimensions of the base are $5\frac{1}{2} \times 5\frac{1}{2}''$. Other dimensions can be readily calculated by applying a rule to the drawing.

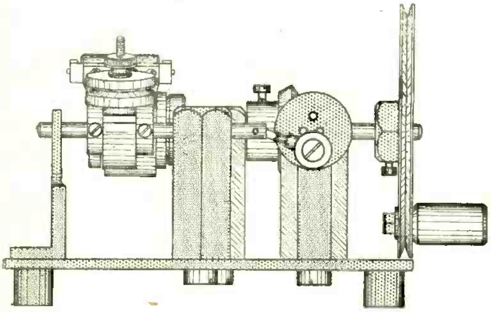


Fig. 3. Front view.

To prepare a former on which the coil is to be wound, the outer ebonite cone is removed by unscrewing it from the spindle. The ebonite drum can now be slipped over, and a strip of paper of the approximate width of the finished coil may be wound tightly round the drum several times, the end being gummed down. Over the paper can be fixed one or two turns of ordinary black insulating tape such as is used by electricians for covering the outside of joints. This will present a sufficiently sticky surface to ensure the first few turns of wire remaining in place. The drum is now replaced and the cone screwed up tightly on to it. This has the effect of holding the paper former rigidly in position by expanding the drum.

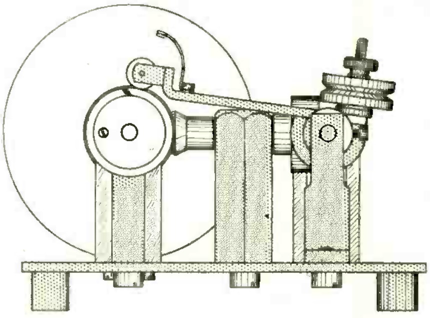


Fig. 4. End view (bobbin end).

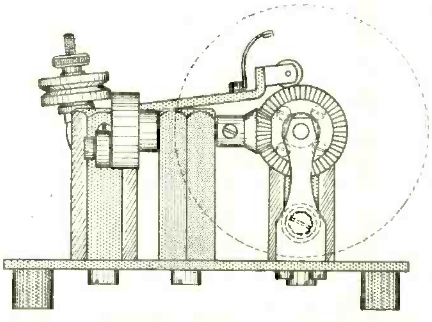


Fig. 5. End view (handle and driving wheel removed).

The winding can be commenced by temporarily fixing the end of the wire to the small extension screw on the left-hand side, Fig. 2. When the required number of turns have been wound, the outside end of the coil may be temporarily held in position by the application of sealing wax or a mixture of paraffin wax and resin, in the proportion of two parts of wax to one of resin, which has been previously melted together. The removal of the finished coil is extremely simple, as by unscrewing the end cone the drum contracts by virtue of its own slight springiness, and the coil, complete with the former, readily slips off. The inner end of the paper former can be stuck down with a little gum or glue.

The photograph shows several coils which have been mounted on small pieces of 3-ply wood, with valve pins screwed into small bars of ebonite. There is no necessity to employ ebonite anywhere near the coils themselves; in fact it is theoretically better not to do so.

FADING

A NEW ASPECT

The authors will be remembered in connection with the Transatlantic Tests, in particular Mr. Burne, who was first prize winner in the Tests 1921-22. The experimental work revealed in this article contains suggestions as to useful research work that can be conducted by other experimenters.

By W. R. BURNE and J. A. CASH.

OWING to the great amount of interest that has been displayed in short wave amateur communication during the last two years, the writers decided to prepare extensive tests during the past winter. Unfortunately their schemes fell short and it was not possible to accomplish all the things that had been planned. However, some very interesting observations were made and a great deal of useful data collected and experience gained.

To this end two special receiving sets were made by the writers, one employing a five-valve high frequency amplifier, detector and one low frequency amplifier, with the occasional addition of a two-valve note magnifier for loud speaking work. The second set is a three-valve outfit (one H.F., detector, one L.F.). The first set is so arranged that any number of valves can be used at will by the use of a wander plug, which can be inserted into any grid socket of a transformer holder.

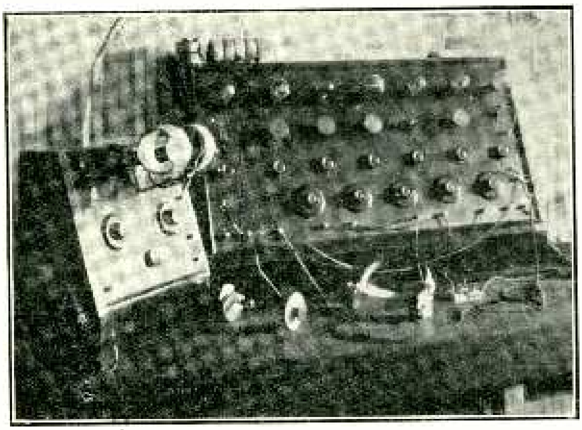


Fig. 1. One of the receivers used for the determinations on fading.

The high frequency intervalve transformers are identical in design to those used in the previous Transatlantic tests by the writers.*

* *Wireless World and Radio Review, page 678, Feb. 4th, 1922.*

It was found that three H.F. valves were sufficient to bring in signals from all over the United States from such stations as:— **1ZE, 2ZL, 3BFU, 4BY, 4DL, 4EA, 4XC, 5TA, 5TJ, 5WW, 5FV, 6TF, 8UE, 8ZZ, 9AUL, and 9CR.**

In the photograph of the seven-valve set (Fig. 1), it will be noticed that the valves have separate filament control; each transformer is tuned by a small variable condenser of 0.00025 mfd. maximum capacity. The tuner on the left of the photograph, constructed very hurriedly, was made for convenience rather than appearance. The coils used are single layer inductances wound on a 4 in. former with stranded enamelled aerial wire, as it was considered these would be superior to multi-layer coils. The switches were intended to series or parallel the A.T.C. and use either inductive or direct coupling at will. Inductive coupling was always employed and also the A.T.C. was always used in series with the aerial circuit. The A.T.C. is a 0·0009 mfd. and the S.T.C. a 0·0004 mfd., while a small vernier condenser was mounted on the bench and connected with the S.T.C. The circuit is standard, rectification being obtained by means of a 0.0003 mfd. Dubilier condenser and a 1.5 megohm grid leak. A 0.01 mfd. condenser is used across the H.T. Various makes of valves were tried but the new Ediswan " R " type gave the best results as a rectifier in this particular set. Mullard " Ora," Ediswan " E.S.2 " and "A.R's " and Marconi " R " valves, were used as H.F. amplifiers and L.F. magnifiers. The circuit is pretty well standard, though by very carefully considering the arrangement of the H.F. transformers and careful selection of valves it is possible to keep the set stable and use the separate heterodyne. This instrument is a Sullivan standard wavemeter and was used throughout the winter. To those who " burn the midnight oil," the writers would strongly recommend the use of a separate heterodyne of some kind. Not only is it far simpler to operate with a number of valves, but it absolutely minimises the risk of radiation. When in use there is no capacity effect noticeable due to the hand of the operator when he adjusts an H.F. tuning condenser. This in itself is a great point to be considered. Next winter the amateur traffic on 200 metres will have increased by leaps and bounds, and if a considerable number of men are using radiating receivers it will not only complicate the job for themselves, but spoil the work of others. In this connection let it be mentioned that when **2GW** and **2KW** use the autodyne method of reception employing two valves, they have no difficulty in communicating by means of their receiving sets over a distance of 10 miles, using 30 volts on the plates. Let this be a warning to all those who make this horrible noise.

Frequently it was impossible to read the more distant stations owing to the interference caused by the American amateur stations situated on the Atlantic seaboard.

This was especially the case during the tests last December, and had the transmitting period in the " free for all " been arranged so that the 5th, 6th and 7th American districts might have had a portion of the morning from 4 to 6 a.m., instead of 12 to 2.30, some very great reception results might have been obtained. The hours of 3 to 6 seemed to be the best.

The receiver used by **2GW** is shown in Fig. 2. The H.F. coupling is again a tuned transformer *whose windings are reversible.* Either one, two or three valves may be used, controlled by switches mounted on the panel. Independent filament control for each valve is again a feature of the set, whilst low resistance phones are always used. All the necessary condensers and grid leaks are Dubilier, as are also the variable condensers on the tuner panel. The coil mount, manufactured by the Manchester Radio Co., Ltd., is of special design and allows a very fine adjustment to be obtained. The circuit of the tuner is a straightforward one, excepting that when in the " stand-by " position both condensers are put in circuit with the A.T.C., as is also a vernier. This is useful when searching for a signal, though it is not advisable to use too big a capacity across the tuning coil. A home-made separate heterodyne is used at **2GW** and may be seen on the right of the photograph.

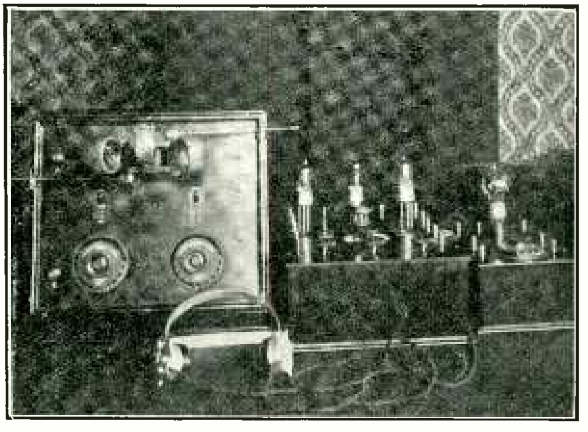


Fig. 2. Other receiving equipment.

One of the greatest problems in short-wave long distance communication is that of fading. Since broadcasting became an everyday instituition in this country, many people have noticed that the more remote stations decrease and increase in strength in a spasmodic manner. This effect is by no means limited to broadcasting stations, but is to be met with on almost all short wave signals. As well as the numerous stations working below 300 metres, there are a multiplicity of harmonics from high power stations and French coast stations using spark transmitters. Many high power stations use arc transmitters which are the bane of the amateur's existence. These particular harmonics apparently do not fade but remain of constant strength, whilst harmonics of **FFU** (Ushant), **GKU** (Devizes), and ships using C.W. and spark certainly fade just like the amateur signals to be met with on these low wavelengths.

With a view to making observations on fading, special bi-weekly tests were arranged with United States **2 ZL**, the station belonging to Mr. J. O. Smith, Long Island, N.Y. The writers wish here to pay a tribute to the whole-hearted co-operation of this gentleman and have nothing but praise for the regularity of the schedule maintained by him. After listening to a number of transmissions from **2ZL** and many other American amateur stations it occurred to the writers that there might be two different kinds of fading. The ordinary kind of fading may be experienced on any night by anyone with a sufficiently powerful set to obtain the necessary range. Many of the theories put forward relate to this type of fading and very possibly explain it.

Let us consider a totally different kind of fading which is always apparent on the U.S. amateur transmissions and sometimes on ships' harmonic, South of England amateurs, and French and Dutch amateurs. This type of fading is a perfectly regular swinging which is totally unlike the erratic fading known to most of us. Observations on this swinging have been made on stations lying in every direction. Apparently direction does not affect it. The writers suggest that the causes of the two kinds of fading are not the same. Might it not be probable that the erratic or irregular variety is due to conditions of the atmosphere or location of the station and the cause of the regular swinging some periodic change? Are we sure that the Heaviside layer plays an important part in the range of these low power stations? If indeed this is the case, can a periodic change in the Heaviside layer account for this swinging?

Mr. Smith, in his book, "Modern Radio Operation" (an American publication), says :—

"The signals from New England stations increase and decrease very rapidly. In fact, it is a common occurrence to hear a New England station fade completely out in the middle of a four-letter word, and come up strong again in the middle of the next word. The rate of rise and fall in the case of Middle West stations is much more gradual. These stations fade out slowly, over a period of 10 or 12 words usually, and then swing back again in the same gradual way. This would seem to indicate that the country intervening in both directions between New York and New England and the West, was the controlling factor. Why should signals fade rapidly in one case and gradually in the other? Is it a question of distance, topography, terrain or what? The old theory of attributing fading to conditions at the transmitting station will not stand in the face of the foregoing facts."

The writers noticed that although the swinging of signals of European origin was regular, the length of time taken to complete one cycle was shorter in comparison to that of signals of American origin. This was the case throughout the winter. Taking concrete examples in support of this assertion it was found that **FFU**, who is 350 miles away, took nine seconds to swing to minimum strength and regain normal strength again. Every time that station has been heard fading since, the period has been nine seconds. Similarly **OMX**, who is 300 miles away, took about seven seconds to swing and moreover, whenever his swinging is regular, the time taken is always seven seconds. The 200 metre harmonic of a ship's C.W. transmitter off Anglesea, about 100 miles away, was noticed to swing every two-and-a-half seconds. Finally **2ZL**, who is 3,200 miles away, swings every eighty seconds. These figures have been obtained after a great number of observations and many weeks of careful listening. When it was possible to hear the 5th, 6th and 9th district stations of America, they were noticed to fade

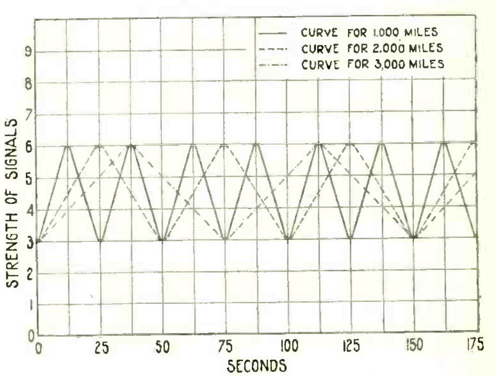


Fig. 3. Fading curves of signals 1,000, 2,000, *and* 3,000 *miles.*

about every two minutes, the distance being about 4,000-5,000 miles. If now, considering the words of Mr. Smith, together with these facts, it is highly probable that distance is the controlling factor to this regular swinging, and it is evidently the same in America as in Europe. Such a position of affairs seems highly probable to the writers, for after the convincing proof of hearing the signals and timing the swings, it would be hard to believe anything to the contrary.

In order that the issue may be the more clearly understood, a diagram is given (Fig. 3) showing how signals coming 1,000, 2,000 and 3,000 miles would be expected to swing. It seems highly probable that the length of time taken to swing is proportional to the distance, and up to now, the amount of data collected by the writers goes to prove this theory.

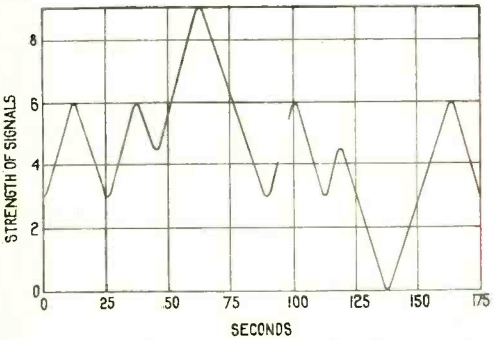


Fig. 4. "Double fade" and "Double increase" of signal strength at 1,000 miles.

A curious modification of this swinging has been noticed with various stations. After a number of regular swings the signal will only half fade, and then increase to double the "normal maximum," after fading to the "normal minimum" point again; this process, after a few more regular swings, is repeated in the opposite direction (see Fig. 4).

Of the many theories that have been put forward in the hope of explaining fading, not one of these seems to have taken into account the regular swinging of signals. Hitherto fading has been an unknown quantity, and it has not been possible to arrive at any definite conclusion.

By observing on stations fading irregularly, one will not reach any definite conclusion, as it would be impossible to arrive at any definite conclusion or formula when the results are so erratic. With the results obtained last winter and the early spring, the writers feel sure that if consistent results can be obtained over a considerable period, it would help in arriving at a theory which would ultimately explain the phenomenon.

Short wave communication is such an irregular sort of procedure, taking the results over a considerable period, that one begins to despair of ever arriving at a definite conclusion. We do not even know that the Austin-Cohen formula applies on the short wavelengths, and indeed it would seem that it does not. Here it would seem that there is some definite regular swinging, and it is surely worth while following up these preliminary remarks in the hope that something definite may result.

The writers would welcome criticism, and hope that these remarks will encourage others to make investigations on the most absorbing subject. It is now impossible to carry out further investigations and until the winter months arrive, apparatus may be improved and everything set for a great effort.

In the next Issue there will appear an article of

Special Interest to Transmitting Licence Holders.

The article, which will be illustrated, is to include Constructional Details of

A Choke Control Telephony Transmitter

STABILISING REACTANCE-CAPACITY COUPLED AMPLIFIERS

By E. H. Robinson.

Methods for controlling the extent of self-oscillation in reactance-capacity high frequency amplifiers are described, while details are included for reducing " overlap " so frequently met with in oscillating receiving circuits. The cause of that undesirable property of a receiver, by which it bursts into oscillation suddenly as the reaction is increased, is dealt with, and methods are outlined for overcoming the difficulty.

THE use of reactance-capacity coupling is rapidly gaining popularity in this country for high-frequency amplification on short wavelengths such as are used for broadcasting and amateur experimental work. As is well known, this form of coupling consists in tuning the anode circuit of the first valve to the signal being received, and coupling the anode of the first valve to the grid of the second by means of a small condenser. By suitably adjusting the capacity of this condenser and providing a leak from grid to filament the second valve may be made to act as detector or as a second stage of H.F., in which case the anode circuit of the second valve must be tuned in a similar way to that of the first.

This method of H.F. coupling is not only simple to instal and operate, but gives good selectivity and amplification on short wavelengths once stable working has been obtained. Difficulty is, however, often caused by two forms of instability, namely, too free oscillation and the irritating phenomenon of " overlap " when the apparatus is adjusted to near the threshold of oscillation.

Let us consider the first of these troubles—that of self-oscillation. In order to secure maximum amplification the anode circuit of each H.F. valve being used must be tuned exactly to the aerial circuit. When this is done it often happens that the set oscillates vigorously even when no positive reaction is being used in the ordinary sense. As a consequence the set becomes insensitive, the signals being completely wiped out by the local oscillations. The usual cause is that the damping of the various tuned circuits is too low and the capacity coupling between the various leads and in the valves themselves is sufficient to make the set oscillate when the anode circuits are tuned.

There are various ways of eliminating this trouble. First get rid of all stray capacity effects possible; it is best to space the valves as far as possible from each other as the working space will permit, and then reduce all connecting wires to their lowest terms. All leads at earth potential, such as filament leads and negative H.T. leads should be bunched together, while all leads at H.F. potentials, such as grid connections and plate connections, should be short, but spaced as far as possible from other wires in their vicinity. The use of reverse reaction is fairly convenient for arresting too free oscillation. A reaction coil is inserted in one of the usual places as shown in Fig. 1, and coupled so as to oppose the production of oscillations. Instead of reverse magnetic reaction reverse capacity reaction may be used. The term " neutrodyne " has been recently, and, it seems, somewhat unnecessarily, coined for the principle of reverse capacity reaction. For details of the " neutrodyne " system readers are referred to a recent issue of *The Wireless World and Radio Review*.* The most satisfactory way, however, of stabilising an unstable set is to increase the damping of the oscillatory circuits. This can be done by using more capacity and less inductance in one or more of the tuned circuits in the set. Thus the use of a parallel condenser instead of a series condenser for tuning the aerial circuit on short waves will often make enough difference to enable the anode circuits to be properly tuned and ordinary reaction to be used before the set will oscillate. This is particularly likely to be the case where the aerial in use is a small one of very low capacity. The apparatus may also be brought under control by increasing the capacity and decreasing the inductance used in the anode circuits. It is not generally advisable, however, to carry this artifice further than is absolutely necessary to obtain stable working in the case of the intervalve couplings, as large condensers and small inductances tend to make the set so selective that very little amplification is obtained unless the anode circuit or circuits

* p. 67, April 21st, 1923.

are dead in tune with the signals being received, a condition which may have its uses, but which is inconvenient for search purposes. Sometimes it is possible to tune the anode circuit entirely by means of a variometer without using a variable condenser. This is very convenient when it can be done without the set oscillating too easily, the resonance peak being somewhat flat, and signals being readily picked up and tuned in. As a rule, however, it is best to use a tapped inductance or plug-in coils and tune with a variable condenser with a maximum capacity of 0·0005 mfd.

A frequently recommended expedient for preventing an H.F. amplifier from oscillating is to maintain the grids of the amplifying valves at a slightly positive potential with respect to the filaments by means of a potentiometer. This is not at all a good plan, as a positive potential on the grid of an amplifying valve causes a grid-filament current to flow which introduces a serious damping effect and reduces the amplification obtainable. True, the set stops oscillating, but at the same time the signals are weakened and the phenomenon of "overlap," referred to below, tends to make its appearance. The potentiometer should not be regarded as a cure-all for all amplifier troubles, but it is very useful if judiciously handled, especially for obtaining fine control of the set when it is just on the point of oscillation. Fig. 1 shows a potentiometer P shunted across the filament battery, the slider always being kept somewhere near the negative end, but just a little way from it so as to leave latitude for slight final adjustments. The various circuits are first tuned and the reaction coil adjusted as well as possible for best signals. When the set is nearly in its most sensitive state, however, slight movement of the reaction coil may upset the tuning appreciably, and it is here that the potentiometer comes in. A slight movement of the slider towards the negative end of the potentiometer will allow the set to oscillate, or, if it is doing so already, a slight movement of the slider towards the positive end will just stop the oscillations. The use of a potentiometer in this manner is particularly convenient in the reception of faint signals on short wavelengths which are easily lost. In order that the potentiometer P shall in no way affect the tuning it should be preferably of a non-inductive type. The writer has used one made of a lead pencil with quite good results. An ordinary potentiometer wound with wire may be used if it is shunted by a condenser C (Fig. 1), which may be of the Mansbridge type, with a capacity of one or two microfarads. This condenser is not necessary if a non-inductive potentiometer is used.

We now come to the second trouble, namely, that of "overlap," which frequently makes its appearance in H.F. amplifiers, and even one-valve sets employing reaction. This consists in that annoying state of discontinuity between the oscillating and non-oscillating states of the set, when the oscillations start or stop with a click as the reaction coupling is adjusted. Starting with the reaction coupling so loose that the set does not oscillate, and gradually increasing the coupling, we come to a point where the set suddenly starts oscillating furiously, and only poor signals are obtained. In order to stop the oscillation we must reduce the reaction coupling considerably beyond the point at which it is started, and thus we cannot hit a sensitive and stable adjustment.

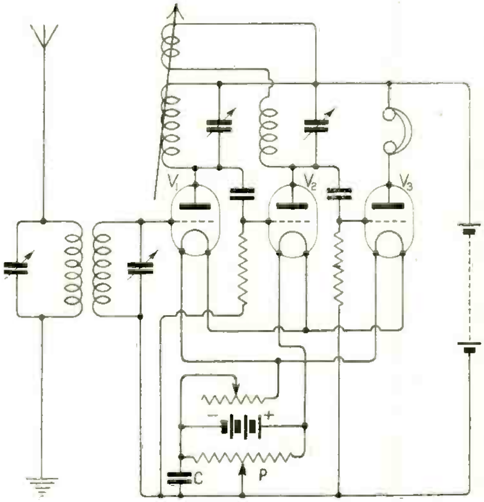


Fig. 1.

This overlap is nearly always due to the variable damping effect caused by one or other of the valves, which are coupled by means of a grid condenser to the plate circuit of a preceding valve, the trouble occurring either at the grid of the rectifying valve or at one of the intermediate H.F. valves if more than one stage of H.F. is being used. What appears to happen is as follows. Suppose we are getting overlap at the valve V_2 in Fig. 1. When the set is not oscillating the grid of V_2 is substantially at zero potential and a small grid-to-filament current can flow owing to some of the electrons from the filament flowing on to the grid. Thus the grid-filament space of V_2 forms a slightly conducting path which, owing to it being shunted across the tuned anode circuit of V_1, has a damping effect on this circuit and tends to prevent oscillations being set up. Suppose that the reaction coupling is now made so tight that oscillations are set up in the anode circuit of V_1 in spite of the damping of the grid circuit of V_2. Owing to the well-known grid-condenser action, rectification will take place, and a large negative potential accumulates on the grid of V_2, this negative potential being great enough to stop all grid current flowing. The short-circuiting effect of the grid circuit of V_2 is thus removed so that oscillations may be maintained even when the reaction coupling is reduced well beyond the point at which they could be started. By reducing the reaction coupling far enough the oscillations are stopped, and once this happens the large negative potential on the grid of V_2 leaks away, the grid damping is re-introduced, and we finish up just where we started.

The foregoing explanation shows that two things should be done to eliminate the possibility of overlap; first, undesired rectification at H.F. valves should be eliminated as far as possible; secondly, it should be arranged that the damping of any grid circuit is small compared with other damping factors associated with the preceding anode circuit to which it is coupled. Therefore whatever happens at any of the grids will not have much weight in deciding whether the set is to oscillate or not. Various practical expedients for eliminating overlap are known, and have been described elsewhere, but those given here are, in the writer's own experience, known to be effective.

The simple brightening of one's filaments frequently reduces, if not entirely eliminates, overlap. This has the effect of increasing the electron emission and reducing the plate impedances in a greater proportion than the grid impedances. An increase in H.T. voltage as well as the increase in filament brilliancy often does the trick, but this, of course, depends to a large extent on the valves in use and what H.T. voltage was being given them in the first place.

The actual selection of valves used very often has a profound effect upon the performance of the set. It may happen that an amplifier, in which apparently similar valves are used throughout, shows bad overlap, which may be entirely eliminated by the simple interchange of valves. As a general rule a set seems to be most stable when the valve with the lowest grid impedance, that is the biggest damping effect, is made the first in the series. This is particularly unfortunate where it is desired to use a soft valve as a detector. Soft valves are magnificent detectors, but usually give ghastly overlap in reactance-capacity sets, owing to the relatively low impedance and consequent high grid-damping of this type of valve. Stability may be obtained by interchanging the soft valve and the hard H.F. amplifying valve, but in such a case exchange is distinctly robbery, as most soft valves are poor amplifiers, while the hard valve does not detect as well as the soft valve.

A good deal depends on obtaining the right values of grid coupling condensers and grid leaks, particularly the latter. If there is a tendency to overlap, try increasing or decreasing the resistance of one of the leaks from grid to filament—usually an increase in resistance

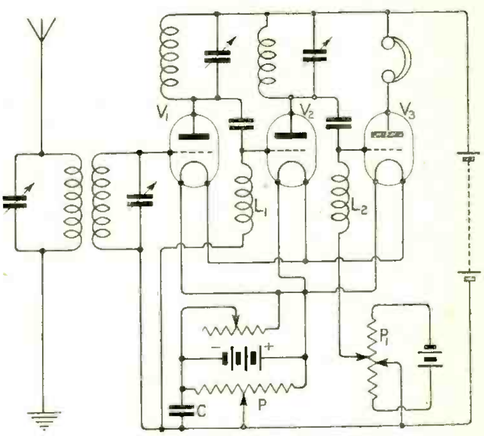


Fig. 2.

is necessary, and sometimes the natural leakage in the apparatus itself is sufficient without it being necessary to provide additional leaks. In any case the best values for grid condensers and leaks are best determined by trial in individual cases.

A very effective way of stabilising a reactance-capacity coupled amplifier is to replace the grid-filament leaks by means of high-frequency chokes as shown in Fig. 2 at L_1

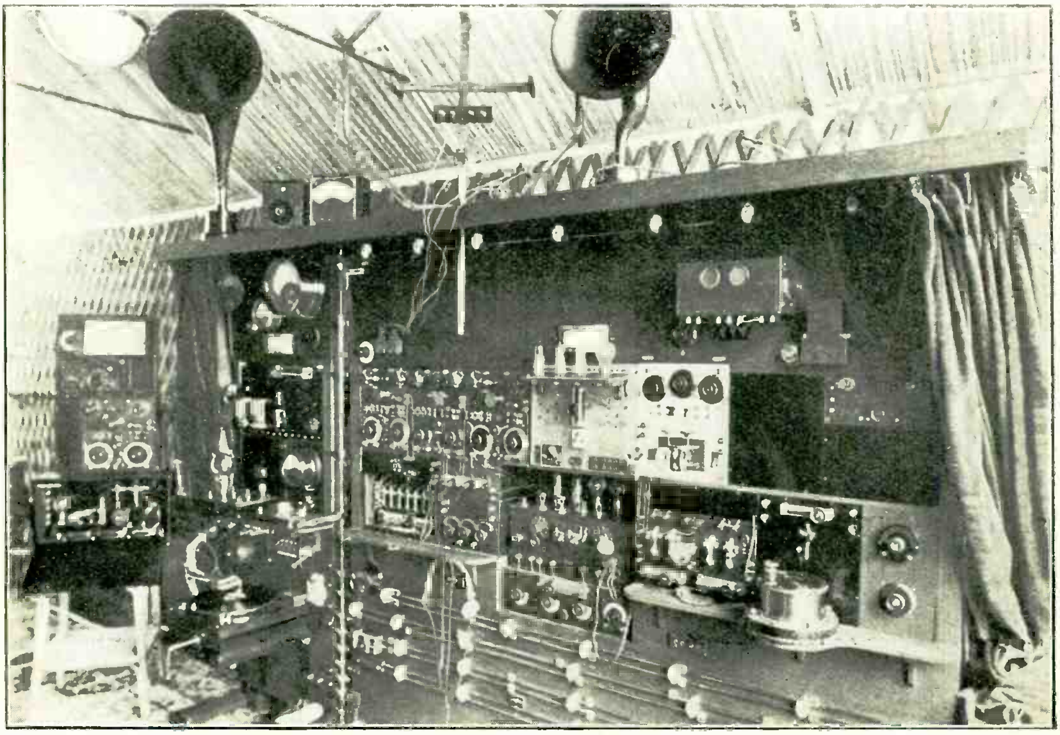
and L_2. For short wavelengths (below 600 metres) these H.F. chokes may consist of basket coils wound with 200 turns of 36 gauge insulated copper wire. These maintain the normal potential of the grids at a perfectly definite value with respect to the filaments, and grid-condenser rectification at H.F. valves is stopped. If, as shown in Fig. 2, the leak of the detecting valve V_3 is replaced by a choke a suitable potential will have to be applied to the grid by means of the potentiometer P_1 in order that V_3 may detect by virtue of working at the lower bend of its characteristic curve. As, however, condenser and leak rectification is more sensitive (in the case of the usual hard valve) it is better to strike a compromise and use a simple leak on the last valve V_3 as shown in Fig. 1, and use chokes as at L_1 in Fig. 2 for any intermediate H.F. amplifying valves.

Although Figs. 1 and 2 show two stages of H.F. amplification, the above remarks apply equally to sets using only one stage of H.F., which latter are perhaps more commonly used for ordinary work. Where only one stage of H.F. is used, any overlap that may take place is pretty sure to be caused by the detecting valve.

AN EXPERIMENTAL STATION AT SHEFFIELD (2 ND).

The illustration on this page depicts the imposing array of apparatus at **2 ND**, an experimental station in Sheffield. Divided into two portions for transmitting and receiving, the set is mounted on a wooden framework, 11 ft. long by 6 ft. high.

The receiving set embodies a seven-valve Marconi amplifier with Mark III tuner. A home-made three-valve L.F. amplifier is used for loud speaker reception, whilst the station also possesses an amplifier with six H.F. valves. Weston and Brown loud-speakers are operated by means of a four-valve note magnifier, and a Morse inker and Siemens relay are used with a Brown microphone amplifier and rectifying panel. The transmitting set works on a wavelength of 200 metres. The high tension current is derived from the Corporation mains, and after rectification is fed to both power and control valves, with a separate battery for the microphone circuit. The choke control method of modulation is employed. The low tension current for charging accumulators, etc. is supplied by a motor connected with a 110-volt 25 ampere D.C. generator.



2 ND, *a finely-equipped experimental station at Sheffield.*

NOVEL IDEAS AND INVENTIONS.

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

A SIMPLE POTENTIOMETER FOR HIGH VOLTAGES.

While convenient in many ways, the ordinary forms of potentiometer consisting of a fine resistance wire wound on some suitable former and provided with a sliding contact or with a series of contact studs, has some disadvantages when required for controlling potentials of a hundred volts or more. The potentiometer resistance in such cases either becomes inconveniently bulky, or becomes incapable of passing more than an almost inappreciable amount of current. For many experimental purposes, the ordinary electric lighting supply current forms a convenient source of voltage, provided that some means are available for adjusting the potential to a value suitable to the purpose in view. An electrolytic potentiometer if properly constructed may provide a suitable means for regulating the potential in the local circuit. It has also the advantage that it cannot burn out as a wire resistance may. A novel form of such a potentiometer is sketched in outline plan in Fig. 1*. It consists of a suitable (insulating) containing vessel, A, such as a glass or stoneware jar in which are suspended four fixed electrodes,

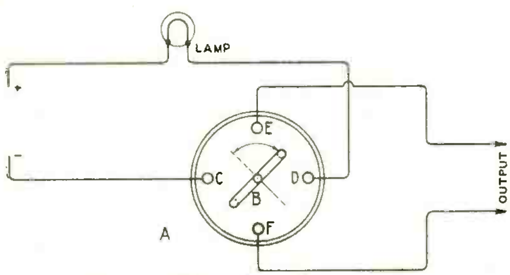


Fig. 1. Electrolytic Potentiometer.

C D E F, such as carbon rods, which are placed at the corners of a square. The supply leads, through an appropriate resistance, such as a lamp or bank of lamps, are connected to an opposite pair of these electrodes, C and D, while the wires to the output circuit are joined to the remaining opposite pair E and F. In the centre of the jar is fitted a baffle plate B, which can be rotated at will by an appropriate handle so that it occupies either the position shown or the one indicated by the dotted line, or any intermediate position. This baffle plate should be of ebonite or some similar insulating material, and should fit the outline of the available space as fully as possible while allowing sufficient clearance for its rotation. When the plate B is in the line joining the two output electrodes EF, there will be no E.M.F. between them, but as it is rotated into a position to one side or the other of this neutral position, there will be an E.M.F. set up in one or the other direction which becomes greater the more the baffle is moved from the central position.

* British Patent 196055, by A. W. Sharman.

IMPROVING THE VALVE RECEIVER.

It has recently been claimed that the action of an ordinary form of detecting valve, provided with the usual grid condenser and leak, may be improved by the addition of another leak resistance connected directly between the grid and the anode terminals.*

This second leak should have a high resistance value—somewhere of the order of 50 megohms. It is shown at R_2 in Fig. 2, the ordinary leak resistance being R_1 connected across the grid condenser C.

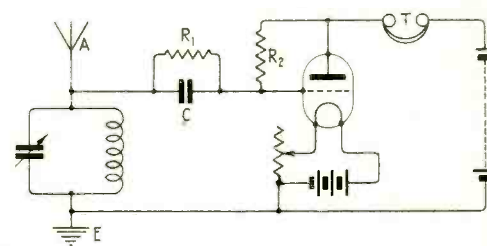


Fig. 2. A Single Valve Receiving Circuit, introducing an additional grid leak resistance.

It would seem that the main action of such a resistance would be to impress a positive potential upon the grid of the valve. The magnitude of this potential would of course depend upon the relative values of the resis-

* British Patent 196233, by A. L. A. Petty.

tances R_2 and R_1, and the voltage of the H.T. battery. Thus if the resistance R_2 has a value of about 50 megohms, and R_1 about 2 megohms, the potential of the grid would be held at an average positive value of about one twenty-fifth of the H.T. voltage, if the effect of the grid current is neglected. This latter will somewhat modify the value of the potential, but not to any great extent unless the grid current is large.

The effectiveness or otherwise of this arrangement will evidently depend upon the characteristics of the detector valve that is used.

THE PRODUCTION OF HIGH FREQUENCY CIRCUITS.

A new departure in methods for setting up radio-frequency currents has recently been patented by Paul d'Aigneaux.* It employs light waves as the controlling means for affecting, through the medium of a photo-sensitive cell, the intensity of a direct current flowing in an appropriate circuit. It is proposed to subject the photo-sensitive cell to the radiation from two light sources of different frequencies, such that the difference between their frequencies (which constitutes a species of "beat" frequency) has the desired radio frequency. Thus the direct current flowing through the photo-sensitive cell would be caused to pulsate at this (radio) beat frequency.

The main difficulty of the method would appear to be to obtain a sufficiently small frequency difference to give a beat frequency of the required order of magnitude.

Since light frequencies are so much in excess of all ordinary radio frequencies, the wavelength difference between the two radiations which are necessary would be extremely minute. Difficulties would doubtless also be found in obtaining a suitable photo-sensitive material to follow these rapid changes of illumination.

THE "COSSOR" VALVE.

The essential features of this valve are set out in a recently granted British Patent.† Its main constructional features consist of an arched filament, an arched grid having flattened sides, and an arched anode also having flattened sides, and enclosing the filament and grid, all of the electrodes being separately and rigidly supported from the stem of the valve.

* British Patent 197782, by Paul d'Aigneaux.

† British Patent No. 197853, by W. R. Bullimore.

AMPLIFYING UNITS.

The assembly of low frequency amplifiers from component parts, so as to include as many stages as desired, is greatly facilitated by the building of each stage into a unit which may simply and easily be connected to the next.* An amplifying unit, as illustrated in Fig. 3, consists essentially of any convenient case containing a low frequency intervalve transformer, and having mounted upon it a valve holder. It is provided with terminals so that by linking corresponding terminals on adjacent units, the separate valve stages are automatically joined in cascade.

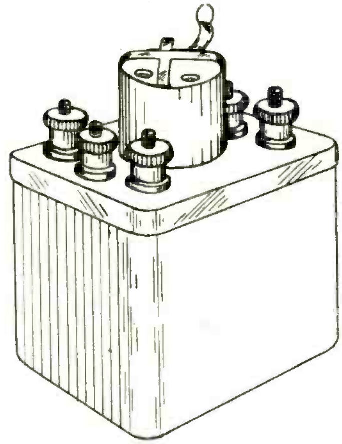


Fig. 3. The Elwell low frequency amplifying unit.

* British Patent No. 197854, by B. E. G. Mittel and C. F. Elwell, Ltd.

A SUMMER SET.

The belated arrival of summer has brought with it an increased demand for a simple portable wireless set for use out of doors with a small and hastily erected aerial. Such a set, of plain and straightforward design, was fully described and illustrated in the *Wireless World and Radio Review* for June 23rd and 30th. Copies of these issues can still be obtained from the Publishers, 12/13, Henrietta Street, Strand, W.C.2. Price 4d., or post free 5d.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XVI.

The series has been specially arranged so that the reader who follows each section as it appears will have obtained a complete wireless education with a minimum of time and trouble, and he will be in a position to successfully design his own wireless equipment.

The last sections deal with series and parallel resonance, the study of which is so important to those who desire a clear understanding of wireless.

By W. James.

35.—Choke Coils.

Iron-cored choke coils are often employed in wireless apparatus, and one should be able to estimate the dimensions necessary to produce a choke coil with a given inductance. It is ordinarily not possible to calculate with any degree of accuracy the exact inductance on account of the effect of the iron used. One is generally not in possession of the magnetic properties of the iron, and in most wireless receivers or transmitters the choke coil carries a steady current as well as a fluctuating current. The fluctuating current will, in general, not have the shape of a sine wave.

The formula generally used, when the iron circuit is closed, is as follows :—

$$L = \frac{1{\cdot}257 \times \mu \times A \times N^2 \times 10^{-8}}{l}$$

Where L = inductance in henries.
μ = permeability (varies from perhaps 1,000 to 2,000).
A = effective area of iron cross section in sq. cms.
N = number of turns.
l = length of magnetic path in cms.

The reader will notice the inductance depends upon the *square* of the number of turns, the area and permeability of the iron, and inversely as the length of the magnetic circuit. The qualities are set out in Fig. 76. In reckoning the area of cross section, allowance should be made for the space occupied by the insulation of the laminations, and it will be reasonable to represent the effective area as 90 per cent. of the total area.

Clearly the inductance will vary with the current passing through the coil because the factor μ is directly affected. To provide a choke with a more nearly constant inductance value it is usual to split the core so that the magnetic circuit includes an air gap. The core may be simply cut through as shown dotted in Fig. 76. The air gap is also beneficial in that the distortion of the wave form due to magnetic hysteresis is reduced. The inductance formula should now be modified as follows :—

$$L = \frac{1{\cdot}257 \times I \times N^2 \times A \times 10^{8}}{l}$$

when L = inductance in henries.
I = current in amperes.
N = number of turns.
A = effective area of air gap in sq. cms.
l = length of air gap in cms.

The formula assumes the whole of the reluctance is concentrated at the air gap or gaps. When the choke coil is to be used in a circuit which carries a normal steady current, an air gap should always be provided.

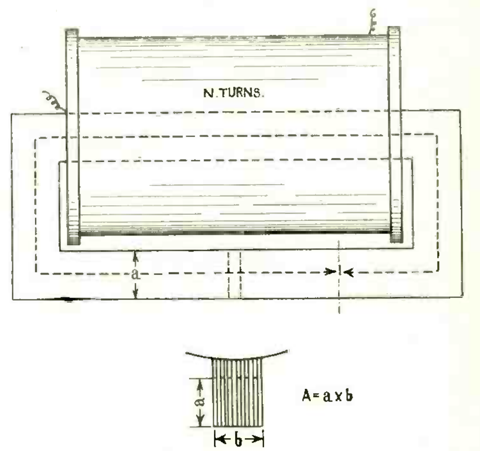


Fig. 76. A useful form of choke. The coil has N turns, and the cross sectional area of the iron $A = a \times b$. If the core is 1¼″ by 1⅛″, and the bobbin is 3″ in diameter and 4½″ long wound with 5,500 turns of No. 26 D.S.C., the inductance will be approximately 6 henries and the resistance 115 ohms.

Probably it is best for those who experiment to construct a variable inductance. The wire should be chosen so that it will properly carry the current without heating, and the turns and the whole winding should be insulated carefully. A suitable choke is shown in Fig. 77. The maximum inductance is in the neighbourhood of 50 henries.

The coils should each consist of about 6,500 turns of No. 22 D.C.C. Bring out four or

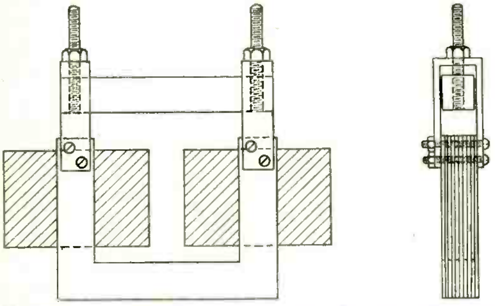


Fig. 77. A choke suitable for he experimenter. The inductance may be varied over a wide range by moving the top limb of the core which is mounted so that it may be moved between the brass end pieces.

five tappings from each coil. The core may have a cross section of 4 square ins., or say 2 ins. by 2 ins. Each coil will occupy a space of 5 ins. by 3 ins., so that the core should be 5 ins. long, and the distance between the cores 6 ins. The top limb of the core is mounted so that it may be moved up or down by adjusting the nuts.

Another form of choke coil which will safely carry a current of 400 milliamperes is shown in Fig. 78. The winding consists of about 6,000 turns of No. 30 D.S.C., and the inductance is close to 2 henries. The core

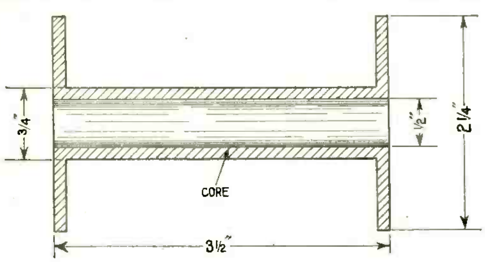


Fig. 78. Open core choke. If the former is wound with 6,000 turns, the inductance will be approximately 2 henries.

consists of a bundle of iron wires which are forced into the central hole of the former. Another choke coil which has given satisfactory service is as follows; Inductance 2 henries, resistance 3,000ω, bobbin $3\frac{1}{2}''$ long and $1\frac{3}{8}''$ diameter. Iron core $\frac{1}{2}''$ diameter of iron wires, wound with No. 42 D.S.C.

It is as well to remember that the inductance of the primary of an ordinary intervalve transformer is of the order of 10 henries, and the secondary may be as high as 100 henries. The transformer may be used as an inductance, either using one of the windings by itself or by connecting them in series, so that the inductances add, *i.e.*, the two windings may be connected so that the turns follow in the same

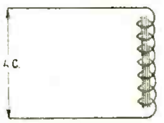


Fig. 79. Usual method of representing a choke in a circuit.

direction. The current passed through the windings must, of course, be limited to a few milliamperes.

The usual method of representing a choke is shown in Fig. 79.

36.—Low Frequency Transformers.

Suppose we wind a second winding over the winding of the choke coil as in Fig. 80. When an alternating pressure is connected to the choke, the alternating flux which is set up around the coil interlinks with the second winding. Consequently a pressure is generated in this winding. The arrangement is called a transformer. The winding to which we apply the power is called the primary. The other winding is the secondary.

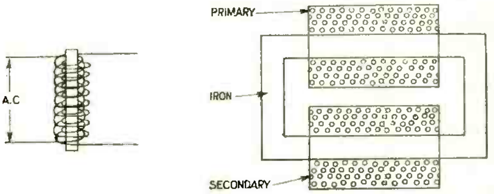


Fig. 80. A transformer consists of a core with a primary and secondary winding.

Naturally, if there are the same number of turns in the secondary winding and the primary, and all the flux which is generated cuts both windings, the pressure induced will be the same

Usual method of showing an iron core transformer, and a transformer without an iron core. The first is usually termed a low frequency transformer, and the second a high frequency transformer.

in each winding. The voltage is given by ωLI, where L is the inductance of the winding. If the primary winding has no resistance and there are no losses, the induced pressure in the primary and secondary windings is equal in magnitude to the applied pressure. Note that the addition of the second winding has not altered in any way the operation of the choke coil. The operation is, of course, modified when we connect a load to the secondary.

Let N_p = the number of turns in the primary winding.
N_s = the number of turns in the secondary winding.
A = the area of the core cross section in sq. ins.
B = the maximum flux density.
f = the frequency of the applied pressure.
E = the induced pressure in volts.

During one cycle the maximum value of the flux changes by $2B$, and the time taken for each change is $1/2f$ seconds, since there are two alternations for each cycle.

The pressure induced has, then, the average value of $4BANf \times 10^{-8}$ volts. The effective or root mean square (RMS, see sect. 18) will be this quantity multiplied by 1·11 assuming a sine wave of pressure. We then have as the fundamental equation for the transformer

$$E = 4{\cdot}44\ BANf \times 10^{-8} \text{ volts.}$$

Instead of BA we may write F for the maximum value of the flux. Then $E = 4{\cdot}44\ FNf \times 10^{-8}$ volts. We may substitute for N either N_p or N_s to obtain the voltage induced in the primary or secondary windings. The voltage induced in the primary is equal to the applied voltage if we assume there are no transformer losses. Considering the phase relationship; the transformer with the secondary winding on open circuit, *i.e.*, not connected to a load, is behaving exactly as a choking coil. The back primary pressure generated is directly opposing the applied pressure as shown in Fig. 81, while the small current which flows to magnetise the core is 90° behind the applied pressure. In the vector diagram E_p represents the applied pressure and E_{back} the back pressure. The magnetising current is shown as I_p. The flux is, of course, in phase with the current. With the secondary circuit not connected to a load, the secondary pressure is as shown at E_s. E_s and E_{back} will be equal when the primary and secondary turns are equal. We assume the transformer has no losses. E_s is then equal to E_p. It is important to note the secondary pressure and the pressure applied to the primary are 180° out of phase. It is clear that the secondary pressure and primary back pressure have the same phase since they are both interlinked with the same flux at the same time. Since the primary circuit has a large inductance the primary current is very small indeed.

(1) *The Voltage Ratio.*

If we call the number of primary turns N_p and the number of secondary turns N_s, we have the simple relationship—

$$\frac{N_p}{N_s} = \frac{\text{Primary voltage}}{\text{Secondary voltage}} = \frac{E_p}{E_s}$$

or $$E_s = \frac{N_s}{N_p} \times E_p \text{ volts.}$$

Thus, if we wish to use a voltage which is lower than that available, it is simply necessary to use fewer turns in the secondary than are used in the primary. If, say, the supply is 500 volts, and we wish to use 20 volts, and the transformer primary has 250 turns, the number of secondary turns required is

$$N_s = \frac{E_s}{E_p} \times N_p \quad \therefore N_s = \frac{20}{500} \times 250 = 10 \text{ turns.}$$

The ratio of the turns is thus 10 to 250 or 1 to 25, *i.e.*, the primary has 25 times the number of secondary turns. It is clear the

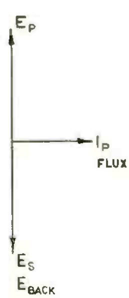


Fig. 81. Phase relationship in unloaded transformer.

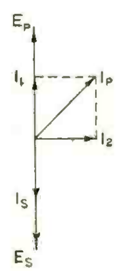


Fig. 82. Phase relationship when secondary is connected to a resistance load.

turn ratio is equal to the voltage ratio. Suppose we require a high voltage, say 2,000, and we have only 250 volts available. The voltage *step-up* required is $\frac{2{,}000}{250} = 8$. The secondary winding will therefore require to consist of 8 times as many turns as the primary.

(2) *Effect of Loading the Secondary.*

Let us suppose we still have our ideal transformer, and we connect a resistance across the secondary terminals. Current of course flows in the secondary circuit, and the secondary voltage and current are in phase. The current is equal to E/R amperes. Now it is perfectly plain we cannot load up the secondary without taking a load from the source which is supplying the primary, and further, the primary load and secondary load balance each other. That is, if we take a large load from the secondary, the primary must also take a large load.

Let us ignore the primary winding for a moment and consider the secondary circuit only. When the secondary current flows, a magnetic field is set up due to the current and the secondary turns. The core is therefore magnetised. But now, with the primary connected, there is a flux due to the primary. The two fluxes react on each other. The value of the magnetising current and the resultant flux must, however, remain unaltered if the transformer is to work properly. The value of F in the above formula must not vary if the voltage induced is to remain the same. Therefore a current flows in the primary winding so that the flux which this current produces neutralises the flux due to the secondary. We have now two components of the primary current—one component which magnetises the transformer and induces the back pressure in the primary, and the pressure in the secondary; and the second component which is termed the load current, which tends to produce a flux which just neutralises the action of the secondary.

Looking at the action a little more closely and referring to Fig. 82, the primary pressure E_p is at right angles to the magnetising current I_2. The secondary pressure E_s is at right angles to the magnetising current, and the load current I_s is in phase with E_s. The combined effect of I_2 and I_s is to increase the flux, but the phase of the flux with respect to the primary pressure is changed. Therefore, a load current will flow in the primary circuit of such magnitude and phase so that the effect of the secondary is neutralised. The primary magnetising current and load current I_1 are now 90° out of phase, and their resultant is given by I_p. The effect of loading the secondary is therefore to load the primary.

(3) *The Current Ratio.*

If the efficiency of the transformer is 100 per cent., the primary input, and the secondary load are equal. Hence

$$E_pI_p = E_sI_s \text{ or } \frac{E_p}{E_s} = \frac{I_s}{I_p}$$

That is, if the voltage is stepped up, the current is stepped down in the same proportion. If the secondary voltage is 10 times the primary, the secondary current can only be 1/10th the primary current.

Wireless Club Reports.

Contributions to this section are welcomed. Reports should be as concise as possible and should record the most interesting features of each meeting. The Editor reserves the right to edit the reports when necessary. **Papers read before Societies will receive special consideration with a view to publication.**

An Asterisk denotes affiliation with the Radio Society of Great Britain.

Wolverhampton and District Wireless Society.*

On Wednesday, June 27th, about 35 members of the Society visited the Birmingham Broadcasting Station (5 IT), and a very interesting time was spent.

This is one of a series of visits to places of interest to radio experimenters arranged for the summer months.

Hon. Sec., J. A. H. Devey, 232, Great Brickkiln Street, Wolverhampton.

Hackney and District Radio Society.*

On Thursday, June 28th, after the usual half-hour of questions, Mr. A. Valins gave an excellent and instructive lecture on "Variometers and Variometer Winding." The lecturer exhibited a large number of variometers of all kinds, winding several before the audience.

An interesting programme has been arranged for the next six weeks.

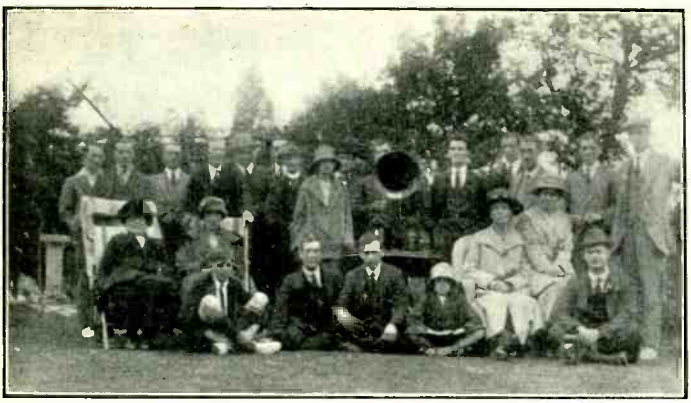
Hon. Sec., Mr. C. C. Phillips, 57, Highfield Avenue, Golder's Green, N.W.11.

Hounslow and District Wireless Society.*

An interesting lecture, the first of a series, was delivered by Mr. O. S. Puckle on June 21st, his subject being "The Elementary Principles of Electricity."

An elementary instructional class has recently been formed, and is proving of great value.

The Society, which meets at 8 p.m. on Thursdays at the Council House, Hounslow, has a number of vacancies for new members, both junior and senior. Enquiries regarding membership, etc., will be gladly attended to by the Hon. Sec., A. J. Myland, 219, Hanworth Road, Hounslow.



Members and friends of the Grimsby Radio Society who visited Ashby on Saturday, June 30th.

Lewisham and Catford Radio Society.*

This Society has now undergone complete re-organisation, and at the last general meeting, Lt.-Col. Assheton Pownall, M.P., was elected President, Lt.-Col. Eric Ball, L.C.C., and Mr. R. O. Roberts, L.C.C., Vice-Presidents, while his Worship the Mayor of Lewisham (Councillor C. H. Dodd), Commander J. M. Buggé, R.N.R., Councillor W. J. Chorley and Councillor J. T. Hallinan are now Patrons.

On June 21st a very instructive lecture was given by the Technical Director, Mr. Stanley, on "The Armstrong Circuit."

Prospective members are asked to write to the Hon. Sec., F. A. L. Roberts, 43, Adelaide Road, Brockley, S.E.4.

North London Wireless Association.*

On June 25th, Mr. E. H. Robinson gave his lecture on the "Armstrong Supersonic Heterodyne," which evoked great interest on account of the easy manipulation of the circuit. The lecturer explained that although loss of strength in signals resulted from the use of a separate heterodyne, yet this loss was replaced and the amplifier gave greatly increased strength.

"Triggered Valve Circuits" was the title of Mr. V. S. Hinkley's lecture, delivered on July 2nd. The lecturer showed on the blackboard the variations of a regenerative circuit, together with the value of coils and capacities. Many other circuits, including a single valve Armstrong, were dealt with, the Armstrong circuit being made up and worked with the Club's apparatus.

A grant of ten pounds was made by the Committee for the improvement of the Society's multi-valve set.

Applications regarding membership should be addressed to the Hon. Sec., J. C. Lane, Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.

Finchley and District Wireless Society.*

Particular attention is drawn to the last meeting of the session, on July 26th, for which the Society has been fortunate in arranging a lecture by Mr. Puckle, who will deal with "Wireless Receivers." Admission is free, and all members and persons interested are earnestly asked to attend this meeting, at which several important items will be discussed.

For particulars of membership application should be made to the Hon. Sec., A. E. Field, 28, Holmwood Gardens, Finchley, N.3.

Grimsby and District Radio Society.

Nearly 30 members and friends attended the Society's outing to Ashby on June 30th, when a very enjoyable time was spent in rambling through the gardens and village and in playing tennis.

On Tuesday, July 3rd, Mr. M. Bennett (Hon. Sec.) exhibited his set, which gave good results and reflected careful workmanship.

Hon. Sec., M. M. Bennett, c/o Club Room, Wellowgate, Grimsby.

The Kensington Radio Society.*

At the June meeting of the above Society, Mr. P. Voigt, B.Sc., delivered a lecture and showed several successful experiments on "Dual Amplification." The lecturer, by means of an ingenious method of his own, constructed the various diagrammatic circuits as he required them for the purpose of explanation.

The Hon. Sec., Mr. J. Murchie, 33, Elm Bank Gardens, Barnes, will be pleased to hear from anyone desirous of joining the Society.

The Southampton and District Radio Society.*

At a well-attended meeting held on June 28th, Mr. Chester lectured on "Magnetic Testing," and afterwards dealt with questions arising out of his subject, in connection with intervalve transformers, etc.

Mr. G. Sutton, Secretary of the Dulwich Wireless Experimental Association, who was present, expressed appreciation of the lecture, and exhibited and described the making of an ingenious variometer rotor constructed from a rubber ball.

Five new members were elected.

Hon. Sec., P. Sawyer, 55, Waterloo Road, Southampton.

The Radio Society of Willesden.*

On June 19th, highly interesting and instructive experiments were carried out by Messrs. Wyatt and Arnoll, using a dual amplification circuit.

The Society has now been established three years, having been one of the first to be formed in this country after the war. Meetings are held regularly every Tuesday evening at 8 p.m. at the Harlesden Public Library and a full and interesting programme is always provided. During August and September the Society will be temporarily transformed into a rambling club.

By courtesy of the British Paramount Wireless Co., who kindly lent a four-valve set, an extremely successful public demonstration of the reception of broadcast telephony was given on June 26th. During the proceedings reception was effected with a human chain aerial, made up of volunteers.

"True Experimenting," formed the subject of a very instructive lecture given by Mr. A. Hinderlich, M.A., on July 3rd. Many points regarding experiments with crystal receivers were put forward and illustrated with apparatus.

Information respecting membership, etc., will be readily supplied on application being made to the Hon. Sec., F. H. H. Coote, 183, Carlton Vale, Kilburn, N.W.6.

Tottenham Wireless Society.*

On Wednesday, June 27th, Mr. J. Kaine-Fish lectured on "Continuous Waves." The lecturer explained the form of continuous waves and fully discussed the various wave forms obtained by superimposing one set of oscillations on another of different frequency or amplitude.

As usual questions were asked and answered, and an animated discussion on the use of a separate heterodyne concluded the meeting.

At the monthly business meeting, held on Wednesday, July 4th, the most important item was the adoption of the Chairman's suggestion to institute examinations in wireless theory and practice. A Committee has been formed to organise the examinations.

Mr. Ellis gave an instructive lecture on "Valve Couplings."

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

St. Bride Radio and Experimental Society.*

On Monday, June 18th, Mr. A. T. Penn delivered a very instructive lecture on "Accumulators for Wireless: their Construction, Maintenance and Charging." A profitable discussion followed, many questions being asked and answered.

Visitors are welcomed at all meetings, and enquiries as to membership will be gladly answered by the Hon. Secretary.

Headquarters, St. Bride Institute, Bride Lane, Fleet Street, E.C.4. Hon. Sec., R. J. Berwick.

Hall Green Radio Society.

An instructive and enjoyable evening was spent on Friday, June 22nd, when the Society was visited by Mr. F. H. Amis, B.Sc., the Engineer-in-Charge of the Birmingham Broadcasting Station. Mr. Amis gave an interesting and full account of broadcasting from Witton, from the actual performance in the studio to the transmission from the antennae. Great interest was manifested in the lecturer's explanation of the difficulties now experienced in broadcasting from Witton, which, he stated, would be obviated when the station could be removed to the centre of the city.

Mr. Winkles was accorded a vote of thanks for having filled the gap caused by the unavoidable delay in the arrival of the lecturer, by explaining the working of a crystal set and answering members' questions.

Hon. Sec., F. C. Rushton, 193, Robin Hood Lane, Hall Green, Birmingham.

Burnley and District Radio Society.

Some valuable information on the care of accumulators was given to the members on Thursday, June 21st, by Mr. F. Drinkwater, of the Hart Accumulator Co. The lecturer touched on the many and varied causes of accumulator troubles, and afforded those present a thorough understanding of the functioning of the low tension supply.

It has been decided to hold a competition for the best portable single valve set, open not only to members, but to anyone in the district. A very low entrance fee has been arranged, and three prizes are offered. Intending entrants should communicate with the Hon. Sec., W. H. Thornton, 16, Bridge Street, Burnley.

The Prestwich and District Radio Society.

A lecture was given on June 21st by Mr. W. J. Brown, of the Metropolitan Vickers Co. Research Department, entitled "The Quality of Wireless Transmission and Reception."

Mr. Brown's remarks proved very helpful, and outlined the difficulties which had been overcome in the working of the Manchester station, 2 ZY. Many suggestions for obtaining improved quality at the receiving end were made, and interesting tests with loud speakers were carried out.

Hon. Sec., H. A. Wood, Spring Bank, Church Lane, Prestwich.

South Dorset Radio Club.

A large number of members and potential members was present at the Weymouth Guildhall on Tuesday, June 5th, when Captain Hobbs (2 OY) gave a lecture on "The Practical Application of Theory."

The membership of the Club is increasing rapidly. A Club-room and workshop have been obtained and by the time this report appears, the Club's three-valve set will be in operation.

Full particulars of membership can be obtained from the Hon. Sec., E. B. Cartwright, 18, Newberry Terrace, Weymouth.

Honor Oak Park Radio Society.

At St. Augustine's Hall on June 27th, a lecture on "Dual Amplification," followed by a demonstration, was given by Mr. J. C. Mackey. The lecturer's own two-valve dual amplification set was used for demonstration purposes, and clear speech and music were received from the Birmingham station on a large "Amplion" loud speaker kindly lent by Messrs. Hughes and Alexander.

Messrs. Alfred Graham & Co. have offered to the Society the services of their principal electrical engineer in an advisory capacity.

Hon. Sec., G. J. Price, 22, Honor Oak Park, S.E.23.

Beckenham and District Radio Society.

The Society gained considerable prominence at the local fête held on June 27th, by carrying out a series of demonstrations during the evening. A six-valve set and two loud speakers were used, and such was the strength of reception that music and speech could be heard at a distance of fifty yards from the tent.

Hon. Sec., J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

DOUBLE MAGNIFICATION RECEIVER.

RECEIVER WITH TWO STAGES OF H.F. AND TWO OF L.F., WITH CRYSTAL RECTIFICATION AND USING TWO VALVES.

IN the issues of May 12th and 19th, we described very fully the methods whereby valves with the associated apparatus could be made to perform a double duty, *i.e.*, amplify the signal before *and* after rectification. Those readers who are not familiar with the principles of double magnification, as the system is called, should refer to those articles for information concerning the methods which are employed. The data accompanying each system is sufficient to enable anyone interested to construct a receiver (and many readers have done so) and it is with the object of removing any doubts which may exist in the minds of those who consider the arrangements given look rather intricate that the writer's receiver is to be described.

The apparatus is assembled in a small box measuring 11 × 9 × 6½ ins. deep. The components are arranged close together, the transformers on one shelf, and the valves on another.

A photograph of the instrument is given in Fig. 1, and Fig. 2 is a front view drawn to scale. Fig. 3 is a scale drawing of the back of the instrument and Fig. 4 a wiring diagram. The components are numbered and can be identified.

All of the components were purchased with the exception of the coils. These were wound "Burndept" fashion on a cylindrical former 1½ ins. in diameter, having two rows of 13 pins driven in a circle around the circumference. One row of pins is opposite the spaces of the other row, and the two rows are ⅜ in. apart. To wind a coil a layer of cotton is wound on first, and then, with one end of the wire fixed, one layer is wound so that a short cylindrical coil is produced. Then the wire is passed back and forth in and out of the pegs so that a single wire zig-zag layer is wound. Next a cylindrical layer is put on, followed by another zig-zag winding and so on until the coil has the right number of turns. If now the cotton is taken off and the pegs withdrawn, the coil may be removed from the former and tied with cotton. Another method of winding a compact yet useful coil is to fix the pegs close together, and wind the wire in and out around alternate pegs. The resulting coil resembles a double basket coil in that the formation of the coil is the same as that of a basket coil, although two rows of holes are visible instead of one as in the usual arrangement.

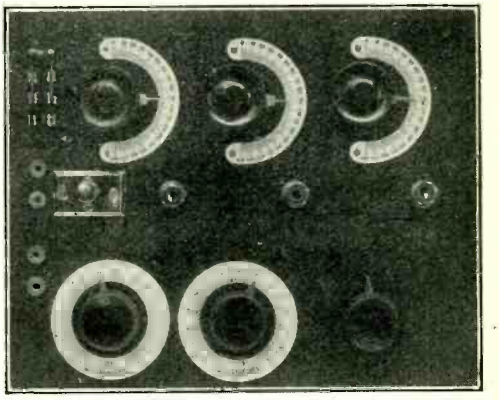


Fig. 1. A front view of the Double Magnification Receiver described in this article.

The aerial coil No. 19, has 35 turns, and the closed circuit coil No. 20, 85 turns of No. 26 D.S.C. wire; coils 21 and 22 respectively have 55 and 85 turns, and coils 23 and 24, 85 and 100 turns all of No. 26 D.S.C., except coil No. 24 which is wound with No. 30 D.S.C. The receiver tunes from 300 to 700 metres.

The apparatus shown on the panel, Fig. 2, is secured with fixing screws. The shelf No. 31, of 5/16 in. ebonite, is supported on brass brackets, one at each end. The screws do not project through the front panel. The transformers 29 and 28 (the latter is a War Office pattern) are fastened to the shelf, and the smaller platform 33, which accommodates the valve legs is held to the shelf with brass straps, 37. The fixed condenser 30 is held in place with straps 38. The two fixed condensers, 25 and 26, are screwed to the panel. The 4BA terminals for the high and low tension batteries are mounted on the back edge of shelf 31. The back nuts of the terminals retain the case in position. The case has an ebonite batten through which the terminals pass. The coil support 34, is let in the outside edge of the shelf, and the two coils are held in place with screws passing through a thin ebonite batten. The coils are separated with a few sheets of paper. Coils 21 and 22 are held 2 ins. away from the bottom plates of the condensers with the ebonite piece marked 35. The ebonite is secured to the condenser bottom plates themselves. Coil 23 is held on the surface of the shelf with two small pieces of ebonite and clamps marked 36. Coil 24, is mounted on a small piece of ebonite, one end of which is fastened to a brass spindle. The spindle projects through the panel and is fitted with the handle 9.

Referring now to Fig. 4, the diagram of connections, when it is desired to employ an outdoor aerial, switch 1 is put in its upper position and the aerial and earth plugged into the sockets 2 and 3. The aerial circuit contains the coil 19 only. The closed circuit consists of condenser 17 and coil 20. The coupling between coils 20 and 19 is fixed, and the best value of the aerial coil determined by experiment. To employ a frame aerial, switch 1 is thrown over, and the frame connections plugged into sockets 4 and 5. Condenser 17 being across the centre contacts of the switch will tune the frame. An external high frequency amplifier may be joined here provided the transformer method of coupling is used. If we have an external stage of H.F. amplification, it is only necessary to connect the ends of the secondary winding of the H.F. transformer with sockets 4 and 5 in place of the frame, when condenser 17 may be used to tune the grid circuit. The battery connections for the external stage may be taken from the terminals of the receiver. One side of condenser 17 connects with grid V_1, and the other side connects with the fixed 0·002 condenser, and the transformer secondary No. 28 O.S. In the anode circuit of the first valve V_1 is connected coil 21, which is untuned, but is tightly coupled with the tuned circuit consisting

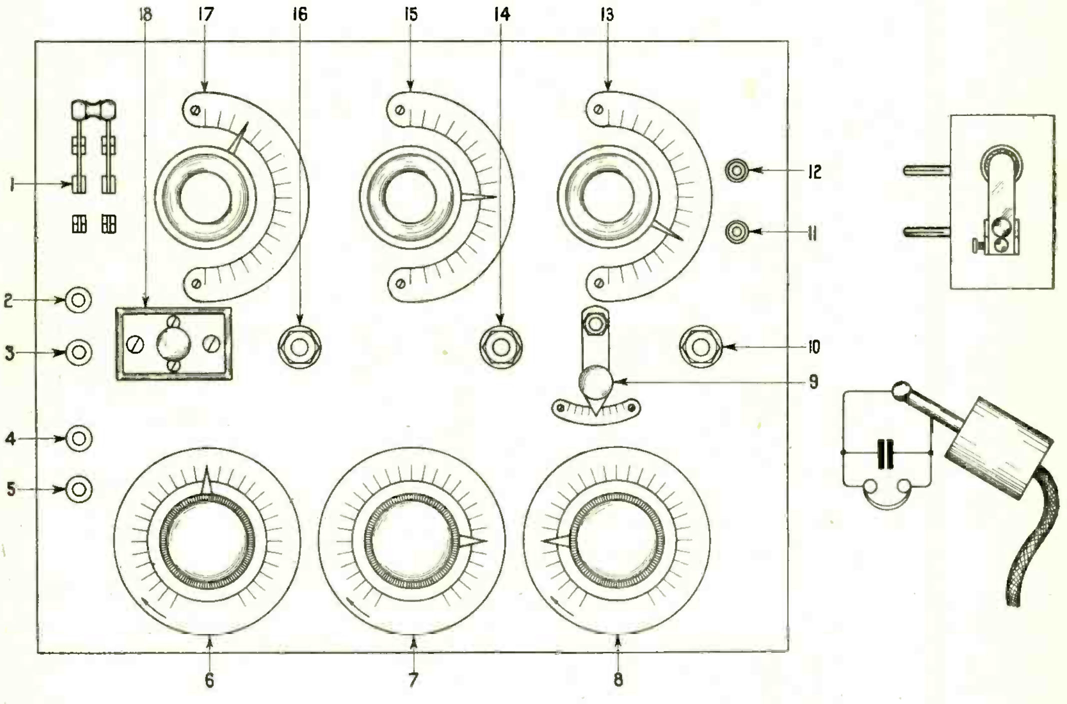


Fig. 2. Front view of receiver to scale.
No. 1 *change-over switch,* 2 *aerial,* 3 *earth,* 4 *and* 5 *frame aerial,* 6 *and* 7 *filament resistances,* 8 *potentiometer,* 18 *filament on and off switch,* 16, 14 *and* 10 *spring jacks,* 9 *coupling,* 17, 15 *and* 13 *variable condensers, maximum value* 0.0003 *mfd.,* 11 *and* 12, *sockets for crystal rectifier. Dimensions of panel* 11 *ins.* × 9 *ins.*

of coil 22 and condenser 15, which is connected to the grid circuit of valve V_2. The anode circuit of V_2 is tuned and consists of coil 23 and condenser 13. Coil 24 is coupled variably with 23, and is connected with the crystal and potentiometer. It will be noticed the potentiometer 8 and resistance 27 are connected in series with the high tension battery between −LT and −HT. The anode current flowing through the resistances, there is a fall of potential across them, and the terminal −HT is negative with respect to −LT. If the normal anode current is 3mA, and the total resistance is 300 + 1,500 ohms, the voltage drop will be 5·4 volts. The fall in potential across the potentiometer (300 × 0·003) is roughly 0·9 volts, which gives us a sufficient potential to select the best operating point of the rectifier. A carborundum-steel combination is used, and though perhaps not so sensitive as some other combinations, is remarkably steady and consistent. A condenser is connected between the moving contact and one end of the potentiometer, and another is joined across the high resistance of 1,500 ohms. This resistance consists of a small bobbin wound with 100 yds. of No. 36 Eureka wire.

The jacks are connected so that with the telephone plug in jack 10, the receiver operates as a two-stage H.F. amplifier with crystal rectification. The upper springs short circuit the secondary winding of the transformer 29 which is joined in the grid circuit of valve V_2. With the plug in jack 14 we have two stages of H.F. rectification, and valve V_2 operates as a note magnifier as well. The upper contacts of jack 14 short circuit the transformer secondary 28 in the grid circuit of valve V_1. When the plug is in jack 16, we have two stages

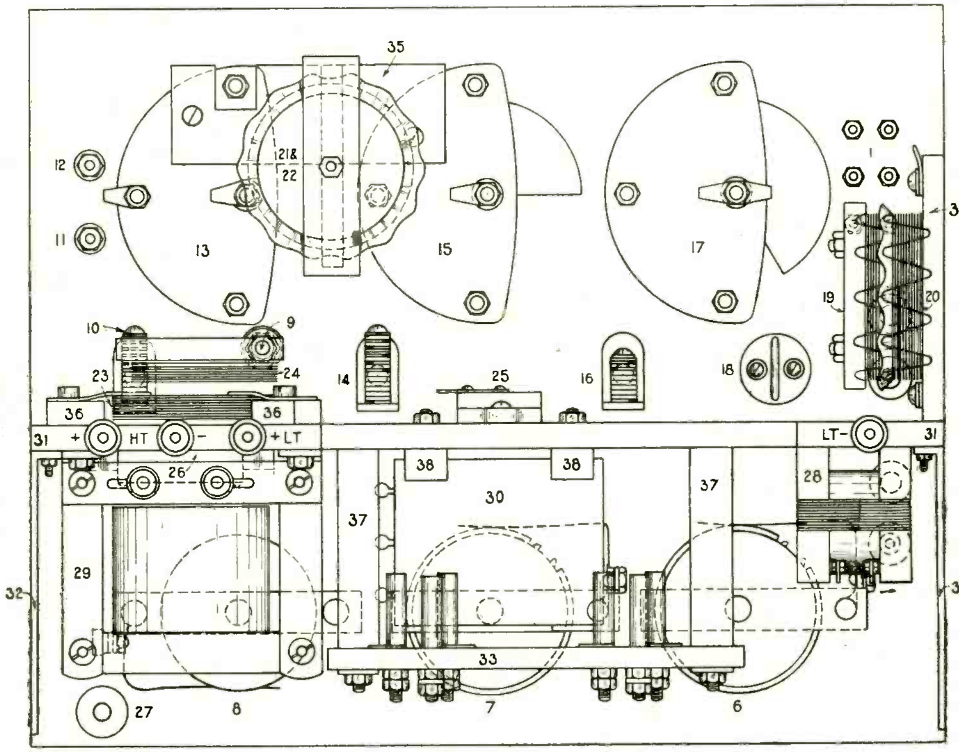


Fig. 3. Rear view of receiver.

Nos. 19 *and* 20 *aerial and closed circuit coils,* 1 *throw over switch,* 18 *filament on and off switch,* 17, 15 *and* 13 *tuning condensers,* 0.0003 *mfd. maximum capacity*; 16, 14 *and* 10 *spring jacks,* 25 *fixed condenser* 0.002 *mfd,* 9 *coupling,* 23 *and* 24 *valve to crystal coils,* 21 *and* 22 *intervalve coils*; 26, 0.001 *mfd. fixed condenser,* 29 *intervalve transformer,* 8 *potentiometer,* 6 *and* 7 *filament resistances,* 30 *Mansbridge condenser three sections* 1 *mfd. each*; 28 *intervalve transformer,* 27, 1,500 *ohms resistance,* 31 *ebonite shelf,* 32 *brass brackets,* 33 *valve shelf,* 34, 35, *and* 36 *coils supporting pieces.*

of H.F. and two of L.F. If it is desired to use external note magnification, the primary winding of the intervalve transformer belonging to the external amplifier should be joined to the plug, which may then be inserted in either of the jacks.

It may be found necessary to add a fixed condenser about 0·001 across the primary winding of transformer 29, depending on the transformer used. The value of the condenser 25, which is in series with the grid circuit of valve V_1 is fairly critical. In some cases it is best to not use one at all, but we have found a condenser of 0·002 μF. beneficial with all the transformers tried.

The receiver is wired with No. 18 tinned copper wire. All connections are soldered.

There is no tendency for the receiver to howl, the connections being different to those usually employed. They are in principle the same as Figs. 9 and 10, page 213, May 19th issue, and Fig. 1, page 280, June 2nd issue.

When first about to tune in a signal a wavemeter will be found a great help. The coils should be adjusted so that the condenser settings are practically alike. It will be noticed more turns are used in the coil which is connected with the crystal. This was found by trial to be beneficial. The variable coupling enables one to vary the amount of energy passing through the rectifier circuit, which is very useful when tuning to the local broadcast transmissions.

Although the connections of double-magnification receivers have been known for some time, and a number of manufacturers have such receivers on the market, there has quite recently been an attempt to renew the acquaintance of wireless folk with such receivers and high claims are made for them.

A receiver such as described may fairly be described as equal in performance to a good three-valve receiver with a crystal rectifier. One may hear Birmingham on the loud speaker quite well 10 miles out of London. Tuning is selective, but not sharp. The closed circuit condenser setting is the most critical of all.

W.J.

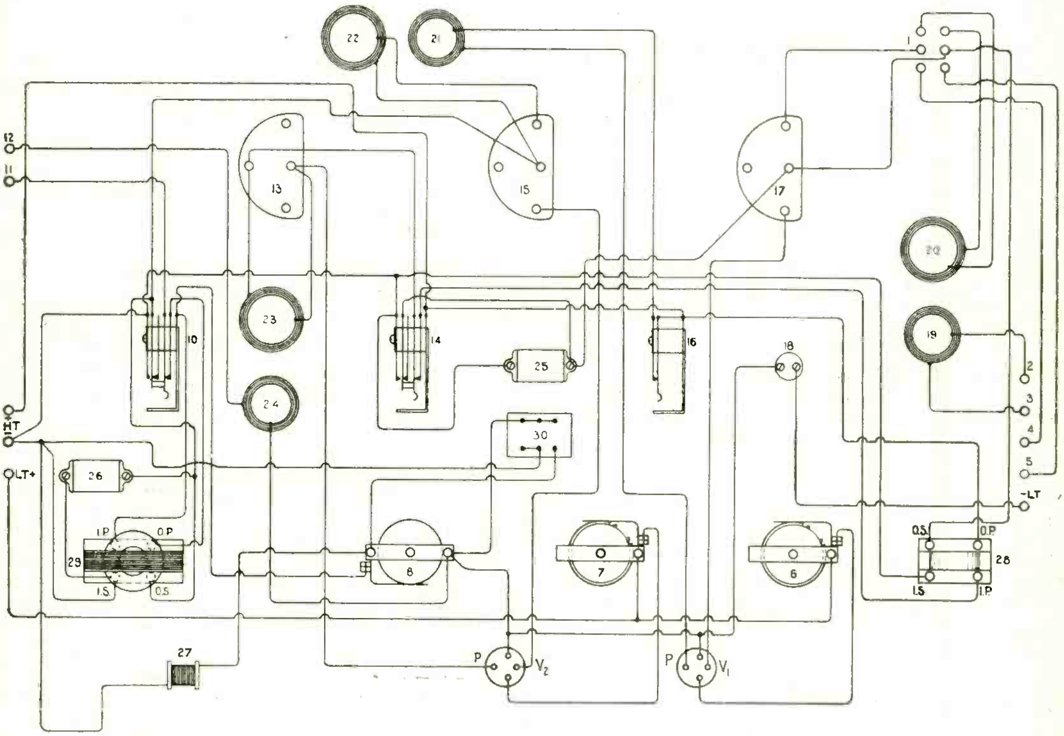


Fig. 4. Wiring diagram of receiver. The components are referred to in Fig. 3.

Notes and News

Steamboats on the Lake of Geneva are being equipped with broadcast receiving sets.

* * * * *

Recent shipping mishaps near the Channel Islands, it is stated, have produced a strong agitation for the establishment of official wireless stations in that area.

* * * * *

The Peking Government has erected a powerful wireless installation at Kashgar, in Chinese Turkestan. The station receives from Nauen, Tashkent, Rangoon, Colombo, and many other points.

* * * * *

A receiving station set up at Port of Spain through the enterprise of the *Trinidad Guardian*, is picking up news broadcast in the United States.

* * * * *

Goteborg Fair.

Wireless occupies an important place in the International Aero Exhibition now being held at Goteborg, Sweden, and a special Radio section is in full swing. Particular attention is given to wireless sets for communication between aeroplanes and the ground.

Sir William Noble.

It is with pleasure that we are able to announce that Sir William Noble has accepted the position of a Vice-President of the Radio Society of Great Britain. Sir William will be remembered as Engineer-in-Chief of the Post Office, a position from which he retired in 1922.

Wireless on Motor Cars.

The popular interest taken in listening-in in the open while picnicking or on tour has received the attention of the Daimler Company, who, in co-operation with the Marconi Company, have successfully developed a complete car receiving equipment, which is easily carried and put into operation, connected to headphones or loud speaker. An interesting demonstration of the results obtainable was given on July 14th in Windsor Great Park, where a number of B.S.A. cars, equipped with standard Marconiphone apparatus, were drawn up along the roadside, and the programme broadcasted from 2LO clearly heard by an interested assembly over an area of 50 yards radius. The provision of broadcast receiving apparatus on touring cars is a progressive step, and confidence can be placed in the success of the design adopted.

Synchronisation of Time Signals.

We have received an interesting letter from Sir Hanbury Brown, of Crawley Down, Sussex, regarding the time signals from Annapolis (**NSS**) and Lyons (**YN**). As stated in our issue of June 30th, the former station sends out a special time signal at 0855 G.M.T. on a wavelength of 17,145. This continues until 0900 G.M.T., and Sir Hanbury states that he is thus able simultaneously to hear this signal and that sent out from Lyons (**YN**) at 0900 G.M.T. on a 15,500 metres wavelength. Sometimes, he states, the tuning for loudest signals is the same for both, at other times it is slightly different, but not more than two divisions on his condenser scale.

A similar experience has been reported to us by Mr. W. J. Thompson, of Kingston-on-Thames, who writes that he was able to hear the two stations

HAVE YOU HEARD THIS STATION ?

A distant view of **WJY** *and* **WJZ** *in New York. This station (actually two in one) is able to broadcast two programmes simultaneously. Two studios are used and transmissions are on* 405 *and* 455 *metres respectively. "Radio Broadcast Central," as it is called, is owned by the Radio Corporation of America.*

with one valve directly coupled to his twin-wire aerial, 23 ft. high and 25 ft. long. The signal strength of NSS and YN was R 2½ and R 6 respectively, the latter station, of course, being de-tuned to get the highest strength from NSS.

The Broadcasting Committee.

Having held twenty-three meetings and heard a large amount of evidence, the Broadcasting Committee, under the Chairmanship of Major-General Sir Frederick Sykes, is now considering the terms of its report, a draft of which has recently been prepared. The prolonged silence of the Committee, which has aroused criticism in many quarters, is accounted for by the Committee's decision not to issue an early interim report, as had been expected. It will be remembered that the immediate question which led to the appointment of the Committee was the difficulty of licensing home-made sets. Other phases of the subject presented themselves, however, and the conclusion was reached that it would be more satisfactory to deal with all branches of the question, deferring a report until all evidence had been received.

This course has been followed and in the meantime many thousands have been able to enjoy broadcast concerts free of all charge. The Committee hopes to be able to present its report at an early date.

A Correction.

An error occurred in the article entitled "Further Notes on the Armstrong Super." by Frederic L. Hogg, in the issue of July 14th, 1923. In Fig. 3, on page 486, a high resistance leak is shown connected to a condenser in the valve grid circuit. This leak should, of course, have been connected between the grid and filament.

Opportunities in the R.A.F.

Wireless operators of good education and between the ages of 18 to 26 (ex-Service men 18 to 30) are required for skilled and semi-skilled positions in the Royal Air Force. The commencing pay is at the rate of 21s. to 26s. 3d. per week and all found. Allowances are issued to wives and children of men of 26 and over. Applicants, who must be physically fit, should communicate with or call on the Inspector of Recruiting, R.A.F., 4, Henrietta Street, Covent Garden, London, W.C.2.

Wireless Operators' Wages Reduced.

It is announced that reductions in the wages of marine operators will shortly come into operation. The employers sought an all-round reduction of 30s. a month, but after negotiations the following reductions were decided upon :

First to third years of service, £1 7s. 6d. a month ; fourth to sixth years of service, £1 5s. a month ; seventh to ninth years of service, £1 2s. 6d. a month.

Salaries of marine wireless operators now range from £7 12s. 6d. a month for the first year of service to £18 17s. 6d. for the ninth year of service.

Messrs. R. Melhuish, Ltd.

We are informed by this company that they have decided in future to issue their "Ironmongery, Electrical and Gas Fittings Catalogue" free of cost. The list contains 336 illustrated pages. The address of the firm is 50, 51 and 84, Fetter Lane, London, E.C.4.

The French Association for the Advancement of Science.

The next meeting of the Association Française pour l'Avancement des Sciences will be held at Bordeaux from July 30th to August 4th. Special attention will be given to electricity, and the Association invites communications on, among other subjects, the physics of broadcasting, particularly on short wave-lengths, and wireless telegraphy.

A Wireless Exhibition in Paris.

The Société Française de Physique is organising a National Physical and Wireless Exhibition, to be held in the Grand Palais, Paris, on November 30th to December 17th. Many leading personages in the French scientific world have become patrons.

A New Variable Grid Leak.

Messrs. A. H. Hunt have recently placed on the market a new type of variable grid leak designed on the principle of an arm moving over a number of studs. The instrument is beautifully finished, and is provided with an extension rod so that it can be operated without bringing the hand near the grid circuit. It should prove useful in the Flewelling circuit, and the importance of adjusting the leak valve or ordinary detector and dual circuits cannot be over-emphasised.

New Belgian Station.

A high power new wireless station is about to be erected at Ruysselede, near Bruges, and a workshop has already been established on the site. It is estimated that this station will be in operation within two years.

FORTHCOMING EVENTS.

FRIDAY, JULY 20th.

The Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove, Highgate. Direction Finding Competition—Analysis of Results.

Leeds and District Amateur Wireless Society. Lectures on "Wet High Tension" and "Care of Brown's 'A' Type 'Phones," by Mr. S. Kniveton, F.R.Met.Soc.

SATURDAY, JULY 21st.

Ipswich and District Radio Society. Visit to Pulham Aerodrome.

MONDAY, JULY 23rd.

The Hornsey and District Wireless Society. Competition: "The Best Answers to 12 Questions."

Sydenham and Forest Hill Radio Society. At 8 p.m. Lecture: "The Flewelling Circuit," by Capt. S. A. Huss.

TUESDAY, JULY 24th.

Plymouth Wireless and Scientific Society. At 7.30 p.m. At Y.M.C.A. Building, Old Town Street. Buzzer Practice. At 8 p.m., Coil winding and testing.

WEDNESDAY, JULY 25th.

The Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. (1) Lecture: "Resistance Capacity Coupled Amplifiers," by Mr. Lionel J. Hughes, of Mombasa (to be read by Mr. Philip R. Coursey, B.Sc., F.Inst.P. (2) "Demonstration on Neon Tubes," by Mr. Philip R. Coursey, B.Sc., F.Inst.P. (3) Demonstration, by M. Marrec of Paris, of reception of American signals on a frame aerial with a special circuit for eliminating atmospherics and other interference.

The Wolverhampton and District Wireless Society. Visit to the Wolverhampton Corporation Generating Station.

THURSDAY, JULY 26th.

Hackney and District Radio Society. At the Y.M.C.A., Mare Street. Lecture: "The Flewelling Circuit," by Mr. Bell.

Lewisham and Catford Radio Society. At 136, Bromley Road, Catford, S.E.6. Lecture: "How Ether Waves may be Detected," by Mr. H. M. Stanley.

Finchley and District Wireless Society. Last Meeting of Session. Lecture: "Wireless Receivers," by Mr. Puckle.

Demonstrations at the Institution of Civil Engineers

THE CATHODE RAY OSCILLOGRAPH AND THE PIEZO-ELECTRIC EFFECT.

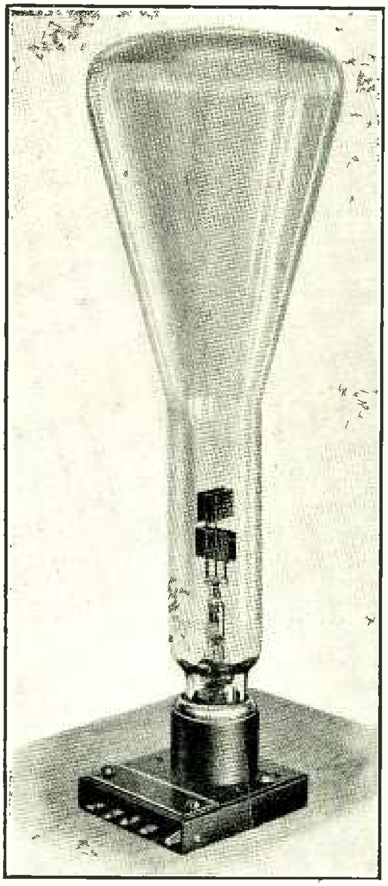
A CONVERSAZIONE was held at the Institution of Civil Engineers on Thursday, July 12th. Whilst the majority of the interesting exhibits were relating to general engineering there were one or two which were of wireless interest.

One of these was a kathode ray oscillograph developed at the laboratories of the Western Electric Company.

The apparatus is a special form of Braun tube employing a hot kathode in the form of a thermionic filament. This instrument is of the same type as that employed recently by Messrs. E. V. Appleton and R. Watson Watt in their investigations on atmospherics.

The chief advantage of the kathode ray oscillograph over other forms of oscillographs is its freedom from inertia and from free period which renders it effective at, for instance, radio frequencies, where other forms fail.

The tube is more convenient to operate on account of the simple nature of the accessory apparatus needed.



Kathode Ray Oscillograph.

It allows of speedy observation of the characteristics of a variety of electrical apparatus and circuits. A demonstration was given of its use for seeing at a glance the characteristics of valves and its application in this connection makes it extremely valuable for laboratory testing.

The oscillograph illustrated in the accompanying picture consists of a glass three-electrode tube about 30 cm. long, in the form of a cylinder about 4 cm. diameter which spreads out into a conical form with a slightly rounded end. The diameter of the large end is about 10 cm.

The kathode consists of a filament coated with active oxides. The anode is a small platinum tube set about 1 mm. from the filament, which is bent into the form of a nearly complete circle. Between the filament and the anode is a small circular screen with a hole in the centre just smaller than the circular filament.

A battery of 250 to 400 volts is connected between the anode and the kathode. This battery raises the anode to a positive potential with respect to the filament, and the electrons, which are supplied by the hot filament, are accelerated by the electric field so produced. A small fraction of the electrons pass completely through the tubular anode and constitute the kathode rays.

The rays then pass between two pairs of deflecting plates set at right angles to each other, and fall upon the large end of the glass tube. The inside of the large end of the tube is covered with a fluorescent mixture which renders the rays visible, so that the form which they take appears much as a picture viewed on the focussing screen of a camera.

Another demonstration of interest was the phenomenon known as the piezo-electric effect, which relates to a variety of solids in the crystalline state, which when subjected to change of stress, become electrically polarised. The reciprocal phenomenon also occurs as the crystals dilate or produce stresses when electric charges are applied to certain regions.

The effect was discovered in the latter part of the 19th century by H. and P. Curie. In 1917 the Research Laboratories of the American Telephone and Telegraph and the Western Electric Companies commenced an enquiry into applications of the piezo-electric effect.

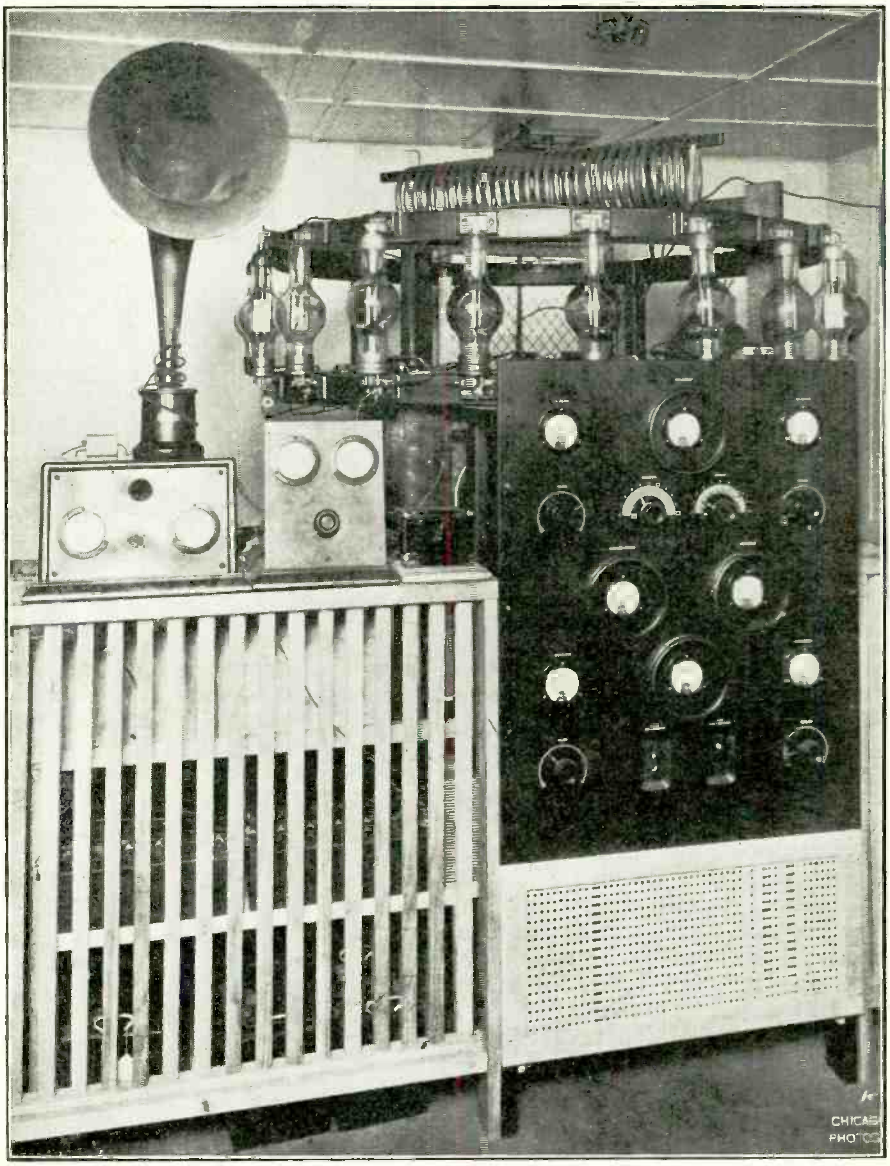
Rochelle salt is particularly active in this respect, and a specially prepared Rochelle salt crystal, about 2 ins. long, was demonstrated in use as a gramophone reproducer. The needle following the grooves in the record is made to set up varying stresses in the asymmetric crystal, which stresses cause varying electromotive forces to be generated internally. Amplification with one valve allows reproduction to be made in telephone receivers.

The crystal also acts as a high impedance telephone transmitter. On account of its high impedance it is particularly suitable for measuring sound waves in what may be called high impedance media, such as water.

Conversely the effect may be utilised to measure mall electric charges by measuring the stress produced. The crystal may also be used as a high mpedance telephone receiver.

The phenomenon is extremely interesting, but probably a definite commercial application has yet to be found for it.

CHICAGO BROADCASTING STATION WJAZ



The layout of the transmitting gear at the Chicago Broadcasting Station, shown above, is of interest as it differs very much from the arrangement employed at the British broadcasting stations. Power is derived from a 10 kW. generator at 4,000 v.

The equipment is installed at the Edgewater Beach Hotel. It is intended to communicate direct with the MacMillan Arctic Expedition, referred to in our last issue, with which members of the American Radio Relay League will carry out communication tests.

EARLY MISTAKES DUE TO LACK OF APPRECIATION OF CAPACITY EFFECTS.*

By J. H. REEVES, M.B.E., M.A.

WHEN I was asked to give a lecture to this associates' branch, I had difficulty in thinking of a suitable subject until it was suggested that mistakes I made when I began, now some few years ago, might prove a useful object lesson to those just starting. Many of these mistakes, and undoubtedly some of the most important, arose from a lack of proper appreciation of the large influence exerted by even minute capacity effects repeated, as they are, many hundreds of thousands of times per second.

Capacity in the right place is essential, in the wrong place it is an abomination. Like friction it is at times a good friend; from its nature it must inevitably be present in every piece of apparatus we construct, but from all places where it is not essential it must be eliminated by every possible means.

What is capacity? In general it is the power which some body or "container" has of storing up something else. Thus a tank has the power of storing water and everyone here was told at an early age that if the length and breadth and depth of a rectangular tank in feet are multiplied together the answer is the capacity of the tank in cubic feet. A rather more complex case as regards estimating its capacity is the cylinder used for holding gases, such as the oxygen cylinder of the doctor. Here the capacity depends not only on the size, but also on the maximum pressure at which the gas can be stored. When we come to storing up electricity yet another factor enters into consideration, for as everyone knows, electricity exists in two states, known still as positive and negative. Hence anything to store electricity must be of a dual nature.

In radio work we have two kinds of containers. One of these, the accumulator, was ably treated in a preceding lecture; the other, the condenser, has now to be considered. Analogies if not pressed too far are useful aids to the conception of new ideas, and I propose to give one. Suppose that overhead we have a tank of small base but of indefinite height, and on the floor we have a pump capable of giving a pressure which can lift water to a height rather greater than the floor level of the tank. If then the pump is set to work it will force water into the tank, the water level will rise until it gets to that height when the back pressure of the water in the tank equals the pressure power of the pump, whereupon further action ceases, the tank is as fully charged, as it can be under the power available and that with a limited quantity of water.

To increase this quantity we must either increase the base area of the tank or increase the pressure the pump can give. In the case of an electrical condenser the base area of the tank represents its capacity and the power of the pump the electrical pressure, which is measured in volts of the source of supply. Thus we see that the amount of electricity stored in a condenser depends (*a*) on its capacity, (*b*) on the pressure in volts of the applied electric force. Further, for a condenser of given size we can, by continuously increasing the pressure, continuously increase the amount stored up until we reach that point when the materials used cannot stand a higher pressure and if we go beyond this there is a collapse.

Reverting to the case of the tank, suppose that when the water has reached its highest level the connection between the tank and the pump is closed. Unless there is leakage the tank will hold indefinitely the water in it, but if we open an aperture in the base we can get back all we put in at a pressure starting with the maximum and falling to zero when the tank is quite empty.

We will now pass on to consider a practical way of making an electrical condenser. The simplest form consists of two flat metal plates thoroughly well insulated and close to one another, which I will refer to as A and B, and the plus and minus poles of a battery as X and Y. The battery is our pump, with this difference that instead of one orifice delivering one kind of liquid there are two, and the internal pressure due to the battery, in volts, is trying all the while to force out from X, positive and

NOTE.—Lecture delivered before The Radio Society of Great Britain to associate members on Friday evening, June 15th, 1923.

om Y, negative electricity. These two sorts ave a strong attraction for one another utside the battery and if a suitable path is ffered they will rush towards one another, o to speak, the battery furnishing fresh upplies. Thus if we join X to Y by means of a conducting wire we shall get in this wire a continuous flow of electrons towards X.

What happens if X is joined to A and Y to B? A certain amount of each of these electricities will rush into A and B until, as in the case of the pump, the position of equilibrium is reached. Suppose now the connections are cut by means of insulated handles. These charges will remain indefinitely on A and B, held together by their mutual attraction through the intervening air. If, however, A is joined to B by a conductor, the two charges rush along this, neutralise one another and the condenser is discharged, this double action being exactly analogous to the single action of the discharge of the tank.

The Lecturer demonstrated the effects by means of a battery, condenser, and galvanometer. The members observed:—

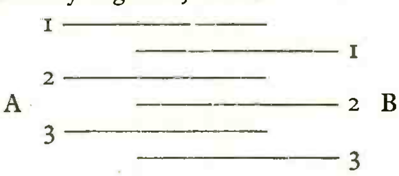
(1) *A galvanometer kick on charge, followed by zero, showing that only a momentary current passed.*

(2) *On discharge, a kick in reverse direction, large if at once, small if delayed, thus showing insulation was imperfect.*

(3) *On charging in the opposite direction all these effects were reversed.*

(4) *The battery power was much reduced, and the switch was operated in harmony with the time taken for the needle of the galvanometer to swing. A maximum to and fro movement was obtained.*

Now let us consider how the size of a condenser can be increased. One obvious method is to increase the size of the plates. If, however, we want a very large condenser, its size would become unwieldly, but we can get over this by having a number of plates connected alternatively together, thus:



Here A1, B1 form one condenser, B_1 and A_2, A_2 and B_2, B_2 and A_3, and so on, and with the seven plates I have shown we get a condenser six times as large as with one pair. Similarly if we have 19 plates the capacity will be 18 times that of a single pair, and if there are n plates, the capacity will be n-1 times.

Another less obvious method, but still easy to understand, is to bring the plates nearer together. The size of the charges depend partly on their mutual attraction and the nearer the plates are to one another the greater is this attraction. If, however, we press this method too far we are met with a difficulty. If at a given distance we increase the pressure too much, or if with a given pressure we decrease the distance too much, the electrical strain set up through the intervening air space is too great, its insulating properties breakdown, a spark takes place, and the whole of the two charges rush across this broken-down insulation. To get over this the effect was tried of putting between the plates some material *P* of high resistive strength to the passage through it of a spark. The experiment succeeded, and even exceeded anticipation, for it was found that not only could a much higher pressure be employed before a breakdown, but also for a given distance apart of the plates the capacity was increased several times. For example, if a condenser with plates 1/100 in. apart had a certain capacity with an air space, then if this space were filled with mica the capacity was about 5½ times larger. This multiplier varies with different materials, and in the case of any one is called its Specific Inductive Capacity. Hence you will see that in all calculations regarding the size required, this number enters as a multiplying factor, that for air being taken as 1.

Some may think "well, if inserting mica makes a given condenser have 5½ times its former air capacity, or conversely if a certain size capacity can be got from a condenser 5½ times smaller, why is this not always done?" The answer is simple. You know well that no body is perfectly elastic; for instance, if there were a perfectly elastic tennis ball, and this were dropped on a hard floor, it would go on bouncing for ever. Likewise none of our insulating bodies is perfect under the strain induced by the rapid alternations at radio frequency, and the result is a loss, known as dielectric loss, in the material. Hence, unless the saving of space is essential it is better to rely on air only between the plates, and if some other material is used it must be one whose dielectric loss is small. Even in the same natural material as mica this loss varies considerably in different specimens. Hence the difference in price between fixed condensers of the same capacity. I do not mean that a cheap condenser is necessarily worse than a high priced one. The maker of the former may have fluked on to a good lot; on the other hand he may not, whereas the maker of the better class one has tested all his raw supplies and has rejected all but the best.

The next question is as to the unit used in stating the size of a condenser, which I think all know is the Microfarad, and sometimes the Micromicrofarad. It is not necessary to know exactly what these are. If you, as a motorist, want your tank filled you order so many cans of petrol. Liquids are purchased as measured in certain well-known units, but if you were asked to define exactly the units in which these are measured, you might well be at a loss. All the same you have a shrewd idea of about how much you are going to get and after a little experience you get to know how many of each will about meet the needs of the moment. The unit, selected for definite electrical reasons, in the case of a condenser, is the Farad. But this is so enormous that to use it would always require a decimal point followed by many O's. So one millionth part of this, the Microfarad, is taken as the working unit. In our work even the microfarad is so large that we still have in most cases to use a decimal point and several O's, and the result is that the smaller the condenser the larger is the number of figures, mostly O's, to express its size. Hence sometimes we take a millionth of this millionth, the Micromicrofarad, and I think that it is about time that this unit were universally adopted. We should then quickly get as much accustomed to thinking and speaking of a 500 condenser just as we do of a 500 coil.

During the discussion it was explained that the actual value in microfarads of a condenser was given by the formula

$$\frac{(n-1)\ \text{Area of one side of 1 plate} \times \text{spec. inductive capacity.}}{4\pi \times \text{thickness of insulator} \times 900{,}000}$$

(all dimensions in centimetres)

(*To be continued.*)

BROADCASTING.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS*:—

GREAT BRITAIN.

LONDON 2 LO, 369 metres; **MANCHESTER, 2 ZY,** 385 metres; **BIRMINGHAM, 5 IT,** 420 metres; **CARDIFF, 5 WA,** 353 metres; **NEWCASTLE, 5 NO,** 400 metres; **GLASGOW, 5 SC,** 415 metres. Regular morning and evening programmes, particulars of which appear in the daily press, are conducted from these stations by the British Broadcasting Company. The usual times of transmission are:—Weekdays, 11.30 a.m. to 12.30 p.m. (**2 LO** only), 3.30 to 4.30 p.m., 5.30 to 11 p.m. Sundays, 3 p.m. (**2 LO** only), 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), **FL,** 2,600 metres. Daily, 7.40 a.m., Meteorological Forecast; 12.15 p.m., Meterological Report and Forecast; 3.30 p.m., Financial Bulletin (Paris Bourse); 6.10 p.m., Concert and Meteorological Forecast; 11.15 p.m., Meteorological Report and Forecast. Sundays, 6.10 p.m., Concert and Meteorological Report.

LEVALLOIS-PERRET (Radiola), **SFR,** 1,780 metres. Sundays 2 to 3 p.m., 9 to 10.30 p.m., Concert. Weekdays, 12.40 p.m. Concert, 5.5 p.m., Financial Bulletin; 5.15 to 6.15 p.m., Instrumental Music; 8.45 p.m., Miscellaneous News; 9 to 10 p.m., Concert. Thursdays, 9.45 to 10.30 p.m., Dance Music.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres, Tuesday and Thursday, 8.30 p.m., Concert. Saturday, 2.30 to 7.30 p.m., Concert.

LYONS, YN, 3,100 metres. Weekdays, 10.45 to 11.15 a.m., Gramophone records.

HOLLAND.

THE HAGUE, PCGG, 1,050 metres. Sunday, 3 to 5 p.m., Concert. Monday and Thursday, 8.40 to 9.40 p.m., Concert.

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

THE HAGUE (**Velthuyzen**), **PCKK,** 1,050 metres. Friday. 8.40 to 9.40 p.m., Miscellaneous.

IJMUIDEN, PCMM, 1,050 metres. Saturday, 8.40 to 9.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres. Wednesday, 8.10 to 9.10 p.m., Concert and News.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. Working days, 12 noon. Meteorological Bulletin. Daily, 4.50 p.m., Meteorological Bulletin, Tuesday and Thursday, 9 p.m., Concert. Sunday, 6 p.m., Concert.

GERMANY.

BERLIN (**Koenigswusterhausen**), **LP,** Sunday, 2,700 metres, 11 a.m. to 12 noon, music and speech; 4,000 metres, 12 noon to 1 p.m., music and speech; Daily, 4,000 metres, 7 to 8 a.m., 12 to 1.30 p.m., 5 to 6.30 p.m., Financial and other news.

EBERSWALDE (2,950 metres), Daily, 1 to 2 p.m., 8 to 9 p.m. Tuesday and Saturday, 6.30 to 7.30 p.m., Concert.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres, 8 a.m., 12 noon and 4 p.m., Meteorological Bulletin and News. 4,500 metres, 10 a.m., 3 p.m. and 10 p.m., Concert.

SWITZERLAND.

GENEVA, HB 1, 900 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

LAUSANNE, HB 2, 1,350 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

* British Summer Time is given in each case.

QUESTIONS AND ANSWERS

"A.W.B." (Walthamstow) *submits a circuit diagram of a three-valve set, one H.F., detector and one L.F. valves, with resistance capacity H.F. amplification, and asks for criticism.*

We have examined the diagram submitted, and find the circuit is incorrect. A correct diagram is given in Fig. 1.

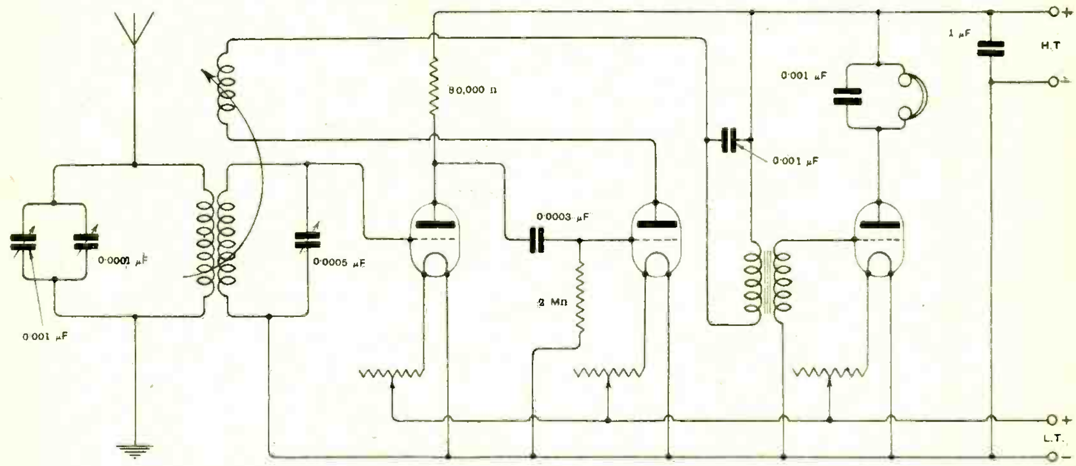


Fig. 1. **"A.W.B." (Walthamstow).** *Diagram of a receiver with one stage of resistance capacity amplification, valve rectifier and note magnifier.* (1 — *v* — 1).

"F.B." (Acton) *asks* (1) *For a diagram of a circuit comprising one H.F. valve, detector, and two L.F. valves.* (2) *Having regard to the different anode potential required by a Dutch valve used as detector in a circuit such as that mentioned in Question* (1) *as compared with that required by "Ora" type valves used as amplifiers, if it would be practicable to arrange the wiring to comply with this requirement.* (3) *For details of a tapped H.F. transformer to cover a range of wavelengths from* 300 *to* 2,000 *metres.*

(1) We would refer you to diagrams Nos. 52 and 54, "The Amateurs' Book of Wireless Circuits," by F. H. Haynes, The Wireless Press, Ltd., 2s. 6d. nett. (2) Diagrams of suitable methods for taking separate H.T. tappings to the anodes of the different valves in the circuit have been given frequently from time to time in recent issues of this journal. (3) We would refer you to the issue of September 23rd. The ebonite former may be 2¼″ in diameter, with 12 slots ⅝″ deep by 1/16″ wide. Each slot should be wound with 120 turns of No. 40 S.S.C. Alternate slots are connected in series for the primary and secondary, and the connections are brought to a switch.

"J.K.M." (Glasgow) *submits a circuit diagram of a two-valve set, with variometer tuning, one H.F. and detector valves, and asks* (1) *How to connect an efficient H.F. valve to the existing circuit without altering the present lay-out.* (2) *and* (3) *How the reactance coupling in the Gecophone V.2 set is connected in the circuit, and what is the effect of the variable metal shield.*

(1) It is not possible to add a high frequency unit to the set as at present constituted, without rearrangement of the components. It would be necessary to transfer the tuner to the new high frequency unit, or to make an entirely separate tuning unit. (2) and (3) The variable metal shield acts in the same way as the metal sheet used in the receiver described in the issue of May 12th, page 168. The reaction coil is coupled to the anode coil.

"RADIOPET" (Oldham) *asks for particulars of the windings required for a loose coupled tuner to tune to a maximum wavelength of* 3,000 *metres, the primary to be wound on a cylindrical former* 3¼″ *in diameter, and the secondary on a former* 2¾″ *in diameter, both formers being* 5¾″ *long.*

You cannot wind an efficient tuner for a maximum wavelength of 3,000 metres with formers of the size suggested without pile winding. We suggest for the primary of the tuner you wind a layer of No. 24 D.C.C. wire on a former 4″ in diameter and 8″ long. For the secondary a layer of No. 28 D.C.C. wire on a former 3½″ in diameter and 10″ long. The primary should be tuned with a variable condenser of 0·001 mfd. capacity, in parallel, and the secondary with a variable condenser of 0·0005 mfd. capacity.

"ALMAR" (Blackburn) *asks* (1) *If the American broadcasting stations transmit every evening, and, if so, at what time.* (2) *If we think he should be able to receive the transmissions from the*

Manchester broadcasting station using a crystal set with a standard 100′ aerial at a distance of 20 miles. (3) *If we consider the reception of transmissions from the principal French stations with a two-valve set to be good when the aerial is screened by telephone wires.*

(1) Most of the American stations broadcast regularly every evening. The most suitable time to listen-in for their transmissions is about 1.30 a.m. G.M.T. (2) With favourable conditions you should be able to get satisfactory reception. (3) The reception is normal.

"ARFRYN" (Wales) *asks* (1) *The purpose of a small screw projecting from one end of the vertical sides of the box enclosing a telephone transformer.* (2) *For the price of fuse wire to take 0·75 amperes.* (3) *If it would be advisable for a beginner to include a fuse in the filament heating circuit of a valve set.*

(1) The object of the screw is to provide a means for connecting a wire to the core so that it may be earthed. (2) Fuse wire is very cheap, and you should enquire the price at a dealers, or special fuses may be purchased from several of our advertisers. (3) Yes.

are the positive and negative terminals respectively of the L.T. battery.

On the diagram in question the terminals should be taken as they are marked. In general the long stroke denotes the positive and the short stroke the negative terminal.

"H.G.S." (London, N.4) *asks how many turns of No. 20 S.C.C. wire should be wound on a former 2¾″ in diameter for use in the closed circuit of a tuner to tune to 369 metres. The variable condenser to be used in parallel consists of two plates 5″ square, each separated by an ebonite sheet 1/20″ thick.*

The approximate maximum capacity of your condenser is 0·0006 mfds. The closed circuit may have a total of 55 turns.

"R.H.H." (Croydon) *asks for a diagram of a rejector circuit which will enable him to tune out* **2 LO.**

You should employ a loose coupled tuner. Also see the article dealing with rejector circuits in the issue of June 16th.

"MUG" (London, S.E.) *has built a five-valve receiver from Fig. 14, page 615, of the issue of February 3rd, 1923, and is unable to receive any British broadcasting station other than* **2 LO.** *He asks for suggestions as to the reasons for the poor results so far obtained, or, alternatively, to give a circuit of a five-valve set, using the same components, with which it would be possible for him to receive from all the British broadcasting stations with sufficient power to operate a loud speaker and to receive the American broadcast transmissions.*

The circuit is a very suitable one. A loose coupled tuner is employed, and with careful tuning one should be able to select the transmissions desired. Dewar type switches are not satisfactory in circuits which carry H.F. currents. The primary winding of the H.F. transformers may be tuned with a 0·0001 mfd. condenser.

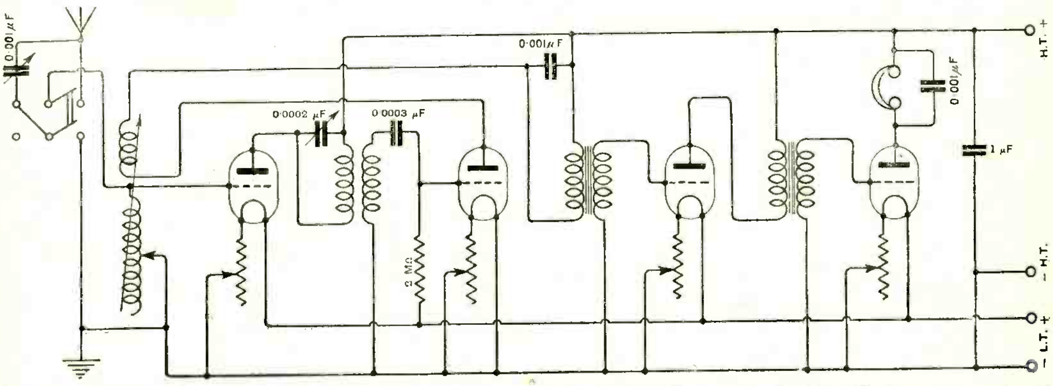


Fig. 2. **"DEER" (Peterboro').** *Connections of a receiver with one stage of H.F., using transformer coupling, valve rectifier, and two stages of note magnification.* (1 – *v* – 2).

"DEER" (Peterboro') *asks* (1) *For a diagram of a four-valve set.* (2) *For particulars of an inductance coil to tune between 200 and 900 metres, suitable for use in the above receiver.*

(1) A diagram is given in Fig. 2. (2) We suggest that you wind 120 turns of No. 20 D.C.C. copper wire on a former 4″ diameter, and take a tapping from every 10 turns. For the reaction coil wind 100 turns of No. 26 D.C.C. upon a 2″ former and take five taps.

"A.B." (Manchester) *asks* (1) *If it would be possible for him to tune out the transmissions from the Manchester broadcasting station at a distance of three miles, and receive from the London broadcasting station, using a three-valve set.* (2) *If the addition of a potentiometer would be of assistance.*

(1) Whether or not depends entirely upon the circuit employed and your skill. (2) The addition of a potentiometer to adjust the value of the grid potential of each high frequency valve is frequently an advantage.

"W.S." (Edinburgh) *asks, with reference to Fig. 2, page 114, of the issue of April 28th, which*

"SCAMP" (Finchley) *submits particulars of his six-valve unit set, and asks for a diagram indicating a method by which a crystal or valve may be used as rectifier.*

As you do not submit details of the switching arrangements at present on your set, it is not possible to give the proper connections. Various methods have been given from time to time. See Fig. 3, page 226, of May 19th issue.

"EXPERIMENTAL" (Grove Park) *asks* (1) *For a circuit diagram of a four-valve receiver, one H.F. valve, tuned anode, coupling, detector, and two L.F. valves with switches to use two, three or four valves.* (2) *For a diagram showing a suggested arrangement of the components on a panel.*

(1) A suitable diagram is given in Fig. 3*a*. (2) A suggested arrangement of the components is given in Fig. 3*b*.

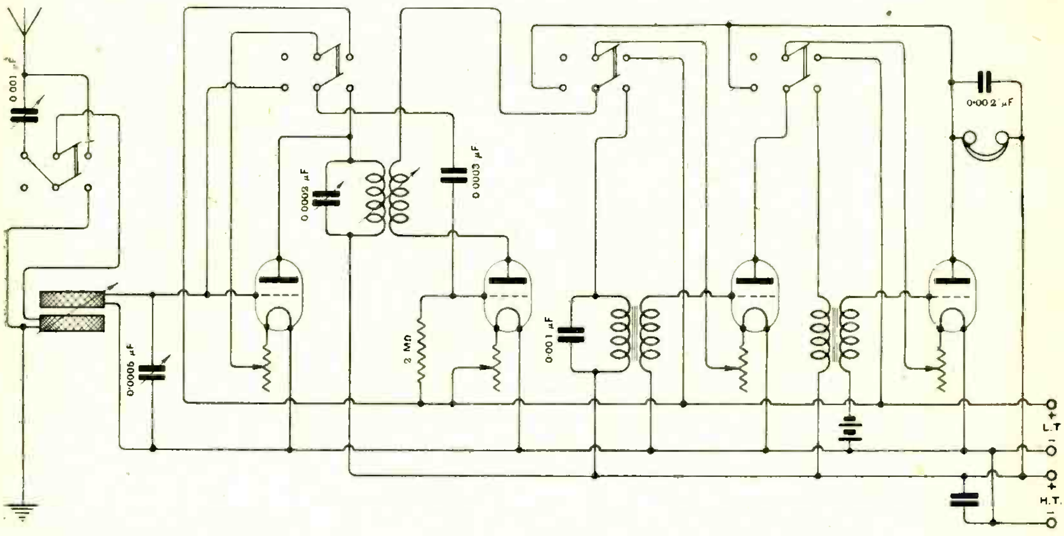


Fig. 3a. "EXPERIMENTAL" (Grove Park). *Diagram and suitable layout of receiver with H.F., valve rectifier and two stages of note magnification, with switches to vary the valves in circuit.*

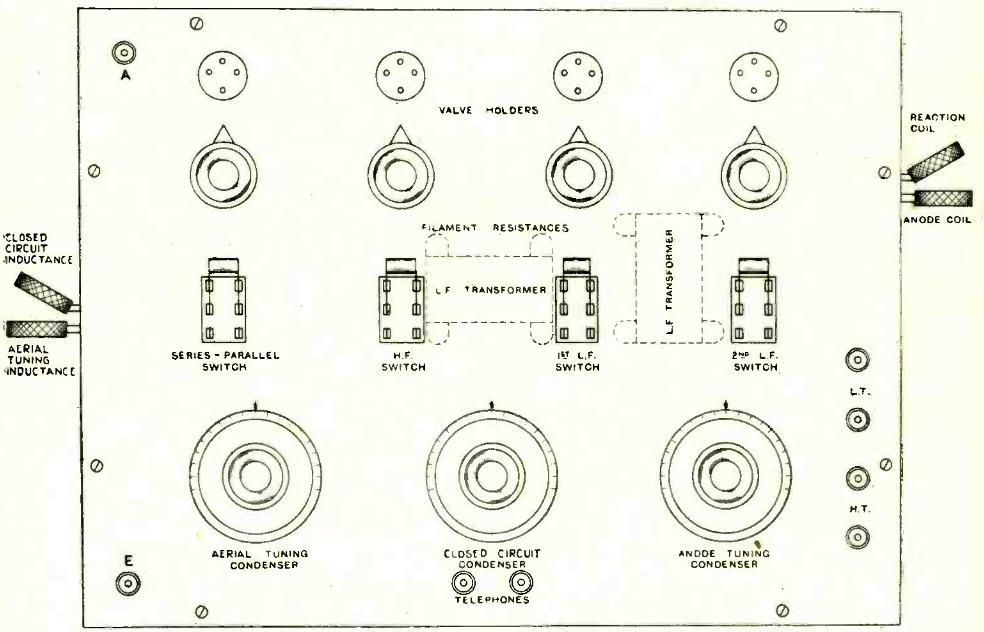


Fig 3b.

"L.G.C." (Bucks) *asks* (1) *To what wavelengths will three honeycomb wound inductance coils tune, with a* 0·001 *mfd. variable condeser in series or* *parallel, each coil being wound with No. 22 D.C.C. wire on a former 2½″ in diameter, and the number of turns of each being 50, 35 and 25 respectively.* (2) *For constructional details of a high frequency transformer to tune to 1,000 metres wavelength, and using basket coils if possible.* (3) *When is it necessary to use a grid leak in a single valve circuit.* (4) *For a circuit comprising a crystal detector and a one-valve amplifier without using a transformer.*

(1) The approximate wavelengths to which the coils will tune, with a 0·001 mfd. variable condenser in parallel are 600 metres, 420 metres and 330 metres. With the condenser in series the wavelengths will be approximately 250, 190 and 150 metres respectively. (2) We suggest that you wind 400 turns of No. 38 S.S.C. wire for both primary and secondary, on a former consisting of an ebonite disc 2½″ outside diameter, and 5/16″ thick, having a peripheral groove 3/16″ wide and ½″ deep. (3) It is necessary to use a grid leak with a valve which is acting as a rectifier in any circuit. (4) The diagram is given in Fig. 4. A choke coil is used

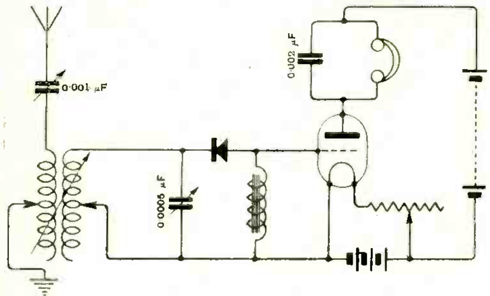


Fig. 4. **"L.G.C." (Bucks).** *Crystal receiver with note magnifier.*

to couple the crystal with the valves. It is not satisfactory to merely connect the crystal with the grid of the valve. The choke may be 10,000 turns of No. 44 S.S.C. wound on an iron core ½″ in diameter, and 3″ long.

"S.R.G.C." (Worc.) *asks for the most suitable sizes of plug-in honeycomb type coils to use in a five-valve receiver employing two high frequency valves tuned anode coupled, detector and two low frequency valves, for the reception of British broadcast transmissions.*

We suggest you use the following coils, with a 0·001 mfd. variable condenser in series with the aerial :—

Aerial tuning inductance ..	No. 75
Reaction coil	No. 50
Tuned anode inductances ..	No. 75

"J.Y." (North Berwick) *makes the following query with reference to tuning. Using certain coils and condensers for the tuning unit it is found that with particular settings for each, sharp tuning on a certain station is obtained. It is desired to know whether, after changing the coils and condensers for those of different values it can be determined exactly beforehand what settings of each will now bring the circuits sharply into tune with the same station.*

If you know the values of the coils and condensers used you can easily find the wavelengths to which they will tune. See "How to Find the Wavelength of Circuits" in the issue of June 16th.

"R.H.W." (Chingford) *has built a receiver from diagram No. 61 in "The Amateurs' Book of Wireless Circuits," by F. H. Haynes, and complains that, when receiving telephony from any station except* **2 LO,** *a loud crashing noise is audible in the telephones, which becomes much worse on the higher wavelengths. He asks for suggestions by which the trouble might be eliminated.*

We cannot help you much from the description given. Perhaps you cannot hear the noise when receiving **2 LO** on account of signal strength. Make sure there are no loose joints. Perhaps the condensers are faulty, and the grid leak may be noisy. Make sure the noise is not due to the H.T. battery or intermittent telephone cords.

"G.F.H." (Manchester) *wishes to use his single valve note magnifier as a power amplifier. He asks* (1) *If the Mullard "Ora" and Marconi "R" type valves can be used for this purpose.* (2) *If a telephone transformer of ordinary design would be satisfactory for use in a power amplifier.*

(1) Of the two types, many consider the "R" type is more suitable fort he purpose. It is better to use a special valve, such as the "LS 3," which requires normal values of L.T. and H.T. (2) Yes. Of course the transformer must be built to work with the loud speaker. We would refer you to the article entitled, "Low Frequency Power Amplifier Unit," in the issue of this journal of May 26th, 1923.

NOTE. *—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—*(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* **The Wireless World and Radio Review,** *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*

THE

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Suggestions for Research.

Every holder of an experimental licence must have intimated to the Post Office at some time or other the nature of the research work he intends to undertake. Without entering into the politics of the scheme by which experimental licences are issued, it should be the aim of everyone possessing an experimental licence to devote thought to the development of some branch of the science in which he, no doubt, has specialised experience. To become a specialist in a particular application not only adds interest to the hobby, but gives rise to progressive developments which in the past have been frequently achieved by the amateur worker. Very few really new devices are being brought forward at the present time, in spite of the large number of experimental licences which have lately been issued, and it is up to the amateur to get busy and defend his title if he is to retain the position as the backbone of wireless research and invention. It is difficult to suggest themes on which research work might be undertaken, as in every instance these must be controlled by individual ability; but to the experimenter with a permit authorising him to undertake research with receiving equipment, a few suggestions may be put forward.

Firstly, the development of a sensitive non-radiating receiving equipment has yet to be produced. Improvements in simultaneous high and low frequency amplification with short wavelengths are badly needed for incorporating in the design of broadcast receiving sets. There is an urgent demand for selective receiving systems capable of simple manipulation, while rejector circuits might receive further investigation.

The application of the neon tube to receiving circuits opens up a new field of investigation, and in particular, the attention of the transmitting licence holder should be directed to the use of this device. He may develop duplex systems of communication; and a very important matter requiring the attention of the experimenter is the development of a system of communication possessing secrecy, the introduction of which would be of infinite service to his country.

There are many experimenters who now work together, and co-operation it is hoped will be further developed as a result of the meeting of transmitting licence holders recently held in London. The "calls heard" section of this journal is a further step to add interest to experimental transmissions.

The majority of transmitting licence holders are members of the Radio Society of Great Britain. The Society closely watches the interests of the transmitting licensee, and interested experimenters are aware that negotiations are at present taking place with the Post Office on the question of the extension of transmitting facilities.

B

WIRELESS TELEPHONY.

A Choke Control Transmitter for Experimenters.

By W. JAMES.

1. INTRODUCTION.

THERE is an essential difference between the signal transmitted in the case of a key-operated transmitter and a telephony transmitter. In the former case the transmitter is simply adjusted to deliver power at maximum efficiency into the aerial. The power is put into the aerial every time the transmitting key is pressed, and the energy radiated consists of continuous waves broken up in accordance with the keying. In the case of a telephony transmitter, we wish to radiate continuous waves modulated according to the speech signal. Speech consists of a range of frequencies from about 200 to 2,000 or more cycles. The whole band of frequencies lying within this range are necessary for good speech. The amplitude of the speech frequencies is, of course, varying, and for successful radiotelephony the whole range of frequencies must be properly transmitted with their relative amplitudes and phases unchanged.

Let us suppose the amplitude of the continuous wave in the aerial is A, and its frequency f. The current is given by

$$i = A \sin \omega t, \text{ where } \omega = 2\pi f.$$

If this continuous wave is modulated by a sine wave of amplitude B for which $i_1 = B \sin \omega_1 t$ where $\omega_1 = 2\pi F$, and F is the frequency of the sine wave, the aerial current may be expressed by the equation

$$i = A\,(1 + K \sin \omega_1 t) \sin \omega t.$$

K represents the modulation constant. When the transmitter is sending out continuous waves only, *i.e.*, when the signal is not being modulated, K is zero and the amplitude of the continuous waves is A. If K is equal to one, and $\sin \omega_1 t$ varies from -1 to $+1$, the amplitude of the aerial energy will vary from zero to $2A$. This equation may be rewritten as follows :—

$$i = A \sin \omega t - \frac{AK}{2} \cos (\omega + \omega_1)\, t + \frac{AK}{2} \cos (\omega - \omega_1)\, t.$$

This is an important equation, and shows the modulated current consists of three frequencies. (1) The carrier frequency (the continuous wave component) equal to $\frac{\omega}{2\pi}$, with an amplitude of A. (2) A side frequency, called the upper side frequency, equal to $\frac{\omega + \omega_1}{2\pi}$ with an amplitude of $\frac{KA}{2}$. (3) A lower side frequency $\frac{\omega - \omega_1}{2\pi}$ with an amplitude of $\frac{KA}{2}$.

When the carrier wave is modulated with the lower frequency $\left(\frac{\omega_1}{2\pi} = F\right)$, side frequencies are formed. When K is zero we have only the carrier wave frequency transmitted ; but when the carrier wave is modulated, the side frequencies $\frac{\omega + \omega_1}{2\pi}$ and $\frac{\omega - \omega_1}{2\pi}$ appear.

If the carrier wave is modulated, not with a single frequency, but with a number of frequencies, a corresponding number of side frequencies will be produced and transmitted. In the case of speech transmission, the frequencies transmitted are those of the carrier wave and an upper and lower band of frequencies. The band of frequencies consists of those between about 200 and 2,000 cycles, so that if the carrier frequency is 1,000,000, corresponding to a wavelength of 300 metres. the lower side frequencies produced lie between 998,000 and 999,800 cycles, and the upper side frequencies lie between 1,002,000 and 1,000,200 cycles. We are therefore, when transmitting speech, using a channel of frequencies 4,000 cycles wide.

2. CHOKE CONTROL TRANSMITTER.

The choke control method of modulation is without doubt the best for amateur use. A diagram of a simple transmitter is given in Fig. 1. The components are labelled for identification. It is proposed to deal with each component in turn.

3. THE OSCILLATOR.

The portion to the left of the dividing line is the oscillator. It consists of the valve with its associated circuits. The valve V_1 is connected to appropriate high tension and filament eating supplies. The grid circuit consists of he coil L_1 and tuning condenser C_2, and the rid condenser and leak C_1 R. The aerial ircuit consists of the aerial and earth, hot wire mmeter and coil L, to which is joined the erial tap A, and the anode tap T. The condenser C is joined in the anode tap lead. Sometimes it is helpful to connect a condenser in the aerial circuit, C_5, to lower the wavelength of the aerial circuit.

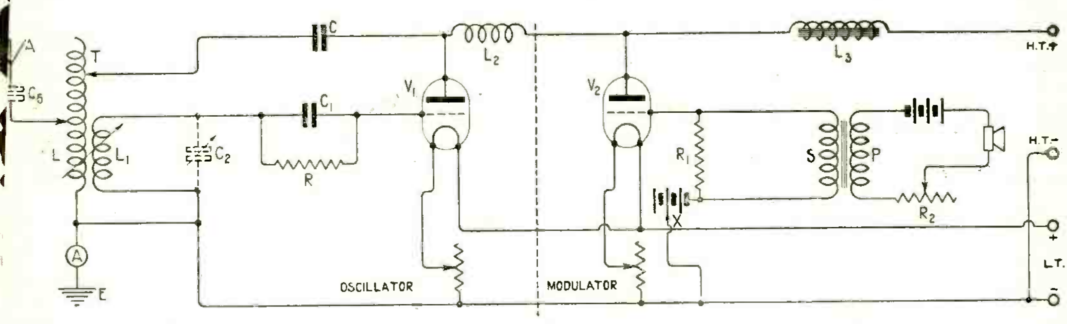


Fig. 1. *Circuit of choke control transmitter. Referring to the oscillator* C_5 = 0·0002 *to* 0·001 μF. L = 30 *to* 35 *turns,* 6″ *diameter.* L_1 = 20 *to* 30 *turns of No.* 22 *D.C.C.,* 5″ *diameter, with* 3 *or* 4 *taps.* C_2 = *about* 0·0003 μF, C_1 = 0·002 μF. R = 10,000 *to* 15,000 *ohms.* C = 0·0005 *to* 0.002 μF. L_2 = *about* 350 *turns of No.* 30 *S.S.C.,* 3″ *diameter.* V_1 = *M.O. T.*30 *or Mullard* 0/30*B.* A = *aerial ammeter (hot wire) reading to* 0·5 *ampere.*

4. THE VALVE.

The valve V_1 may very well be a M.O. or Mullard 30-watt valve (designated T30 and 0/30 B respectively).

M.O. T 30.—Filament voltage 7, filament current 1·8 amperes, anode voltage 1,000 to 1,250 volts, maximum emission 110 milliamperes, normal impedance 12,500 ohms. The magnification factor is 25.

Mullard 0/30.—Filament voltage 7, filament current 2·5 amperes. Anode voltage 400 to 600 volts, total emission 150 milliamperes, normal impedance 12,000 ohms.

Each valve is capable of dissipating 30 watts; that is, the anodes will safely deal with a power dissipation of 30 watts without damage to the anode or the vacuum.

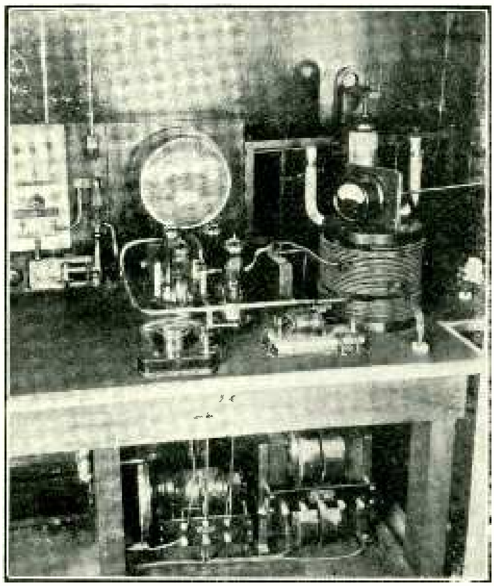
The filament of a valve is naturally its weakest point. The life depends very largely upon the temperature to which it is heated, and a small departure from the rated heating current may double or halve the life. The emission increases rapidly with increases of temperature, and this provides the temptation to overrun the filament. At the normal operating temperature a small increase in filament current results in a much larger increase in the emission; at the same time the life is greatly reduced. During the life of the valve, the filament becomes thinner, and its resistance is increased. If the heating current is maintained at a constant value, the temperature must be greater when the valve is old than when it is new, because the temperature is proportional to I^2R, where I is the filament current and R its resistance. The emission may be a little larger, but the life is seriously curtailed. If the voltage across the filament is held constant during its life, the emission will fall off, but not to a great extent. In addition, a small increase in the filament voltage produces only a small increase in the emission, and consequently a small reduction in normal life. It is better from all points of view to use a filament voltmeter in preference to an ammeter.

The anode current is quite a considerable percentage of the heating current, and this current has to return to the filament. When the heating current is from a supply of D.C. the negative H.T. will be joined to either + or − L.T. It is immaterial in which side the filament resistance is joined, the anode current will add to that in the −ve leg and subtract from that in the +ve leg. This accounts for the difference in filament brightness when the valve oscillates.

5. THE GENERATION OF OSCILLATIONS.

The oscillator may be divided into several sections. There is the circuit which is provided with adjustments to fix the frequency (wavelength) of the oscillations, the reaction coil or coupling coil, the purpose of which is to excite the grid, and the power supply.

We will take these in turn. The frequency is fixed by the constants of the aerial circuit, the condenser C, and the inductance coil L, Fig. 1. Amateur aerials vary considerably in capacity, probably from 0·0002 μF. to 0·0008 μF., or higher. The inductance which with the aerial will tune to the amateur wavelengths, 180 to 220 and 440 metres, cannot accurately be given, but those who know the constants of the aerial are easily able to find the inductance required from the wavelength formula. The dimensions of the coil may then be found, but to commence with a considerably larger coil should be used. The coil should be wound preferably with copper strip in the form of a



A typical experimental transmitter.

helix or spiral, whichever is preferred, although No. 12 bare copper wire is satisfactory. Insulation should be most carefully attended to. To reduce losses the turns should be spaced and the minimum amount of insulating material used in the construction of the coil. A skeleton former construction is preferred. For experimental work the coil may be 6 ins. in diameter, wound with 35 turns of either copper strip or ribbon, of No. 12 bare copper as mentioned above, and the turns should be spaced ¼ *in. apart*. Connections to the coil are made with clips or with plugs and sockets. The position of the aerial tap is then settled by experiment. Condenser C_5 may be 0·0003 to 0·001 mfds.

The function of the anode tap circuit, C T L and earth, is to excite the aerial circuit, aerial, A, L, and earth. Varying the position of the tap T changes the coupling. In addition, the anode tap circuit is roughly tuned. There is one best adjustment for each wavelength and setting of the valve, and this should be found. When the aerial circuit is of high resistance, at short wavelengths the anode tap will probably be above the aerial tap. For lower resistances, the anode tap is, in general, lower. If the anode tap is too low an excessive current will flow in this circuit and heat up the valve. Maximum output is secured when the load impedance is about equal to the valve impedance, and this may only be found by changing the position of the anode tap. Aim at greatest efficiency. It is not worth while increasing the aerial current slightly at the expense of a large increase in the power taken for the H.T. supply. The value of condenser C is not very critical, and may be between 0·0005 μF and 0·002 μF. Note that the full pressure of the H.T. supply is across this condenser. (If there were no condenser the supply would be short-circuited through the coil L). It is important to use a good mica dielectric condenser.

The Grid Circuit.—The input circuit of the valve is excited by coupling the aerial coil with the grid circuit L_1 C_2. The coil L_1 should be mounted so that its position relative to the aerial coil is variable. It is not always necessary to provide the tuning condenser C_2, and since its inclusion adds another adjustment to the transmitter, some may prefer to dispense with it. Coil L_1 may consist of 20 to 30 turns of No. 22 D.C.C. wound on a tube 5 ins. in diameter so that it will fit in the bottom end of the aerial coil. The turns should be spaced. The tuning condenser, when used, should have a maximum capacity of about 0·0003 mfds. The ordinary receiver condenser will probably break down, so a special condenser should be used which will safely withstand the voltage set up in the grid circuit. The setting of this condenser is critical. Changes from the correct setting generally stop the valve oscillating, so that care should be taken. If no condenser is used it is necessary to take several tappings from the grid coil and to determine by experiment the best number of turns.

The purpose of the grid condenser and leak is to provide the grid with a suitable normal potential with respect to the filament. The values are in general not critical. Good average values are 0.002 mfd. and 10,000 to 15,000 ohms. The grid leak may be constructed by winding a bobbin with No. 40 D.S.C. German silver or Eureka resistance wire. No. 40 German silver wire has a resistance of about 25,000 ohms per 1,000 yards and Eureka, 37,000 ohms per 1,000 yards. Alternatively the wire may be wound upon a strip of mica, and this construction has the advantage that taps may be easily taken off.

It is obvious that if the power was applied directly between the filament and anode, no voltage variation could take place across the valve if the supply had a low impedance. Provision is therefore made by connecting the radio frequency choke L_2, so that it will prevent the radio frequency energy generated by the valve passing through the supply, and at the same time offer little impedance to the low frequency currents. The coil may have an inductance of 4,000 μH, and consist of 360 turns of No. 30 S.S.C. on a tube 3 ins. in diameter and $5\frac{1}{2}$ ins. long. Sometimes this coil is tuned to the frequency of the oscillator, but this is not necessary. It is absolutely essential to provide this coil in the circuit.

6. ADJUSTMENTS.

One cannot give the precise values of the components in a transmitter on account of the different anode voltages which will be used, different aerial constants, etc. Best operation is only secured through careful systematic experiment.

When the circuit is first set up, the valve filament should be heated at its rated temperature, but it is advisable to use less than the normal anode voltage. Couple the grid coil tightly with the aerial coil, place the anode tap above the aerial tap, and switch on the power. Tune the grid circuit, when the valve should oscillate. The valve should be carefully watched, and the power cut off if the anode rises beyond a dull red heat. If the circuit does not oscillate, change the position of the aerial tap, and tune the grid circuit again. It is quite easy to make the circuit oscillate.

Once an aerial reading is obtained, measure the wavelength with the wavemeter, and make changes until the wavelength is correct. One may now systematically make adjustments for best efficiency, that is, the best ratio of aerial current to input power. An aerial ammeter (hot wire) and a direct current ammeter (moving coil), joined in the feed circuit between + H.T. and the choke are required to enable one to make the best adjustments.

There are six possible adjustments—filament temperature, anode voltage, anode tap, grid coupling, grid leak resistance, and frequency.

We will suppose the position of the aerial tap is fixed so that the frequency is right. It will be found there is a filament temperature below which the valve will not oscillate; on the other hand, raising the filament temperature beyond a certain point will not increase the output. We may therefore eliminate one variable at once by fixing the filament heating current.

The anode volts should be fixed at the rated valve voltage. If variations are made, the lower the voltage the lower the output, until as the voltage is decreased the valve stops oscillating.

The coupling, as mentioned above, is varied by changing the position of the anode tap T. When the anode tap is down close to the earth end of the coil so that only a few turns are in circuit, it will be noticed the reading of the valve feed current is high while the aerial current is low. As more turns are included in the circuit by raising the anode tap, the aerial current, and therefore the efficiency, increases rapidly. If the anode tap is too high, the efficiency is in general high, but the output power lower than necessary. The best adjustment is found by taking readings of aerial and feed current, and then making the adjustment which gives the best ratio of aerial current to feed current.

The aim in adjusting the grid circuit (coil L_1 and tuning condenser C_2) is to obtain sufficient power in this circuit to properly excite the grid of the valve. The adjustment of the grid coil with the aerial coil is therefore varied, bearing this in mind. If the coupling is too tight, power will be wasted in the grid circuit, and the grid of the valve may be overheated. An adjustment may be found which will give the best ratio output power to input power. It is generally better to adjust the grid condenser so that the grid circuit is not quite in tune with the aerial circuit.

The adjustment of the grid leak resistance is important, since it has considerable influence upon the efficiency, and the other factors just dealt with. If the grid resistance is increased the output is lowered, but the efficiency probably increased. The smaller output may be compensated for by increasing the anode voltage. At the same time the power output may be obtained with a little less filament current. If it is desired to secure long life of the filament, and still maintain the output power, the grid resistance should be high, and the anode volts high.

Those who wish to key a circuit of this description may place the key in the grid circuit so that the grid leak is connected to the grid condenser when the key is pressed.

Once suitable values are obtained for best results, the number of turns in the aerial and grid coils may be modified if desired. There is no use for turns of wire which are connected to the circuit but which take no part in its operation, and it is better to remove them and so prevent the losses which occur in them.

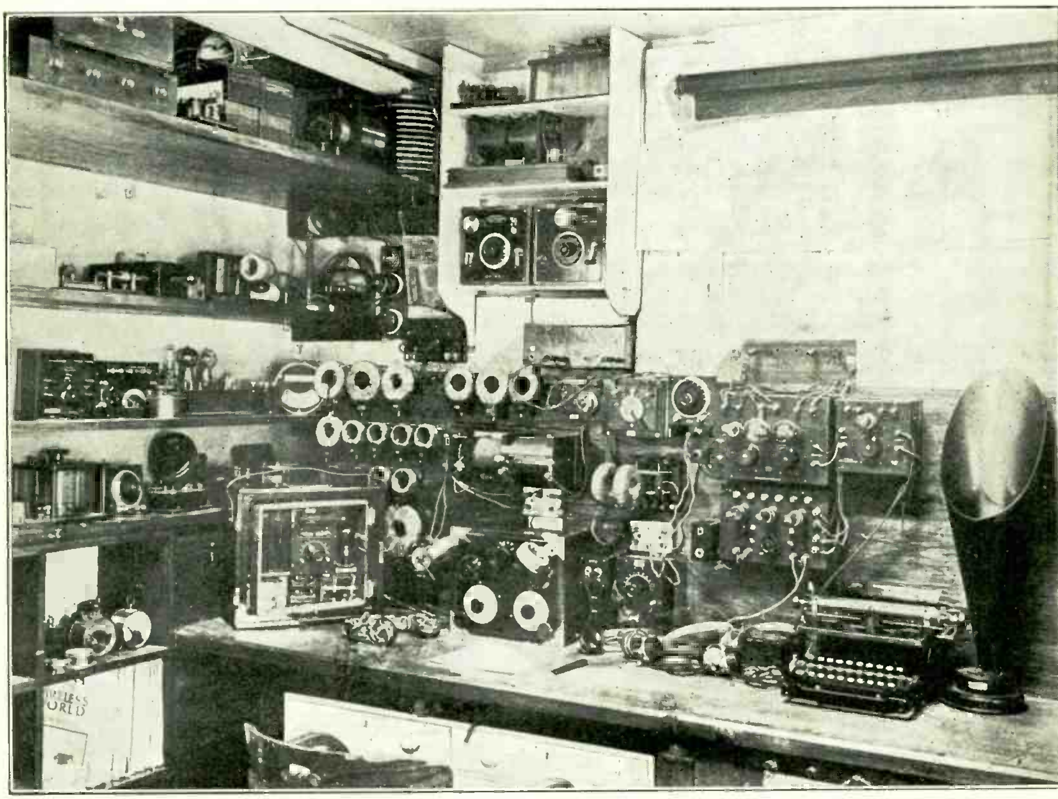
It should be remembered that the aerial inductance in particular is alive, and beside requiring careful insulation, calls for careful handling.

It is better to mount the components reasonably close together, to reduce so far as possible the length of the connecting wires. Stiff wires are an advantage in wiring up, although it is convenient sometimes to use heavily insulated rubber-covered flexible cable.

To protect the valve, it is advisable to connect a spark gap between the grid and filament legs of the valve itself, and to include a fuse in the power supply circuit. The spark gap should be adjusted to between one-sixteenth and three-sixteenths of an inch, depending on the anode voltage used.

(*To be concluded.*)

A NEW ZEALAND EXPERIMENTAL STATION.



Our illustration shows the particularly neat installation of a New Zealand experimenter, Mr. F. Dillon Bell. Many standard British instruments will be identified.

MEASURING AND MARKING OUT INSTRUMENTS.

By Richard Twelvetrees, A.M.I.Mech.E., M.S.A.E., M.Soc.Ing. Civ. (France).

READERS will recollect that in the issue of April 7th last, reference was made to various tools required in wireless constructional work, and for the benefit of those who, having acquired the various instruments recommended therein, desire to extend their equipment on more comprehensive lines, it is now proposed to deal with various classes of tools in somewhat greater detail.

With this object in view let us classify each section of the equipment according to their special uses, the subject thus being dealt with in convenient form for future reference.

The various instruments required for measuring and marking out component parts under construction form a convenient subject for starting the discussion on workshop equipment, and suitable arrangements are desirable whereby this special class of instrument should be kept in one very accessible place, preferably in a cabinet provided for the purpose.

MEASURING INSTRUMENTS.

Machine Divided Steel Rules.

For small work an ordinary 4 in. steel rule, graduated to 16ths, 32nds and 64ths of an inch, will be convenient. The pattern which is marked on the reverse side to indicate tapping sides is very useful and it is quite a good plan to carry a reserve 12-in. three-folding rule in a small leather case in the waistcoat pocket. In passing, the amateur should be warned against cultivating the habit of carrying any other tools in his pocket, as no surer way of mislaying things can be imagined.

Carpenters' or draughtsmen's boxwood folding rules are sometimes used formeasuring larger objects, but these seem to possess the tendency to promote inaccurate measurements when used in close work, and the writer prefers to use steel rules for all purposes. Somehow a steel rule exercises an influence towards accuracy. There is a patent rule made by Chesterman which, measuring 2 ft. in length, has a single firm joint and is marked off with a scale of chords on one side from 0 degrees to 120 degrees, advancing by half degrees. Two centre dots are marked, one on each blade, so that by the aid of a pair of dividers the rule can be set to any desired angle or *vice versa*, and any angle can be determined by the rule. Full instructions as to the manipulation are issued with the rule when purchased.

A great deal of time and labour can be saved in wireless work by the accurate measuring of long lengths of wire used for various purposes. As an ordinary flat rule is not convenient in this respect, a steel tape measure should be purchased. These are made in several patterns, and vary in price according to the finish and length of the tape.

Sliding Calliper Gauges.

Next in order of importance to rules comes the sliding calliper gauge of which there are many varieties, varying from the adjustable vernier with graduations of 1/1000th in., to the type which is little more than a steel rule with a sliding attachment. In selecting the gauge for our particular purpose neither extreme is recommended, and a very useful tool is shown in Fig. 1 (6), which consists of a gauge equally convenient for measuring external diameters. The vernier marked on the sliding portion gives readings down to 1/128 in., and 1/10th millimetres on the opposite edge. When opened to the required degree, the slide can be locked by means of a set screw which increases the usefulness of the tool for repetition work.

Micrometer Gauges.

Although the micrometer gauge is not absolutely indespensable in the wireless workshop, its inclusion in the stock of instruments is very desirable. When a good deal of turning work is contemplated, the accuracy obtainable by its use, as well as saving of time effected, are valuable features. The amateur who becomes accustomed to micrometer work instinctively turns out better work than those who are content with less accurate measurements, and experimental results are often marred because certain details have not been treated with sufficiently close attention to fine measurements. Therefore the type of micrometer illustrated in Fig. 1 (5) is recommended for general use, and by means of supporting it in a special stand, its range of usefulness will be increased as it is inconvenient to hold certain parts and measure them with the micrometer at the same time.

Depth Gauges.

The importance of the depth gauge as a measuring instrument may be judged from the fact that it is commonly used in vernier and micrometer form, but a plain pattern fitted with a narrow steel rule is all that the wireless amateur needs, unless he prefers the type in which the rule is substituted by a wire.

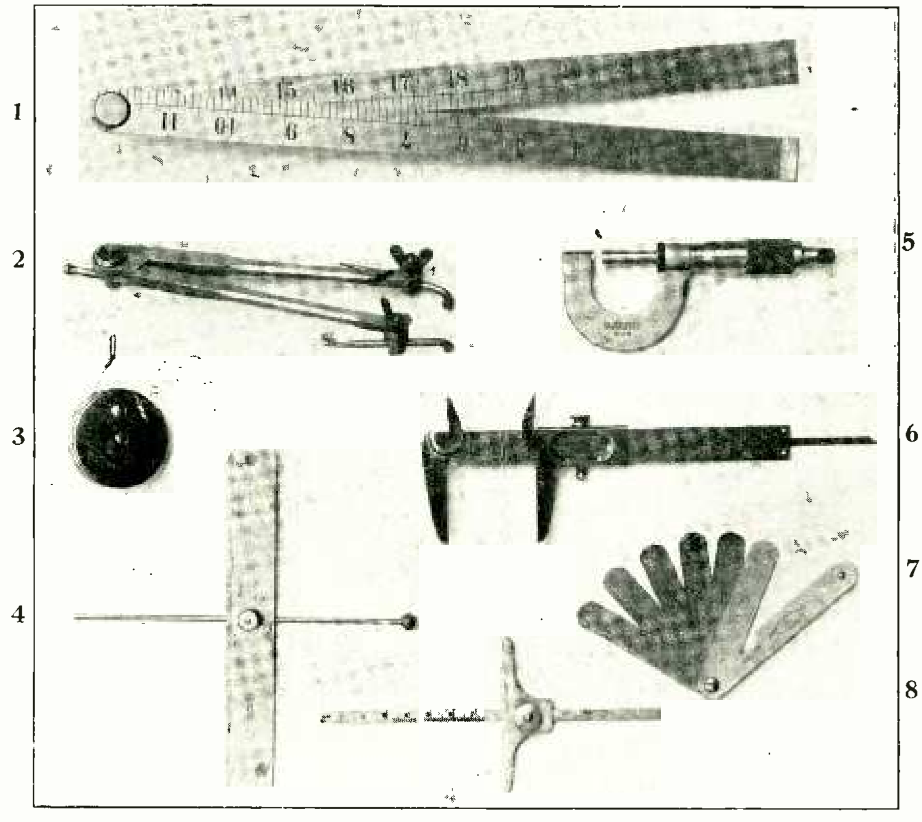


Fig. 1. Measuring Instruments used in Wireless instrument making.
(1) *2-ft. steel rule*; (2) *Universal callipers*; (3) *Steel tape measure*; (4) *Simple depth gauge*; (5) *Micrometer*; (6) *Sliding calliper gauge*; (7) *Feeler gauge*; (8) *Depth gauge*.

Universal Callipers.

In the ordinary way several pairs of callipers are needed, but by purchasing a pair of universal callipers as shown in Fig. 1 (2), one pair alone will be necessary, this instrument also serving as dividers for marking out. The legs can be locked in position by means of a lever lock, the points can be set at right angles to the working faces, and can also be set for different planes, suitable detachable points being provided enabling the instrument to be used for various purposes indicated.

Feeler Gauges.

Feelers or thickness gauges are used for measuring spaces between surfaces which are too close together to permit of measurements by the rule. These take the form of thin strips of tempered steel of varying thicknesses fitted into a steel casing. The latter has a pivot to which the strips are hinged in the manner of a pocket knife blade, and all the strips are marked with numbers corresponding to their thicknesses in thousandths of an inch.

Thread Gauges.

Similar in form to feeler gauges are thread gauges, the strips in this case being of equal thickness and have serrated edges by means of which the number of threads per inch in a screw can be determined.

The above described selection of measuring tools can be elaborated *ad infinitum*, but those detailed will be found quite adequate for all ordinary purposes, and this brings us to the question of marking-out tools.

MARKING-OUT TOOLS.

The first essential for the accurate marking out of raw materials to be fashioned into wireless components is a flat surface, upon which to support the wo k. This is provided by the marking-out plate, together with other instruments for marking out. The plate should measure at least 8 ins. by 12 ins., and be accurately planed on the upper surface, edges and points on which it stands. It must be remembered that this plate is for *marking out*, and will be rendered useless if employed as a hammering block. Scribing blocks can be purchased in very simple forms, but the variety of applications of the universal type justify the slight difference in cost between this and the simpler patterns.

a groove running from end to end. A centre square, protractor and try square are made with slots, into which the rule fits, and special locking screws to secure them in position for use. Thus the tool can be used for three distinct classes of work: (1) Marking the centres of round objects; (2) Calibrating parts in degrees such as scales for condensers, variometers and the like; (3) As an ordinary try square for 90 degrees and 45 degrees. The square, it will be noticed, is provided with a spirit level, and the round knob of a scriber projects from a recess made to contain this indespensable tool.

Considering its wide range of application the combination set is one of the most inexpensive tools in the amateur's outfit, and once its advantages are realised the purchase price, which ranges from 15s. 6d. upwards, is quite a small matter.

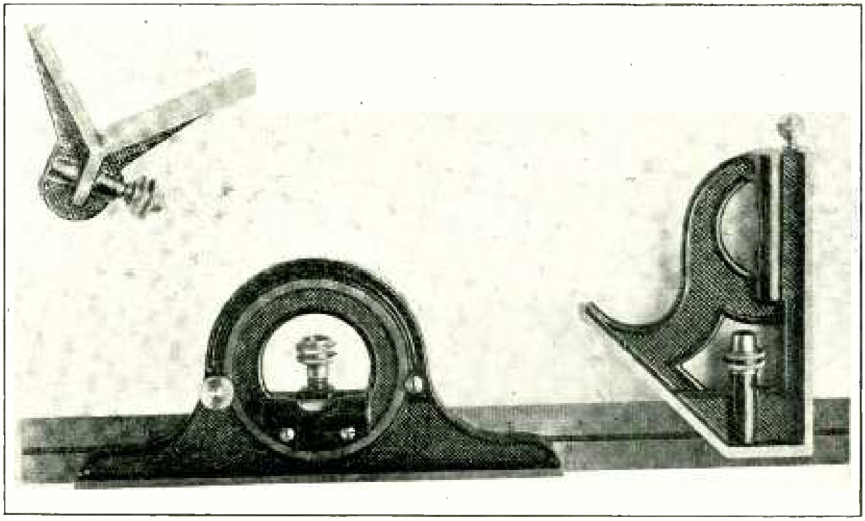


Fig. 2. A combination square and protractor.

Combination Sets.

Fig. 2 illustrates one of the most valuable tools designed for marking out, and a whole article could be devoted to its uses without exhausting the subject. For the present, however, we must be content with mentioning but a few of the applications. The set consists of a hardened steel rule provided with

Plain Protractors.

Those who already possess squares and centre squares may not feel disposed to invest in a combination set, yet feel the frequent need of a protractor. This need can be met by buying a plain protractor which only costs about four shillings, and serves fo most ordinary purposes.

CARE OF MEASURING TOOLS.

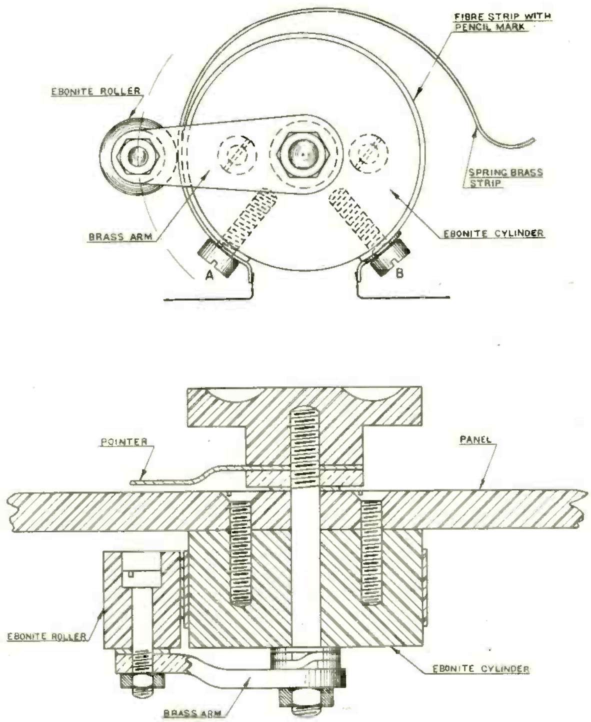
All kinds of tools must be reated with the greatest respect, and those belonging to the classes we have just considered are particularly liable to suffer if neglected in any way. When not in actual use, all bright parts should be protected with a film of petroleum jelly or similar rust-preventing composition. If the tools are kept loosely in a drawer they are liable to become damaged by contact with each other, and therefore it is best to keep them suspended from hooks inside a suitable cupboard where they can be found quickly whe required, and protected from any risk o damage.

In a subsequent article a few hints will b given on tool making so that the amateur wh has more time than money to devote to hi hobby will be able to make many of the instruments described in subsequent articles (*The tools for the preparation of the illustration were kindly lent by Messrs. Richard Melhuish Ltd.*).

A Novel Variable Grid Leak.

By H. W. RICHARDS.

THE actual resistance of this grid-leak consists of a pencil mark made on a strip of fibre, which is afterwards lightly varnished with very dilute shellac varnish, to avoid changes due to moisture. This strip is arranged round the periphery of a small ebonite cylinder, of which it embraces about three-quarters of the circumference, being held in position by two screws, one at each end, which also form the terminals, screwed radially into the ebonite. One of these set-screws, "A," carries a strip of sheet brass bent into the form of a curve, which embraces the ebonite cylinder and grid-leak without actually touching it. The operating rod passes through the centre of the cylinder, bearing an arm, with an ebonite roller at the outer end. When this arm is rotated, it forces the brass strip into contact with the fibre grid-leak strip, any required portion of which may thus be short-circuited.



A new and ingenious grid leak.

By properly arranging the curvature of the brass strip, no sliding motion will take place between the brass and the pencil mark, which thus permanently maintains its original value. It is important that, for a given diameter of the cylinder, the brass strip should not be made of too thin material. By arranging the pencil mark to be thick and heavy at the set-screw B, and tapering it down so that it disappears altogether at half an inch before "A" is reached, practically any value from about 50,000 ohms to infinity may be obtained in the one instrument.

THE AMATEUR'S EXPERIMENTAL LABORATORY

VIII—HETERODYNE METHODS OF MEASUREMENT.

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

AT this stage in the series of measurements and tests being described in these articles, it will be convenient to discuss other ways in which the three-electrode valve with appropriate associated circuits may be used for carrying out simple tests and measurements. Of these, the most important are doubtless those making use of or depending upon the use of what are known as various heterodyne methods, and some reference will now be made to these.

In those measurements which have already been described, use was made of a single oscillating valve, and the effects produced by the currents induced by this oscillator into the measurement circuit were employed. In the heterodyne arrangements, two distinct oscillator valves are used, with the result that a different series of phenomena are called into play.

Most experimenters are doubtless familiar with the whistles and similar sounds which are heard when an oscillating receiver is used. Such whistles are generally referred to under the general term of heterodyne beat notes. Like the "double-click" method which has already been described, they provide a very simple yet very accurate way of indicating resonance between two circuits. Hence by appropriate disposition of the circuits and of their components, this method can be used to carry out the same, or similar, measurements as have already been described in conjunction with the "double-click" method. The heterodyne method, however, possesses several well-marked advantages over the double-click method for certain measurements in particular. As a general rule, too, it enables the resonance point to be determined with greater accuracy, besides permitting when required the use of harmonic oscillations, certain applications of which will be dealt with later. Owing to the greater sensitiveness, too, a weaker coupling can be used between the circuits—an arrangement which tends to the attainment of greater accuracy.

The general principles underlying the production of beats between two high-frequency oscillations need not be discussed in great detail here, as they are doubtless familiar to the majority of radio experimenters. The chief point of interest to which at the moment it is desired to draw attention is the increase of accuracy which is obtained as the wavelength of the oscillations is reduced. This may perhaps be emphasised by the diagram Fig. 1. When two high-frequency oscillations of slightly different frequencies interact to produce beats, there are set up in the circuits as a result of this interaction electromotive forces, the frequencies of which are respectively equal to the sum and to the difference between the frequencies of the two initial oscillations.

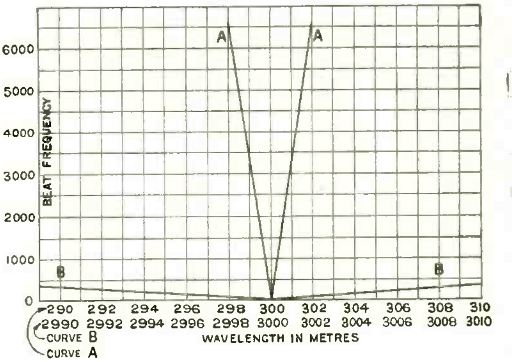


Fig. 1.

For our purposes the frequency equal to the sum of the two initial frequencies may be disregarded, as it will obviously be very much higher than either of these frequencies (*i.e.*, it will have a short wavelength), and currents of this frequency will not easily be able to flow in the circuits. The frequency equal to the difference between the two initial oscillation frequencies is what is ordinarily known as the "beat" frequency, and is the one with which we are most concerned here. The values taken by this beat (or difference) frequency as the wavelength of one of the oscillations is changed through resonance with the other are illustrated in the diagram Fig. 1 for two resonance wavelengths, one a short wave, and the other long. In this diagram the upper V-shaped curve marked A is drawn for a resonance wavelength of 300 metres, and shows the rise of beat frequency from zero at resonance to quite high values, as the second oscillation circuit is detuned to wavelengths a few metres above or below the resonance wavelength of 300 metres. Similarly the curve marked B shows how the beat frequency changes when similar changes are made in the wavelength of the second circuit above or below a resonance wavelength of 3,000 metres, instead of 300 metres as for curve A. By inspection of these curves we see that to obtain the low beat note of say 300 cycles requires that one circuit shall be detuned about 9 metres from the other when the resonance wavelength

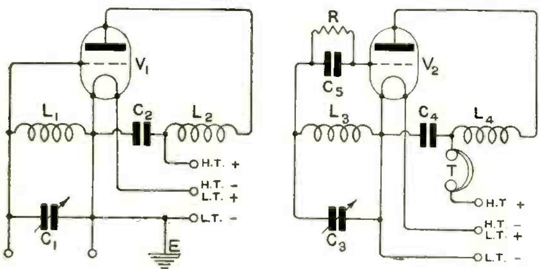


Fig 2.

is 3,000 metres (*i.e.*, from 3,000 to 2,991, or to 3,009 metres); whereas to obtain the same beat frequency when the resonance wavelength is 300 metres requires that one of the circuits shall be detuned only about 0·1 metre (*i.e.*, from 300 to 299·9 or to 300·1 metres). Hence it becomes evident that at the shorter wavelengths the possible degree of tuning becomes much sharper, since the detection of any detuning between the two circuits depends upon the ability to detect the beat frequency in the telephones.

The general outline of the arrangement of the circuits for employing heterodyne methods of comparison is sketched in Fig. 2. It will be seen from this diagram that in general outline it consists simply of two oscillator valves connected up in the same way as the ones that have already been used, with the exception that the telephones T are connected into the plate circuit of one valve only, which valve also has in its grid circuit a grid condenser C_5 and parallel leak resistance R, such as are usually employed for detector valves. A convenient value for C_5 is about 0·00025 microfarad, and for R anything between about $1\frac{1}{2}$ and 2 megohms. These values are not very important, but may conveniently be of about the sizes given. The inductances L_1 L_2 should preferably be either in the form of two windings placed close together upon a single former, or be made of two plug-in coils of any of the well-known standard forms. When the latter are employed care should be taken that their relative positions are not changed during any one experiment, as such changes would alter the oscillation frequency of the circuit. It will be noted that two terminals are shown as connected across the tuning condenser C_1. These are provided so that any external condensers, etc., can be joined into circuit as required for various tests.

In lieu of joining the telephones directly into the plate circuit of the valve V_2, they can of course be connected thereto *via* a telephone transformer. This latter is an arrangement that possesses some advantages since one terminal of the telephones can then be connected to earth, thus avoiding changes of tuning due to varying capacity between the 'phones and the wearer's head. Another arrangement that possesses many advantages from the point of view of convenience in operation consists in replacing the telephones T, Fig. 2, by an intervalve transformer, and adding one or two stages of low frequency amplification with a loud speaking telephone in place of the usual headphones. It is then unnecessary to go near to the detector-oscillator valve V_2, or its associated circuits when adjusting the first oscillator circuit C_1, thus avoiding changes due to stray capacities introduced in this manner.

For a similiar reason it is desirable to connect one terminal of C_1 to earth—the terminal connected to the valve filament—so that the electrostatic potential of the system is defined, and all stray capacities definitely become capacities to earth only.

It is usually desirable to use separate L.T. and H.T. batteries for the two valves, as otherwise it is frequently found that there is too much coupling between the circuits for proper measurements to be made.

Evidently the detector-oscillator valve V_2 can, with its associated circuits, be replaced by simple form of radio receiver if one is conveniently available, and if the receiver is fitted with sockets for plug-in coils it is easy to adapt it for use with any wavelength that may be desired for measurement purposes—the coil L_3 being the main tuning coil, and L_4 the reaction coil. If the set is fitted with a three-coil holder, the aerial tuning coil holder can be swung around out of the way, and no coil plugged in, the coil L_3 being plugged into the socket for the "secondary" coil. The tuning condenser C_3 will then naturally be connected across the coil L_3 as required here. Should the set only have a two-coil holder, the aerial lead should be disconnected (the earth may be left on), and the aerial tuning condenser should be in the "parallel" position, not in series with the aerial circuit. Such a set, if fitted with a low frequency amplifying valve as well, will enable a loud speaking telephone to be used if desired in the manner that has been indicated above.

The experimenter desiring to make use of these arrangements should set up the apparatus that has been outlined, and familiarise himself with the proper relative dispositions of the parts necessary to secure good clear beat whistles in the telephones. If the coupling between the two valve circuits is too close, the "dead space" between the two whistles on each side of resonance becomes widened out so that accurate tuning is no longer possible. When this is the case the beat note also, instead of commencing at a very low-pitched tone as soon as the tuning of one circuit is altered, does not commence until a considerable alteration of tuning has been made, and it then commences not as a low tone, but jumps straight away to a fairly high-pitched whistle. This can be cured by weakening the coupling between the two valve circuits, and some considerable time can usefully be spent in arriving at the most satisfactory arrangement which gives the sharpest and clearest indication of tuning, so that the method can be ready for use in some of the tests which will be described in subsequent articles.

Plate and Filament Current from D.C. Mains.

By J. S. ATTLEE.

IT is generally the aim of the experimenter when D.C. mains are available, to derive plate current and battery charging current from this source as economically as possible.

The method described below can be used where the supply is from 200 to 240 volts, and where the *negative* side of the mains is earthed.

It is a cheap method, and the initial outlay should certainly not exceed 10s. No more current is taken from the mains than is required by the valves, which, of course, is a distinct advantage over the potentiometer method. The only extras needed are the "Osglim" lamp, and a condenser having a value of between 2 and 3 mfds., together with a small two-way switch.

The first step is to identify the polarity of the mains at the distribution fuses, and this can easily be accomplished by attaching lengths of flexible wire under two of the fuse clips and immersing the ends in a glass of water, taking care that the wires do not touch. It will be noticed that bubbles of gas are evolved from the wires, but it will be readily observed that the effervescence is more vigorous at one lead than the other. The lead from which the larger quantity of gas is evolved is the negative.

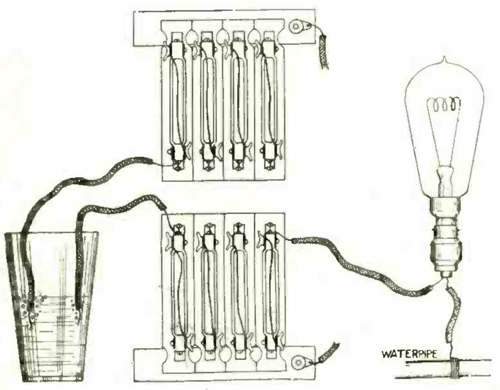
The next step is to ascertain which of the main leads is earthed, and this can be done by taking a lamp such as is used on the circuit, held in a bayonet holder which has flexible lead attached. One lead is taken to the water pipe, and the other lead may be attached to one of the two sides of the main circuit. It will be found that when contact is made with one side of the mains the lamp will light, and this main is of course the one which is above earth potential. It is as well at this stage to label the two buss bars at the fuse box "plus" and "minus," and also to mark an "E" on the side which is earthed, *i.e.*, the one which, when touched by the wander lead from the bayonet fitting, does not cause the lamp to light.

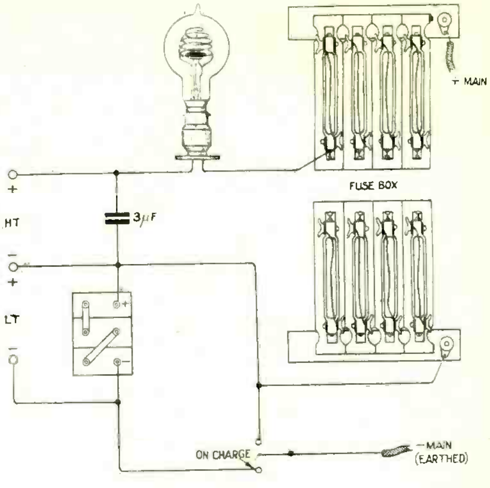
The lead which is earthed is the one into which the accumulator charging circuit must be connected in order that the filament circuit of the battery will not be at high potential above earth, and by this means shocks are avoided.

The method of connecting up is shown in the accompanying diagram, and it will be noticed that by means of a two-way switch it is possible to throw the L.T. battery on charge. The batteries should be left on charge when the receiver is not in use, and it can be seen that any current which is taken from the house supply will be fed through the accumulator, and thus the battery will become charged without extra cost.

When receiving, however, a slight hum may be set up if the accumulator is left on charge, and so the switch can be moved over, it being borne in mind that, in so doing, the house lighting circuit is temporarily interrupted as the switch moves from one position to the other.

A novel method is employed for deriving plate current, inasmuch as a neon lamp of the "Osglim" type is employed to restrict the current which is supplied in this circuit, and this lamp current is used to charge a large capacity condenser. This arrangement will be found to practically eliminate the hum, though it must be remembered that one neon lamp only passes a very limited current, often insufficient for a two or three-valve receiver.





It is essential to employ a loose-coupled receiving circuit in cases where the source of high tension or filament current is earth connected.

SECRET RADIO TRANSMISSIONS.

Many attempts to obtain secrecy in the transmission and reception of radio signals have been made from time to time. One such consists in changing the wavelength of the transmitter repeatedly through a series of valves, the tuning of the receiver being simultaneously changed either automatically or by hand so as to enable the signal to be received continuously. A further extension of this idea consists in continuously modulating in a predetermined manner the wavelength of transmission*, and in automatically varying the tuning of the receiver likewise. Thus not only does it become extremely difficult to pick up such a signal, but the receipt of such a signal by the proper receiver is less liable to continued interference, since a given interfering station would affect it only at irregular periods due to the continuously changing wavelength of transmission.

P. R. C.

* British Patent No. 180288, by National Pneumatic Co. (U.S.A.) *Patent void.*

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XVII.

The series has been specially arranged so that the reader who follows each section as it appears will have obtained a complete wireless education with a minimum of time and trouble, and he will be in a position to successfully design his own wireless equipment.

The last sections deal with series and parallel resonance, the study of which is so important to those who desire a clear understanding of wireless.

By W. James.

(4) *Transformer Losses.*

Up to the present we have assumed the transformer to be ideal, that is (*a*) its windings possessed no resistance; (*b*) the whole of the flux generated cut the primary and secondary windings, or, in other words, there was no magnetic leakage; (*c*) no power was lost through magnetising the core, that is, there is no loss due to hysteresis and eddy currents. The effect of imperfections is discussed briefly below.

(5) *Losses Due to Resistance.*

When the windings possess resistance, power is lost in heating the wire. With no secondary load, the primary loss will be quite small, but still a small component of the applied primary pressure is required to send the current through the resistance, and the back pressure generated will be less than the applied pressure. When the secondary is loaded, the primary current of course increases, and the volts drop in the primary increase. At the same time the terminal voltage of the secondary is lower than it was when not loaded. The effect of resistance is clearly to cause a fall in the secondary terminal pressure, which increases with the load. That is, as the secondary current is increased the secondary terminal voltage falls. With a non-inductive load, *e.g.*, a resistance, the terminal voltage will be $(E_s - e)$, e being equal to $R_s I_s$ volts where R_s is the secondary winding resistance and I_s is the current.

If we assume the turn ratio is unity, it is clear if there is a drop of 1 volt in the primary there will be a drop in the secondary voltage of 1 volt due to the primary. If the turn ratio is $\frac{N_s}{N_p}$ and the primary resistance is R_p, we may transfer this resistance to the secondary and call it the equivalent resistance of the primary referred to the secondary. Thus R_p is equivalent to a secondary resistance of $R_p \times \left(\frac{N_s}{N_p}\right)^2$ ohms. If the ratio $\frac{N_s}{N_p}$ is 10, and the primary resistance is 1 ohm, the equivalent secondary resistance due to the primary is 100 ohms, and the voltage drop in the secondary is $100 \times I_s$ due to the effect of primary resistance above. A little reflection will show this to be true. The total equivalent secondary resistance is then equal to $R_p \times \left(\frac{N_s}{N_p}\right)^2 + R_s$. The quantities are represented in Fig. 83.

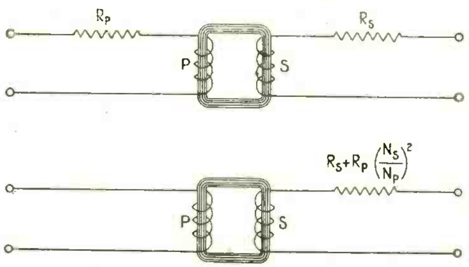


Fig. 83. The resistance of the primary winding may be designated by R_p and that of the secondary R_s. The equivalent resistance of the transformer referred to the secondary is equal to $R_s + R_p \left(\frac{N_s}{N_p}\right)^2$

(6) *The Effect of Magnetic Leakage.*

Suppose now the whole of the flux generated by the primary does not link with the secondary, and that the flux set up by the secondary does not all link with the primary. The secondary voltage will obviously not be so high, and as the amount of leakage flux will vary with the load, the secondary pressure will vary with the load. We may, in fact, represent the effect of leakage by an inductance connected in each circuit as in Fig. 84. Here the effect of the leakage upon the primary is as though a reactance coil X_p is connected in series with it, and the effect upon the secondary is as though a reactance X_s is in circuit, so that if we assume the transformer is ideal, and connect appropriate reactances X_p and X_s we have the

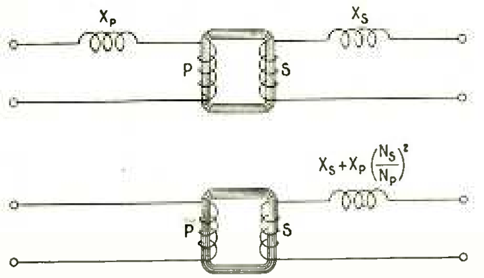


Fig. 84. On account of magnetic leakage the transformer may be represented as an ideal transformer with a choke X_p and X_s joined in the primary and secondary. The equivalent reactance of the transformer referred to the secondary is equal to

$$X_s + X_p \left(\frac{N_s}{N_p}\right)^2.$$

approximate effect of an imperfect transformer with magnetic leakage. The whole effect may be represented by including in the secondary circuit a reactance equal to $X_s + X_p\left(\frac{N_s}{N_p}\right)^2$.

The effect is now clearly seen that the flux set up around the coils X_p and X_s causes a pressure drop in those coils which reduces the terminal pressure of the transformer, and further, as the load increases, the fall in pressure across the reactances increases (ωLI), therefore the secondary voltage falls with an increase in load.

(7) *The Effect of Core Losses.*

When the iron is magnetised there are losses due to the generation of eddy currents,

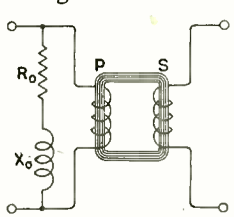


Fig. 85. The effect of the core losses may be represented as an impedance consisting of X_o and R_o connected across the ideal transformer.

and also to hysteresis. At the same time there is the magnetising current. At no load, therefore, the current from the mains will be equal to the vector sum of the magnetising current, and the current which flows due to the core losses. We may represent the effect by assuming an ideal transformer with an impedance, *i.e.*, a coil with inductance L_o and with resistance R_o, connected across the primary, as in Fig. 85. For a given transformer, so long as the applied pressure and frequency remain unchanged, the iron losses remain about constant with changes in the load.

(8) *The Effect of Capacity.*

What now is the effect of connecting a condenser across the secondary terminals? Besides the condenser taking current, and altering the phase relationship between the primary current and voltage (and therefore the power factor), the combined effect of the transformer inductance with the capacity is to produce a circuit which has a resonant frequency. The effect is sometimes desirable, as in the case of a spark transmitter where the primary circuit of the transformer is tuned to the frequency of the alternator, but generally, and in particular in the case of transformers employed to couple valves, the effect is quite undesirable. Sometimes when the windings consist of a large number of turns of fine wire, the capacity of the transformer itself, that is, the internal capacity, is so large that with the transformer inductance a circuit is formed whose resonant frequency is an audible frequency. More will be said about this later.

If the secondary circuit capacity is equal to C farads, we may represent this as equivalent to a capacity of $C \times \left(\frac{N_s}{N_p}\right)^2$ farads in the primary circuit. If the condenser is joined in the primary circuit, the effective capacity in the secondary circuit may be represented by $C \div \left(\frac{N_s}{N_p}\right)^2$ farads. Thus, if the capacity of the condenser in the secondary side is $0{\cdot}001\ \mu F$, and the transformer ratio $\left(\frac{N_s}{N_p}\right)$ is equal to 100, the equivalent primary capacity is $0{\cdot}001 \times 10{,}000 = 10{\cdot}0\ \mu F$. It will be noticed that whereas a small inductance in the primary side of a step-up transformer is equivalent to a larger inductance in the secondary, the reverse is true of the capacity.

Reduction of Losses.

To reduce the resistance loss it is clear we must use as large gauge wire as possible.

To reduce magnetic leakage the primary and secondary coils should be arranged so that they are as close to each other as possible. Thus it is not always good practice to wind one winding upon one limb of the transformer and the other winding upon the other. It is better to wind the secondary over the primary or *vice versa* (Fig. 86A), as is the case with most transformers used in wireless receivers. It would be better still to split the windings up into sections as in Fig. 86B and to interleave them.

The core losses are reduced by using special iron such as stalloy, and by building the core

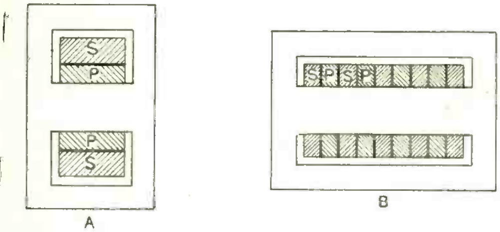


Fig. 86. To reduce magnetic leakage the windings should be split up and interleaved as in B. The transformers are of the shell type.

from laminations. The laminations should be quite thin, say 6 to 12 mils. thick. The magnetic circuit should be complete, that is, its reluctance should be small. The magnetising current is reduced by winding a large number of primary turns, and using a core of high permeability with small reluctance. The core should be worked at a low flux density, since the flux density is a factor which helps to decide the iron losses.

Types of Transformer.

There are, broadly speaking, three types of transformer—(1) the shell type; (2) the core type; (3) the open core type.

The shell type of transformer is represented in Fig. 86, and the core type is Fig. 87. A

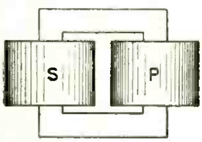


Fig. 87. Core type transformer.

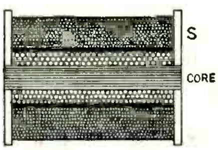


Fig. 88. Open core type transformer.

transformer of the third type is shown in Fig. 88. The method of building up the laminations is shown in Figs. 89 and 90. It will be noticed the joints are not all on one side, the laminations being first placed one way round and then the other way round as shown. The effect is to provide a better magnetic path than would be provided were the joints all at one side. It will also be noticed in the shell-

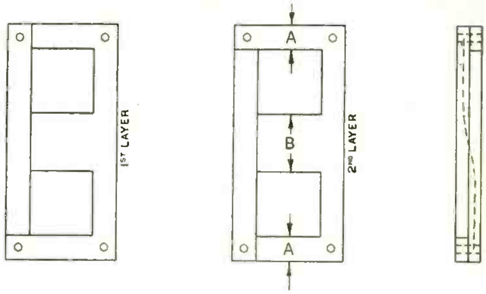


Fig. 89. A usual shape of laminations used in the construction of shell type transformers. The layers are arranged as indicated to reduce the reluctance of the core by reducing the effect of the joints.

type transformer (Fig. 89), that the width of the stampings at A need only be half the width B. While the whole of the flux is carried by the central portion B, the limbs A each carry half the total flux. There is not a great deal to choose between either construction (1) or (2) from an electrical point of view, but most transformers used in wireless receivers are built as shell transformers. The laminations are usually held together by a

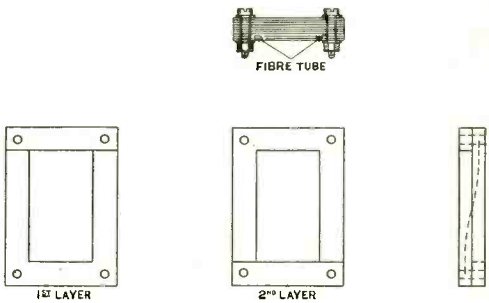


Fig. 90. Laminations used in the construction of a core type transformer. The bolts which hold the laminations together should not make contact with them, otherwise the eddy current loss will be larger than will be the case when the bolts are insulated.

small bolt placed at each of the corners. An insulating bush and washers should be fitted to prevent the bolts short-circuiting the laminations, and so increasing the eddy current losses. The stampings need to be lightly clamped to prevent humming.

The windings should, of course, be properly insulated, and tightly held in place. In particular large voltages may be generated in the end turns of the transformer. In large power transformers it is usual to connect small chokes, which are very carefully insulated in the leads of the high tension side. With small power transformers there is no need for this elaborate precaution, but still the insulation should be carefully seen to, because large voltages may be set up when the circuits are suddenly made or broken. To further reduce risk of breakdown, the transformer secondary sometimes has its mid-point joined with the core, or with earth. Wireless transformers cannot be joined to earth as a rule, especially in the case of those used in the receiver, but the connection may be made with the core, care being taken not to join the core with earth.

Calls Heard.

(Listeners-in are invited to forward to the Editor lists of experimental stations heard for inclusion under this heading).

Prestonpans, N.B.

2 FN	2 FQ	2 GG	2 JJ	2 JO	2 KF	2 KO	2 MG
2 NA	2 NN	2 OM	2 UC	2 2K	3 ST	5 BA	5 CD
5 CX	5 GS	5 IP	5 WR	5 2V	8 AA	8 AQ	8 BF
8 BM	8 BV	8 22	0 BM	0 DV	0 XL		

(Capt. E. A. Anson.)

Edinburgh.

2 DF	2 DX	2 KF	2 KR	2 KX	2 LG	2 NK	2 NM
2 OD	2 UL	2 WJ	5 BG	5 BV	5 DN	5 GS	5 IC
5 IJ	5 JF	5 KO	5 LC	5 NN	5 RB	5 XC	5 ZV
6 GO	8 AA	8 AB	8 AQ	8 BF	8 BM	8 BV	8 CF
8 CS	8 CZ	8 ZZ	0 AA	0 MX	0 NY		

(Marcus G. Scroggie.)

Dollar, N.B.

1 NM	2 DF	2 FL	2 HS	2 JO	2 JZ	2 KD	2 KF
2 AW	2 MG	2 MM	2 NA	2 OD	2 OM	2 ON	2 TF
2 LV	2 VK	2 VT	2 WH	2 XR	2 ZY	5 IO	5 JX
2 TT	5 NS	5 OM	5 ST	5 SW	8 AB	8 BF	8 BM
5 MN	8 BQ	0 BQ	0 DV	0 NY	0 SA	0 SR	0 YS
8 BN	PCII	W QN					

(Ian F. Sime.)

Faxe Ladeplads, Denmark.

2 OM	5 WR	8 CS

(James Steffensen.)

Copenhagen.

2 NA	2 NO	2 OD	2 RB	2 SM	2 WF	5 DN	5 KO
8 AG	8 BF	8 BM	0 BS	0 DV			

(Norge Jorgensen.)

Arundel.

2 AJ	2 FJ	2 FQ	2 KB	2 KI	2 MP	2 MT	2 OJ
2 OM	2 SQ	2 SS	2 X2	5 BB	5 CP	5 L2	5 LP
5 LT	5 MR	5 MS	5 PQ	5 QL	5 QQ	5 VR	5 2U
6 FP	6 MP	6 SY					

(W. H. Newman.)

Clapham Common, S.W.

2 AM	2 BS	2 CR	2 DM	2 DX	2 FL	2 FY	2 HS
2 JL	2 KQ	2 KV	2 LZ	2 MQ	2 NM	2 OD	2 RB
2 VN	2 WQ	2 WZ	2 YZ	2 ZL	2 ZO	2 ZT	2 BT
5 CO	5 DH	5 DS	5 GS	5 HK	5 IQ	5 IX	5 JX
5 KO	5 OP	5 OS	5 PB	5 QK	5 UD	5 VM	5 VP
5 XI	5 XY	8 AB	8 AP	8 BM	8 BY	8 CS	B XH
0 MX							

(H. C. Exell.)

Wireless Club Reports.

Contributions to this section are welcomed. Reports should be as concise as possible and should record the most interesting features of each meeting. The Editor reserves the right to edit the reports when necessary. **Papers read before Societies will receive special consideration with a view to publication.**

An Asterisk denotes affiliation with the Radio Society of Great Britain.

North London Wireless Association.*

In his lecture on July 9th, entitled "Radio Metal Craft," Mr. W. L. Johnson dealt with the correct method of soldering, referring to the right kinds of flux for the purpose. Soft and hard soldering were treated in turn, and the simplicity of the lecturer's explanations was such that even the veriest novice could not fail to grasp their purport. The lecture concluded with hints on money-saving gadgets.

It was agreed that the Association should close during the month of August.

Enquiries regarding membership should be addressed to the Hon. Sec., J. C. Lane, Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.

The Radio Society of Highgate.*

In spite of the warm weather this Society has recently been very active, and several interesting events have taken place during the last few weeks. On June 29th an exhibition and demonstration of loud speakers was held, several interesting comparative tests being made.

On July 6th Mr. J. Steell gave an account of his adventures as a war-time operator, vividly describing his experiences of observation balloon work.

On July 13th Messrs. H. Andrewes **(2 TA)** and F. G. S. Wise **(5CF)** gave a lecture and demonstration of direction-finding.

An interesting test was carried out on Sunday, July 15th, by means of a mobile transmitting set fitted to a motor car. Members of the Society listened-in to the transmissions by means of frame aerials in an endeavour to follow the course of the car. The results are not yet available, but are awaited with interest.

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

The Wireless Society of Hull and District.*

The annual general meeting was held on Friday, July 6th, when Mr. C. B. Snowden was elected as President, following the resignation of Mr. G. H. Strong. By unanimous consent, Mr. Nightscales was re-elected as Hon. Secretary.

Meetings are to be held fortnightly during the summer months, and an interesting syllabus has been arranged.

Hon. Sec., H. Nightscales, 47, Wenlock Street, Hull.

St. Bride Radio and Experimental Society.*

At a meeting held on Monday, July 9th, Mr. Norman G. Widger, of Marconi's Wireless Telegraph Co., Ltd., delivered a lecture on "The Transmission and Reception of Wireless Telephony."

Despite the attraction of outdoor sports, and with the thermometer at 90 degrees or thereabouts, a good audience was present, and everybody enjoyed Mr. Widger's lecture, which was instructive and entertaining, being interspersed with numerous anecdotes.

Hon. Sec., R. J. Berwick, St. Bride Foundation Institute, Bride Lane, Fleet Street, E.C.4.

Tottenham Wireless Society.*

The Society's second demonstration evening was held on Wednesday, July 11th, when experiments were carried out with a view to cutting out **2 LO.** A frame aerial made by one of the members was found very efficient.

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

North Middlesex Wireless Club.*

Whatever else may be said of this go-ahead Club, no one can deny that its members are very fortunate in the variety of the lectures provided for them.

An alfresco wireless party enjoying broadcasting on the Marconiphone. The Daimler car is used to support the aerial.

At the last meeting, held on July 11th, Mr. J. Maxwell Savage gave an excellent paper on "Radioactivity and its Bearings on Wireless," and he showed that the trend of modern science is to justify, to some extent at least, the dreams of the alchemists of old. The application of this branch of science to the theory of the wireless valve was well brought out by the lecturer.

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

The Southampton and District Radio Society.*

On Thursday, July 12th, Mr. J. Wansbrough gave an instructive lecture dealing with the evolution of two and three-valve circuits from an ordinary single-valve circuit, upon which an interesting discussion subsequently took place.

Five new members were elected.

Hon. Sec., P. Sawyer, 55, Waterloo Road, Southampton.

Bath Radio Club.

At two recent meetings of the Bath Radio Club, members welcomed the return of Mr. L. E. R. Boxwell, whose lectures had proved so popular at the commencement of the year.

The subject of Mr. Boxwell's first lecture was "Aerials and Earths," during the course of which the lecturer emphasised the importance of high aerials and short earth-leads. Mr. Boxwell's second lecture was an exhaustive exposition of batteries.

The Committee are endeavouring to obtain new and more suitable headquarters before the commencement of the winter session.

Hon. Sec., G. H. Barron Curtis, F.S.A.A., F.C.I.S., 6, Pierrepont Street, Bath.

The Thornton Heath Radio Society.

The first public meeting of the Society was held on Thursday, June 21, at the Polytechnic, High Street, when a good attendance was recorded.

Full details were given by the Secretary of the objects of the Society, which embrace the following :—Lectures, general discussions, buzzer classes, direction finding, practical demonstrations, elementary lessons on electricity and magnetism, advanced lectures for experimenters, outings and visits to works, aerodromes and ship stations, demonstrations for charitable purposes, construction of club set, library and museum, etc.

Full particulars of membership can be had from the Hon. Sec., R. S. Keeler, 72, Bensham Manor Road, Thornton Heath.

Wimbledon Radio Society.

Mr. Atkinson, of the Igranic Electric Co., Ltd., gave an interesting lecture on Thursday, June 21st. The lecturer described the construction of an efficient four-valve set employing the tuned anode circuit, also referring to the screening of aerials and giving some practical experiences.

A full transmitting permit having now been obtained, a complete transmitting set is under construction. New members will be welcomed and full particulars can be obtained from the Hon. Sec., C. G. Stokes, 6, Worple Avenue, Wimbledon, S.W.19.

Sydenham and Forest Hill Radio Society.

At a recent meeting an interesting lecture, with demonstration, was delivered by Mr. Voigt. Many members were surprised at the strength obtained with one valve and a crystal, sufficient to operate a loud speaker. Mr. Voigt's method of placing on the blackboard largely drawn circuits on drawing paper was much appreciated, and his ingenious system of adding smaller sheets to build up the various circuits, served to make his remarks comprehensible to all.

Mr. C. A. Percival, of the Edison-Swan Electric Co., recently gave an instructive lecture on the intricacies of valve manufacture. The lecture dealt with every stage of manufacture, from the blowing of the bulb to the finished article.

The Hon. Sec. wishes to inform all wireless enthusiasts in the district whose knowledge is still rudimentary, that on applying to him they may hear something to their advantage. The Hon. Sec. is M. E. Hampshire, 139, Sydenham Road, S.E.26.

Leicestershire Radio and Scientific Society.

On Monday, June 25th, Mr. C. T. Atkinson President of the Society, lectured on "Selected Problems," his remarks proving of great interest and value to his audience.

Hon. Sec., J. R. Crawley, 269, Mere Road, Leicester.

Fulham and Chelsea Amateur Radio and Social Society.

On Saturday afternoon, June 23rd, about twenty members of the Society enjoyed a visit to the Croydon Wireless Station. The officials very kindly explained the working of the station, which was seen in operation, and the afternoon proved most interesting and instructive.

Hon. Sec., N. Mickle, 544, King's Road Chelsea.

St. Pancras Radio Society.

A Wireless Society has been started in St. Pancras, and the following Committee and Honorary Officers have been elected :—

President, His Worship the Mayor of St. Pancras ; Vice-Presidents, Captain Ian Fraser, C.B.E., and Mr. F. H. Haynes ; Honorary Secretary, Mr. R. M. Atkins and Honorary Treasurer, Mr. W. G. Jeremy. Captain Fraser has been appointed Chairman for the ensuing year.

A special general meeting will be held at the Working Men's College, Crowndale Road, St. Pancras, at 8.30 on the evening of Thursday, July 26th, to discuss and approve rules and other arrangements for the conduct of the Society, and all listeners-in in the neighbourhood are cordially invited to attend, and since arrangements are being made for a loud speaker demonstration of reception of the evening's programme broadcast from the London station, a large audience is expected.

The Society is fortunate in its Committee. The Honorary Treasurer and Secretary are men well known in business and other circles in the Borough ; Mr. F. H. Haynes, the Assistant Editor of the *Wireless World and Radio Review*, brings to the Society considerable experience and long association with experimental work. Mr. J. S. Rowe is Senior Demonstrator in the Science Laboratory at the Working Men's College, and Captain Fraser is himself a most enthusiastic experimenter.

Notes and News

A censorship of broadcast programmes is pro-osed in France to prevent the circulation of rroneous news, particularly in respect of market ransactions.

* * * *

Bermondsey Guardians are to install a wireless et at their Ladywell Institution at a cost of :52 19s. 2d.

* * * *

Manchester broadcasting has now been heard n a Wigan coal-mine at a depth of 260 yards. This eats the previous record at Lanark when a Glasgow rogramme was heard 300 feet below the surface.

* * * *

With a capital of £133,000, The Austrian Marconi Company, Ltd., has been formally constituted in Vienna. It is hoped that traffic with other countries will be opened before the end of the year.

* * * *

Wireless Between Punta Arenas and Stanley.

Direct wireless telegraphic communication has now been established between Punta Arenas and Stanley Falkland Islands. Although at present messages can only be sent by Punta Arenas for Stanley, it is hoped eventually to make arrangements for messages to be sent via Stanley to all parts of the world.

Medical Advice by Wireless.

In our issue of June 16th we referred to the adoption by the Norwegian and Swedish Government of a service of medical advice by wireless for mariners. This practice is now being followed by the Danish Government, and sailors will now be able to obtain free advice from Blaavand **(OXB)** or Copenhagen **(OXA)**, transmitting in English Danish, French, German or Swedish.

The prescriptions will be issued from either the Esbjerg Municipal Hospital or the Copenhagen Marine Hospital.

Errors in Wireless Time Signals.

The results of the comparisons made at Greenwich Observatory of wireless time signals for last year are given by the Astronomer Royal in his annual report. The "annual means" are :—

Paris	. . plus 0.10 sec.	0.06 sec. of this accounted for.
Bordeaux	. . plus 0.14 sec.	
Nauen	. . 0.00 sec. . .	"Dead" on time.
Annapolis	. . plus 0.03 sec. (Aug. to Dec. only)	

The plus value means that the other station is late on Greenwich. In the case of the Annapolis time signal the discordance can be accounted for by the time of transmission. As much as 0.06 sec. of the French discordances is due to the fact that in France Leverrier's Tables of the Sun are used, while at Greenwich, Newcomb's values are used.

W. G. W. M.

The D.P. Battery Co.

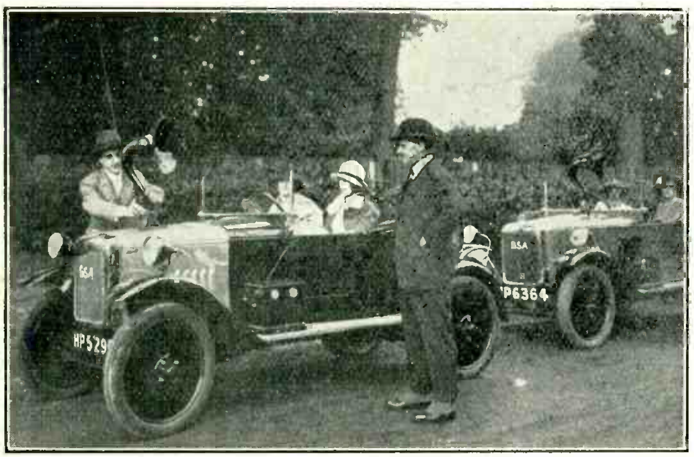
The fifth annual outing of the staff of the D.P. Battery Co. took place on Saturday, July 7th. The party, numbering 47, visited the most picturesque parts of the Peak district, proceeding to Buxton, and concluding a most enjoyable day by visiting the Opera House to witness the performance of "When Knights were Bold."

"Police Radio."

Exciting passages occur in a little book which has been issued under the above title by the Amalgamated Wireless (Australasia), Ltd., recounting the services rendered by wireless in the past in the detection and suppression of crime. It appears that wireless was first employed by the police in the famous "Crippen" case, when the notorious doctor was "run to earth" on an Atlantic liner.

Both the British and French police are keenly alive to the possibilities of radio. The New York police have installed a broadcasting station, and Chicago will soon possess eight high-powered "bandit cars," equipped with receiving sets. The Australian police have carried out successful experiments with wireless patrols.

There is no suggestion, however, in this thrilling little book that wireless can also serve the criminal. A point for reflection.



At a Demonstration of B.S.A. cars fitted with Marconiphone receiving equipment. Captain Twelvetrees is nearest to the camera.

Poet's Corner.

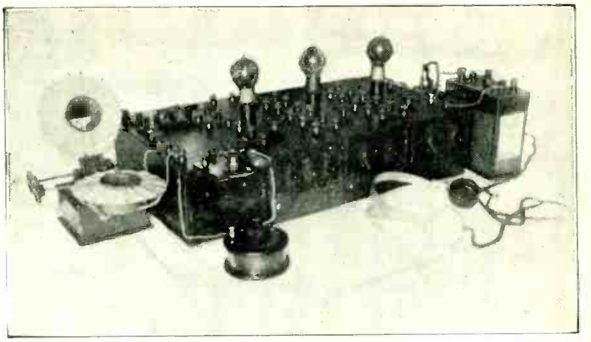
The following lines emanate from a poetical correspondent who endeavours to listen-in in the neighbourhood of a well-known arc station :—

We find them here,
We find them there,
We find the beggars everywhere
Are they in heaven ?
Are they in hell ?
Those *** harmonics of ***

Can anyone complete the last line ?

A Transatlantic Set.

Our illustration shows the home-made set of Mr. D. A. Broun, of Stockwell, with which he was successful, when in Birmingham, of receiving American signals during the Transatlantic tests last winter. The set comprises the usual detector, and two low frequency valves.



The home-made set of Mr. D. A. Broun, with which he was successful, when in Birmingham, in receiving American signals during the Transatlantic Tests.

Amateur Wireless Regulations in France.

According to the French press, the present tax of 10 fr. per annum levied on all amateur receiving apparatus in France will shortly be dispensed with. An agreement has been reached between the Ministries of the Interior, War, Finance, and Posts and Telegraphs, and new regulations are to be published, whereby owners will be exempted from the tax, although registration will still be compulsory. An exception will be made in the case of public establishments which profit by the use of wireless apparatus for attracting customers.

International Wireless Conference Next Year.

A Committee consisting of the Directors of the British, French and Italian Telegraphic Services was held at the London offices of the League of Nations on July 16th and 17th. At this meeting, members of the Committee declared themselves unanimously in favour of a universal conference, on the lines of a proposal put forward by the Italian Government, at which wireless telegraphy should be considered with a view to co-operation with the League of Nations.

Experimental Transmission 18 Years Ago.

Interesting details of amateur transmission in 1905 were given by Mr. E. Wilkinson, lecturing before the Honor Oak Park Radio Society on July 11th. Using an induction coil giving a 3-in. spark controlled by a telegraph key, and connected directly to the aerial, successful transmission was obtained for a few hundred yards, and this distance was increased to over two miles by the use of Tesla coils, with magnetic interrupter worked by a small motor, Leyden jar condensers and a 20-watt dynamo

FORTHCOMING EVENTS

THURSDAY, JULY 26th.

St. Pancras Radio Society. At 8.30 p.m. At the Working Men's College, Crowndale Road. Loud Speaker Demonstration.

Hackney and District Radio Society. At the Y.M.C.A., Mare Street. Lecture: "The Flewelling Circuit," by Mr. Bell.

Lewisham and Catford Radio Society. At 136, Bromley Road, Catford, S.E.6. Lecture: "How Aether Waves may be Detected," by Mr. H. M. Stanley.

Finchley and District Wireless Society. Last meeting of session. Lecture: "Wireless Receivers," by Mr. Puckle.

Liverpool Wireless Society. At 7.30 p.m. At the Royal Institution. Demonstration of New Type of Loud Speaker, by Messrs. S. G. Brown, Ltd.

FRIDAY, JULY 27th.

The Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove. Lecture by Mr. F. L. Hogg. (Last meeting of session.)

Radio Association of Brockley and District. At 8 p.m. At Gladstone Hall, New Cross Road. Lecture: "A Few Considerations of Aether, Electric and Material Phenomena," by Mr. G. A. Saunders.

MONDAY, JULY 30th.

Ipswich and District Radio Society. At 55, Fonnereau Road. Ordinary Meeting.

THURSDAY, AUGUST 2nd.

Hackney and District Radio Society. At the Y.M.C.A., Mare Street. Lecture: "Accumulators and Their Care," by Mr. Wall.

2 US.

We are informed by the Radio Society of Highgate that this Society's call-sign, **2 US**, is being illegally used. Several reports of the transmission of **2 US** have recently been made, and in view of the fact that the station has not been transmitting of late, these reports are rather significant. The Hon. Secretary, Mr. J. F. Stanley, B.Sc., 49, Cholmeley Park, Highgate, N.6, would welcome reports from anyone hearing this call-sign, as it may thereby be possible to discover the locality of the offender.

A Duolateral Basket Coil.

Apropos of our description of a duolateral basket coil, which appeared in the issue of this journal for June 23rd, we are informed by the Société Belge Radio Electrique, that this method of winding is covered by the English patent, Binard 167,767, of August 9th, 1921, of which the Company possesses the exclusive licence.

Wireless and Aviation.

The wireless stations at Manchester and Birmingham Aerodromes have been re-opened, states the summary of the Annual Report on Civil Aviation, issued by the Air Ministry. A new station has been erected at Bickendorf Aerodrome in Cologne, and the establishment in the near future of a service between Southampton and Havre or Cherbourg has necessitated the erection of a station at Guernsey.

Books and Catalogues Received.

Percival Marshall & Co. (66, Farringdon Street, E.C.1.):—

How to Make a Valve Receiving Set. By A. V. Ballhalchet, M.Inst.J.E. (42 pages. Price 6d. nett.)

Clock Repairing and Adjusting. By W. L. Randell. (68 pages. Price 9d. nett.)

Gear Wheels Simply Explained. By Alfred W. Marshall, M.I.Mech.E. (63 pages. Price 9d. nett.)

Screw Cutting Simply Explained. By George Gentry. (63 pages. Price 9d. nett.)

Admiralty Handbook of Wireless Telegraphy, 1920 (Revised). Price 7s. 10d. post free. Obtainable from H.M. Stationery Office, Imperial House, Kingsway W.C.2.

Radiotélégraphie et Radiotéléphonie à la portée de tous. By G. Malgorn. (Paris: Gauthier-Villars et Cie, 55, Quai des Grands-Augustins. 231 pages, 160 figures. Price 10 frs.)

Marconi's Wireless Telegraph Co., Ltd. (Marconi House, Strand, London, W.C.2.) "The English-Continental Wireless Telegraph Service." Describing arrangements at Radio House, Ongar and Brentford.

The Schools Radio Society.

A meeting in connection with the Schools Radio Society was held on Saturday, July 14th, at Hastings House, Norfolk Street. The Schools and teaching profession generally was represented by Messrs. A. Ritchie-Scott, D.Sc., F.R.S.E., W, Hannaford-Brown, M.A., W. Garside, B.Sc., and R. J. Hibberd, Member I.R.E. (Organising Secretary). There were also present, representing the Radio Society of Great Britain, Messrs. L. McMichael, L. Fogarty, A.M.I.E.E., R. E. H. Carpenter and H. S. Pocock.

Mr. Hibberd gave a detailed account of the progress made in the formation of the Society. He had already received ninety letters from schools asking for particulars of the Society and thirty letters from schools expressing wholehearted support of the scheme and their desire to join.

The meeting was unanimous in expressing the view that the results achieved justified the immediate formation of the Society, and it was agreed that the name of the Society should be "The Schools Radio Society."

The constitution of the Society was discussed, and various suggestions brought forward concerning which it is hoped to give a full account at an early date. All those interested in the Society should communicate with Mr. R. J. Hibberd, Grayswood Mount, Haslemere, Surrey.

BROADCASTING.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:—

GREAT BRITAIN.

LONDON 2 LO, 369 metres; **MANCHESTER, 2 ZY,** 385 metres; **BIRMINGHAM, 5 IT,** 420 metres; **CARDIFF, 5 WA,** 353 metres; **NEWCASTLE, 5 NO,** 400 metres; **GLASGOW, 5 SC,** 415 metres.; Regular morning and evening programmes, particulars of which appear in the daily press, are conducted from these stations by the British Broadcasting Company. The usual times of transmission are:—Weekdays, 11.30 a.m. to 12.30 p.m. (**2 LO** only), 3.30 to 4.30 p.m., 5.30 to 11 p.m. Sundays, 3 p.m. (**2 LO** only), 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), **FL,** 2,600 metres. Daily, 7.40 a.m., Meteorological Forecast; 12.15 p.m., Meteorological Report and Forecast; 3.30 p.m., Financial Bulletin (Paris Bourse); 6.10 p.m., Concert and Meteorological Forecast; 11.15 p.m., Meteorological Report and Forecast. Sundays, 6.10 p.m., Concert and Meteorological Report.

LEVALLOIS-PERRET (Radiola), SFR, 1,780 metres. Sundays 2 to 3 p.m., 9 to 10.30 p.m., Concert. Weekdays, 12.40 p.m. Concert; 5.5 p.m., Financial Bulletin; 5.15 to 6.15 p.m., Instrumental Music; 8.45 p.m., Miscellaneous News; 9 to 10 p.m., Concert. Thursdays, 9.45 to 10.30 p.m., Dance Music.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres, Tuesday and Thursday, 8.30 p.m., Concert. Saturday, 2.30 to 7.30 p.m., Concert.

LYONS, YN, 3,100 metres. Weekdays, 10.45 to 11.15 a.m., Gramophone records.

HOLLAND

THE HAGUE, PCGG, 1,050 metres. Sunday, 3 to 5 p.m Concert. Monday and Thursday, 8.40 to 9.40 p.m., Concert.

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

THE HAGUE (Velthuyzen), PCKK, 1,050 metres. Friday, 8.40 to 9.40 p.m., Miscellaneous.

IJMUIDEN, PCMM, 1,050 metres. Saturday, 8.40 to 9.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres. Wednesday, 8.10 to 9.10 p.m., Concert and News.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. Working days, 12 noon, Meteorological Bulletin. Daily, 4.50 p.m., Meteorological Bulletin Tuesday and Thursday, 9 p.m., Concert. Sunday, 6 p.m., Concert.

GERMANY.

BERLIN (Koenigswusterhausen), LP, Sunday, 2,700 metres, 11 a.m. to 12 noon, music and speech; 4,000 metres, 12 noon to 1 p.m., music and speech; Daily, 4,000 metres, 7 to 8 a.m., 12 to 1.30 p.m., 5 to 6.30 p.m., Financial and other news.

EBERSWALDE (2,930 metres), Daily, 1 to 2 p.m., 8 to 9 p.m. Tuesday and Saturday, 6.30 to 7.30 p.m., Concert.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres, 8 a.m., 12 noon and 4 p.m., Meteorological Bulletin and News. 4,500 metres, 10 a.m., 3 p.m. and 10 p.m., Concert.

SWITZERLAND.

GENEVA, HB 1, 900 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

LAUSANNE, HB 2, 1,350 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

*British Summer Time is given in each case.

EARLY MISTAKES DUE TO LACK OF APPRECIATION OF CAPACITY EFFECTS.*

By J. H. REEVES, M.B.E., M.A.

(*Continued from p.* 536, *July 21st*, 1923.)

I will now proceed to apply the lesson I have endeavoured to inculcate to the practical problems of our hobby, and I propose to begin with the aerial, and to proceed regularly through the whole of a reception unit.

The aerial and the aerial lead-in. Of course these must be well insulated, and in particular the material of which the insulation is composed at the free end should have the least possible dielectric losses. I have not tried a new type of glass insulator recently put forward, but Mr. Maurice Child has tested this for such losses with most satisfactory result. This, however, is not a capacity effect. One day a friend came to me in some trouble. He had bought a high-grade crystal set—stamped B.B.C.—but results were poor. We proceeded to investigate the source of trouble on the spot. The set was in a front room, the aerial was at the back. The lead was brought in at the back door, was very neatly run along the wall till it came to the doorway of the back room. It was run up along the top and down the frame of the door, then again along the floor till it reached the front room. I said, pointing to this, "There is your trouble." My friend was astounded, for he had run this with the very highest grade insulated wire he could get. Now just think out what occurred. Referring to Fig. 1, we have here the aerial with its insulated centre of metal. This wire is one plate of a condenser, the other being the floor and wall. Now the aerial is in effect the battery and reversing key of the experiment described earlier, and so there is continuous leakage from the lead to earth through the insulation.

At my suggestion he ran a proper leading-in tube through the woodwork at the top of the window of the back room, which was but little used. From this a wire went across the room just above the level of the picture rail, through an inconspicuous hole in the wall between the two rooms and ended in a well-insulated terminal fixed to the picture rail in the front room. The result was an immediate increase of signal strength that shortly after my friend was thinking of a two-valve note amplifier and a loud speaker.

The lecturer was asked how far from a wall the lead should be. He replied that in the case of a simple brick wall with no complications, 2 ft. may suffice, but if pipes, wires, steel girders, etc., are near the proposed line of the aerial, then 6 ft. is not too much. If there is a long earth lead it should be treated as carefully as the aerial lead.

Passing from the aerial lead we reach the A.T.I., and I have been many times asked to explain the exact function of the tuning condenser. To give the mathematical proof would be out of place, and yet I have never seen any other which is satisfactory. I think

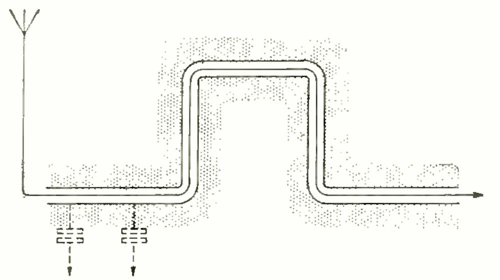


Fig. 1.

perhaps a help to understanding can be had from the analogy of tuning a string. Consider a stretched string such as that of a violin. If while the string is otherwise unaltered you put on to it a covering of thick varnish you would lower its note, and conversely if you rub it thinner you would raise the note. A condenser can be regarded as a loading applied to the inductance which can be easily adjusted. The analogy is far from perfect but may be useful. The mathematicians go further than giving us a formula which gives the wavelength in terms of inductance and capacity. They show that there is a damping due to capacity. Hence the general rule to use in tuning as much inductance and as little capacity as possible.

There is, however, a capacity effect which must be avoided. This arises directly out of the lesson learnt from the running of the

* Lecture delivered before The Radio Society of Great Britain to associate members on Friday evening, June 15th, 1923.

erial lead. Just as there is capacity between the lead and earth, so is there capacity between each turn of a coil and its neighbour. The total of all these is known as the self-capacity of a coil, and for similar reasons this must be made as small as possible. The worst possible type of tuning coil is the old slab inductance now happily passing into oblivion. Next in point of badness is the long cylindrical coil of enamel covered wire. Manufacturers vie with one another in producing coils of the basket and honeycomb type with a minimum of self-capacity. For short wave work, I prefer single layer cylindrical coils, with the turns not only double-cotton covered but spaced as well. A convenient method of winding is to put on two wires side by side and when finished remove one. Cardboard is a better mount than ebonite because of its smaller dielectric losses, and when winding such coils on ebonite I have marked a distinct advantage from putting over the ebonite several thicknesses of well dried paper. Provide tappings freely.

After the A.T.I. we come to the secondary. As regards coupled circuit working I will say no more than that in my opinion the gain is well worth the extra trouble and expense.

There is however a capacity snag to be avoided. In Fig. 2 we have three coils all wound in the same sense, which I have indicated as right-handed helixes, and the connections to A, E, Filament and Grid are as shown. In a preceding lecture dealing with electro-magnetic induction, Mr. Maurice Child showed that an increasing current in the A.T.I. passing in one direction, say, left to right,

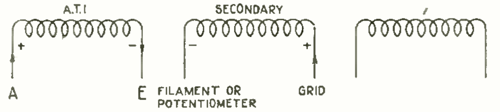


Fig. 2.

induces in the secondary, a current in the secondary growing from right to left. Under these circumstances a positive potential at the A connection causes the grid to be positive compared with the filament. Besides this magnetic coupling between the two coils, there is another known as electrostatic coupling, or capacity coupling, arising from the fact that the metallic parts of the two coils act in much the same way as do the insulated plates of a condenser. That is, the positive impulse from the aerial causes a positive charge on the A.T.I., and on this account also the grid is made positive. If, however the A and E connections are reversed, the magnetic coupling changes sign but the capacity coupling does not. Hence as shown connected, the two effects help one another, but if one set of connections is reversed the two act in opposition, with consequent loss of efficiency. Thus there is a right way and a wrong way of connecting up the four ends, and this is true even with honeycomb and basket coils. From the little said in the books I have read concerning this capacity coupling, I thought it quite unimportant, until I found that there are circumstances when it may be as large as the magnetic coupling and so the two may completely neutralise each other.*

We will now consider the action of the third coil, the reaction coil, which may be used for other than the broadcast waveband. It is usual when using a three coil arrangement for reception to fit a switch so that either the secondary or the A.T.I. can be joined to the detector. The connections to the reaction coil must be such that the magnetic field produced by it shall increase the current in the secondary; that is, the current induced in the secondary must under the circumstances run in the secondary from right to left. If now we switch over to single circuit working and leave the reaction coil coupling unaltered, the current its field induces in the A.T.I. opposes the incoming current, so that if increase of strength due to reaction is wanted there must be a reversing switch put in the reaction coil circuit. These considerations show at once a convenient method of getting the connections correct. We will presume this reversing switch has been provided, also one to give coupled or single circuit working. If using cylindrical coils, connect the secondary as shown in Fig. 2; if using honeycomb, my experience says it does not much matter whether the inside or outside is put to grid. Put the secondary to detector and alter the reaction switch till the valve oscillates; now reverse reaction, switch to single circuit and alter the A and E connections till again the valve oscillates. The magnetic and the capacity couplings of the A.T.I. and secondary are now in the same sense and maximum efficiency is obtained.

* This principle has been made use of as a method of eliminating interference. See *The Wireless World*, p. 346, June 17th, 1922, and p. 464, July 7th, 1923.

Passing on from the tuner we reach the panel. From what has been said it is clear that here capacity effects must be avoided and the only way to do this is to keep the wiring down to a minimum, have as few crossings as possible and keep all wires as far apart as possible. If there comes a choice between a nice-looking symmetrical appearance on the top of the panel with a complicated lot of wires behind, and an unsymmetrical panel with simple wiring choose the latter. A good plan is to set out the proposed arrangement on a piece of cheap fretwood and actually mount all the components on this before touching the ebonite. It costs less to spoil a piece of wood than a piece of ebonite.

Excluding the idea of starting with H.F. amplification, the first item on the panel is the grid condenser and its corresponding grid leak. The theory of why a grid condenser rectifies is a little complex and the only advantage of completely understanding this is to have the right idea as to sizes. Here the recommended range from 0·0002 to 0·0003 mfds. is right. If the bulk of reception is on short waves, use the smaller. The most important thing is to take the utmost pains to ensure the highest degree of insulation in the grid stem of the valve, and the ends of the condenser and leak which join this. I thoroughly endorse all that was said at the last of these meetings as to the poor quality of some of the valve sockets on sale. Just at that time I was much troubled with a set not nearly so efficient as it ought to have been. I pulled out the valve socket, substituted four pins put into a piece of first-class ebonite well rubbed down on both sides, drilled out the hole in the panel through which the grid leg passed and then soldered the grid condenser and leak terminals to this. The improvement was immediate and great.

In the normal single valve panel only one more condenser is usually found, viz., that across the telephones or the telephone transformer. We have seen that a big inductance such as that of the coils of the telephones acts as an almost complete block to high frequency currents which can pass freely through a condenser. Conversely a condenser is an almost complete block to low frequency currents. Hence by putting a condenser across the telephones we provide a by-pass for the H.F. current while taking nothing away from the audio-frequency currents which continue to pass through the 'phones where they are wanted. Of course, this condenser must not be too large and the text-book size of 0.002 mfds. is about right.

In audio-frequency amplification capacity effects are small, still they should be avoided as tending to produce howling. When we come to H.F. amplification no effort can be too great to cut out all stray capacity. Even the capacity of the valves, that between the four pins of the valves and of the plug-in type of H.F. transformer, and even that of the two pin connectors of the honeycomb coil mount are all appreciable. I have demonstrated to several friends the immediate effect of cutting out the zero capacity of a small billi condenser of under 0·0001 mfd. capacity. Absence of capacity not only increases efficiency, but has the desirable effect of extending in the lower limit the wavelength to which any given coil or transformer will tune. There are two low capacity valves of British manufacture and the use of one or other is highly desirable. Unfortunately the clips for each are different, hence once a panel is laid down for the use of either, one is limited solely to that type. Further, owing to the small demand these two types are little stocked. Still my experience shows that the advantages outweigh these disadvantages.

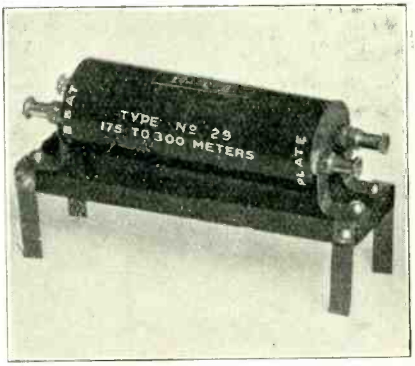


Fig. 3.

In the matter of mounting honeycomb coils one British firm has broken away from the convention of connecting the ends to two parallel pins and I have recently seen a H.F. transformer, an importation, which does not end in four parallel pins (Fig. 3). These are all steps in the right direction and I hope that as the detrimental effect of capacity in the wrong place is more and more realised, efforts of this sort will be extended.

In conclusion, I wish to thank Mr. Child for the loan of the apparatus which has been used.

The Annual Outing of the Radio Society of Great Britain.

As previously announced, the annual outing of the Radio Society of Great Britain took place on Wednesday, July 18th, when a visit was made to the laboratories of the General Electric Company at Wembley, and also to the Post Office station at Northolt.

The party met in Kingsway at 2.15 p.m. and proceeded by charabanc to Wembley, where they were welcomed by Mr. L. B. W. Jolley. The visitors were then sorted out into small parties and conducted through the laboratories. The extent to which their visit was appreciated was evidenced by the agitation of those who were responsible for keeping the excursion up to the time scheduled in the programme, for it was only with great difficulty that the party could be persuaded to come away something like an hour later than had been planned.

Probably the sections of the laboratories which attracted greatest attention were those where lamp and valve manufacture was in progress, and again where tests were being conducted and valve characteristics recorded. In the lamp development section there is a complete manufacturing plant for producing all types of lamps. Adjoining this section is the valve department, where amongst other matters of interest a large transmitting valve was seen in the process of being exhausted.

The electrical laboratory contained many subjects of interest. In particular, apparatus for the study of distortionless amplification at voice frequencies.

After the party had been entertained to an unexpected tea, a photograph, shown here, was taken just as the coaches were ready to move off *en route* for Northolt.

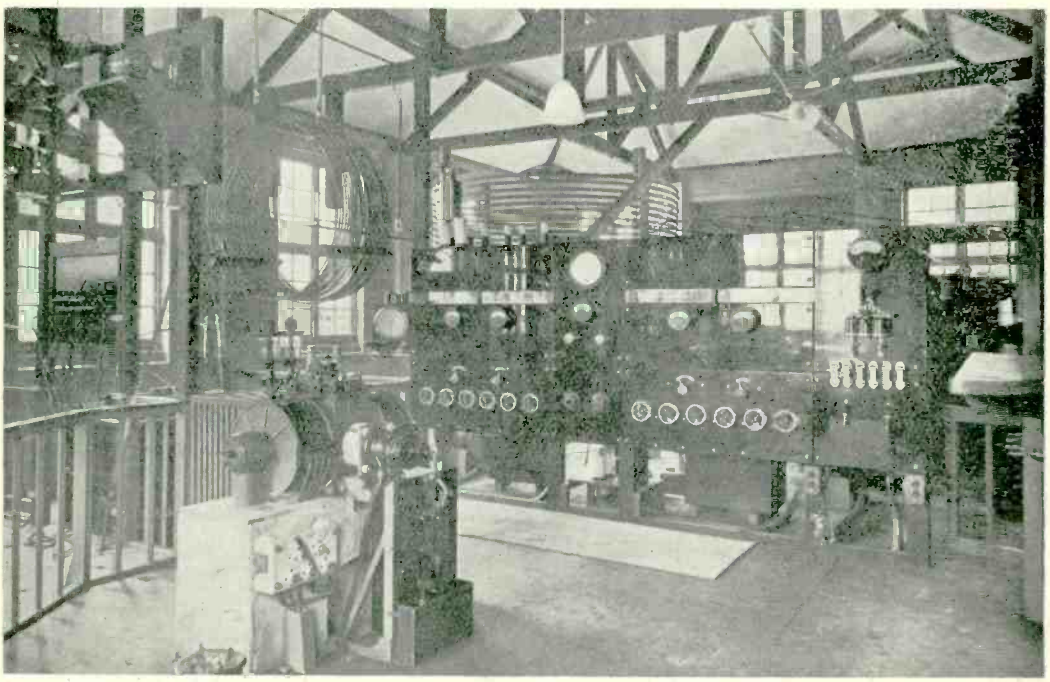
Arrived there, Mr. E. H. Shaughnessy, of the General Post Office, who was a member of the party, described the equipment of the station, photographs of which were obtained by kind permission of the Post Office. Special interest was taken in the high power valves of the Western Electric Company having water-cooled anodes, and also the silicon rectifying valves developed by the Mullard Radio Valve Company.

After a visit, made all the more interesting through being conducted personally by Mr. Shaughnessy, the party proceeded to tea at Harrow and from thence returned to Kingsway, arriving there shortly after 7.30 p.m.

The party totalled about 70, and it was easy to see that the excursion was thoroughly enjoyed by everyone. Those who took part are much indebted to the courtesy of both the Post Office and the General Electric Company for the part they played in making the excursion so successful.

Outside the entrance to the laboratories of the General Electric Company just before leaving for Northolt.

Interior of Northolt Station, showing the arcs, and, on the right, the lead-in.



Another view showing the valve panel and, behind, the tuning inductance.

New Instruments.

A new design of intervalve transformer has recently made its appearance on the market, and

New Transformer by the Formo Co.

Variable Grid Leak.

it is novel inasmuch as the entire coil and windings are enclosed in a cast metal box for the purpose of screening and preventing interaction between adjacent transformers.

Another instrument of interest is a simple and cheap form of variometer. It is built up in a manner which will permit of it being used attached to a base-board or to a panel by means of the bush which is provided on the spindle.

Readers will remember that a few weeks ago details were given of a variable grid leak in which

The "Formo" Variometer.

plunger was arranged to slide into the end of the tube containing the material of which the high resistance is composed. An instrument built on these lines is now available on the market, and can easily be substituted for an existing one of fixed value, considerable advantage being gained by the adoption of a leak resistance which may be varied.

QUESTIONS AND ANSWERS

"A.S.C." (Faversham) *asks* (1) *If a satisfactory telephone transformer could be made by utilising an iron core ½ in. in diameter and 2½ in. long, the primary winding being* 3 *ozs. of No.* 44 *enamelled wire, and the secondary winding* 6 *ozs. of No.* 32 *S.S.C. wire.* (2) *For the approximate area of the overlap of tinfoil required in two variable condensers constructed in accordance with the diagram given on page* 12 *of the issue of April 7th,* 1923, *the capacities required being* 0.0005 *mfd. and* 0.001 *mfd.* (3) *For particulars of a set of basket coils to tune from* 150 *to* 12,000 *metres with a* 0.0005 *mfd. variable condenser in parallel.* (4) *When should a grid leak be included in a valve circuit.*

(1) Yes. (2) We refer you to the article dealing with condensers in the issue of June 9th. (3) You

should wind a number of coils, two or three with 50 turns of No. 26 D.C.C. and others with 80 and 120 turns each. The formers should be 1½ in. in diameter, with 15 spokes. (4) A grid leak is connected to the grid of a valve when a stopping condenser is used. If no grid leak is connected, the stopping condenser may become charged, and the valve would not function properly. A grid leak is connected to allow the charge to leak away at a suitable rate.

"A.B.C." (Bradford) *submits a diagram of a three-valve set, and asks (1) With reference to the circuit given in reply to* **"D.T." (S.E.22)** *on page 128 of the issue of April 28th, if we advise the adoption of this circuit in preference to the one submitted. (2) What gauge of wire and how many turns are required for a set of honeycomb plug-in coils to tune from 300 to 500 metres, using a former 2 in. in diameter. (3) What should be the width of the former, and the number of pins.*

(1) The circuit given in reply to **"D.T." (S.E.22)**, would be preferable to the one submitted. (2 and 3) Use No. 26 D.C.C. wire, and wind coils on a former 2 in. in diameter, 1 in. in width, and having 30 pins on each face with the following number of turns: Aerial 75 and 35 turns; Secondary, 50 and 75 turns; Reaction, 100 and 75 turns; Anode, 75 and 100 turns.

"H.J.N.W." (Birmingham) *asks for particulars which will enable him to construct a tapped high frequency transformer for use on wavelengths from 150 to 30,000 metres.*

We would refer you to the reply given to **"M.A.H." (Stoke Newington)**, in the issue of March 24th, 1923.

"G.J." (5 SC), *asks (1) For particulars to enable him to construct two telephone earpieces of 2,000 ohms resistance each. (2) If a buzzer wavemeter is necessary for the operation of a crystal set. (3) If a coil, particulars of which he gives, might be used with the set described in the issue of April 7th. 1923.*

(1) Purchase 2 ozs. of No. 47 S.S.C. wire, and four standard bobbins, with cores in position. Two bobbins will be required for each earpiece, and each bobbin will require approximately 900 ft. of wire. Care must be taken in the proper insulation of the wire from the core, and in the insulation between successive layers. The diaphragms should be of standard pattern and should be purchased. (2) A buzzer wavemeter is recommended for use with a crystal set. (3) The coil is suitable.

"F.R.S." (Bletchley) *submits a sketch of a three-valve L.F. amplifier. He is troubled with L.F. oscillation, when the third L.F. valve is switched into circuit, and asks what is the remedy.*

Try reversing the connections to the transformer terminals; joining a 0.001 μF condenser across the primary windings, connecting the cores to earth or positive H.T.; connecting —L.T. with earth and connecting a 100,000 ohm resistance across the secondary windings. The transformers should not be placed too close together, and they should be arranged so that the coils are at right-angles.

"QUERIES" (Surrey) *asks the following questions with reference to the circuit given in Fig. 9, page 41, of the issue of April 14th. (1) How to determine whether the crystal is operating in the proper manner. (2) How a potentiometer might be added to this circuit, and what alteration in the wiring would be involved. (3) How a H.F. valve might be added to this circuit.*

(1) If removing the cat whisker from a crystal does not cut out the signal, the receiver is not working properly. The connections to the crystal should be reversed. The anode voltage of the valve and the filament temperature should be adjusted to prevent the valve operating as a rectifier. (2) The method of using a potentiometer in a crystal circuit has been given in many recent issues of this journal. In particular, we would refer you to Fig. 3, page 654, of the issue of February 10th, 1923. (3) The method of adding a H.F. valve to this circuit is illustrated in Fig. 1.

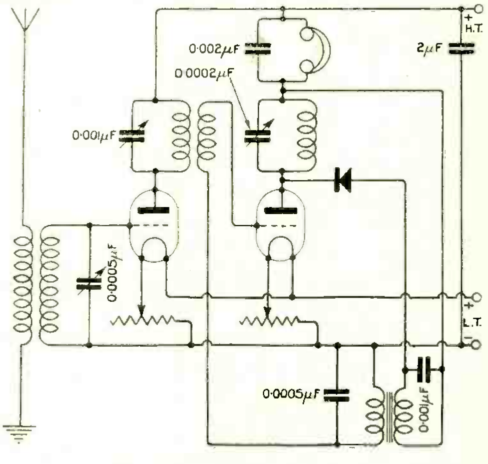


Fig. 1. **"Queries" (Surrey).** *Receiver with two stages of H.F., crystal rectifier, the second valve also operating as a note magnifier.*

"T.A.T." (Acton, W.3) *asks, with reference to Figs. 1 and 2 on pages 879 and 880 of the issue of March 31st, should the crystal be subjected to the full potential of the H.T. battery.*

The diagrams are correct. It is advisable, however, when using the crystal alone, to adjust the H.T. battery so that a small voltage only is applied to the circuit.

"REGULAR READER" (Handsworth) *asks (1) With reference to Fig. 2, page 814, March 17th issue, how the return lead from the telephones to the secondary coil is made when the crystal alone is used. (2) For brief information on calibration waves. (3) If there is any disadvantage in using a mica dielectric variable condenser in place of an air dielectric condenser. (4) Which type of tuner gives best selectivity.*

(1) The circuit is completed through the H.T. battery to the secondary coil. You should remove the positive plug from the H.T.

battery and tap off from a low voltage of this battery, when using the crystal alone. This will prevent the proper action of the crystal from being upset by the high potential. (2) We suggest you listen for the transmissions of stations over as wide a wavelength range as possible. In conjunction with a list of call signs, no difficulty should then be experienced in making a complete calibration. (3) The condenser will probably be satisfactory, although it might be better to use a good air dielectric condenser in a wavemeter. (4) To obtain best selectivity, only part of the secondary coil should be coupled with the aerial coil. Use a coil of about 10 turns for coupling, and place the secondary coil proper so that its coupling with the aerial circuit is nil.

"CURIOUS" (Hounslow) *asks* (1) *The cause of noises.* (2) *For a method of utilising the house electric lighting supply, particulars of which he gives, for charging accumulators.* (3) *If any advantage is likely to arise from the fact that the connections to the valve socket legs are attached by nuts, and not soldered.* (4) *For a method of marking the positions of valve legs for drilling in ebonite.*

(1) Probably the grid leak is faulty. Examine the receiver for loose connections, and make sure that H.T. battery is in good condition. (2) It will be necessary to put several lamps of the voltage suited to your supply in series in the charging circuit. By including an ammeter in the circuit, the number of lamps may be modified until the current flowing corresponds to the charging rate of the accumulator. (3) Provided that the connections to the socket legs are made firm, there is no disadvantage in not soldering them. There should be no difficulty in soldering these connections, however, if a small soldering iron is used, and this form of connection is to be preferred. (4) The dimensions for the spacing of valve legs will be found in the issue of this journal of June 2nd.

"E.G.J." (Catford, S.E.6) *submits a circuit diagram of a four-valve receiver, three H.F. resistance capacity coupled valves and detector. He asks* (1) *If the diagram is correct, and if the values indicated for the various components are suitable.* (2) *For a diagram showing how to connect a reaction coil.*

(1) The circuit diagram is correct, but several of the values of the components are not the most suitable. Usual values are indicated on the diagram in reply to question (2). (2) A suitable method of including a reaction coil in the circuit submitted is given in Fig. 2.

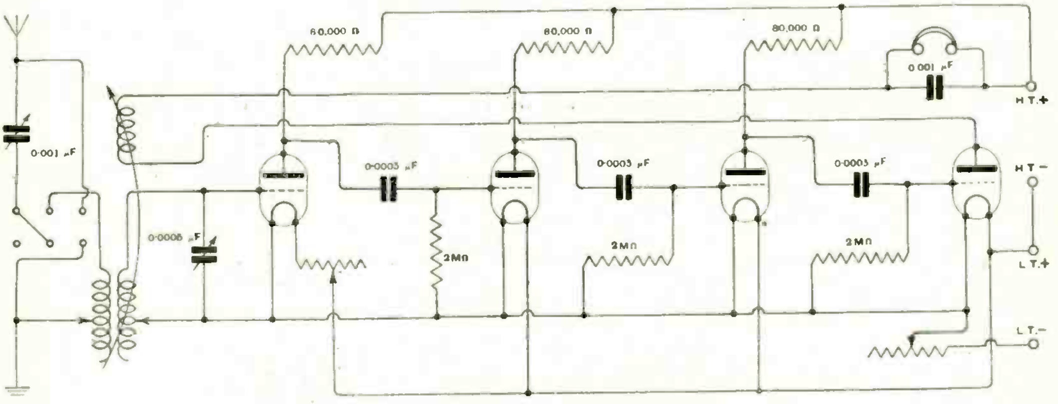


Fig. 2. **"E.G.J." (Catford, S.E.6).** *Three H.F. resistance-coupled valves with valve rectifier and reaction.*

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* **The Wireless World and Radio Review, 12/13.** *Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*

REGULAR TRANSMISSIONS

OF METEOROLOGICAL AND OTHER EUROPEAN WIRELESS TELEGRAPHY AND TELEPHONY STATIONS.

Great strides are at present being made in the broadcasting of Time signals, Meteorological information and Navigational warnings, chiefly for the benefit of Mariners and Airmen. During the course of the year it is anticipated that a great many corrections and additions will be necessary to the Supplement of Regular Transmissions published in *The Wireless World and Radio Review* of June 16th last.

This list is undoubtedly of great value to the experimenter, and it is proposed, therefore, to issue at frequent intervals a list of corrections and additions.

It might be as well to remind readers that all times are given in Greenwich Mean Time, and that during the summer months the necessary correction for Summer Time (*i.e.*, an advance of one hour) must be made.

AMENDMENTS TO LIST OF JUNE 16th, 1923.

Time.	Station.	Correction.
0150	Bucharest-Herestrau.	Amend wavelength to 8,150 metres, C.W.
0150	Toulon-Porquerolles.	Amend time to 0145.
0215	Warsaw.. ..	Amend time to 0210.
0255	Washington ..	Amend wavelength to 2,650 metres, spark.
0300	Ain-el-Turk ..	Transmission discontinued.
0315	Sidi Abdallah ..	Transmission discontinued.
0336	Air Ministry ..	Transmission discontinued.
0458	Massawa-Eritria	Alter time to 0452 and wavelength to 2,650 metres, spark.
0550	Le Bourget ..	Transmission discontinued.
0705	Renfrew.. ..	Remove from list.
0715	Borkum.. ..	Alter call sign to **KBM.**
0720	Wilhelmshaven..	Alter call sign to **KAN.**
0730	Malta	Remove from list.
0740	Karlsborg ..	Transmission discontinued.
0740	Reval-Tallin ..	Transmission discontinued.
0805	Reval	Amend wavelength to 1,900 metres, spark.
0815	Warsaw.. ..	Amend time to 0810.
0820	Deutsch Altenburg (Vienna).	Amend call sign to **OHL.**
0845	Casablanca ..	Transmission discontinued.
0845	Mediouna ..	Transmission discontinued.
0845	Bucharest-Herestrau.	Amend wavelength to 8,150 metres, C.W.
0900	Ain-el-Turk ..	Amend time to 0905 and wavelength to 3,300 metres, C.W.
0910	New Holland (Petrograd).	Remove from list.
0915	Toulon-Porquerolles	Synoptic report is in code.
0930	Rome	Alter name of station to Coltano and wavelength to 10,750 metres, C.W.
0955	Balboa (Panama)	Amend wavelength to 7,000 metres, C.W.
1100	Borkum.. ..	Amend call sign to **KBM.**
1100	Brussels.. ..	Amend name of station; insert call sign **OPO,** system telephony.
1155	Nauen	Amend wavelengths to 3,100 spark, and 13,000 C.W.
1200	Lausanne ..	Insert call sign **HB2;** amend wavelength to 1,110 metres.
1305	Renfrew.. ..	Remove from list.
1315	Borkum.. ..	Alter call sign to **KBM.**
1320	Wilhelmshaven..	Alter call sign to **KAN.**
1340	Karlsborg ..	Transmission discontinued.
1350	Bucharest-Herestrau.	Amend wavelength to 8,150 metres, C.W.
1415	Warsaw.. ..	Amend time to 1410.
1430	Mediouna ..	Transmission discontinued.
1435	Monsanto ..	Transmission discontinued.
1445	Ain-el-Turk ..	Transmission discontinued.
1510	New Holland (Petrograd).	Transmission discontinued.
1515	Casablanca ..	Transmission discontinued.
1520	Deutsch-Altenburg (Vienna).	Amend call sign to **OHL.**
1520	Sidi Abdallah ..	Transmission discontinued.
1550	Brussels.. ..	Amend name of station; insert call sign **OPO,** system telephony.
1605	Renfrew.. ..	Remove from list.
1655	Washington ..	Amend wavelength to 2,650 metres, spark.
1750	Lausanne ..	Remove from list.
1755	Balboa (Panama)	Amend wavelength to 7,000 metres, C.W.
1815	Borkum.. ..	Amend call sign to **KBM.**
1820	Wilhelmshaven..	Amend call sign to **KAN.**
1840	Karlsborg ..	Transmission discontinued.
1840	Gibraltar ..	Amend wavelength to 4,000 metres, C.W.
1850	Bucharest-Herestrau	Amend wavelength to 8,150 metres, C.W.
1850	Malta	Remove from list.
1900	New Holland (Petrograd).	Amend wavelength to 1,500 metres, spark.
1945	Mediouna ..	Transmission discontinued.
1955	Sandhamn ..	Insert wavelength 5,700 metres, C.W.
2000	Ain-el-Turk ..	Transmission discontinued.
2000	Bordeaux ..	Amend wavelength to 18,940 metres, C.W.
2020	Sidi Abdallah ..	Transmission discontinued.
2030	Toulon-Porquerolles.	Synoptic report is in code.
2045	Rome (**IDO**) ..	Temporarily closed, July 1923.
2050	Reval	Amend wavelength to 1,900 metres, spark.
2155	Moscow.. ..	Amend call sign to **RAI.**
2210	Moscow.. ..	Transmission discontinued.
2355	Nauen	Amend wavelength to 3,100 spark, and 13,000 C.W.

ADDITIONS.

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
0000	Nauen	POZ	4,700	C.W. ..	Navigation warnings in German, French and English.
0000	Leafield	GBL	8,750	C.W. ..	Foreign Office News Message.
0000	Cadiz	EAC	2,540	Spark ..	Press Message.
0030	Coltano	ICC	10,750	C.W. ..	Working with Halifax (Canada).
0044	Devizes	GKU	2,100	C.W. ..	Calibration signal.
0105	Cherbourg	FUC	3,300	C.W. ..	Weather bulletin.
0115	Lorient	FUN	2,800	C.W. ..	Meteorological report.
0120	Sidi Abdallah	FUA	5,150	C.W. ..	Tunisian synoptic report.
0125	Brest	FUE	2,800	C.W. ..	Meteorological report.
0135	Rochefort	FUR	3,300	C.W. ..	Meteorological report.
0140	Ain el Turk	FUK	3,300	C.W. ..	North African synoptic report.
0150	List	KAL	1,250	Spark ..	Weather bulletin in plain language (German).
0150	Leafield	GBL	8,750	C.W. ..	News.
0200	New York	WSE	2,800	C.W. ..	Press message.
0200	Mediouna	CNM	5,000	C.W. ..	North African synoptic report.
0255	Kavite (Philippine I.) ..	NPO	5,200	C.W. ..	Time signals.
0300	Borkum	KBM	600	Spark ..	Navigation warning.
0300	Arlington (U.S.A.) ..	NAA	2,650	Spark ..	Weather bulletin.
0300	Key West	NAR	5,700	C.W. ..	United States weather report and forecast.
0300	Louisburg (Nova Scotia)..	VAS	2,800	C.W. ..	News.
0330	Salonica	SXC	7,000	C.W. ..	Weather bulletin.
0330	Arlington (U.S.A.) ..	NAA	2,650	Spark ..	Weather bulletin.
0330	Port Patrick	GPK	600	Spark ..	Navigation warning.
0430	Paris	FL	8,000	C.W. ..	News (in French).
0444	Devizes	GKU	2,100	C.W. ..	Calibration signal.
0500	List	KAL	1,250	Spark ..	Weather bulletin in plain language (German).
0530	Le Bourget	FNB	1,400	C.W. ..	Repetition of 0100 observations.
0600	Rome, S. Paolo	IDO	11,000	C.W. ..	News in Italian. Station temporarily closed, July 1923.
0600	Sevastopol	RCT	2,500	Spark ..	Weather bulletin.
0600	Moscow	MSK	5,100	Spark ..	Press message.
0630	Le Bourget	FNB	1,400	C.W. ..	Special aviation bulletin.
0630	Cairo	BVT	1,800	C.W. ..	Synoptic message.
0630	Rome, Centocello ..	ICD	2,250	Spark ..	Press message.
0700	Nicolaev	RAK	4,000	Spark ..	Press message.
0700	Coltano	ICC	10,750	C.W. ..	Working with Mogadiscio (Somaliland).
0700	Borkum	KBM	600	Spark ..	Navigation warning.
0700	Lausanne	HB2	1,100	C.W. ..	Aviation weather bulletin.
0700	Munich	MÜ	1,825	C.W. ..	Weather bulletin.
0705	Cranwell	GFC	1,300	C.W. ..	Synoptic reports transmitted in succession by the stations named.
0705	Leuchars	GFD	1,300	C.W. ..	
0705	Grain	GFG	1,300	C.W. ..	
0705	Calshot	GFL	1,300	C.W. ..	
0705	Plymouth	GFM	1,300	C.W. ..	
0705	Shotwick	GFO	1,300	C.W. ..	
0705	Renfrew	GER	1,300	C.W. ..	
0705	Borkum Riff Lightvessel..	KBR	600	Spark ..	Synoptic report.
0705	Amrum Bank Lightvessel	KAF	300	Spark ..	Weather bulletin in plain language (German).
0710	Freidrichsort	KBK	820	Spark ..	Synoptic report.
0715	Lorient	FUN	2,800	C.W. ..	Meteorological report.

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
0720	Friedrichshafen	FD	1,300	C.W.	Weather bulletin
0725	Brest	FUE	2,800	C.W.	Meteorological report.
0730	Salonica	SXC	7,000	C.W.	Weather report.
0730	Adlergrund Lightvessel	KAG	300	Spark	Weather report in plain language (German).
0730	Pillau	KAP	600	Spark	Synoptic message.
0730	Frankfort-on-Main	FR	1,875	C.W.	Weather bulletin.
0735	Danzig	DG	1,950	—	Weather bulletin.
0735	Rochefort	FUR	3,300	C.W.	Meteorological report.
0740	Malta	GHA	4,800	C.W.	Synoptic report.
0745	Berlin	DL	2,000	C.W.	Weather bulletin.
0755	Breslau	BU	1,550	C.W.	Weather bulletin.
0800	Bar Harbour (U.S.A.)	NBD	2,750	Spark	Press message.
0800	Constantinople	IQK	3,000	C.W.	Weather bulletin.
0800	Naples	ICN	3,800	C.W.	Southern Italy weather report.
0800	Rome, S. Paolo	IDO	11,000	C.W.	Press message in French. Station temporarily closed, July 1923.
0800	Mediouna	CNM	5,000	C.W.	Moroccan synoptic report.
0805	Konigsberg	KÖ	2,600	C.W.	Synoptic report.
0810	Florence	G'IF	900	—	Northern Italy weather report.
0830	Constantinople, Osmanie	OSM	7,500	C.W.	Weather report.
0830	Coltano	ICC	10,750	C.W.	Naval traffic.
0830	Lyons	YN	15,100	C.W.	Press message in French.
0844	Devizes	GKU	2,100	C.W.	Calibration signal.
0850	Beirout	UAB	6,100	C.W.	Syrian synoptic report.
0855	Annapolis (U.S.A.)	NSS	17,145	C.W.	Special time signal on full power (until October 15th, 1923).
0900	Malin Head	GMH	600	Spark	Weather forecast and report.
0900	Coltano	ICC	10,750	C.W.	Press in Italian.
0905	Paris	FL	6,500	C.W.	News bulletin in German.
0905	New Holland (Petrograd)	RAC	1,600	Spark	European weather report.
0918	Land's End	GLD	600	Spark	Weather forecast and report.
0930	Sandhamn	OJA	6,200	C.W.	Press message in English.
0945	Rome, S. Paolo	IDO	11,000	C.W.	News in Italian. Station temporarily closed, July 1923.
0945	Monsanto	CTV	600	Spark	Portuguese synoptic report.
0945	Casa Blanca	CNP	1,800	Spark	Moroccan weather report.
0945	Bucharest	BUC	7,400	C.W.	Press message in French.
0945	Mediouna	CNM	1,500	Spark	Weather bulletin.
0950	Munich	MÜ	1,825	C.W.	Weather bulletin.
0950	Le Bourget	FNB	1,400	C.W.	Aerial route forecast.
1000	San Diego (California)	NPL	9,800	C.W.	Press message.
1005	Plymouth	GFM	1,300	C.W.	Synoptic reports transmitted in succession by the stations named.
1005	Calshot	GFL	1,300	C.W.	
1005	Shotwick	GFO	1,300	C.W.	
1005	Renfrew	GER	1,300	C.W.	
1010	Friedrichsort	KBK	820	Spark	Synoptic report.
1010	Warsaw	WAR	2,100	Spark	Press message.
1015	Norddeich	KAV	1,800	Telephony	Synoptic report and forecast for North Sea.
1015	Amrumbank Lightvessel	KAF	300	Spark	Weather bulletin in plain language.
1015	Lorient	FUN	2,800	C.W.	Meteorological report.
1025	Brest	FUE	2,800	C.W.	Meteorological report.
1030	Swinemünde	KAW	1,800	Telephony	Weather forecast for Western and Middle Baltic.
1030	Coltano	ICC	10,750	C.W.	Working with Halifax (Canada.)
1030	Adlergrund Lightvessel	KAG	300	Spark	Weather bulletin in German.
1040	Christiania	LCH	5,400	C.W.	News.
1040	List	KAL	1,250	Spark	Weather bulletin in plain language (German).
1045	Athens	SXA	600	Spark	Eastern Mediterranean weather report.

(To be continued).