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QUESTIONS AND ANSWERS DEPARTMENT: Under the Supervision of W. JAMES.

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POLITICS IN WIRELESS.

THE AMATEUR'S POSITION: A WORD OF WARNING.

THE purpose of this editorial is to point out that in our opinion the amateur should at this time take a very careful survey of the future, and see in what direction events are leading him.

We doubt if any genuine amateur can look back a few years without experiencing a feeling of honest regret at some of the changes which have taken place.

Formerly, the amateur devoted his whole attention to the furtherance and development of wireless, and when there arose the necessity for joint action on the part of amateurs in connection with any threatened encroachment on their rights, all were ready as one body to give the strength which unity alone can give to the voicing of their wishes, with never a thought of allowing private or personal interests to intervene.

Rivalry in enterprise is essential to progress, and healthy rivalry has contributed largely to the developments made in the science of wireless; this is just as it should be. Every amateur should compete with other amateurs on the technical side, but is there not at the present time far too much petty rivalry in what may be described as the politics of wireless?

Instead of each amateur or group of amateurs having at heart, first of all, the welfare of the amateurs as a whole, we find on every side politics in wireless which lead to petty jealousy between individuals and between one amateur society and another. Criticism is resorted to far more readily than a helping hand, with the result that amateurs are drifting further and further apart instead of strengthening the bonds of unity.

If it is our honest desire to help to strengthen the amateur's position, then it is clearly our duty to put our shoulders to the wheel and help instead of standing passively aside to criticise others, who, though we need not wholeheartedly endorse their every action, are nevertheless honestly endeavouring each one "to do his bit."

There is a lesson we may learn from the late war. The outbreak of war found this country divided into political parties, no one of which was alone strong enough for the arduous task which had to be performed. What happened has now become history. Party politics were forgotten, and petty differences of opinion were sunk in the interest of forming a strong government united in effort to meet the emergency. Nobody suggested that every step taken and every action of the Government could meet with universal approval; the one thought which was uppermost was to "get on with the war," and bring it to a victorious conclusion.

The amateur's war has not yet begun, but that it may commence at any moment and that it will be a fight for his very existence should be apparent to anyone who is watching closely events which concern the official position of amateur experimenters. We are not yet clear as to what may be the recommendations resulting from the Broadcast Enquiry, nor should it be overlooked how vitally the pending revisions to the Wireless Telegraphy Act of 1904 may affect our activities.

When an effort is made to emphasise a point, particularly in editorials, there is often a tendency to indulge in exaggeration in order that the views may be more forcibly expressed. In this instance, however, we feel convinced that no element of exaggeration as to the seriousness of the situation has been introduced. To describe the situation as "serious" is in fact a mild expression.

If we are to be in a position to assert ourselves and to maintain our freedom it can only be done by presenting a united front, so that our demands shall be made with one voice, expressing the wishes of every amateur throughout the country. Such unity in no way interferes with the freedom of the individual nor of separate groups of individuals. It is essential that each society should be independent as regards its own domestic affairs, but where united effort is called for, every individual and every party must give its support to strengthen the position of the amateur community as a whole.

H. S. P.

COMBINED HIGH AND LOW FREQUENCY AMPLIFIER

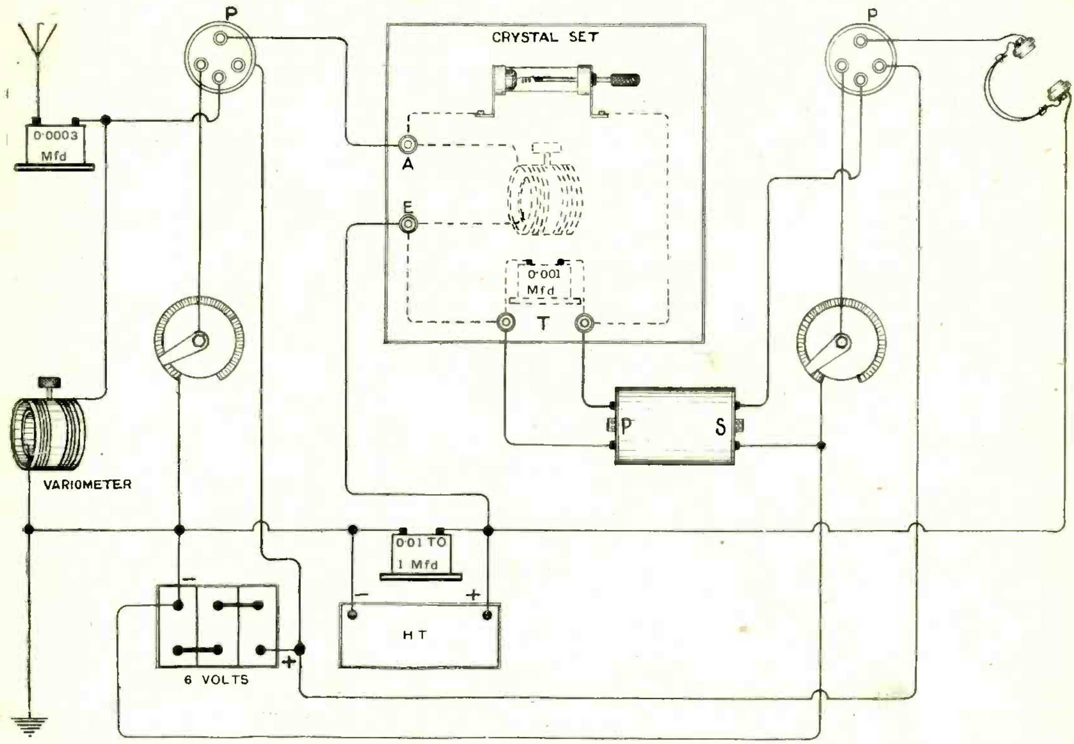
FOR ADDING TO A CRYSTAL RECEIVER.

This instrument has been specially designed to meet the requirements of the listener-in who has become accustomed to the operation of the crystal receiver and is desirous of experimenting with valve apparatus. The design given is so arranged that it does not become necessary to scrap the crystal set, which is made use of in its entirety.

By F. H. Haynes.

When the need is felt for an amplifier to be added to a crystal receiver one is sometimes in doubt as to whether to adopt high or low frequency amplification. In considering the merits already audible, that a combination of both high and low frequency amplification is necessary to give good reception under varying circumstances.

The crystal detector is well known to give better results than a detector valve,

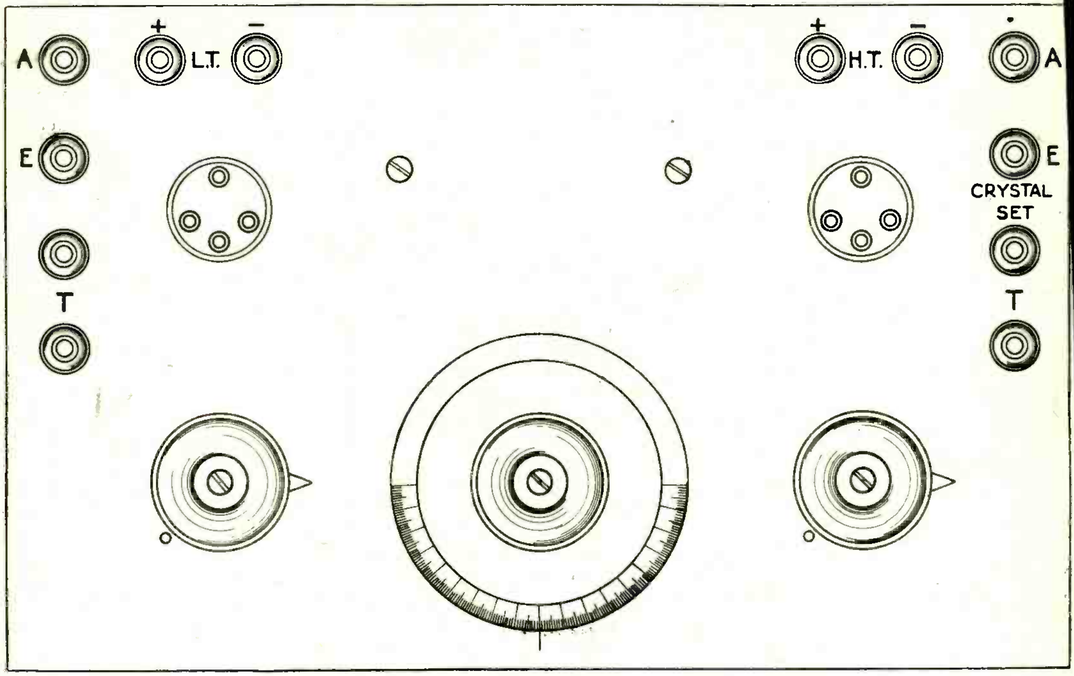


The principle of the circuit employed can be followed from this diagram. The aerial tuning induct[illegible] the crystal receiver is used as the tuned anode coil. If it is not desired to go to the trouble of incorporating the components into a complete instrument they may be set out as shown and secured to a base board.

of each system it is obvious that while high frequency amplification will extend the range of reception and low frequency will only render somewhat stronger, signals whilst the tendency of the high frequency amplifier to be introduced, to self-oscillate, compensates for the absence of any direct reaction coupling. Thus, the arrangement under description is equal to any three-valve receiver, whilst no alteration is necessary to the tuning circuit of the crystal set.

The principle of the instrument embodies the introduction of a tuned aerial circuit comprising fixed condenser and variometer. A valve is arranged as a high frequency amplifier connected on the tuned anode principle, and makes use of the variometer, or tapped or sliding contact inductance, of the crystal set. The crystal still functions as the rectifier followed by a note magnifier connected up through a low frequency transformer. No attempt is made to feed back for the purpose of producing dual amplification as it is well known that there is no arrangement capable of easy manipulation in which improvement is obtained in signal strength on wavelengths below 400 metres.

An ebonite panel 5/16 ins. in thickness is employed to carry the component apparatus and measures $11\frac{1}{2}$ ins. by $7\frac{1}{4}$ ins. A variometer for aerial tuning is arranged in the centre lower half of the panel, and on either side are the variable filament resistances. Between the valve holders, which are above the resistances, is an intervalve transformer. The latter must be of th highest grade procurable, and it shoul be ascertained when purchasing that it windings consist of no less than 30,000 turns A high step-up ratio is not required, particu larly when the primary is connected in serie with the crystal detector, as in the presen case, and transformers can be procured hav ing a turns ratio of about two to one. Th method adopted for attaching the com ponents to the panel is not dealt with as their dimensions, and thus the location of holes, varies according to the types procured. It is quite easy for anyone possessing a hand brace, an assortment of twist drills, and a few taps to effectively mount the components on the panel. In addition to the parts already mentioned two condensers will be required, one having a value of between 0·01 and 1 microfarad and another of 0·0003 microfarads and also twelve terminals. In selecting the latter it is advisable to have those of medium size. Small terminals not only look unsightly on a large panel, but are not convenient for making connections.

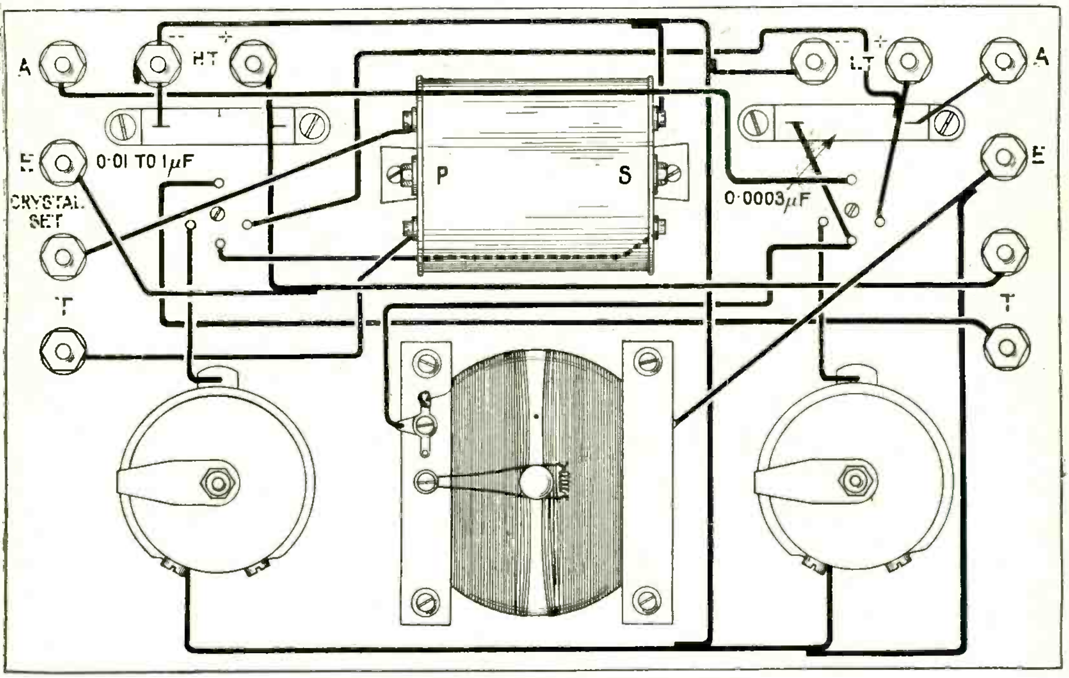


Scale drawing of the face of the panel.

Wiring up may be carried out either with No. 20 S.W.G. copper wire (tinned if preferred) and insulating tubing, or with No. 16 or 18 S.W.G. bare wire. The diagram of the under side of the panel only indicates the points between which leads are to be run, and the approximate route they should take, depending of course on the space occupied by the components. If bare No. 16 wire is used, as is an excellent arrangement, careful consideration must be given to the right-angle bends necessary to give good spacing to the wires as they cross over one another. It is better to solder to the terminals (not, of course, the transformer terminals) than to hold the wires under the nuts. Remember that a good hot clean iron is the secret of successful soldering. Do not keep the iron too long in contact with the parts to be soldered or they will get over-heated and burn the panel. If the solder will not run, the iron is either dirty or not hot enough. As each lead is put in, run a pencil line on that lead in the diagram. Suitable box work can be constructed to house the apparatus on the under side of the panel. A fillet along the front and back edges of the inside can be arranged to support the panel just a little raised above the top of the box.

Before connecting up it is necessary to verify the circuit to which the crystal receiver is wired. In a few cases a small fixed condenser will be found connected between the aerial terminal and the inductance, in which case it must be short-circuited. The crystal and telephone terminals of the crystal set should be connected as shown in the diagram, and if the telephone terminals are not bridged with a small fixed condenser, one having a value of 0·001 microfarad must be connected across the "T" terminals (crystal set) of the amplifier.

The operation of the amplifier in combination with the crystal receiver is quite simple in view of the fact that there are only two tuning adjustments to be made. These must be varied more or less simultaneously, and a few hours spent in adjusting the outfit will readily reveal the necessary settings for producing really good reception.



Under side view of panel showing the wiring.

Readers are reminded that should difficulty be experienced in the setting up of this useful instrument, that the "Questions and Answers" department of this journal is at their service.

WIRELESS TELEPHONY.

A Choke Control Transmitter for Experimenters.

By W. James.

(*Concluded from page* 546, *July*, 28*th*, 1923.

7.—Meissner Circuit.

THE oscillator circuit of Fig. 1 is extensively used, but many advantages are to be gained through the use of the Meissner circuit of Fig. 2. Here the aerial circuit contains tap. The amount of power transferred fro the anode circuit is controlled by the couplin between coils L and L_4. As before, it is nc always necessary to include the tunin condenser C_2 in the grid circuit, but it i certainly a convenience for experimenta

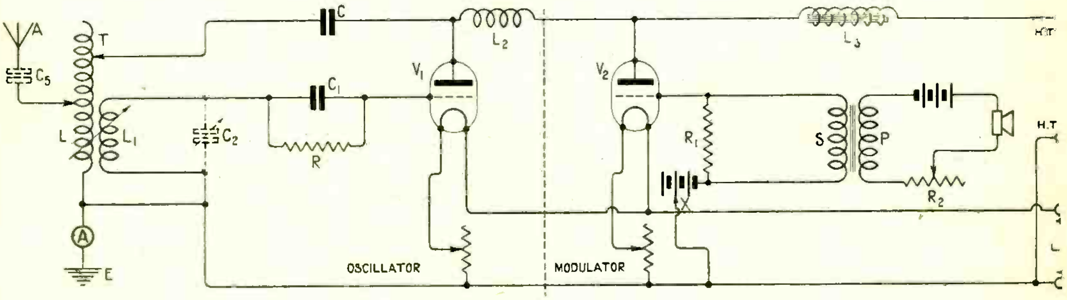


Fig. 1. *Circuit of choke control transmitter. Referring to the oscillator* C_5 = 0·0002 *to* 0·001 μF L = 30 *to* 35 *turns*, 6″ *diameter.* L_1 = 20 *to* 30 *turns of No.* 22 *D.C.C.*, 5″ *diameter, with* 3 *or* 4 *taps* C_2 = *about* 0·0003 μF, C_1 = 0·002 μF. R = 10,000 *to* 15,000 *ohms.* C = 0·0005 *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 = *aeria ammeter (hot wire) reading to* 0·5 *ampere. Referring to the modulator,* P = 250 *turns of No.* 22 *D.C.C.*, S = 22,000 *turns of No.* 40 *S.S.C.*, *core* ¾″ *in diameter of iron wires and* 3″ *long;* R_1 = *about* 0·2 *megohm.* R_2 = *variable resistance up to* 20 *ohms;* L_3 = *see text.*

the tapped inductance L, and preferably a shortening condenser (joined in series with L as in Fig. 1). The grid (excitation) circuit consists of coil L_1, tuning condenser C_2, grid condenser and leak C_1 and R_1, and* is coupled to the aerial coil. The anode circuit comprises coil L_4, tuning condenser C_4, stopping condenser C, and the choke L_2. Inductance L_4 is coupled with the aerial circuit.

The advantages of this arrangement are the great flexibility and the ease with which adjustments are made.

The wavelength of the aerial circuit is, of course, settled by the position of the aerial work until the proper value of inductance for coil L_1 is found. The anode circuit requires careful adjustment, and it may be found possible to dispense with the tuning condenser C_4. This condenser should be carefully insulated to withstand a pressure considerably greater than that applied to the anode of the valve, and in addition, its losses ought to be made small by proper design.

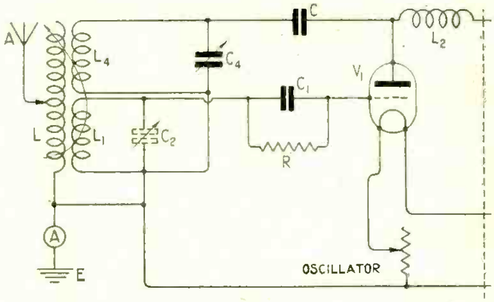


Fig. 2. *Coupled or Meissner circuit. Valves as in Fig.* 1, *also* L_4 = 25 *to* 30 *turns of No.* 22 *D.C.C. on former* 5″ *diameter,* C_4 = *variable condenser* 0·0002 μF.

The coil L may be the same as coil L of Fig. 1; also coil L_1 and condenser C_2. Coil L_4 may consist of 25 to 30 turns of No. 22 D.C.C., wound upon a tube 5 ins. in diameter, or any equivalent inductance with a few taps. The turns should be spaced a ttle. Condenser C_4 may have a maximum alue of 0·0002 μF, but if the experimenter as no variable condenser of this size which vill safely deal with the voltage, it is ecommended that he does not employ one .t all.

The anode and grid circuits ought not to e coupled together, but each should couple with the aerial circuit. It may be found that short wavelength oscillations are produced hrough the anode and grid circuits because of capacity and magnetic coupling. These oscillations are often confined to these circuits, not passing to the aerial circuit at all. They may be prevented by proper proportionment and a little careful adjustment.

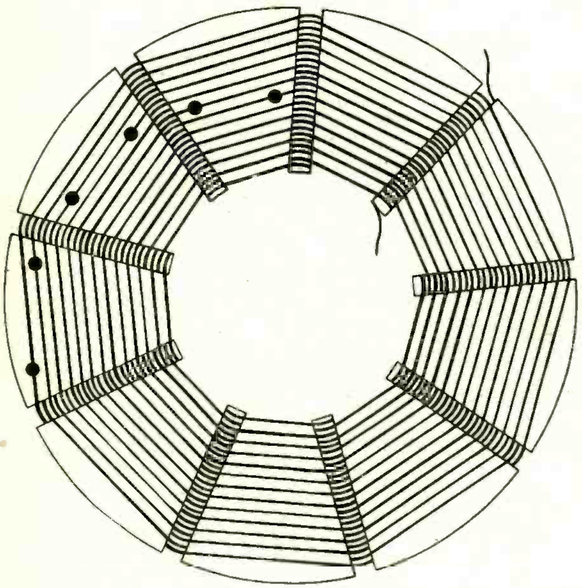


Fig. 3. Basket coil with taps. No. 18 D.C.C. wire wound upon ebonite or other insulating material. Sometimes a wooden former with wooden pegs is used. Suitable for small power transmitters.

8.—Arrangement of the Coils.

A number of suitable coils are given. For small power sets the coils may very well be basket coils (Fig. 3) wound with heavy gauge or stranded wires, a few tappings being taken and clips used for connections. For larger powers the aerial coil may be wound with copper ribbon, the coil preferably being held together with a few strips of ebonite, and connections being made with clips (Fig. 4).

It will be noticed the portion of the aerial coil (Fig. 1) between the aerial tap and earth carries a much higher current than the remaining portion, which is included in the anode tap circuit. Therefore the aerial coil could be made in two portions, one of heavy gauge copper and the other of thinner copper since the anode circuit only carries a small current. This is arranged for in the particulars given above. The grid coil is usually wound upon a former which may rotate or slide inside the aerial coil (Figs. 5 and 6). The anode coil (Fig. 2) may also be constructed in this fashion, although some may prefer the arrangement in which the aerial coil is the central one, with the grid and anode coils on either side.

9.—The Modulator Action.

Before describing the construction of the modulator, it may be helpful to discuss the operation of modulation.

The oscillator is capable of generating continuous waves, and what we wish is to so modulate them that the energy which is collected at the receiver will, after rectification, produce sounds in the telephones precisely the same as those spoken before the microphone (allowing no distortion in the receiver, of course).

The continuous waves may be modulated in several ways, but the particular method we are interested in varies the *voltage applied to the oscillator*, and therefore the power output. To be successful the oscillator must be so adjusted that the power output really is varied exactly according to the anode voltage, and further, the oscillator must be arranged so that it will respond equally well when the anode volts rise above the normal value as well as when the voltage falls below normal.

It will be noticed that the anode current for both valves (Fig. 1) flows through the choke coil L_3, and the valves are in parallel. When the microphone is disturbed by speech its resistance varies in accordance with the diaphragm vibrations, and the current in the primary circuit which includes the primary of the transformer is varied. Voltages are induced by transformer action in the secondary circuit; therefore the input circuit of the valve has applied to it voltages corresponding to the microphone variations. Normally the valve is passing between filament and anode a steady current, but now this current varies according to the grid potentials. If there were no impedance between the anode voltage supply and the modulator anode, the supply current would simply vary and supply the demands of the modulator valve. Nothing would happen to the oscillator, *i.e.*, there would be no modulation of the continuous waves. It is the purpose of choke L_3 to maintain the supply current appreciably constant to changes in current of telephone frequency. When this is the case, if the grid potential of the modulator for an instant is less than normal, so that the anode current is reduced, the oscillator is forced to take more current, since the choke coil prevents any change in the supply current. Now the only way to force more current through the oscillator is by an increase in the voltage. Therefore the voltage applied to the oscillator varies according to the speech. The normal oscillator and modulator currents are generally about the same, so that if the modulator current falls to zero, the oscillator current rises to twice its normal value. At the same time the voltage must also be doubled, so that at the instant considered the power output is four times the normal power, *i.e.*, the power when not modulating. When the modulator has a voltage applied to its grid circuit so that the anode current rises, the oscillator voltage and current falls. The power generated by the oscillator, therefore, varies according to the speech signal, and the oscillator must be so adjusted that it is capable of delivering power proportional to the voltage when the volts vary from normal to a very low value (theoretically to just a few volts), and also when the voltage rises to about twice normal.

The operation may perhaps be made a little more clear by the following explanation.

Suppose (as it actually does) the current through the choke varies by, say, 10 per cent. If the inductance of the choke is 10 henries, the frequency of the variation is 1,000 cycles, and the average value of the supply current is 100 mA.

Then the voltage drop across the coi which is given by—

$$2\pi fLI \text{ volts} = 2\times 3{\cdot}14\times 1000\times 10\times 0{\cdot}1\times 0{\cdot}1$$
$$= 628 \text{ volts.}$$

If the supply pressure is 1,000 volts, th voltage across the anodes and negative H.T will vary from (1,000−628) to (1,000+628) or from 372 to 1,628 volts.

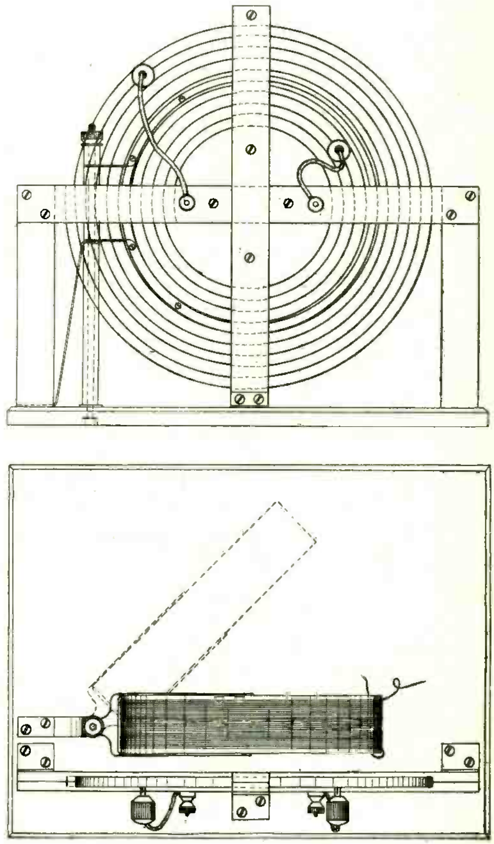


Fig. 4. Suitable for a larger power transmitter as described. The helix consists of 10 turns spaced ¼" apart, outside diameter about 9". Connection for aerial and anode tap is made with clips. The grid coupling coil is the small cylindrical coil, 5" in diameter wound with 20 to 30 turns of No. 22 D.C.C. suitably mounted.

10.—The Modulator Construction.

Referring now to the modulator, the fluctuation in grid voltage must have sufficient magnitude to vary the anode current from nearly zero to nearly twice normal. This requires a considerable voltage change, which is only obtainable through the use of a transformer. For values larger than about 50 watts it is generally necessary to use a speech amplifier, but in the smaller power sets sufficient power is generated in the microphone circuit to properly operate the modulator valve. The microphone may be of any standard manufacture, special microphones not being generally available to the experimenter. The primary winding of the transformer should be designed to work with the microphone, and the secondary to supply the highest possible voltage. For general purposes the primary winding may consist of 250 turns of No. 22 D.S.C., and the secondary 22,000 turns of No. 40 S.S.C. copper wire wound upon a former 1 in. in diameter and 3 in. long. The core may be built up of stampings or of No. 24 iron wire, and will have a diameter of about $\frac{3}{4}$ in., allowing for the thickness of the former. The iron circuit must not be closed, *i.e.*, there must be a small air gap. A transformer which was largely used in the R.A.F. Mk. III transmitter has a core of iron wires $\frac{5}{8}$ in. in diameter and 4 ins. long, with a primary winding of 360 turns of No. 22 D.S.C., and a secondary winding of 20,000 turns of No. 40 S.S.C.

Resistance R_2, which may be variable up to about 20 ohms, is included to control the amount of power in the microphone circuit, and therefore the degree of modulation.

The inductance of the secondary winding being very high, and because grid current may flow, it is usual to shunt the secondary with a resistance R_1, which may be about 0·2 megohms. This helps to prevent distortion by providing a constant load for the transformer. Obviously, if the load varied a good deal during speech, through varying grid currents flowing, the secondary voltage would vary according to the magnitude of the grid current, and the voltage would vary on this account. The battery X is provided to give the grid of V_2 a suitable negative potential. It should be varied for best operation.

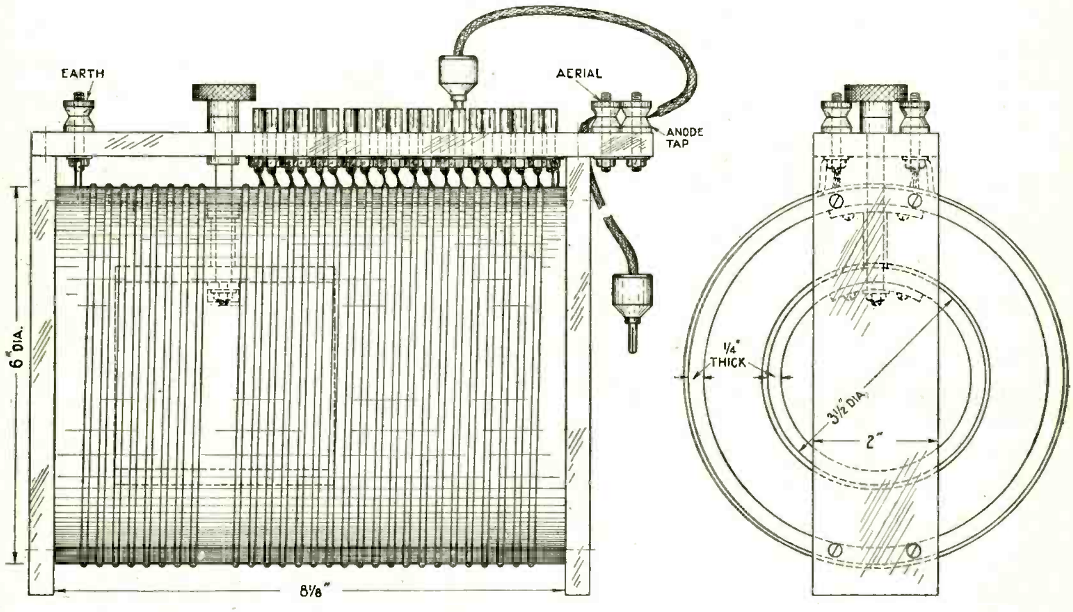


Fig. 5. Here the aerial coil is wound with bare No. 14 wire with the turns spaced. Tappings are taken to sockets, and connections for the aerial and anode tap are made with plugs. The grid coil rotates inside the large coil. The dimensions are given.

To make sure the load current to telephone frequency variations is almost constant, the reactance of the choke L_3 at the mean speech frequency should be made two or three times the impedance of the oscillator. The normal impedance of the valves suggested in section 4 is about 12,500 ohms. Now

$$\text{reactance} = 2\pi f L \quad \text{or} \quad L = \frac{\text{reactance}}{2\pi f} \text{ henries.}$$

Then a suitable inductance is about

$$\frac{3 \times 12{,}500}{2 \times 3{\cdot}14 \times 800} \text{ or 8 henries.}$$

On account of the steady anode current which flows through the choke, the iron core should have an air gap, and it is usual to design it so that the number of turns is relatively high with a corresponding low flux density. A suitable choke may be constructed as shown in "Wireless Theory," page 520, July 21st issue, Fig. 76, provided an air gap about 0·1 in. wide is provided in the core. For small transmitters, when "R" or similar valves are used, the choke may consist of 20,000 turns of No. 40 S.S.C. wound upon a core $\frac{5}{8}$ in. in diameter and 4 in. long.

11.—OPERATION.

It will be noticed the speech currents pass through the coil L_2. This coil, however, is designed so that its reactance is large to radio frequencies, but low to telephone frequencies, and besides the reason given for its use in Section 5 it keeps the high frequency energy out of the modulator. The condenser C (Figs. 1 and 2) takes a charging current which is supplied by the modulator, but if its capacity is kept reasonably low (0·0005 to 0·002 μF) it will not be a cause of speech distortion.

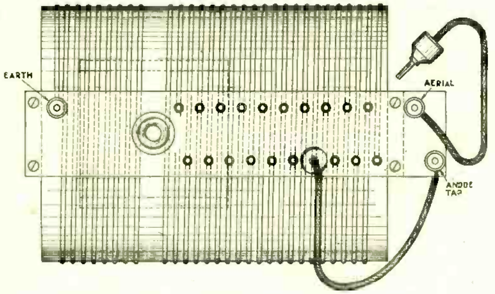


Fig. 6. Plan of the coils shown in Fig. 5.

For successful telephony transmission, the voltage of the H.T. supply is generally somewhat less than the voltage which, with the same valves, would be used for ordinary morse transmission, so that although, if the valves suggested are used, the rated normal anode voltage is 1,000 to 1,250 volts, it is advisable to employ about 800 volts. The normal anode current of the oscillator should then be adjusted by changing the value of the grid potential, so that it is about one-half the normal value when the set is used purely as an oscillation generator for morse transmission. That is, the oscillator is adjusted for maximum aerial power, and then the aerial current is reduced to about half this value by adjusting the grid potential, *i.e.*, increasing the value of the grid leak and adjusting the grid coupling. The grid bias of the modulator is also adjusted so that the modulator current is about the same as the oscillator current.

It is helpful to provide a small power lamp in series with the anode of the modulator. If the lamp is heated to a dull heat by the normal steady current, it will be made brighter by the fluctuating current caused by speaking into the microphone. Some experimenters couple a telephone receiver to the modulator in order to hear their own speech, but the power output of the microphone being quite small, it is not recommended to include a winding on the microphone transformer for this purpose. It is better to make use of a wavemeter or a crystal receiver suitably coupled. The best results are naturally obtained through working with a distant station possessing a good receiver. It is as well to remember that what is heard at the receiver is the *change* in amplitude of the transmitted wave.

When proper adjustments are made it will be found the aerial ammeter only varies slightly while speaking, although the aerial current is greater than when not speaking.

It should be emphasised that good modulation will only be secured when the oscillator is adjusted so that *the power output varies exactly in accordance with the varying voltages generated across the oscillator*, and further, the voltages may fall to a low value and rise to a high one compared with the normal value of applied H.T.

It is of course quite possible to connect valves in parallel, and those who prefer to use small power valves may wish to use, say, two as oscillators and two as modulators. The modulator valves are simply connected in parallel, and no circuit alteration is required, but in the case of the oscillator, where a second valve is used, the value of the grid leak will need to be changed. Since the negative potential given to the oscillator valve grid depends upon the grid current and the resistance, joining two valves in parallel will double the grid current, therefore the grid leak resistance should be halved.

Aerials and earths have been fully dealt with from time to time, and we would simply point out that the range may very often be greatly increased by half-an-hour's attention to this portion of the transmitter.

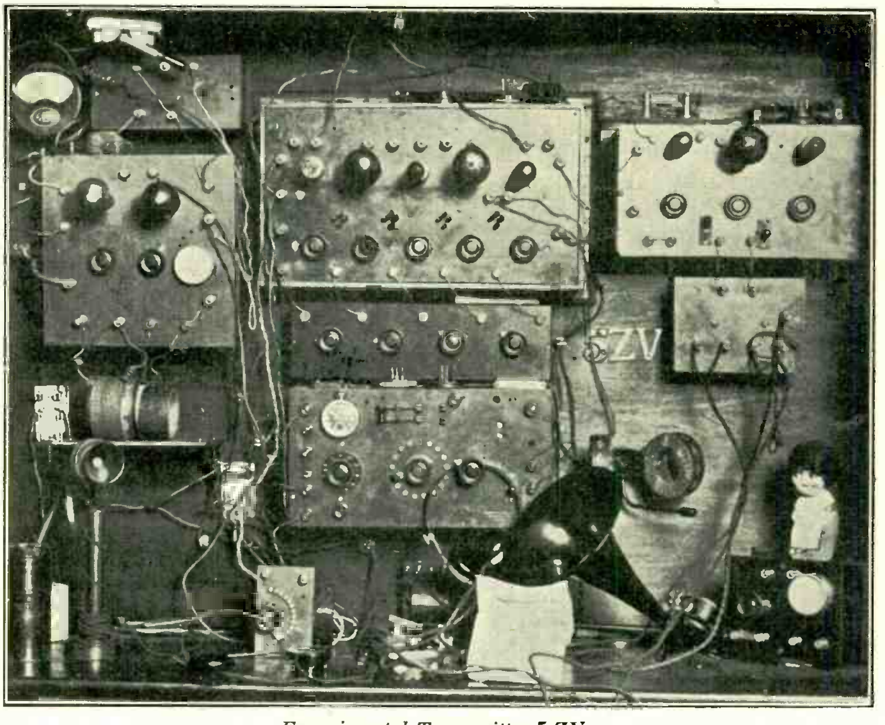
The power supply often presents difficulties, and will be dealt with in a later issue, but there is one point which should be noticed, which is this. When using the choke control method of modulation do not connect large condensers across the H.T. supply, or the action of the choke may be entirely upset.

12.—Layout.

A layout is not given because experimenters usually prefer to make their own arrangements. A good plan is to mount every component upon a large board, bearing in mind that the oscillator circuits require most attention. Particular care is necessary with the oscillator circuits in order to prevent losses or circuit changes through the use of long flexible leads.

Lincoln Experimental Station.

The accompanying photograph of **5 ZV** may be described as representing a typical experimental station and is the work of Mr. W. Herring of Lincoln. It is obvious that very little attempt has been made to produce an outfit of beautiful instrument finish, yet the general design and layout of the components permit of tests being carried out and general experimental work undertaken. The apparatus is arranged to occupy a minimum of space, and being housed in a cabinet it can rapidly be put away without disconnecting or rearranging the components.



Experimental Transmitter **5 ZV.**

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. 13.

To show the effects in the plate circuit of a valve when the latter is rectifying by the grid condenser method.

The apparatus required is as follows :—
"R" valve and socket.
Filament resistance.
Milliamperemeter scale reading 0 to 5 m.a.
6-volt accumulator battery.
Telephone transformer.
Fixed condenser, 0.001 mfd.
Leak resistance, 2 megohms,
Two single-pole switches.
Four dry cells.

The apparatus should be connected up as in Fig. 22. The low resistance winding of the telephone transformer is connected through a single-pole switch to the four

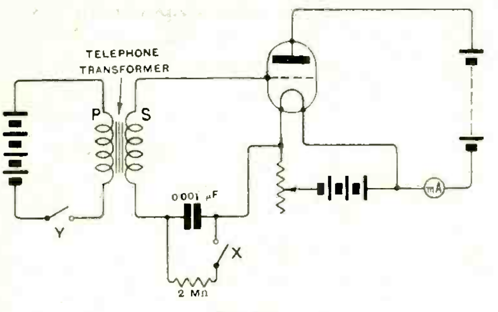


Fig. 22.

dry cells in series. The high resistance winding of the telephone transformer is connected to the grid of the valve and one side of the 0·001 mfd. condenser, the remaining side of the latter is joined to the negative filament terminal of the valve. The milliamperemeter is placed in series between the H.T. battery and the plate of the valve. The leak resistance is connected through a single pole switch across a fixed condenser. On the valve lighting and the switch "X" being opened, a certain plate current will be registered, the amount depending on the H.T. volts and the filament temperature. For an "R" valve with 60 volts the current may be to the order of 1 to 1½ milliamperes. On closing the switch "Y" an induced E.M.F. in the transformer winding connected to the valve will cause the fixed condenser to become charged. This will result in the milliamperemeter needle moving either to a higher reading or to a lower reading. It should be noted that if the reading tends to be higher, it will only be in the form of a momentary movement. If now the switch "Y" is opened, another impulse will be given to the fixed condenser, and the effect on the milliamperemeter will be opposite to that which was obtained when the switch "Y" was closed. In this case, if the needle indicates less current, the deflection from normal will be considerably greater than in the first test and will probably be of a fairly permanent character, providing the insulation of the valve socket is very high and that of the fixed condenser also. It is important that the switch "X," together with the leak resistance, is highly insulated, not only in their own parts, but also from the bench or table on which the experiment is being made. The lever of the switch must be well insulated with good ebonite, in order that when it is handled no leakage occurs through the hand of the experimenter.

To hasten the return of the milliamperemeter needle to normal, the switch "X" can be closed. If we assume that every time the switch "Y" is opened the effect is to shut off the plate circuit current, the switches "Y" and "X" can be operated alternately and the effect repeated many times. If preferred, the closing of the "Y" switch may be caused to produce a diminution of plate circuit current by either reversing the battery connections of the transformer, or reversing the secondary connections of the valve and fixed condenser.

The chief point to note in this experiment is that there is a very considerable change in the plate current when it tends to decrease compared with the momentary increase which takes place when switch "Y" is operated.

With a little patience, it will be noted that the faster switch "Y" is operated (*i.e.*, opens and closes the battery circuit of the transformer), the more rapidly must switch "X" be operated in order that the milliampere needle shall return to its normal reading before the following operation of "Y." In actual practice the switch "X" is eliminated and the leak resistance is permanently connected to the fixed condenser in order that the normal plate current may be restored sufficiently rapidly, as the frequency of the currents affecting the grid is far more rapid than the hand operation of "Y" could ever be.

If four dry cells are found to be rather too much to give useful readings, of course the number may be reduced.

Experiment No. 14.

To cause a 3-electrode valve to act as a detector of high-frequency oscillations :—

Apparatus required :—
- 3-contact tuner.
- Fixed condenser, 0.0003 mfds., with one leak resistance of 2 megohms.
- "R" valve.
- Filament resistance, 8 to 10 ohms.
- 6-volt accumulator battery.
- Variable H.T. battery.
- Telephone transformer.
- Buzzer wavemeter.

The apparatus must be joined up as in Fig. 23. The filament temperature, together with the value of the H.T. battery volts,

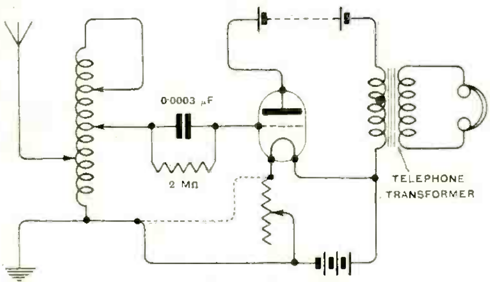


Fig. 23.

must be adjusted until the maximum strength in the telephones is obtained, when the tuner is adjusted to any given wavelength to which the wavemeter is set. The wavemeter should be placed at sufficient distance from the tuner in order that its signals shall be only just audible when the maximum sensitiveness of adjustment of the valve is obtained. When once the position of the filament resistance and the voltage of the H.T. battery has been determined by the above method, the only adjustments that the experimenter need vary are those on the tuner itself. The action of this circuit is precisely similar to that which was noted in the case of Experiment 12, the only difference being that the variation in plate current from normal is detected by means of the induced impulse in the secondary of the telephone transformer which is connected to the telephones; hence the sound in the telephones gives a comparative measure of the plate circuit current variation.

The alteration of the plate circuit current from normal is caused by high frequency potentials charging up the grid condenser by virtue of the oscillatory currents in the aerial circuit and tuner. See Experiment 13.

The method of operating the tuner is exactly the same as has been already given in Experiment 9.

Note.—In making the adjustments on the three-contact tuner, it is practically essential that the hand does not come in contact with any of its metal parts as, if so, there will be either a complete cessation or a very great reduction in the strength of received signals. The tuner circuits may be improved with variable condensers as already indicated in Fig. 15.

THE SCHOOLS RADIO SOCIETY.

We have pleasure in announcing that the Presidency of the Schools Radio Society, concerning which a note appeared in our last issue, has been accepted by Dr. W. H. Eccles, F.R.S.

As President of the Radio Society of Great Britain, Dr. Eccles is well known to most of our readers, and the Schools Radio Society is to be congratulated on the honour it has received from so illustrious a personality in the sphere of radio science.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XVIII.

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 circuits, damping, choke coils, and transformers.

By W. JAMES.

37.—Transformer Design.

IT is not intended to discuss fully the design of transformers. The object is to give a safe, practical method which will enable the experimenter to design his own transformer. In general the experimenter who wishes to build a small transformer has to choose the size of the iron core not from the results of calculation so much as from the size of stampings which he is able to purchase.

It might be mentioned here that when the transformer is to be operated at a definite load it is best to arrange the design so that the copper losses are equal to the core losses at the load at which the transformer will generally work. At higher and smaller loads the efficiency will be less. If the transformer will be required to work partly loaded for the longest time, it will be better to make the copper losses greater than the core losses.

Suppose we wish to build a transformer of the core type to step up the voltage from 110 volts, 50 cycles, to 1,000 volts; secondary load 250 watts, core to be of alloyed steel such as stalloy.

We will start by assuming the power factor at full load is 0·9 and the efficiency 90 per cent. We can now find the full load primary current. On account of 90 per cent. efficiency the primary watts at full load are equal to $\frac{250}{0 \cdot 9} = 277$ watts, and because of the power factor the apparent watts will be $\frac{277}{0 \cdot 9} = 308$. The line current is then, say $\frac{308}{110} = 2 \cdot 8$ amperes. The secondary full load current is $\frac{250}{1000} = 0 \cdot 2$ amperes. The fundamental equation given above* is

$$E = 4 \cdot 44\, B\, A\, N f \times 10^{-8} \text{ volts.}$$

* Wireless Theory, page 522, July 21st issue.

Now, $E = 110$ volts and $f = 50$. We do not know B, A or N (the maximum flux density, the cross section, or the number of turns).

(1) *The Iron Circuit.*

When the frequency is only 50 cycles, and best quality transformer stampings are to be used, the maximum flux density may safely be 50,000 to 60,000 lines per sq. in. With poor quality iron it is not safe to use a higher value than 30,000 lines per sq. in. If we take the safe value as 50,000 lines per sq. in., we can write in this value of B in the equation.

Another point which has to be decided is the best ratio of core width to depth. If the core is square, less copper is required. When a rectangular core is used, more copper is required, but the other important factor, the cooling surface, is larger. It is considered good practice to make the core depth about 1·5 times the core width.

(2) *The Number of Primary and Secondary Turns.*

The next factor to be cleared up is the number of turns per volt. We will assume, from our experience, that there will be between two or three turns per volt. Suppose we assume as an average figure there are to be 2·5 turns per volt. We find the number of primary turns at once is equal to $110 \times 2 \cdot 5 = 275$ turns. The number of secondary turns (assuming, of course, losses are negligible) is then given by $N_p \times \frac{E_s}{E_p}$ (N_p being the total number of primary turns and $\frac{E_s}{E_p}$ the voltage ratio). Since $N_p = 275$ turns and the voltage ratio is $\frac{1000}{110} = 9 \cdot 1$ the total number of secondary turns required is $275 \times 9 \cdot 1 = 2{,}500$.

(3) *The Area of the Core.*

We have now found all the values required except the core area, which is easily obtained by putting the values in the equation and working out.

Thus $E = 4{\cdot}44\, B\, A\, N\, f \times 10^{-8}$

and $A = \dfrac{E \times 10^{-8}}{4{\cdot}44 \times B \times N \times f}$

Now $E = 110$, B 50,000, $N = 275$, $f = 50$.

Then $A = \dfrac{110 \times 10^{8}}{4{\cdot}44 \times 50{,}000 \times 275 \times 50}$

$= 3{\cdot}6$ sq. ins.

This value represents the area of the cross section of the iron itself. On account of the insulation on the surface of the laminations the total area will be somewhat greater. If we decide 90 per cent. of the gross area is iron, the core should be $\dfrac{3{\cdot}6}{0{\cdot}9} = 4$ sq. ins. so that we may decide the core width shall be 1·6 ins. and its depth 2·5 ins.

We have now decided suitable values for the core cross section and the number of turns. We have now to choose a gauge of wire for the primary and secondary which will safely carry the current, the insulation, the space occupied by the windings the length of the core and yoke, and then to work out the iron and copper losses, and so find whether the design is satisfactory. If the losses are too high, and the estimated working temperature is too high, the design must be modified.

(4) *The Gauge of the Wire.*

At full load, the primary winding has to carry a current of 2·8 amperes, and the secondary 0·25 amperes. It is safe to allow a current density of 1,200 amperes per sq. in.; therefore the area of the primary wire is $\dfrac{2{\cdot}8}{1200}$ $= 0{\cdot}0023$ sq. ins., and the secondary $\dfrac{0{\cdot}25}{1200}$ $= 0{\cdot}00021$ sq. ins. From the wire tables, the nearest gauges of wire are No. 17 S.W.G. and No. 27 S.W.G. Each wire should be double cotton covered. From the tables we find we may wind 14·7 and 36·8 turns per in. respectively, and 216 and 1,450 turns per sq. in. respectively. Allowing 10 per cent. extra space for unskilled winding, we will estimate 13 and 33 turns per in. and 169 and 1,090 turns per sq. in. of winding space respectively.

We therefore require $\dfrac{275}{169} = 1{\cdot}6$ sq. ins. of winding space (A × B, Fig. 91) for the primary, and $\dfrac{2{,}500}{1{,}090} = 2{\cdot}3$ sq. ins. for the secondary.

The coils will be wound upon formers having the shape of the cross section of the core, plus an allowance all round for insulation. In the case of the primary we shall allow a covering for the core upon which the primary will fit $\frac{1}{8}$ in. thick, and in the case of the secondary $\frac{1}{4}$ in. thick.

Now let us assume the length of the winding space A, Fig. 91, is 4 in. If we make the length of the primary and secondary 3·5 in.

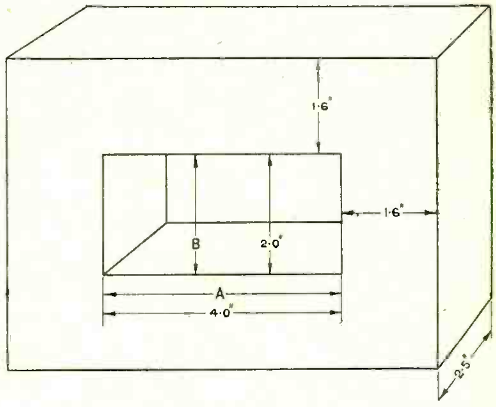


Fig. 91. Dimensions of the core which is built up of 10 to 14 mil. laminations of transformer steel.

we leave sufficient room between the ends of the windings and the core. The depth of the primary winding is obviously equal to its cross section divided by the length allowed, in this case $\dfrac{1{\cdot}6}{3{\cdot}5} = 0{\cdot}46$ in., or say 0·5 in. allowing for a sheet of insulation between layers. The depth of the secondary is $\dfrac{2{\cdot}3}{3{\cdot}5} = 0{\cdot}66$ in., or say 0·75 in., allowing for extra insulation. The width of the winding required is then equal to the sum of the quantities shown in Fig. 92, which includes a space of 0·4 in. between the coils, and is equal to 2 ins.

(5) *Losses.*

We have now full particulars of the coils and the iron core, and we should next determine the approximate losses.

(6) *Copper Loss.*

The copper loss is found by working out the resistance of the windings, and then using the formula watts $= I^2 R$.

Mean length of primary turns

$= 2\,(2{\cdot}35 + 3{\cdot}25) = 11{\cdot}2$ ins.

Mean length of secondary turns

$= 2\,(2{\cdot}85 + 3{\cdot}75) = 13{\cdot}2$ ins.

Total length of primary

$= \dfrac{11{\cdot}2 \times 275}{36} = 385{\cdot}5$ yds.

Total length of secondary

$= \dfrac{13{\cdot}2 \times 2{,}500}{36} = 917$ yds.

Resistance of No. 17 S.W.G.

$= 0{\cdot}00976$ ohms per yd.

Resistance of No. 27 S.W.G.

$= 0{\cdot}1138$ ohms per yd.

Resistance of primary

$= 0{\cdot}00976 \times 85{\cdot}5 = 0{\cdot}834$ ohm.

Resistance of secondary

$= 0{\cdot}1138 \times 917 = 104{\cdot}4$ ohms.

Watts lost through primary resistance at full load $= I_p{}^2 R_p$

$= 2{\cdot}8^2 \times 0{\cdot}834 = 6{\cdot}54$ watts.

Watts lost through secondary resistance at full load $= I_s{}^2 R_s$.

$= 0{\cdot}25^2 \times 104{\cdot}4 = 6{\cdot}52$ watts.

Total loss $= 6{\cdot}54 + 6{\cdot}52 = 13{\cdot}06$ watts.

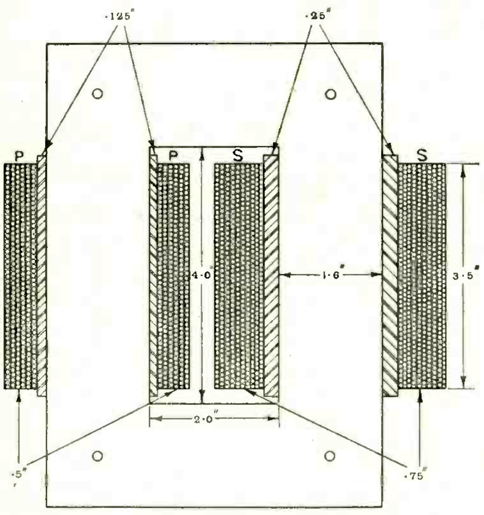


Fig. 92. Leading dimensions of the transformer. The primary winding has 275 turns of No. 17 D.C.C., and a sheet of paper is placed between each layer. The secondary winding has 2,500 turns of No. 27 D.C.C., with each layer separated with a sheet of thin paper or oiled silk. The coils should be tapped with empire cloth.

(7) *Iron Loss.*

Volume of core $= 3{\cdot}6 \times (9{\cdot}8 + 8) = 64$ cubic inches.

Now 1 cubic inch of transformer steel weighs 0·28 lb.

$\therefore$ Weight of core $= 64 \times 0{\cdot}28 = 18$ lbs.

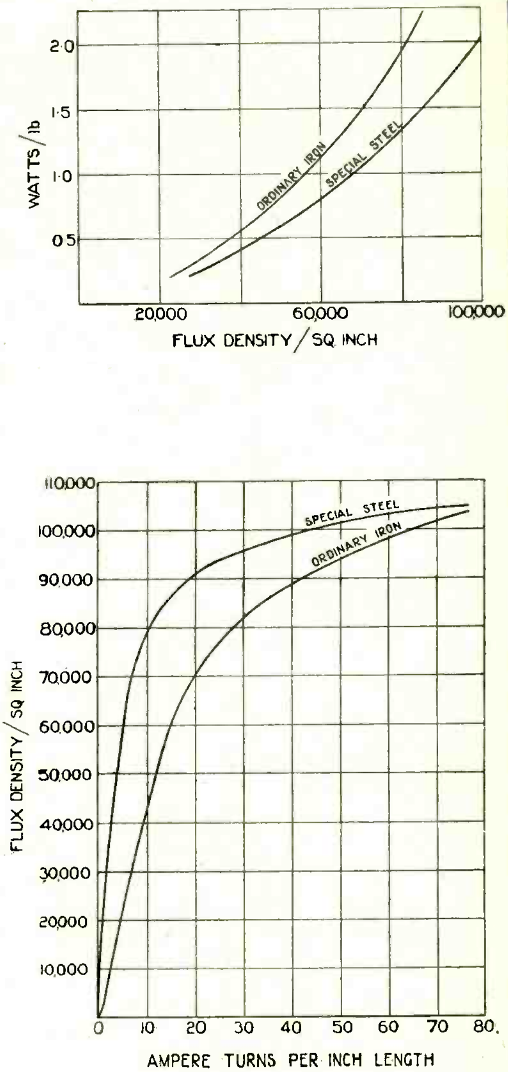


Fig. 93. The upper curves show the watts lost per pound of transformer steel at various flux densities. The lower curves show the ampere turns per inch length of the magnetic circuit required to produce various flux densities.

In Fig. 93 we have curves showing the total watts lost per pound for various flux densities, the frequency of the supply pressure being 50 cycles. The curves actually refer to laminations 0·015 in. thick, but the error will not be great for slight variations in the thickness. Referring to the upper curve, special alloy sheet steel, we find with the flux density 50,000 lines per sq. in. the loss is 0·6 watts per pound. The total core loss is therefore $0{\cdot}6 \times 18 = 10{\cdot}8$ watts.

(8) *Magnetising Current.*

Up to the present we have assumed the magnetising current negligible, but we may at this stage find the magnetising current, and see that the design is such that it is reasonable. Referring to Fig. 93, we have plotted ampere turns per inch length and flux density. In our case the flux density is 50,000, and from the curve we require 5 ampere turns per inch length. This amount will be greatly increased if the magnetic joints are poor.

The length of the magnetic circuit is $2\times(4+1{\cdot}6) + 2\times(1{\cdot}7+1{\cdot}6) = 17{\cdot}8$ ins.

Therefore the total ampere turns

$$= 17{\cdot}8 \times 5 = 89.$$

The magnetising current

$$= \frac{\text{Ampere turns}}{\text{Primary turns} \times 1{\cdot}4} = \frac{89}{275 \times 1{\cdot}4}$$

$= 0.23$ amperes.

(9) *Efficiency.*

The efficiency is equal to the output divided by the output plus the losses, or closely,

$$\text{Efficiency }\% = \frac{250 \times 100}{250 + 13{\cdot}06 + 10{\cdot}8} = 91\,\%.$$

(10) *Temperature Rise.*

The temperature rise is roughly given by

$$\frac{250 \times \text{Total watts lost}}{\text{cooling surface in sq. ins.}}$$

degrees centigrade.

In the above example the total watts lost $= 23{\cdot}86$ watts.

The cooling surface is roughly 150 sq. ins.

$$\therefore \text{ temperature rise} = \frac{250 \times 23{\cdot}86}{150} = 39^\circ\text{ C.}$$

The design is therefore satisfactory. It will be noticed the secondary voltage at full load is not quite 1,000 volts. Actually it is practically $0{\cdot}25\,(101 + 0{\cdot}823 \times 9{\cdot}1^2) = 42$ volts less. This is easily allowed for by increasing the number of secondary turns slightly.

Each layer of winding should be separated from the next with a layer of paper or thin empire cloth. The coils should be tapped before assembling the core.

When the secondary voltage is to be above 1,000, it is advisable to split up the secondary into sections, each of which should be sufficiently insulated.

Metres or Kilocycles?

From our New York Correspondent.

SINCE the first use of tuned circuits in radio they have been rated according to wavelength in metres. Thus we speak of a transmitter of 200 or 360 metres, or of a receiving set designed to tune over a range of 200 to 1,000 metres. Since the distribution of wavelengths has been given such serious consideration it has been found that wavelength bands can be more accurately pictured when expressed in terms of kilocycles than wavelength. The simple formula for wavelength is

$$\lambda = \frac{300{,}000{,}000}{f}$$

where λ is the wavelength, f the frequency, and 300,000,000 the distance in metres travelled by an electric wave per second. From this you will see that the frequency is determined by the formula

$$f = \frac{300{,}000{,}000}{\lambda}$$

where the constants are the same as above.

The important factor in determining the separation of wavelength required between transmitted stations for non-interference is determined not by the difference of the wavelength in metres, but by the difference of frequency expressed in cycles. To save writing zeros, the term kilocycles is employed, indicating 1,000 cycles. For example, 100,000 cycles is equal to 100 kilocycles.

To illustrate the point just made, 50 transmitters can operate simultaneously at wavelengths between 150 to 200 metres for the difference in kilocycles is 2,000 to 1,500 or a separation of 500 kilocycles. On the other hand only one station can operate at a time between 1,000 and 1,050 metres for the difference between them is only 14 kilocycles.

The disadvantage in rating radio circuits in wavelength became so apparent at the Second National Conference held at Washington, D.C., in March that the recommendation was made and adopted by the Department of Commerce and other Government Departments that circuits should be rated in kilocycles. The wavelength in metres will be given, however, enclosed in parentheses after the kilocycle rating.

For all practical purposes the value of three hundred million metres per second is satisfactory in determining the frequency, but for those who wish to be entirely accurate the value of 299,820 should be employed.

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.

Smethwick Wireless Society.*

An interesting and profitable discussion on the latest types of circuit took place on July 21st. At the same meeting Mr. A. C. Hulme (5NH) gave some remarks on the subject of his transmissions, and experiments were conducted with the Society's apparatus.

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

Radio Society of Bradford-on-Avon.

A very interesting lecture was delivered by Mr. L. Boxwell on Thursday, June 28th, entitled "Direction Finding."

The lecturer dealt with the early attempts made in direction finding, leading up finally to the apparatus now used for marine and aeronautic purposes.

Hon. Sec., H. Helps, 4. Ivy Terrace, Bradford-on-Avon, Wilts.

Paddington Wireless and Scientific Society.

On June 25th, the members proceeded to Stanmore for a field day, and before lunch the following apparatus was erected:—

Inverted L aerial supported by 30-ft. portable masts (a 6-ft. kite was flown supporting 200-ft. aerial), Bellini-Tosi aerial and radiogoniometer for direction finding; portable frame aerial with two H.F., detector and two L.F., mounted on a motor cycle and side-car. In addition to the receiver previously mentioned, the following members provided receivers:— Mr. A. L. Beak, detector and two L.F.; Mr. G. Turton, two H.F., detector and L.F.; and Mr. A. Hoban, units for demonstration to junior members.

Lunch and tea were partaken of at "The Vine," Stanmore, and the catering arrangements were much appreciated. (Other Societies please note.)

Useful results were achieved by Messrs. Beak and Turton, and by the Hon. Seretary, reception including telephony from London amateurs, British and Continental air stations, and concerts from Radiola and others.

Particulars of membership can be obtained from the Hon. Sec., L. Bland Flagg, 61, Burlington Road. Bayswater, London, W.2.

Stratford-upon-Avon Wireless Society.

A successful exhibition was held by the Society in the Public Hall on Monday, July 2nd. Both amateurs and the Trade were well represented in the exhibits.

The hall was gaily decorated, and a fairly large audience was entertained with broadcasting from London, Birmingham, Cardiff and Manchester.

The membership of the Society is growing rapidly, and it is hoped that the Grammar School boys will join in the near future. It is suggested that non-experts, wishing to enjoy the broadcast programmes, should be admitted to membership at a nominal fee.

Hon. Sec., E. W. Knight, 17, Park Road, Stratford-upon-Avon.

Radio Association of South Norwood and District.

The meeting held on Thursday, June 29th was opened with the presentation of a four-way crystal panel to Mr. R. T. Mayes, winner of a competition for the junior members for the best home-made crystal set.

A discussion on "Modern Receiving Circuits" was then opened by Mr. C. H. P. Nutter (5 DB) and Mr. J. L. Jeffree (5 FR).

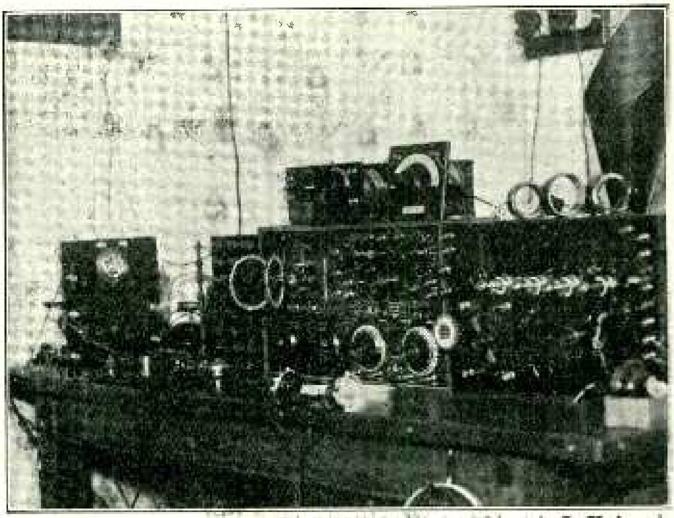
Hon. Sec., C. H. P. Nutter, Radio Corner, 243a, Selhurst Road, Norwood Junction, S.E.25.

Leyton and District Wireless Club.

A successful meeting was held on Monday, July 2nd, when a demonstration in polishing was given by Mr. F. Browne, followed by a very interesting lecture by Mr. P. J. Slade, entitled "The Elementary Principles of Wireless."

The Hon. Secretary would be glad to hear from anyone interested.

Hon. Sec., W. G. Peacocke, 73, Frith Road, E.11.



Transmitting station **5DN** *at Sheffield, belonging to Captain L. Halcombe.*

Croydon Wireless and Physical Society.

On July 7th, Mr. G. W. Hale (**2 HS**) described [an]d demonstrated a three-valve set (one H.F., [on]e detector and one L.F.) of his own design. [A] special feature was the stability and selectivity [ob]tained without loss of efficiency

Owing to the holidays, the next meeting is held [ov]er until the middle of September.

Hon. Sec., B. Clapp, "Meadmoor," Brighton [R]oad, Purley.

by Mr. C. H. P. Nutter (**5 DB**) and Mr. J. L. Jeffree (**5 FR**). Mr. Nutter gave many useful hints with regard to the construction of apparatus.

Equally interesting was a talk by Mr. Jeffree on circuits of the so-called "freak" description, illustrating with a number of diagrams that quite simple principles were responsible for the apparent freaks.

New members are very welcome, and all interested should apply for full particulars to the Hon. Sec.,

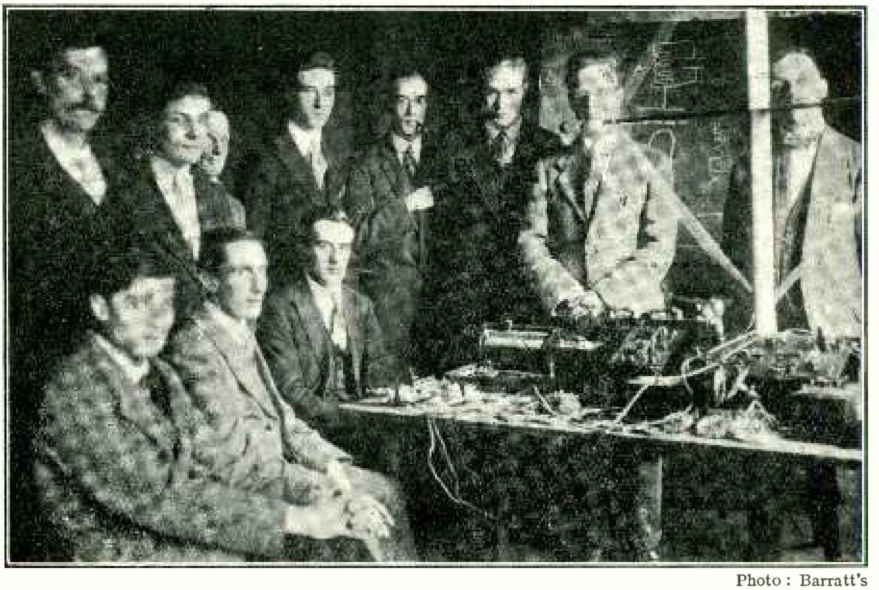


Photo: Barratt's

Members of the Tottenham Wireless Society with their apparatus.

Liverpool Wireless Society.

On Thursday, July 12th, the Society's Vice-President, Dr. S. S. Richardson, A.R.C.Sc., addressed the members on the "Control of Intrinsic Reaction." Dr. Richardson outlined the various phases and characteristics of magnetic and static reaction, and illustrated by suitable diagrams their application in the Reinhartz, Armstrong, and later circuits. Various methods of reducing intrinsic reaction were explained, and the principles involved in carrying out these methods were elucidated.

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

Beckenham and District Radio Society.

On Thursday, July 12th, Mr. Voigt, ably assisted by Mr. Knight, gave an instructive lecture on "Dual Amplification." By means of a host of diagrams, Mr. Voigt described the construction of a dual amplification set, concluding with a very convincing demonstration with his own experimental set designed on this principle.

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

Brockley and District Radio Association.

At the June meeting of the Association highly interesting and instructive lectures were delivered

R. O. Watters, "Grove House," Brockley Green, S.E.4.

Sydenham and Forest Hill Radio Society.

Members of the Society paid an interesting visit to **5 DT** transmitting station (owned by the Vice-President), on Saturday, July 7th. The party was fortunate in arriving at a time when a special test was being carried out with a new type of crystal. With low resistance telephones the new crystal appeared to be very sensitive. During the afternoon members of the party spoke into the transmitter.

Hon. Sec., M. E. Hampshire, 139, Sydenham Road, S.E.26.

The Radio Society of Willesden.

Owing mainly to the inclement weather there was a rather sparse attendance at the Society's meeting on July 19th. Mr. Coote conducted buzzer practice, and later in the evening Mr. Earnshaw-Wall demonstrated to an appreciative audience the results obtainable with a double magnification circuit. Gratifying results were obtained on an improvised indoor aerial. Applications respecting membership should be addressed to the Hon. Sec., F. H. H. Coote, 183, Carlton Vale, Maida Vale, N.W.6.

Notes and News

The Edmonton Education Committee has granted permission for the erection of an aerial by the Croyland Road County Secondary School.

* * * *

Up to the present the following wireless licences have been issued: Experimental receiving licences, 52,264; broadcast receiving licences, 111,905; transmitting licences, 843.

* * * *

Senatore Marconi proposes to carry out more wireless experiments on his yacht "Elettra," and will probably work in conjunction with the land station at Poldhu.

* * * *

The construction of the Bournemouth Broadcasting Station is likely to be delayed owing to difficulties in selecting a site.

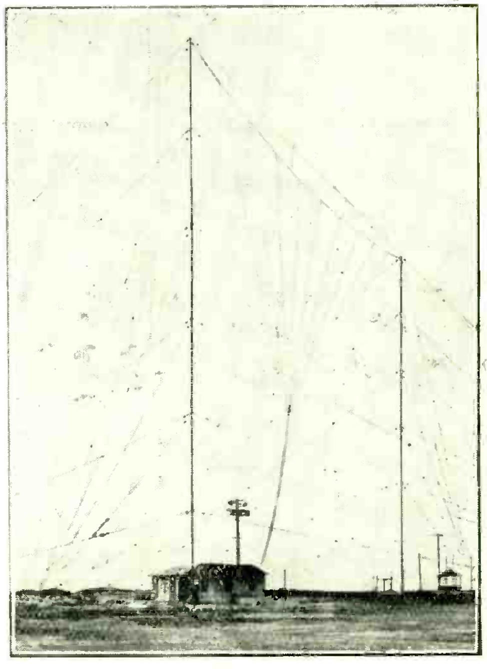
Wireless Licence Difficulties.

A problem now exercising Parliament is whether the Postmaster-General should retain the authority to grant licences for wireless telegraphic stations and apparatus.

Sir L. Worthington-Evans, Postmaster-General is in favour of the continuance of this policy for another year.

Radio Exhibition at Liége.

From September 30th to October 11th a wireless exhibition is to be held at Liége, Belgium, organised by the *Journal de Liége*. Since the exhibition will be open during the Annual Fair in the same city, a very large number of visitors is expected. Wireless demonstrations will be given and for this purpose a receiving station and direction finding installation are being specially installed. A course of lectures on wireless telegraphy for the benefit of amateurs, will be an important feature.



The antenna at the Chicago Broadcasting station **WJAZ**. *It will be observed that the fan-shaped aerial is suspended from an insulated wire attached to the two masts. The arrangement is particularly efficient for transmission on short wavelengths of* 200 *or* 250 *metres.*

B.B.C. Time Signals.

Since April last, when Mr. Hope-Jones gave the first time signal from a British broadcasting station, this feature has received such appreciation as to merit permanent adoption. Owing to unsatisfactory clock arrangements, the British Broadcasting Company has instructed the Synchronome Company to instal a special time equipme[nt] for each broadcasting station.

Each installation will consist of a Synchrono[me] master clock and a dial, in close proximity to t[he] microphone, indicating the seconds. This dial c[an] be made to tick fairly loudly and can be adjust[ed] to begin thirty or forty seconds before the hou[r]. The announcer can then take up the count, ringi[ng] the gong on the stroke of the hour. The electric circuit operating the device has to be closed by t[he] announcer before the dial can begin to function.

Hightensite, Ltd.

The employees of th[e] Company held their an[]nual outing on Saturda[y] July 21st, when a part[y] of over a hundred visite[d] Southend-on-Sea. Aft[er] luncheon the annua[l] sports took place i[n] Hockley Woods, wher[e] tea was served. Th[e] evening was occupied i[n] open-air dancing an[d] Southend was left a[t] 9 p.m. after a most suc[]cessful day.

Telephony from Denmark.

The telephony transmission on 2,700 metres, from Lingby, near Copenhagen, referred to in our issues of June 16th and July 7th, has been heard by Mr. M. Sainsbury, of Bournemouth. Mr. Sainsbury employed a detector and one low frequency valve, and, although reception was very weak, the performance is very creditable in view of the southerly position of the station.

Empire Wireless.

An important statement on the subject of Imperial wireless was made by the Postmaster General (Sir Laming Worthington-Evans), when a deputation from the Empire Press Union attended the General Post Office on July 23rd.

Within twelve months, or perhaps a small margin over that time, said the Postmaster-General, a Government high power station would be in operation. About that time a Marconi station would also be in operation, and the object of negotiation with them was to see that a working commercial arrangement was made between the various stations.

n reply to a question, the Postmaster-General l that there would probably be reasonable com- ition with the cable companies, and the Govern- nt, being itself interested in the "pool" of vate enterprise, would be enabled to see that re would be no undue nbination against the public terest.

FORTHCOMING EVENTS.

THURSDAY, AUGUST 2nd.
Hackney and District Radio Society. At the Y.M.C.A., Mare Street. Lecture: "Accumulators and their Care." By Mr. Wall.

FRIDAY, AUGUST 3rd.
Wireless Society of Hull and District. At 7.30 p.m. Questions and Answers. Buzzer Practice.

SATURDAY, AUGUST 4th.
Ipswich and District Radio Society. Field Day with Felixstowe Wireless Society to Levington Bridge.

MONDAY, AUGUST 6th.
Bank Holiday.

Correction.

In our issue of July 14th, was erroneously announced at Mr. F. A. Nutter had en elected an associate mem- r of the Radio Society of eat Britain. Mr. Nutter, hose initials are C. H. P., was ected to full membership of e Society.

ightning Effects.

Graphic accounts have ap- eared in the daily press oncerning the valour of ousands of wireles amateurs ho, attired only in socks and pyjamas, braved e downpour during the recent thunderstorm order to "short" their aerials to earth.

In view of the interest so obviously taken in ghtning phenomena, the following report from a orrespondent, which emphasises the value of a ain water pipe as a conductor, may prove instruc- ive.

Lightning struck a house in Sunbury on the evening of July 10th, and after damaging the roof travelled along the gutter and down a pipe which terminated six inches above a drain. It then jumped eight inches to a lead overflow pipe projecting through a wall from the cistern in the kitchen. From the cistern, the lightning leaped to the main supply pipe, punching a hole in the latter and incidentally flooding the kitchen. Through the main supply pipe it completed its journey to earth.

A noteworthy point is that the lightning missed a pipe attached to the cistern and penetrating the ground to a depth of a foot or two, preferring the more conductive main pipe.

Catalogues Received.

Fulk Stadelmann & Co., Ltd. (Efesca Electrical Works, 83, 85 and 87, Farringdon Road, E.C.1). Catalogues 496 and 500, relating to Efesca Wireless Components and Efescaphone Valve and Crystal Sets.

Eagle Engineering Co., Ltd. (Eagle Works, Warwick). Catalogue of the firm's "Chakophone" Receiving Sets and Accessories.

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 and Sundays, 10 to 10.45 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.

IN THE COURTS.

THE CASTLE RUBBER CO., LTD. v. RADIO ENGINEERING CO., LTD.

REPORT OF PROCEEDINGS.

At Warrington County Court, on Thursday, July 19th, before His Honour Judge Whitmore Richards, the Castle Rubber Co., Ltd., Warrington made a claim for £31 9s. 4d., value of 274 lbs. of ebonite, against the Radio Engineering Co., Ltd., who brought a counter-claim for £18 8s., the cost of machining the ebonite which they alleged was not in accordance with the sample on which they had purchased.

Mr. C. W. Lee, solicitor (of Messrs. Henry Greenall & Co.), appeared for the plaintiffs, and Mr. J. Greenwood, solicitor (of Messrs. Robert Davies & Co.), represented the defendants.

The plaintiffs relied on Section 35 of the Sale of Goods Act, and contended that as the defendants had retained the ebonite in their possession for a period of six weeks before intimating to the plaintiffs their intention of rejecting the material, the section was fatal to defendants' claim, and they had no right to reject the goods.

The ebonite was of the cheapest grade, having been specially prepared for wireless purposes, and it was a well-known fact in the trade that ebonite of that description could not produce the best results. The ebonite was bought at the crest of a boom in the wireless trade in which defendants were engaged, and it had since suffered a slump. Plaintiffs suggested that it was because of the slump that they had rejected the goods. Six weeks elapsed before any complaint was made, and they contended that it was not a reasonable time, especially as the goods were delivered at urgent request. They emphasised the fact that several tons of the material had been supplied without a single complaint.

Mr. Hodson, managing director of the Castle Rubber Co., gave details of the ingredients of the ebonite, which included reclaimed rubber. He agreed that there was no sign of metallic matter in the sample submitted, and that particles of metal were visible in fractures of the ebonite supplied. Another witness for the plaintiffs caused amusement by the admission that he was not aware that wireless was electrical work.

The defendants gave evidence that they purchased the material from a sample which showed no signs of metallic contents, whereas the material supplied contained brass, lead, steel and other materials which were visible on fracture and rendered the material totally unsuitable for their purpose, namely, that of insulation on oscillation transformers for marine work. They stated that it was wrong to suggest that the material was rejected on account of the slump in wireless that had set in, and asserted that they had had to purchase other ebonite to complete the job. They claimed that sound ebonite could be purchased for the same price as they had paid for the goods complained of, and that they had, as a matter of fact, secured excellent supplies for completion of the work at similar prices.

Mr. Robert E. Beswick, of the Radio Communic tion Co., Ltd., gave evidence on behalf of t defendants. He said he was an engineer and h had considerable experience in the manufactu and use of ebonite. There was a distinct differen between the sample and the ebonite supplie The ebonite was totally unsuitable for any wirele purposes.

His attention was drawn to a statement by witness for the plaintiff company that they had sol three tons of ebonite of similar quality, of whic they had had no complaint. Witness said the ev dence given in that case that day would cause sensation in the trade. The bulk of the materia went to factors who did not machine it to an great extent, but sold it to amateurs, who had onl few tools and no voice to complain. "Factor are unloading on to the amateurs," he said, "larg quantities of stuff that no manufacturer will pu on his set. I can buy good quality ebonite wit high insulating value at 2s. 6d. per lb."

Judge Richards: Three tons of this useles stuff are now in the hands of the public?

Witness: I am afraid they are. They ar probably in the hands of amateurs makin their own sets.

The Judge: So it is useless to them?

Witness: They are buying experience, bu after this case they will know quite a lot. Th evidence given in this case will be a bombshell to the trade.

The Judge: How much ebonite is used in a wireless set?

Witness: You may use two or three pounds on one panel.

The Judge: So taking it that three tons have been distributed, there are 5,000 people with defective wireless sets?

Witness: I should be astonished if it were not twice that. I don't say their sets are bound to fail, but they are likely to get leakage across where there is metallic matter in the ebonite. They will also have trouble in machining. It is not ebonite, it is rubbish.

Asked if he could suggest any purpose for which this material would be suitable, witness replied that in his long experience of ebonite he had never discovered such a purpose. He suggested that its real function would be that of a slow leak, such as a grid leak. Cross-examined, witness admitted that manufacturers of cheap wireless sets might employ such material.

Judgment was given for plaintiffs in both claim and counter-claim with costs, His Honour holding that the plaintiffs were unaware of the purpose for which the ebonite was required, and that the delay between the receipt of the goods and the complaint amounted to more than a "reasonable time." He indicated that this judgment would not deprive defendants of their right to an action for damages for breach of warranty.

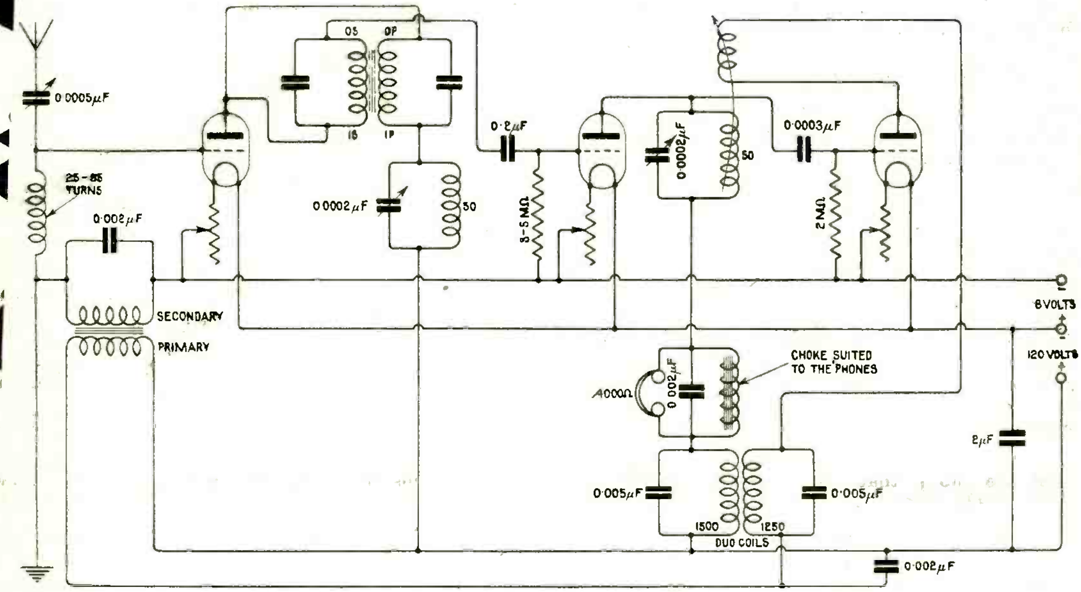
Correspondence

ual Armstrong Circuit.

To the Editor of The Wireless World and Radio Review.

Sir,—Readers will probably be interested in ie following combination of a super-regenerative et with dual amplification which I have come to fter much experimenting, and designed from data yards away from the set. One cannot miss the terrific howl heard when the right setting of condensers is attained.

The coils used are all basket coils wound on cardboard former with No. 26 D.C.C., 17 cuts, 2 in. internal diameter, and up to 6 in. exterior diameter.



Mr. Stainer's Dual Armstrong Circuit.

collected in past numbers of *The Wireless World and Radio Review.* Results are quite good using "R" valves and 120 volts on the plates, aerial and earth being disconnected. Manchester broadcasting comes in loud speaker strength. You will notice that with the two anode tuned high frequency valves before the Armstrong regenerator there is no, or very small, reradiation, although an exterior aerial is actually used. Tests with a portable receiving set have failed to show the slightest reradiation at a distance of 100 yards from the aerial, although there is no very great gain in signal strength with the use of an outdoor aerial, the limiting factor of the valve being there. I have not tried power valve, having none at hand.

The chief feature of the set is that by short circuiting the two Armstrong inductances, the set is an universal receiver for all wavelengths providing suitable coils are plugged in, and one has the advantage of dual amplification. Tuning is rather sharp, but I have used successfully a single valve autodyne receiver as a short wavemeter for tuning the set, the autodyne receiver being placed a few

Hoping some of your readers will still improve on it, I remain,

Faithfully yours,

A. L. Stainer.

Louvain, Belgium.

Spark Interference on Broadcast Wavelengths.

Sir,—In this neighbourhood, worse than any ship station is the D.F. Station at Goswick, near Berwick-on-Tweed, which sends on 450 metres. When working it completely jams all broadcasting, and interferes seriously, to put it mildly, as far away as Edinburgh. It is to be hoped that some one will take this matter up, as it must be an intolerable nuisance in Haddingtonshire and Northumberland, as well as here. As its useful sending is over water, it is hard to see why it need employ the power it does. It is about 21 miles in a direct line from here.—Yours, etc.,

Geo. G. Turnbull.

Grantshouse, Berwickshire.
July 7th, 1923.

Comparison of Time Signals.

To the Editor of The Wireless World and Radio Review.

Sir,—In reply to Mr. Trott's letter, *re* time signals from NSS and YN, in your issue of July 14th, I have been observing these signals for over two months, and have noticed that the "lag" of NSS varies considerably from day to day.

With all due respect to Mr. Trott, I suggest that another factor also comes in, viz., variations in transmission. I have never heard the NSS signal come before the YN signal, but I have heard them come exactly together.

I take off my hat to Mr. Trott as another who has not entirely forsaken the "long waves" for broadcasting, etc.

A. C. H. Bassano.

Old Hill, Staffs.

The "Wireless World" Dual Amplification Circuit.

To the Editor of The Wireless World and Radio Review.

Sir,—I have made up the dual amplification circuit described in the last issue, and have had splendid results from it already, using plain basket coils instead of Burndept type, and correcting the values accordingly.

It is certainly the best dual amplification circuit I have wired, and Mr. James is to be congratulated on his excellent article, which makes the wiring-up simplicity itself. I might say that within two minutes of soldering the last wire I was receiving signals. The concert from Manchester, 30 miles away, was very strong in the loud speaker, with less than 60 volts on the plates.

The only alteration I had to make from the initial wiring was to change round the leads from one of the transformer secondaries to cut out a howl.

I find that a carborundum crystal is quite efficient, and the music is very pure with this type of rectifier. The circuit is very silent, and in every way is excellent.

Louis J. Wood.
Hon. Sec., Halifax Wireless Club.

Calls Heard.

(*Listeners-in are invited to forward to the Editor lists of experimental stations heard for inclusion under this heading.*)

Shepherd's Bush, London.
2 AH 2 AJ 2 AN 2 BZ 2 DK 2 FQ 2 FU 2 ID 2 JV 2 KV 2 KZ 2 LT 2 MF 2 MJ 2 MK 2 MO 2 OM 2 PA 2 QN 2 QQ 2 TI 2 VJ 2 XB 2 XL 2 XZ 2 YS 2 YY 2 ZA 2 ZO 5 AD 5 AR 5 AQ 5 AY 5 BT 5 CB 5 CP 5 DR 5 HY 5 IO 5 IS 5 LP 5 MA 5 OX 5 PB 5 PU 5 SU 5 VL 5 VM 5 YD 5 YP 5 YR 6 HD 6 IM

(F. G. Bowles).

Manor House, Boxworth, Cambridge.
2 KE 2 OM 2 SZ 2 TO 2 TV 2 UV 2 WD 2 WJ 5 DT 5 GF 5 GS 5 LP 5 PU 5 QQ 5 RI 5 TG 5 ZV

(E. B. Thornhill).

REGULAR TRANSMISSIONS

of Meteorological and other European Wireless Telegraphy and Telephony Stations.

(*Continued from page* 574, 28*th July*, 1923.)

ADDITIONS.

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
1100	Eilvese	QUI	9,600	C.W.	Transatlantic News bulletin.
1100	Friedrichsort	KBK	600	Spark	Weather forecast for Western Baltic.
1100	Borkum	KBM	600	Spark	Navigation warnings.
1100	Lyngby	OXE	5,600	C.W.	News (in English).
1200	Prague	PRG	4,500	C.W.	News (in French).
1200	Nauen	POZ	4,700	C.W.	Navigation warnings.
1200	Sevastopol	RCT	2,500	Spark	Weather report for Black Sea.
1200	Casablanca	CNP	600	Spark	Weather report.
1205	Paris	FL	3,200	Spark	News in French.
1220	Nauen	POZ	9,400	C.W.	News.
1220	Nauen	POZ	4,700	C.W.	News.
1230	Lyons	YN	15,100	C.W.	Press message in English.
1244	Devizes	GKU	2,100	C.W.	Calibration signal.
1300	Archangel	RCE	1,800	Spark	Weather bulletin.
1300	Moscow	RAI	5,000	Spark	Russian synoptic report.
1300	Lausanne	HB2	1,100	C.W.	Aviation weather bulletin.
1305	Borkum Riff Lightvessel	KBR	600	Spark	Synoptic report.
1305	Amrumbank Lightvessel	KAF	300	Spark	Weather report in plain language (German).

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
1305	Cranwell	GFC	1,300	C.W.	Synoptic reports transmitted in succession by the stations named.
1305	Leuchars	GFD	1,300	C.W.	
1305	Grain	GFG	1,300	C.W.	
1305	Calshot	GFL	1,300	C.W.	
1305	Plymouth	GFM	1,300	C.W.	
1305	Shotwick	GFO	1,300	C.W.	
1305	Renfrew	GER	1,300	C.W.	
1310	List	KAL	1,250	Spark	Weather bulletin in plain language (German).
1310	Friedrichsort	KBK	720	Spark	Synoptic report.
1315	Lorient	FUN	2,800	C.W.	Meteorological report.
1315	Eilvese	OUI	14,400	C.W.	Transatlantic news bulletin.
1320	Prague	PRG	4,600	C.W.	News.
1325	Rochefort	FUR	3,300	C.W.	Meteorological report.
1325	Brest	FUE	2,800	C.W.	Meteorological report.
1330	Frankfort-on-Main	FR	1,875	C.W.	Weather bulletin.
1330	Pillau	KAP	600	Spark	Weather bulletin.
1330	Bordeaux-Lafayette	LY	23,450	C.W.	News in English.
1330	Sidi Abdallah	FUA	5,150	C.W.	Tunisian synoptic report.
1345	Ain el Turk	FUK	3,300	C.W.	Algerian and Tunisian synoptic report.
1345	Berlin	DL	2,000	C.W.	Weather bulletin.
1355	Kavite (Philippine I.)	NPO	5,200	C.W.	Time signals.
1400	Mediouna	CNM	5,000	C.W.	North African synoptic report.
1405	Danzig	DG	1,950	—	Weather bulletin.
1420	Breslau	BU	1,550	C.W.	Weather bulletin.
1425	Rochefort	FUR	3,300	C.W.	Meteorological report.
1430	Monsanto	CTV	600	Spark	Weather bulletin in plain language (Portuguese).
1500	Arlington (U.S.A.)	NAA	5,950	C.W.	Weather forecast.
1500	Athens	SXG	3,600	Spark	Press message.
1500	Borkum	KBM	600	Spark	Navigation warning.
1530	Arlington (U.S.A.)	NAA	5,950	C.W.	Weather bulletin.
1600	Nantes	UA	2,800	Spark	Navigation warning.
1600	Leafield	GBL	8,750	C.W.	Foreign Office news message.
1600	Coltano	ICC	10,750	C.W.	Working with Halifax (Canada).
1605	Königswusterhausen	LP	5,700	C.W.	European upper air report.
1605	Shotwick	GFO	1,300	C.W.	Synoptic report.
1605	Renfrew	GER	1,300	C.W.	Synoptic report.
1615	Amrumbank Lightvessel	KAF	300	Spark	Weather report in plain language (German).
1615	Mediouna	CNM	1,500	Spark	Weather bulletin.
1615	Casablanca	CNP	1,800	Spark	Moroccan weather forecast.
1630	Adlergrund Lightvessel	KAG	300	Spark	Weather report in plain language (German).
1630	Carnarvon	MUU	14,000	C.W.	Press message.
1640	List	KAL	1,250	Spark	Weather bulletin in plain language (German).
1644	Devizes	GKU	2,100	C.W.	Calibration signal.
1700	Cadiz	EAC	2,540	Spark	Press message.
1700	Coltano	ICC	10,750	C.W.	U.R.S.I. signals.
1715	New Holland (Petrograd)	RAC	1,600	Spark	European weather report.
1755	Lausanne	HB2	1,100	Telephony	Weather forecast for Switzerland.
1800	Oran	FUK	600	Spark	Navigation warnings.
1800	Moscow	MSK	5,100	Spark	Press message.
1800	Lausanne	HB2	1,100	C.W.	Aviation weather bulletin.
1805	Cranwell	GFC	1,300	C.W.	Synoptic reports transmitted in succession by the stations named.
1805	Leuchars	GFD	1,300	C.W.	
1805	Grain	GFG	1,300	C.W.	
1805	Calshot	GFL	1,300	C.W.	
1805	Plymouth	GFM	1,300	C.W.	
1805	Shotwick	GFO	1,300	C.W.	
1805	Renfrew	GER	1,300	C.W.	

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
1805	Borkum Riff Lightvessel..	KBR	600	Spark ..	Synoptic report.
1810	Friedrichsort	KBK	720	Spark ..	Synoptic report.
1815	Friedrichshafen	FD	1,300	C.W. ..	Weather bulletin.
1815	Lorient	FUN	2,800	C.W. ..	Meteorological report.
1820	Danzig	DG	1,950	—	Weather bulletin.
1825	Brest	FUE	2,800	C.W. ..	Meteorological report.
1830	Frankfort-on-Main ..	FR	1,875	C.W. ..	Weather bulletin.
1830	Pillau	KAP	600	Spark ..	Synoptic bulletin.
1830	Sidi Abdallah	FUA	5,150	C.W. ..	Tunisian synoptic report.
1840	Malta	GHA	4,800	C.W. ..	Synoptic report.
1845	Ain el Turk	FUK	3,300	C.W. ..	Algerian and Tunisian synoptic report.
1845	Berlin	DL	2,000	C.W. ..	Weather bulletin.
1855	Breslau	BU	1,550	C.W. ..	Weather bulletin.
1900	Eilvese	OUI	9,600	C.W. ..	Transatlantic news bulletin.
1900	Coltano	ICC	10,750	C.W. ..	Naval traffic.
1900	Borkum	KBM	600	Spark ..	Navigation warning.
1900	Mediouna	CNM	5,000	C.W. ..	North African synoptic report.
1905	Konigsberg..	KÖ	1,150	C.W. ..	Synoptic report.
1905	Amrum Bank Lightvessel..	KAF	300	Spark ..	Weather report in plain language (German).
1910	List	KAL	1,250	Spark ..	Weather bulletin in plain language (German).
1930	Naples	ICN	3,800	C.W. ..	Southern Italy weather report.
1930	Prague	PRG	4,600	C.W. ..	Press message.
1930	Taranto	ICT	5,000	C.W. ..	East Mediterranean weather forecast.
1940	Florence	G'IF	900	—	Northern Italy weather report.
1945	Warsaw	WAR	2,100	Spark ..	Press message.
1950	Beirout	UAB	6,100	C.W. ..	Syrian synoptic report.
2000	Constantinople, Osmanie..	OSM	7,500	C.W. ..	Turkish synoptic report.
2000	Leafield	GBL	8,750	C.W. ..	Foreign Office news message.
2000	Karlsborg	SAJ	2,500	Spark ..	News.
2010	Paris	FL	8,000	C.W. ..	News.
2030	Lyons	YN	15,100	C.W. ..	News.
20 0	Nauen	POZ	4,700	C.W. ..	News.
2030	Bordeaux-Lafayette ..	LY	23,450	C.W. ..	News.
2044	Devizes	GKU	2,100	C.W. ..	Calibration signal.
2045	Coltano	ICC	10,750	C.W. ..	Italian Meteorological report.
2100	Malin Head	GMH	600	Spark ..	Weather forecast and report.
21 8	Land's End	GLD	600	Spark ..	Weather forecast and report.
2130	Norddeich	KAV	1,800	Telephony	Synoptic report and forecast for North Sea.
2130	Budap st	HB	3,1[illegible]0	Spark ..	News in French.
2130	Monsanto	CTV	600	Spark ..	Portuguese synoptic report.
2145	Brest	FUE	2, 00	C.W. ..	Weather bulletin.
2145	Swinemü ıde	KAW	1,800	Telephony	Weather forecast for Western and Middle Baltic.
2155	Moscow, Khodynka ..	RAI	5,000	Spark ..	Time signals.
2200	Arlington (U.S.A.) ..	NAA	5,950	C.W. ..	Weather forecast.
2200	Coltano	ICC	10,750	C.W. ..	Working with Halifax (Canada).
2220	List	KAL	1,250	Spark ..	Weather forecast in plain language (German).
2230	Lyons	YN	15,100	C.W. ..	Press message.
2300	Borkum	KBM	600	Spark ..	Navigation warnings.
2330	Nauen	POZ	12,600	C.W. ..	Transocean news.

OBSERVATIONS ON ATMOSPHERICS*

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LET me say in the first place how much I appreciate the privilege of talking to you about atmospherics under the chairmanship of my own chief†, and during the presidency of Dr. Eccles. Dr. Eccles and I are, I think, the only two people in these islands who have consistently loved atmospherics, or X's, as we affectionately call them, for their own sakes; while everyone else has been calling them horrid names, such as strays, static, parasites, sturbs, and much worse names than that.

Not very long ago it would have been easy to tell you in an hour's lecture—from a half-sheet of notepaper, so to speak—all that was known about atmospherics. Happily that is not now the case, and failure in a recent attempt to crowd into three hours a summary of recent work on the subject warns me that I must be highly selective in my present attempt. I propose, then, to limit myself to some recent investigations under the auspices of the Radio Research Board, and I must ask you not to interpret the absence of reference to many other recent papers on the subject as anything other than a confession that lack of time will tie me to the things with which I myself have been most closely associated. I particularly want to tell you about British work on this subject, because a good deal of the work has not been widely published, and I am anxious to show that, in atmospherics research at least, Great Britain has always, since the classical work of Eccles and Airey in 1911, been well ahead in all save what I may call the publicity aspect.

The patent offices of the world are bulging with specifications for anti-interference devices, which we may conveniently call X-stoppers. Between 1906 and 1918 about a hundred such specifications have been published in Great Britain, and yet one of the few conclusions on which all radio engineers are in agreement is that the greatest unsolved problem in radiotelegraphy is that of interference by atmospherics. Why is this?

When Scotland Yard want to stop a culprit—someone who has been reacting directly into his aerial circuit for example—they circulate a complete description of the man and his habits, his height, his breadth, the colour of his eyes, the route by which he is supposed to be travelling. But the X-stoppers have almost invariably gone to work without inquiring about the appearance and habits of their culprits. In some cases they have made up an interesting description of what a culprit ought to look like, and acted on that. I admit that it wasn't entirely their fault, but I do feel strongly that until we know about the X and its habits, until we can write the first few chapters of a treatise on "The Nature and Origin of Atmospherics," we shall not go far towards the elimination from our receiving gear of the noxious effects of atmospherics. It is easy to specify the sort of thing we want to know about atmospherics. We want to know their shape and size, how long they last, at what intervals they follow one another, where they come from, along what routes they travel, whether they travel along the earth's surface or come down from aloft, and what causes them.

Now the earliest and crudest of observations enable us to say this much about the culprit—that he is a very big fellow, but doesn't last long enough to be measured by the methods applicable to sustained signals, and so it happened that until very recently indeed one could only deal with average values derived from observations on whole streams of atmospherics.

DIRECTION FINDING ON THUNDERSTORMS.

About 1915, indeed almost the only average measurement one could make with any hope of clear interpretation was that of the direction from which the main stream of atmospherics appeared to reach an observing station. Senatore Marconi had, in 1906, called attention to the fact that atmospherics had a predominant direction of arrival, varying from time to time, and suggested an investigation of the relation between this direction and the position of storm centres. I am not aware that the suggestion was acted upon until it was made again, independently, in 1915, and became the starting point of the work which I wish to describe to you.

Captain C. J. P. Cave was at that time investigating the possibility of warning flying officers of the approach of thunderstorms and line squalls, which may be a grave danger to aeroplane or airship, and was using the earliest type of recorder for atmospherics, a coherer recorder. Dr. R. Whiddington, now of Leeds University, suggested to him that the Bellini-Tosi radiogoniometer might be used to determine the direction from which the atmospherics were coming, and lent the apparatus necessary to make the test. We were able to show that the direction of arrival at Aldershot of atmospherics at noon of December 1st, 1915, corresponded to the position of a thunderstorm which was in progress at Selsey at that time. The results of the first six months' work were so encouraging that the Admiralty coastal direction-finding stations undertook to report to us the observed bearings of atmospherics. In the four years 1916—1920, 15,000 observations of the apparent direction of arrival of atmospherics were reported by twelve stations, 13,000 observations being made by six of the stations. I shall come in a moment to some of the uses we made of all this data, but I just want to fix a date for the first recognised location of a thunderstorm by radiotelegraphic means.

* A paper read before the Radio Society of Great Britain on June 27th, 1923.

†Admiral of the Fleet Sir Henry B. Jackson was in the chair.

Suppose we have a chart in which the line joining any point, representing in this case the "office of origin" of the atmospherics, to any other point, representing a direction-finding station, makes with the meridian line an angle equal to the "bearing" of the one point from the other, *i.e.*, an angle equal to that between the plane of the great circle joining the points and the plane of the meridian. Then if we lay off from each direction-finding station a line along the direction reported as that from which atmospherics are coming in, and if there is only one limited source of atmospherics, and if the electromagnetic waves constituting the atmospheric have travelled along great circles without deviation, and if the direction-finder has told the truth, then the lines will intersect at a point which indicates the position of the source from which the atmospherics have emanated. A chart on the gnomonic projection centred on 52 30′ N. 5 W., gives absolutely true bearings of any point from that centre, and the British Isles are so small that bearings from any other point within them other than this centre are negligibly in error.

Observations made by the naval stations of Roscarberry and Lizard, and by the Meteorological Office Station at Aldershot, on the evening of July 24th, 1916, gave a very good intersection near the sources of the Suir and Nore in S. Ireland. Later we learnt that exceptionally severe thunderstorms were experienced in this region at the time and date in question. The observations provided many cases of this kind, showing that the detection and location of thunderstorms by direction-finding is quite practicable.

I can quote here only one or two of the most striking cases of thunderstorms detected and located by these means.

At 5.30 a.m., on November 1st, 1917, three British Stations gave a good intersection off the North coast of Sicily, near Trapani. (I call an intersection good when the bearings come within 10 miles of meeting in a point). Trapani reported lightning to northward during the night hours. Trapani is 1,500 miles from Peterhead, the most distant station participating in the location.

At 8 p.m. of September 20th, 1916, four British stations gave an intersection in the Bay of Naples. Thunderstorms were occurring in Naples and all the surrounding country at this time. Naples is about 1,200 miles from the most distant participating station.

At 1.30 p.m., on July 29th, 1917, six British stations reported bearings all meeting at the town of Helmond, near the Eastern frontier of Holland. The Dutch Meteorological Service informs that thunder began at Helmond at 1.5 p.m., and the thunderstorm continued till after 2 p.m. Helmond is 165 miles from the nearest and 600 miles from the most distant station participating.

I have purposely chosen cases of very distant storms, because I think they constitute the best reply to the pessimist who says, "But, my dear good chap, you must know the X's get knocked about most horribly en route, Heaviside layer and all that, and the direction they appear to be coming from when they reach you needn't be anything like the direction from which they set out." One can only reply that if the great circle bearings produced over 2,000 k., intersect at a point where a thunderstorm was in progress at the time of observation, it takes a really enthusiastic pessimist to doubt the conclusion that the atmospherics have travelled straight from the thunderstorm without being deflected at all from the good navigator's great circle course, and without undergoing the other changes which may cause the direction-finder to give erroneous bearings.

Atmospherics and Rainfall.

But this agreement with thunderstorms reported by local meteorological observers is comparatively an infrequent occurrence. Taking the actual statistics of the two years 1916-1918, I find that there were 1,000 cases in which three or more stations obtained a bearing for atmospherics within the same hour; this we may take as an approximation to simultaneous observation. Of these 1,000 cases, the bearings gave reasonably small regions of intersection on the gnomonic chart in 500 cases. I have not yet been able to check more than 300 of these cases against ordinary meteorological data, on account of the difficulty of obtaining sufficiently detailed information about such phenomena, which may be very local. But of these 300 cases I have as yet found only 45 in which thunder was actually reported as heard or lightning seen near the place which the radio observations indicated as the source of atmospherics. To this 15 per cent. agreement with thunderstorms we may add another 10 per cent. supported by reports of squall phenomena, such as are usually associated with thunderstorms. This leaves 75 per cent. unaccounted for, 225 specified places accused of being, at a specified time, the source of atmospherics, and with their meteorological crime sheets more or less open to inspection. Examination shows that in 207 of these cases, or 69 per cent. of the original 300, rain was falling at place specified during the 24 hours containing the time of observation, without reports of any of the phenomena which one regards as distinctive of thunderstorms. Further, in 105, or 35 per cent. of the cases examined the apparent source of atmospherics lay on the advancing edge of an area of rainfall, on that edge where the convective stirring of the air which goes with rainfall is most active. We may sum up these results in this form :—

In 50 per cent. of the cases in which short wave direction-finding stations were able to obtain simultaneous bearings for direction of arrival of atmospherics, the intersection of these bearings indicated an apparent source of atmospherics in Europe or North Africa. And in 94 per cent. of the cases in which meteorological data are available, these sources are associated with rainfall areas with or without thunderstorms. Put into relation to the period of observation, the results show that on the average five locations per week were obtained, and more than half of these have already been accounted for in the comparison with meteorological data which is still being carried on. The figures which I have given you are therefore subject to minor revision, but the main conclusions cannot be substantially modified by other examination.

It is of interest to notice that some results of observations at Strassbourg fit in with our conclusions. Lacoste, in 1921 and 1922, using a frame antenna, concluded that atmospherics came from the south-easterly portions of depressions. Being derived from a very limited series of observations with a single direction finder, which is of course unable to give locations, as opposed to mere bearings, Lacoste's conclusion is somewhat sweeping. We had, in 1919-20, tried to bring some 10,000 observations into relation with depressions, and found that there was little evidence of a simple and general relationship. But when one considers that the south-easterly region of a depression is the region of most active convection, the Strassbourg results lend valuable support to the conception of a region of strong convection as a source of atmospherics.

The absence of thunder and lightning reports from rainfall areas identified as sources of atmospherics poses a very interesting problem for the meteorologist. Was the electro-magnetic wave train constituting the atmospheric radiated from a discharge identical with the visible and audible discharge called lightning ? If so, are such discharges taking place above the cloud sheet of all, or nearly all, rainfall areas ? And if so, why are the discharges not audible ? We may concede that they are not visible in the daytime because of the opacity of the cloud sheet, but why are they not visible over the edge of the cloud sheet at night ? And, if not, what possible discharge can be imagined, capable of radiating energy at a rate comparable with that involved in the propagation of atmospherics ?

Lightning as a Transmitter.

Mention of this question of radiation from lightning makes me revert to the data for typical thunderstorms locations which I quoted, and to use them to refute a common misconception. In 1912 Mosler asserted that the atmospherics radiated from lightning were not perceptible at distances of more than 100 k. from the source. De Groot, working in the Dutch Indies, specifies a range "certainly less than 900 k.," and Bellecsize, in his recent interesting paper on "Atmospherics," quotes the limiting range of 100 k. as generally accepted. I have a record of atmospherics from a distance of over 400 k. affecting a coherer recorder, for which no one ever invented a trade name beginning with "super." The thunderstorm at Helmond was located by stations, all of which were over 250 k., and one of which was 950 k., from the source. The thunderstorm at Trapani was 2,400 k. from the most distant station reporting it.

Indeed, it would be astounding if a lightning flash were such a poor transmitting station as to have a range of only 100 k. Consider the great French station at St. Assise, and consider a lightning flash. St. Assise has an antenna 170 m. high, and an antenna current of 500 amps. ; its metre-amperes are therefore 85,000 ; with these it has a range of more than the earth's semi-circumference —20,000 k. According to the measurements made by Mr. C. T. R. Wilson at the Solar Physics Observatory, Cambridge, an average lightning flash has a "moment" of at least 40 kilometre coulombs, constituted by a discharge of 20 coulombs through a height of 2 k. From measurements to be described later in this lecture, we know that an average atmospheric lasts for a five-hundredth of a second. The average current in the discharge is therefore of the order of 10,000 amperes, and the metre-ampere value of the lightning transmitter is twenty million, or 250 times that of the St. Assise station. Even when we divide this ratio by 40, the ratio of the equivalent wavelengths, it is

Tables O and I.

		Station	Total T	midnight - sunrise m	sunrise - noon r	noon - sunset u	sunset - midnight e	sunrise - sunset L	sunset - sunrise D	midnight - noon AM	noon - midnight PM	Spring P	Summer M	Autumn A	Winter W
Table O	Number of Observations	Peterhead	1366	412	84	240	630	329	1037	500	866	426	201	424	313
		Flamborough	1549	394	102	293	760	396	1153	496	1053	465	243	495	346
		Carnsore	4299	1388	364	945	1582	1318	2981	1766	2533	1226	966	776	1331
		Browhead	2675	760	228	519	1173	743	1932	983	1692	746	453	711	165
		Prawle	1569	288	61	282	938	341	1228	348	1221	300	144	516	609
		Lizard	1515	261	38	323	893	364	1151	308	1207	302	175	404	554
			12973												
Table I	Most Frequent Direction of Arrival of Atmospherics X_F	Peterhead	157	159	140	143	153	141	156	159	153	160	139	150	150
		Flamborough	146	157	133	122	147	120	142	155	143	153	133	138	147
		Carnsore	149	152	147	143	147	144	150	151	148	148	153	157	148
		Browhead	139	159	132	137	139	137	139	159	138	138	99	133	140
		Prawle	153	168	173	95	152	95	153	168	152	153	93	127	153
		Lizard	148	163	95	92	148	90	150	166	148	148	89	122	148
	Mean Direction of Arrival of Atmospherics X_M	Peterhead	51·1 ± 0·6	159·9 ± 0·9	129·4 ± 3·5	138·1 ± 1·7	151 ± 0·6	136·7 ± 1·5	154 ± 0·5	156·5 ± 1·0	146 ± 0·7	161·4 ± 0·5	141·6 ± 1·5	143·9 ± 1·1	151·8 ± 1·0
		Flamborough	141·2 ± 0·6	151·5 ± 0·8	132·3 ± 3·9	126·5 ± 1·7	142·3 ± 0·8	126·1 ± 1·6	146·4 ± 6	147·2 ± 1·5	138·3 ± 0·7	154 ± 0·6	137·7 ± 1·2	138·2 ± 1·3	142·2 ± 1·0
		Carnsore	148·4 ± 0·4	153·6 ± 0·8	151·9 ± 1·5	141·1 ± 1·0	147·3 ± 0·6	146 ± 0·8	150 ± 0·5	153·7 ± 0·7	145·3 ± 0·5	150·2 ± 0·5	147·4 ± 1·0	150·1 ± 1·1	147·2 ± 0·9
		Browhead	139·7 ± 0·6	157·3 ± 1·4	129·0 ± 3·0	124·8 ± 1·5	137·1 ± 0·6	128·6 ± 1·3	143·2 ± 0·7	154·8 ± 1·3	133·7 ± 0·6	161·5 ± 0·9	117·3 ± 2·0	136·7 ± 1·2	143·8 ± 1·2
		Prawle	150·5 ± 1·0	153·3 ± 2·6	171·9 ± 1·2	101·3 ± 2·6	148·6 ± 0·8	101·5 ± 2·5	158·7 ± 0·9	177·4 ± 2·0	148 ± 1·0	156·1 ± 1·2	104·6 ± 3·7	124·1 ± 1·9	158·8 ± 1·2
		Lizard	160·3 ± 0·8	165·7 ± 2·3	101·8 ± 7·7	105·8 ± 2·1	141·3 ± 0·6	98·2 ± 2·1	165 ± 0·9	161·1 ± 2·2	137·3 ± 0·8	150·1 ± 1·0	103·8 ± 3·0	128·6 ± 1·4	147·5 ± 1·3
	Standard Deviation from Most Frequent Direction σ_F	Peterhead	21·7	17·7	33·8	25·8	15·3	26·3	16·7	23·6	20·2	10·6	21·4	22·8	18·2
		Flamborough	24·4	16·4	39·6	26·8	19·6	32·5	19·6	27·0	24·2	13·4	29·0	28·5	18·3
		Carnsore	27·9	30·0	30·1	30·3	22·3	30·6	26·2	29·6	26·1	18·7	31·5	29·1	31·2
		Browhead	32·6	37·8	43·9	36·4	20·9	36·5	30·0	39	26·6	25·6	45·0	32·3	32·0
		Prawle	38·6	58·6	48·7	44·2	27·2	47·7	32·4	39·1	34·8	20·3	45·0	43·1	30·1
		Lizard	30·9	36·9	47·7	40·7	20·5	41·5	26·4	39·2	30·9	16·6	41·9	31·2	30·4

obviously absurd to set such a limit as 100 k. to the signalling range of the X transmitting station. It should be remembered that even those heavily-

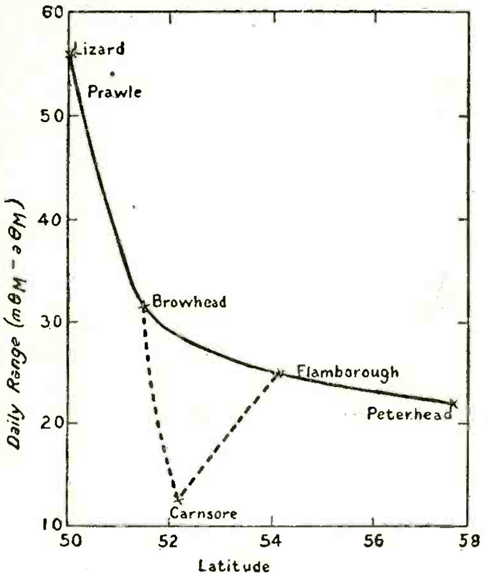


Fig. 1. Mean daily range of mean direction of arrival of atmospherics plotted against latitude.

absorbed short waves called light are detected by the short wave receiver called the eye, when they are radiated by night from a lightning flash within 400 k.

DIRECTIONAL OBSERVATIONS.

I pass now to another type of examination to which the directional data from coastal stations have been subjected. Of the 15,000 observations which I have mentioned, only some 2,000 were involved in the location of sources. But it is legitimate to ask that they should all take part in providing us with an indication of the most frequently disturbed direction, and of the daily and seasonal variations of the direction of greatest disturbance, with their relation to geographical position. A statistical analysis has therefore been made of the data for six of the stations, with the results shown in Tables 0 and I.

The most frequently disturbed direction, over the whole of the four years' observations, varies from 139° E. of true north, *i.e.*, approximately S.E., at Browhead to 157°, or S.S.E. at Peterhead. The direction of greatest disturbance varies, however, with the time of day and with the season.

If we divide the day into four periods—which we shall call morning (midnight to sunrise), forenoon (sunrise to noon), afternoon (noon to sunset), and evening (sunset to midnight)—we find that the apparent direction of arrival swings counter-clockwise as the sun's altitude increases, but lagging on the sun, being most southerly in the morning period, most easterly in the afternoon. (It should be explained that all observations have an ambiguity of 180°, but that all evidence, direct or indirect, points to the quadrant between east and south as being far more disturbed than the corresponding N.W. quadrant.) When we deal with the seasons in similar fashion, we find a somewhat similar rule of counter-clockwise swing following solar altitude, the mean direction of arrival swinging back through 30° between spring and summer. The greatest deviation from the mean occurs earlier in the west, later in the east. Figs. 1 and 2 reproduced, deal with the range of the daily swing in relation to geographical position, and with the scattering from the most disturbed direction, in relation to time of day, time of year, and geographical position. The "standard deviation" shown on these curves is a measure of the variability of the direction of arrival which may best be understood thus. On a compass face lay off a line representing the most frequently disturbed direction for any given period. On each side of this line lay off a line making with it an angle equal to the standard deviation. Then two-thirds of all the observed directions of arrival will fall within the range thus marked off. If there is very little scattering during the period the standard deviation will be small, the sector will be narrow, and *vice versa*.

The majority of the observations which we have been considering were made on circuits tuned to very short wavelengths. It is a matter of general experience that X disturbance increases very rapidly with increase of wavelength. For that reason the wavelength used in the Aldershot observations was gradually increased from 600 metres in 1915, to 5,000 metres in 1916, and up to 20,000 metres in 1920. It may be mentioned that the directional observations on these diverse

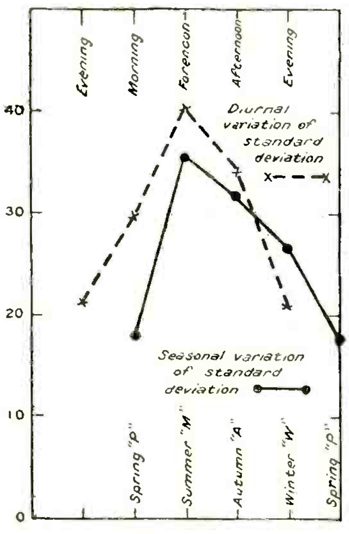


Fig. 2.

wavelengths fitted into locations with the short wave Admiralty observations.

We have examined the results of a year's observations made at Aldershot on a wavelength of 20,000

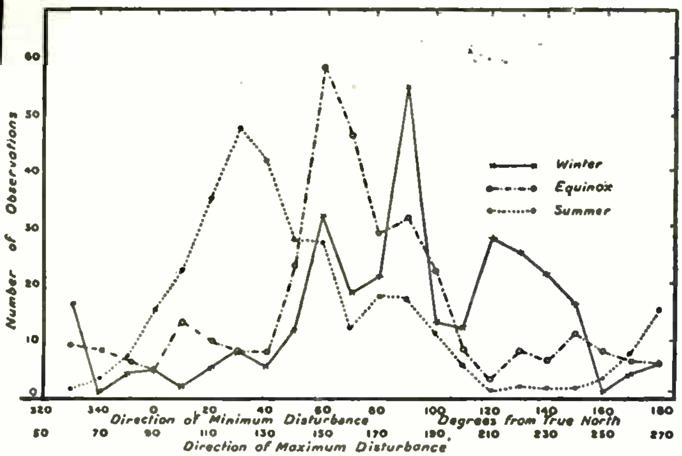


Fig. 3. Seasonal variation of direction of arrival of atmospheric frequency curves.

metres, and the general features of the data, as shown in Figs. 3 and 4 are in close agreement with those which I have just mentioned as derived from short wave data. We have the same law of counter-clockwise variation of apparent direction of arrival with the increasing sun's altitude, indicating an extremely definite control of either or both of (*a*) the position of the source of atmospherics or (*b*) the changes undergone by the atmospherics on their way from source to receiver, which, owing to the imperfections of the direction finder, cannot readily be disentangled from true variations in the position of the source.

A Directional Recorder.

I suppose we are none of us at all fond of doing work ourselves if we can get it done for us, and so while making these observations by listening in with headphones, we were trying to get an automatic recorder to do this work for us. Figs. 5 and 6 show you the arrangement of a type of recorder which has been listening-in for a year and a half at Aldershot. It consists of a frame antenna, 2 metres square, driven by a clock, and carrying a drum on which atmospherics are recorded by a syphon pen fitted to an Abraham-Bloch oscillograph. The atmospherics picked up by the frame are passed through an amplifier with 6, 7, or 8 stages, the oscillograph being in the plate circuit of triodes which are in parallel in the last stage. The recorder uses dull emitter triodes, and is very docile, requiring attention once a day only, for chart changing and clock winding. The filament accumulator is changed twice a week, the H.T. accumulator, 60 volts, once a week.

An atmospheric is recorded in a position on the chart which tells us three things: (1) the magnitude of the disturbance; (2) the time at which it arrived, and (3) the position in which the frame happened to be sitting when the atmospheric arrived. If the atmospherics are coming mainly from a specific direction we shall have a record in which the markings are crowded on the vertical lines corresponding to the direction from which they come, sparse in the region at right angles to this direction.

It will be clear that we can, by measurement from these records, plot curves showing the mean apparent direction of arrival, and the mean intensity of atmospheric disturbance for every hour of every day, and we may hope that the running of such recorders in various parts of the world may, with the minimum of effort, provide us with a general picture of the sorrow of the wireless operator on all the seven seas.

Just recently we have been experimenting on the possibility of making the recorder show the direction of arrival without the ordinary ambiguity of 180°. It is not an easy task to produce an arrangement which will give a sharply defined single minimum, but Figs. 7 and 8 show simultaneous charts from an ambiguous and

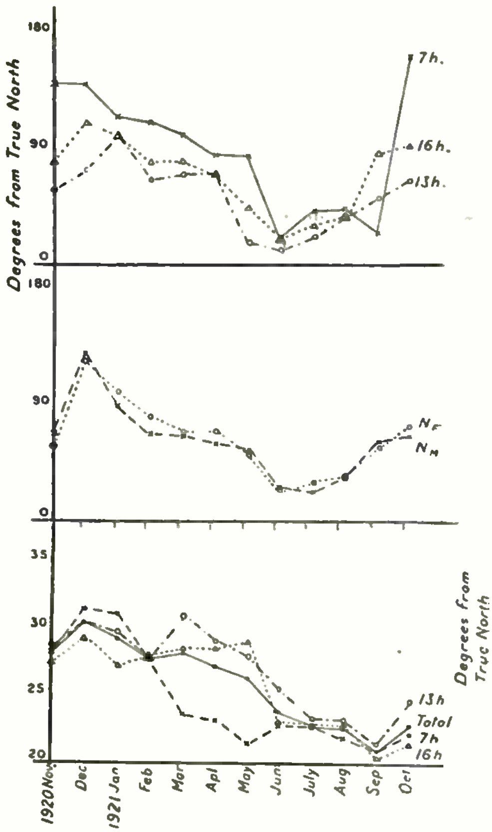


Fig. 4. Monthly mean directions of minimum atmospheric disturbance.

an unambiguous recorder and show how interesting such records would be.

The Wave Form of Atmospherics.

We have begun then to learn where the culprit comes from, something about the route he prefers, we have hints of strange vicissitudes on his journey. But what is he like? Well at last we are able to say something about these details, although we are only beginning on the long task of building up a portrait gallery of typical atmospherics.

When the Radio Research Board was formed in 1920, Dr. Appleton, of St. John's College, Cambridge, and I made independent suggestions that an instrument in which the moving part was a beam of slow moving electrons, a cathode ray oscillograph could be developed with sufficient sensitivity for the examination of individual atmospherics. While we were working towards the development of an instrument of sufficient sensitivity, the Western Electric Research Laboratories in America produced for other purposes a cathode ray oscillograph and the very type of instrument that we required, and Dr. Appleton and I joined forces to apply the new tube to the examination of atmospherics at the Aldershot station, the station which had been started in 1915 for the thunderstorm inquiry of which I have spoken, and which has now become the Radio Research Board Station, Aldershot, applying itself to the study of atmospherics in general.

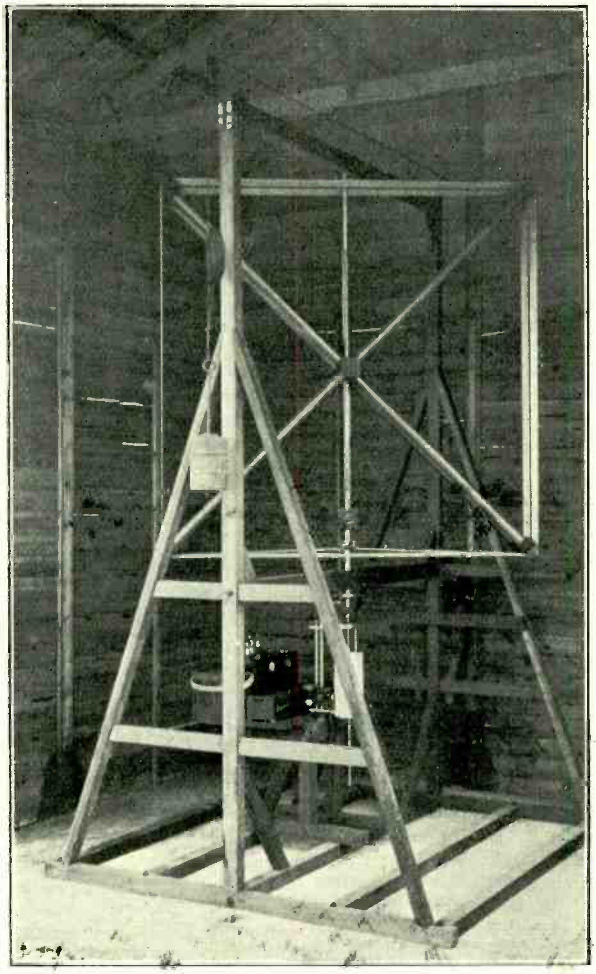


Fig. 5. Directional frame and apparatus used in recording atmospherics.

The electrode system is shown in greater detail in Fig. 9). A filament taking $1\frac{1}{2}$ amperes at 2 volts, emits electrons, which are accelerated by 400 volts applied between the filament and the tubular anode of 1 mm. bore. A beam of electrons shoots through this bore with a velocity of 25,000,000 miles per hour, and can b deflected by the electrostatic fields resultin from any potential difference between the deflecto plates, of which there are two sets at right angle The beam is focussed on the screen by ionisatio of a trace of argon left in the vacuum. A sharpl defined spot of brilliant green fluorescence i produced at the point where the beam strikes th screen, and if the beam is deflected at any spee other than a ver slow one, this spo is drawn out into a line which shows the path traced out by the spot. The afterglow of the fluorescent material, and persistence of vision, combine to enable us to see this line even when the deflection is executed very rapidly. In fact, if the electrons moving forward at a speed of 12,000 k/sec., are deflected so that they have also a transverse velocity of 1/10 k/sec., or 225 m.p.h., *i.e.*, so that the fluorescent spot may be regarded as travelling over the screen at this speed, the line of fluorescence is still distinctly visible, even though the line is traced once only.

In order to examine such a transient phenomenon as an atmospheric, occurring at any moment whatever, we must have some means of making the oscillograph draw a "graph" of the variation with time of the voltage produced by the atmospheric. This is accomplished by applying to that pair of deflecting plates which produces an horizontal deflection, a voltage from a low frequency triode oscillator. This oscillator is designed to give the nearest possible approach to a pure sine wave over a wide range of frequencies. Then the beam of electrons will trace on the screen a base line, whose length we can adjust by altering the coupling to the oscillator, and which is best visualised as the projection of a uniform circular motion seen edge on. If we consider one complete cycle of the oscillator, tarting from the left hand end of the base line, he spot starts from rest, increases in speed until he middle of the base is reached, then slows down radually till it comes to rest for a moment at the ight hand end. It then performs a similar motion rom right to left. If then the voltage due to the tmospheric be applied to the plates producing ertical deflection, we shall have this base being ontinually retraced before and after the arrival f the atmospheric, but while the voltage from the tmospheric persists we shall have a curve traced ut in which the abscissæ measure time on the inusoidal scale, whose main features we have raced, while the ordinates are proportional to the nstantaneous voltage produced at each moment by the atmospheric. Fig. 10, showing a curve on such a base, and then reduced to an even time scale, will show you the type of distorted picture obtained, and how it must be treated before it can be interpreted.

So much for the oscillograph and the picture it produces. We must now consider how we may obtain a voltage which shall tell us as much as possible about the atmospheric in the ether, without complications due to the receiving aerial and the auxiliary apparatus. You are aware that in any circuit containing inductance or capacity an applied electromotive force produces effects which are of two kinds—one a "free" disturbance whose form and duration depend only on the constants of the circuit, and on the conditions under which the external force is applied, the other a "forced" motion which reproduces faithfully the variation in the applied force. In order to examine the applied force, in this case the electromotive force produced in the antenna circuit by the variations of the external field constituting the atmospheric, we must—by choosing suitable values for the circuit constants—arrange that the free disturbance is negligible in relation to the forced motion, and we must know the scale on which the forced e.m.f. reproduces the external field variations.

Considering the antenna circuit represented by the diagram (Fig. 11), we have conditions such as are used in the circuits employed for determining the wave form of atmospherics. The capacity of the antenna to earth is represented by C_0. Its "effective height" is h metres. Its inductance is very small in comparison with C_0, a damping resistance R, of such value that the circuit is "aperiodic," *i.e.*, it is incapable of oscillating freely, is introduced, and a variable condenser C_1 is put in series with the resistance.

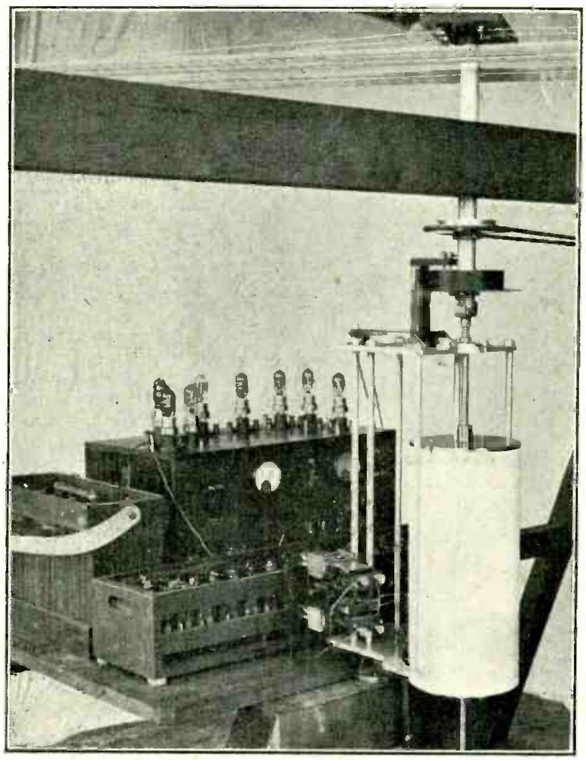


Fig. 6. Showing details of the directional recording apparatus.

In these circumstances the "free" disturbance will be of measureable amplitude for a period less than $5CR$ seconds, when C, the capacity of C_o and C_1 in series or $\frac{C_o\ C_1}{C_o + C_1}$ is measured in farads and R in ohms; after that time it is negligibly weak. If we can arrange that $5CR$ is very small compared with the duration of the atmospheric to be measured, then the free pulsation will be over and done with so early in the history of the atmospheric that we can neglect it. In practice $5CR$ is reduced below 1/10,000 sec.

If we join the oscillograph deflector plates across C_1, we shall have applied to them at any instant a voltage equal to

$$\frac{C_o}{C_o+C_1}$$

times the voltage existing in the antenna at that instant, and that antenna voltage will be h times the instantaneous field strength in the ether due to the atmospheric, measured in volts per metre. Thus if E is the field strength, V the voltage across the deflector plates,

$$V = \frac{C_o}{C_o + C_1} hE.$$

The deflection on the screen is proportional to V, it is in fact 1 mm. per volt, so knowing C_o, C_1, and h we can at once determine E.

In practice there is a slight complication to be introduced. The antenna which we erected at Aldershot for these experiments was a single 1,500 ft. span of galvanised steel cable, with a capacity of 2,550 $\mu\mu F$ and an effective height of 15 metres. If now we consider an atmospheric whose field strength is an eighth of a volt per metre, we should have a maximum voltage in the antenna of 15/8, or just short of two volts. We are unable to measure the total antenna voltage directly, however, and so we must introduce the condenser C_1, and C_1 must have such a capacity that the shunting effect of the oscillograph itself, which behaves as a 2 megohm leak, is negligible. This forces us to use a value for C_1 not less than 5,100 $\mu\mu F$. $\frac{C_0}{C_0 + C_1}$ becomes equal to $\frac{1}{3}$, and the voltage across C_1 falls below $\frac{2}{3}$ of a volt, the deflection below $\frac{2}{3}$ of a millimetre, too small to be measured.

There are two possible ways of overcoming this difficulty. One could try to reduce the shunting effect of the measuring instrument by making its resistance of the order of 10 megohms, in which case C_1 could be made five times smaller and a nearer approach to the antenna voltage attained; one could amplify the voltage across C_1 by a known amount before applying it to the oscillograph. Or we can do both at once. We can interpose between condenser and oscillograph one stage of amplification, using the resistance battery coupling so that the amplification may be independent of the duration of the disturbances. A suitable triode, such as the Western Electric 102 D.W., will give us a voltage amplification of 15 to 20 without difficulty and the grid circuit, shunted across C_1, has a resistance of 50 megohms, and even with a grid leak of 10 megohms, to enable the amplifier to be worked at a point where a long range of linear amplification can be obtained, the shunt is now 8 megohms instead of 2, and we have a deflection of 1·5 cm. per condenser volt instead of 1 mm. per volt.

With these we can proceed to copy the instantaneous pictures on the screen, knowing that they are, within limits which we recognise, faithful reproductions of the field changes in the ether (if ether there be) due to atmospherics. As it is impossible to demonstrate to the whole of a large audience at once the working of the apparatus, I propose to show it in operation at the end of the lecture. (*A demonstration was given at the end of the lecture.*) Fig. 12 illustrates typical atmospherics and we must imagine the base line to be visible all the time, though we must now cut it off for a moment. We draw the shape we have seen, mark against it the peak voltage read from a scale written on the tube itself, note the base frequency and the value of the coupling capacity, and wait for the next atmospheric. The waiting is not tedious, a normal night provides a hundred pictures per hour. Fig. 12 shows panels from the portrait gallery, these are untouched photographs of the original sheets on which the screen images were drawn down, and indicate the diversity of form which is met with. There are, however, well marked families of atmospherics and the four main classes are shown in the figure. The first classification one can make is that of aperiodics in which

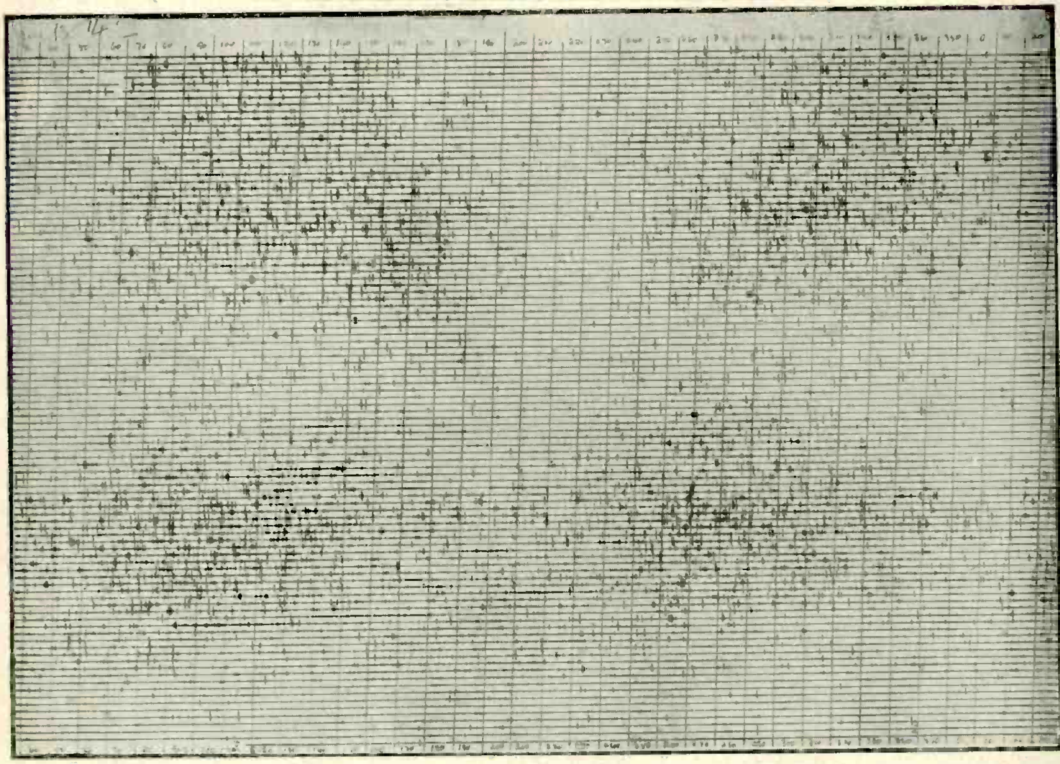


Fig. 7. Chart from ambiguous directional recorder for atmospherics, 1932 *G.M.T. June* 13*th to* 1923 *G.M.T. June* 14*th.*

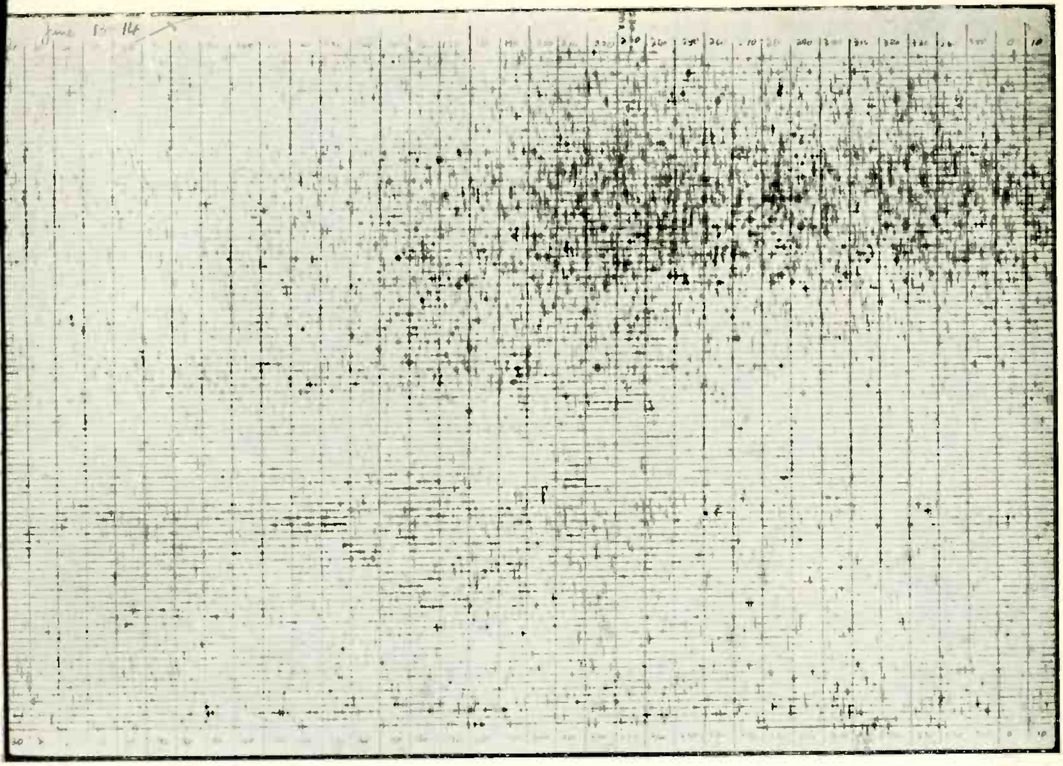


Fig. 8. Chart from unambiguous recorder. 0813 *June* 13*th to* 0812 *June* 14*th.*

the measured voltage does not reverse in sign, and the quasi-periodics, in which one or more reversals take place during the discharge. These two types may each be subdivided into two classes, peaked and rounded. I shall enumerate, very briefly, the principal characteristics of the first six hundred examined by the cathode ray oscillograph, as shown in Tables II. and III.

On the whole the quasi-periodics occur a little more frequently than the aperiodics, their larger half wave is as often positive as negative and the mean peak field strength is 1/8 v/m. The quasi-periodic lasts for a five-hundredth of a second, and usually contains one complete oscillation. Thus his frequency is about 500 per second, his wave-length is 600,000 metres; since accuracy of tuning is not of much importance in this case, we may say that it lies between half a million and a million metres; a single wavelength would stretch from 5 LO to 5 SC and beyond.

The aperiodics have about the same peak field strength; the majority of them do not last so long as do the quasi-periodics, the most frequently noted duration being 0·0012 sec. The aperiodics showed a notable predominance of atmospherics producing an upward electromotive force in the aerial, aperiodic atmospherics of this sign being seven times as numerous as those of the opposite sign.

The rounded forms are 2.43 times as frequent as the peaked forms, and the maximum voltage of the peaked form is 2.14 that of the rounded form. It is curious and significant that these two ratios remain the same, within a fraction of 1 per cent., whether aperiodic or quasi-periodic atmospherics are considered.

In many cases the observed wave forms included ripples whose periods were such as to bring them near or within the upper range of radio wavelengths, and in many other cases the forms were too complicated to be readily interpreted.

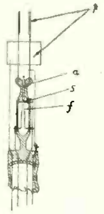


Fig. 9. Electrode system of Western Electric cathode ray oscillograph.

We may compare the field strengths just specified with those due to signals, and with the permanent field existing in the atmosphere.

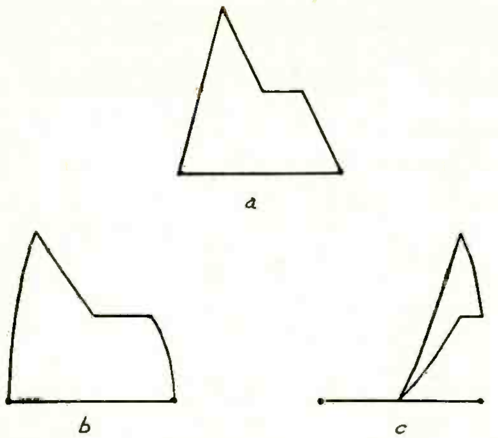


Fig. 10. *Figure drawn on (a) linear base, (b) and (c) sinusoidal base.*

On the one hand, when we compare the atmospherics with the more or less steady field due to the earth's charge, we find the atmospheric producing a change of $\frac{1}{8}$ of a volt per metre in a field of about 200 volts per metre. On the other hand, the field strengths corresponding to good transatlantic reception need not be so great as 50 millionths of a volt per metre. So, to take a rough analogy, if we were to represent the transatlantic signal by a tiny ripple 1 cm. high and 1 cm. long on the ocean of the earth's field, we should have to picture an ocean 40 kilometres deep, and the average

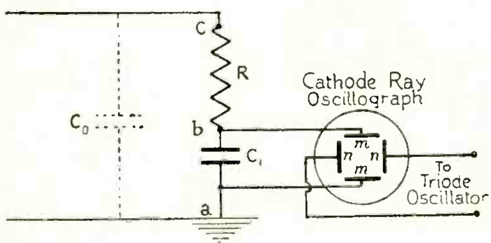


Fig. 11.

atmospheric as a mighty tidal wave, "as steep as a house end," 25 metres high and only half a metre long. This ocean would have a slow swell and other tidal waves, some higher but much less steep —but that is another story.

Conclusion.

I have confined myself to-night to the description of established methods of investigation, and to the presentation of observed facts. I have been unable to touch on the most recent work at Aldershot, because there are some very interesting experiments which are only in the earliest stages of development. I have omitted mention of work done abroad. I have avoided all speculation. I have not once mentioned the ruddy planet Mars, because I want to urge that what is needed to clea[r] the fog of mystery which seems to have envelope[d] atmospherics is not a speculation, is not a poun[d] of theory perilously perched upon an ounce of fact is not an occasional observation isolated in spac[e] and time with unspecified circuit constants, but i[s] simply measurement—measurement which nee[d] not be elaborate or difficult, but which must b[e] organised, systematic, and sustained.

In conclusion I would suggest that ther[e] is much that you, individually and as a society, can do to elucidate the problem of atmospherics. The recording of the atmospherics occurring immediately after time signals, which was asked for by the British Association Committee just before the war, can be done by most amateurs who care to add a simple recording device to their amplifiers. The last slide of all shows the type of records one can obtain from a simple syphon recorder. Many of you have frame aerials with which you can make systematic directional observations on atmospherics. Some of you may care to attempt a solution of the most untouched problem of the inclination to the vertical of the wave front in atmospherics. Some might prefer to try forecasting local weather by observation of the types of atmospherics preceding different meteorological events. And some could help us in our work at Aldershot by sending us a

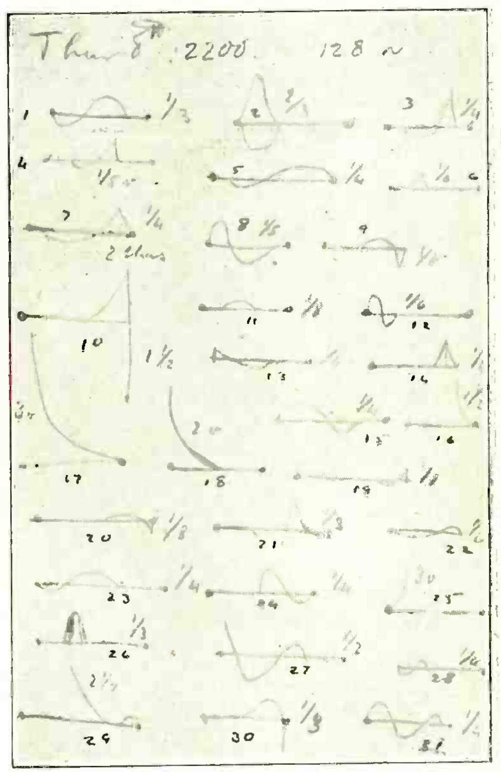


Fig. 12. *Typical drawings of atmospheric wave forms.*

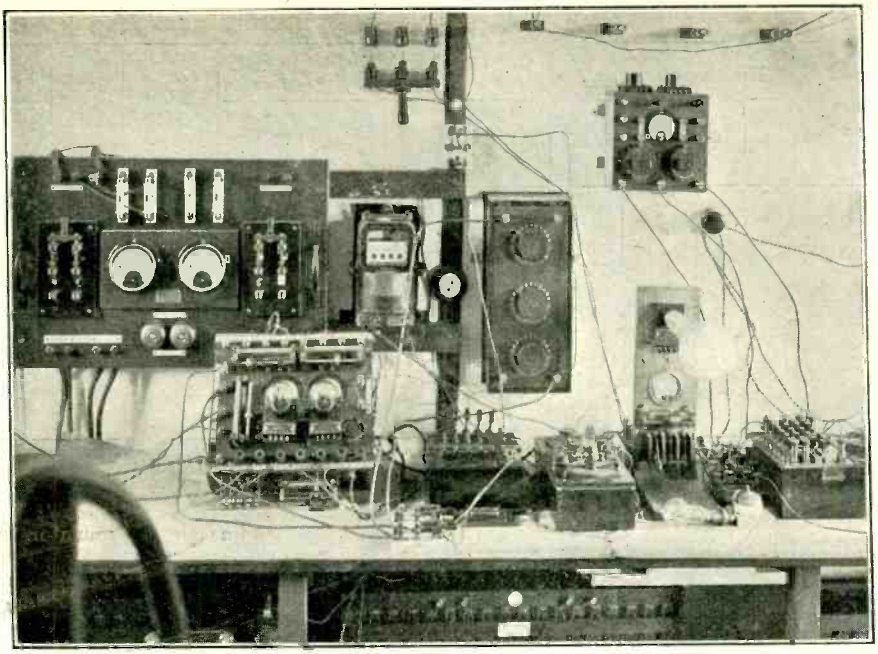


Fig. 13. Apparatus for examination of wave form of atmospherics.

Table II.—Characteristics of the Main Types.

Type and sign	Number observed.	E, v/m.			Duration, μ s.			Period.	Peak ratio.
		Mean.	Mode.	Maximum observed.	Mean.	Mode.	Maximum observed.		
A + ..	38	0·05	0·035	0·10	1475	1250	2,500		
A − ..	254	0·14	0·045	0·80	4625	1250	55,000		
A both signs	292	0·125	0·04	—	4245	1250	—		
Q + ..	105	0·20	0·04	0·67	2075	2000	8,500	2320	1·8
Q ± ..	73	0·07	0·025	0·33	1925	2000	13,750	2880	
Q − ..	120	0·10	0·04	0·58	1800	2000	10,000	2580	2·0
All Q's ..	298	0·13	0·04	—	1900	2000	—	2600	

postcard specifying the place and the exact time—really exact time to a second or two—at which lightning flashes are observed by them.

I have to express my indebtedness to the Radio Research Board, under the chairmanship of Sir Henry Jackson, for providing the facilities for carrying out most of the work which I have described, and for permission to talk to you about it. I am also indebted to Mr. J. F. Herd, M.I.Rad.E., professional assistant at the Aldershot station, for

TABLE III.—CHARACTERISTICS OF THE SUB-TYPES.

Type.	Number observed.				Mean E, v/m.				Mean duration	Cycle ratio.	Slope ratio.	
	+	±	−	Total.	+	±	−	Total.			1.	2.
									μ s.			
A peaked ..	1	—	50	51	0·07	—	0·12	0·12	1080	—	5·0	1·64
A rounded ..	33	—	91	124	0·045	—	0·06	0·056	1470	—	2·0	1·13
Q peaked ..	10	9	28	47	0·094	0·084	0·095	0·092	2290	1·2		
Q rounded ..	29	37	48	114	0·045	0·032	0·052	0·043	2115	1·5		
A	34	—	141	175	—	—	—	0·075	1280			
Q	39	46	76	161	—	—	—	0·058	2160			
Peaked ..	11	9	78	98	—	—	—	0·11	1650			
Rounded ..	62	37	139	238	—	—	—	0·05	1730			

* (1) Gives mean with values > 10 included as 10.
(2) Gives mean with values > 10 excluded.

preparing the demonstration (*a demonstration was given at the close of the meeting*), and to your Secretary for lending the accumulators necessary for the experiment.

QUESTIONS AND ANSWERS

"A.B.C." (Burton-on-Trent) *asks* (1) *If a small fixed condenser could be permanently connected in series in the aerial circuit, retaining a variable condenser in parallel with the aerial tuning inductance.* (2) *What is the most suitable metal for the "cat whisker" of a crystal detector in which synthetic galena is employed.* (3) *How can the strengths of different signals be compared.*

(1) The arrangement is to be recommended in some cases. You should find by experiment whether the results are improved through adding the condenser. (2) Various metals have been used with equally satisfactory results. We suggest that you make tests with brass, copper and gold "cat whiskers." (3) The strength of signals may be compared by the shunted telephone method, which is described in most wireless text-books.

"J.W." (Bristol) *asks* (1) *With reference to the article, "The Construction of a Four-Valve Detector Amplifier" in the issue of March 24th, how is a three-coil tuner connected to the set.* (2) *If the ends of the filament resistances for the L.F. valves should not be connected to negative L.T. instead of positive in the circuit diagram of his set.*

(1) The three coils of the tuner should be arranged so that the aerial tuning inductance is at one side, the closed circuit inductance in the middle, and the reaction coil on the other side. The two terminals of the aerial tuning inductance are connected to aerial and earth respectively, the two terminals of the closed circuit inductance are connected to the terminals marked "A" and "E" on the set, and the reaction coil terminals are connected to the two terminals marked "R" on the set. (2) The filament resistance connection in this diagram is not correct. The end of the filament resistance should be connected to negative L.T., as you point out.

"A.S.C." (Faversham) *asks* (1) *If a satisfactory telephone transformer could be made by utilising an iron core* ½″ *in diameter and* 2½″ *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. They should be wound on a former 1½″ 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.

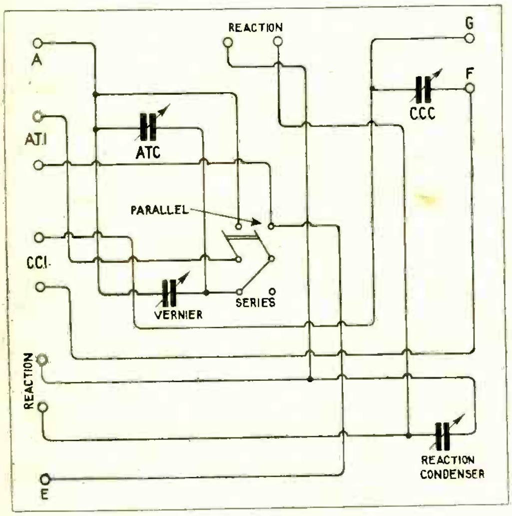
"A.B.C." (Bradford), *submits a diagram of a three-valve set and asks* (1) *With reference to the circuit given in reply to* **"D.T." (S.E.22)** *on page*

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 diameter.* (3) *What should be the width of the formers, and the number of pins on each.*

(1) The circuit given in reply to **"D.T." (S.E.22)** would be preferable to the one submitted. (3) and (2) Use No. 26 D.C.C. wire, and wind coils on formers of 2″ in diameter, 1″ in width, and having 30 pins on each face with the following numbers of turns: aerial 75 and 35 turns; secondary 50 and 75 turns; reaction 75 and 100 turns; anode 75 and 100 turns.

"J.G.D." (Lewisham) *submits a diagram of a two-valve set, detector and one L.F. valves, and asks* (1) *Why it is impossible to tune out the transmissions from the London broadcast station when receiving the transmissions from other broadcast stations, using a set constructed according to the diagram submitted.* (2) *Why the addition of a H.F. amplifying valve decreases the strength of signals received.* (3) *For a diagram of a one-valve H.F. amplifying panel, to include a switch for cutting out the valve when desired.* (4) *If various alterations to his aerial would be advisable.*

(1) The principal reason why you cannot tune out the transmissions from **2 LO** is because you are employing a single circuit tuner. We recommend that you employ a loose coupled tuner, the closed circuit coil being tuned with a 0.0005 mfd. variable condenser. (2) You have not given us particulars of the H.F. amplifier. We presume the H.F. circuits are capable of being tuned to the correct wavelength. If you are employing reaction it is just as well to reverse the connections to the reaction coil when a valve is switched in between the detector and the aerial circuit. (3) A suitable diagram is given in Fig. 1. (4) We think that you would be well advised to retain your aerial.



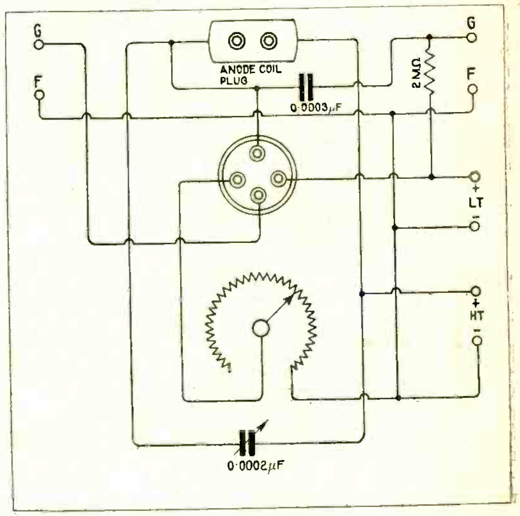


Fig. 1. **"J.G.D." (Lewisham).** *Tuner and single valve H.F. panel.*

"DUSTY" (Yorks) *asks the following questions with reference to Fig. 1, page 61, of the issue of April 14th.* (1) *If a set constructed from this diagram would be approved by the P.M.G.* (2) *How much wire of the same size as sample submitted. should be used for the primary winding of a L.F. intervalve transformer, and also for a telephone transformer.* (3) *What would be the gauge and weight of wire to use for the secondary windings of the transformers.* (4) *If "The Radio Experimenters' Handbook," by P. R. Coursey, will give information on the building of coils.*

(1) If, when constructed, the set is incapable of setting up oscillations in the aerial circuit, it would be approved by the P.M.G. The circuit is a good one, the reaction coil being coupled with the anode coil. (2) and (3) The sample of wire submitted is No. 34 D.C.C., and is not suitable for use in an intervalve transformer, but may be used for the secondary winding of a telephone transformer. An intervalve transformer may be built as follows:—Primary winding 8,000 turns of No. 42 S.S.C., secondary winding 20,000 turns of No. 44 S.S.C. Core ½″ in. diameter of No. 22 soft iron wire. The telephone transformer primary winding may have 8,000 turns of No. 42 S.S.C. and a secondary winding of 1,500 turns of No. 34 S.S.C.

"F.W." (Manchester) *submits a diagram of a three-valve set, detector, and two L.F. valves, and asks* (1) *If the diagram is correct.* (2) *If the variometer in the plate circuit of the detector valve will produce regeneration.* (3) *Would the production of oscillation render the set unsuitable for the reception of British broadcast transmissions.*

(1) The diagram is correct. (2) A variometer will give regenerative effects when connected in

the plate circuit of the rectifier valve. (3) It is not permissible to use any form of reaction which will set up oscillations in the aerial circuit, during the hours of British broadcast transmissions.

"E.C.G." **(Luton)** *asks* (1) *For a diagram of a five-valve receiver employing two H.F., detector, and two L.F. valves. A series-parallel switch is required for the aerial condenser, and switches for controlling the number of valves in use.*

The diagram is given in Fig. No. 2.

"**H.J.N.W.**" **(Birmingham),** *asks* (1) *For particulars which will enable him to construct a tapped high frequency transformer for use on wavelengths from* 150 *to* 30,000 *metres.*

(1) We would refer you to the reply given to "**M.A.H.**" **(Stoke Newington)** in the issue of March 24th, 1923.

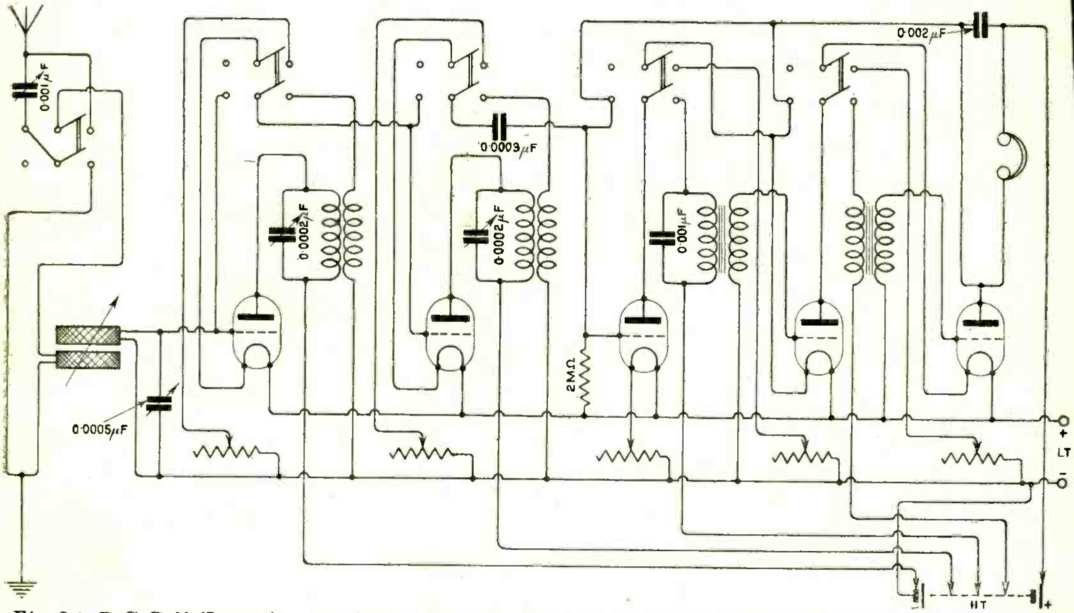


Fig. 2 "**E.C.G.**" **(Luton).** *Receiver with* 2-*v*-2. *A separate anode voltage may be provided to each circuit.*

"**T.A.L.D.**" **(Woking)** *asks* (1) *Which of the following batteries would be most satisfactory for use as a L.T. unit* (a) *Sack Lechlanche.* (b) *Bichromatic.* (c) *Daniell.* (2) *If a* 400-*volt accumulator could be charged from a battery of Daniell cells.*

(1) None of the batteries mentioned is suitable for the purpose of supplying filament current for a valve set. These batteries give the most satisfactory service when the discharge is of an intermittent character. (2) A suitable battery of Daniell cells would be expensive to install, and would require continual attention. The cost would probably be out of all proportion to that incurred by charging accumulators in the usual manner.

"**H.S.**" **(Littlehampton)** *asks for a diagram of a four-valve set comprising one H.F. and three L.F. valves. He complains that he is unable to operate a loud speaker satisfactorily with a receiver having four L.F. valves.*

We would refer you as follows :—Fig. 5, page 259, May 26th, 1923 ; Fig. 4, page 296, June 2nd, 1923 ; Fig. 5, page 366, June 16th, 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 WIRELESS WORLD AND RADIO REVIEW

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Under the Supervision of W. JAMES.

CONTENTS

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EDITORIAL NOTES

The New Organisation for Amateur Unity,

In this issue an announcement is made regarding a scheme which is being introduced whereby wireless societies throughout the Kingdom may be brought more closely in touch and share directly in the responsibility of watching the interests of amateur users of wireless as a body.

Hitherto, the Annual Conference of wireless societies called by the Radio Society of Great Britain, has been the only opportunity which the representatives of radio societies have had for meeting and discussing matters affecting their mutual welfare. At the last Annual Conference an effort was made to bring about some closer method of co-operation between all societies, but no definite scheme was introduced. Now the Radio Society has itself formulated a scheme whereby elected representatives from amongst the affiliated societies shall form part of the permanent Committee of the Radio Society and by attending committee meetings will be able to give direct expression to the views of their electorate.

This scheme, which has been occupyi the attention of the Committee of t Radio Society for some time, should res in a very considerable strengthening of t amateur position. It is fortunate that tl organisation should have been launch with no further delay since there is eve indication that there is much work to done in the near future.

The aim of everyone at the present tim if he is in any way interested in preservi for the amateur a recognised place in t ether, should be to make every effort ensure unity in the matter of gener policy. He must show a bold front i the event of any proposals being intr duced which may adversely affect th amateur's status.

The experimenter should not lose sight o the fact that amongst users of wireless h may find that he is a minority, and *unles a minority is well organised and determined* it must eventually become subservient t the majority.

High Frequency Amplification below 200 Metres.

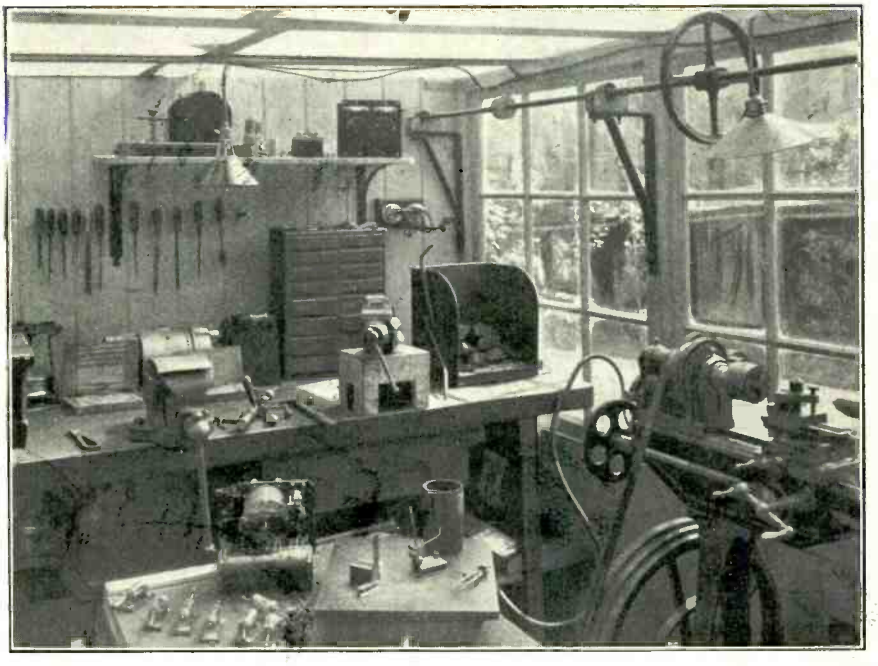
Many transmitting amateurs are devoting their attention to the design of transmitting apparatus suitable for working on wavelengths below 200 metres in order that they may avoid interference with broadcasting and at the same time permit of transmission and reception taking place during broadcasting hours.

Difficulties in the design of the transmitter having been overcome, one is faced with the problem of designing an efficient receiver to work on the short wavelengths. A receiver in which high frequency amplification is not employed can be made quite easily to tune to 200 metres, but it is not an easy matter to devise a high frequency amplifying circuit suitable for use on these short wavelengths. High frequency amplification of course must be adopted for long range experimental work, and judging from queries which have come to hand, a good deal of trouble has already been experienced in this direction. It is not thought that the arrangement of the supersonic-heterodyne completely solves the problem. The trend in the design of receivers for short wavelengths is to employ a variometer in the plate circuit of the high frequency amplifier. This is generally adopted in America, but the degree of amplification produced is not always entirely satisfactory in view of the small inductance necessary to tune to the short wavelengths. The effects of stray capacity in the plate circuit may produce serious detrimental effects, for it must be remembered that a capacity of 10 micromicrofarads represents a very low resistance path to the oscillatory currents used on the short wavelengths. This stray capacity is, of course, utilised in bringing the plate circuit into tune, yet if good amplification is to be obtained the capacity in the plate circuit must be kept to a minimum. The construction of a sensitive receiver for use on wavelengths below 200 metres is a matter to leave in the hands of the experimenter, and it is to be hoped that new features in design may be forthcoming.

NOTES ON THE CONSTRUCTION OF WIRELESS WORKSHOPS.

By Richard Twelvetrees, A.M.I.Mech.E.

As soon as the amateur constructor who works indoors finds that his activities are too much limited by want of proper workshop facilities, he begins to think about a separate workshop. He may or may not be inclined to build the latter himself, but in either case there are certain points to consider if the proposed shop is to give the best service. A good many amateurs of scientific bent are all at sea when it comes to building operations, even on a small scale, and as I gained quite a lot of experience over mistakes made in building my own wireless workshop perhaps it may prove of some value to readers.



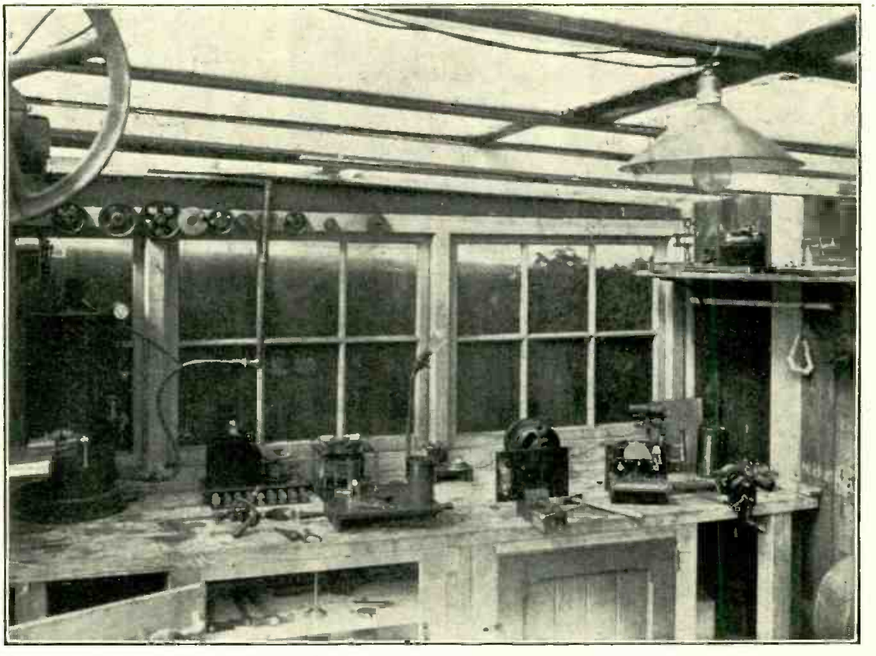
A Corner of the Author's Workshop.

Selection of Site.

In small garden plots the site of the workshop seldom presents difficulties, because as a rule only one spot will be at all suitable, but in larger gardens there may be the choice of several positions. As the workshop cannot be considered as self-contained if advantage is taken of electric light, gas and water supplies from the house, the workshop is the better and the less the expense incurred in arranging for these services. Its position relative to certain rooms in the house is very important; for the amateur whose pleasure interferes with the repose of less active members of the family, soon becomes unpopular. Again, the position of the workshop may suit everyone on their own side of the fence, but prove a continual nuisance to one's neighbour. This is all very important, for once the workshop has been erected, at no small expense, it becomes more or less a permanent feature of the suburban landscape; that is why I emphasise the importance of selecting a site unlikely to inconvenience anybody.

Foundation of the Workshop.

It is very necessary that the workshop should have sound foundations, even though the structure be but of a portable nature. A nice substantial looking wooden shed when viewed in the builder's yard may prove a very different affair after it has been in service for a few months, unless suitable foundations are provided.



Another view of the workshop. It will be noticed that both gas and electric light are available. The provision of ample cupboard space and racks is essential where the workshop dimensions are limited.

One starts with a modest tool equipment, and all is well. Later on more elaborate equipment is acquired and the door begins to jamb, which generally means that the shed has commenced to subside. Further additions are made, a lathe and other heavy articles are added and the whole building gets strained almost to the point of collapse. After a few rainy days the roof begins to leak, which, of course, marks the beginning of the end of that building, for no one will leave expensive tools and apparatus exposed to damage from rust.

If one is spending money on a really businesslike workshop, a substantial foundation is really essential. A square foot flower bed or lawn has not a very great lo resisting capacity, and therefore the porti of the garden given up to the worksh should be dug up and planted with coar rubble to a depth of 6 ins. to 1 ft. Th surface should be smoothed and cover with concrete, which will provide t necessary support for the workshop.

Frame Buildings.

The production of all classes of portab buildings has improved so greatly th amateurs need not take the trouble to build their own workshops unless this course is rendered essential for financial reasons. Sectional buildings capable of being extended to almost any size, and which can be fixed up by a few bolts, can now be purchased from various firms, these serving as excellent workshops for amateur wireless constructors. Having selected the building one intends to purchase or drawn out the one to be constructed, the points at which electric light, gas, and water supplies are to be led in, have to be determined, so that the cable and pipes can be run under the ground, thus creating no unsightly appearance or setting local electrical disturbances in the case the electric cable. The practical value of e workshop is enormously increased by e above-mentioned services, for during the inter no one enjoys working in a cold, mly lighted shed, where any useful ex-erimenting is out of the question. I once eard the house of an enthusiastic wireless mateur described as somewhere to go when e had to come out of his workshop, which nowed that he, at all events, knew how o arrange things, and had his shop built to atisfy his needs in respect of comfort. Needless to say, the work he turned out was of the very highest order.

The sides of the workshop may be as flimsy as you like provided they hold up the roof and keep out the rain, but the flooring needs to be of very sturdy description. Suppose one uses a treadle lathe at first, the desire to spend one's energies in a better way than doing an electric motor out of a job soon results in the adoption of power to drive the lathe. In small workshops it is better to use the floor as a fixture for motors than to use overhead countershafts, as the latter tend to shake the structure and the consequent vibration is very annoying. The floor boards should be supported on stiff cross battens, raising it well above the concrete foundation, and if tongued and grooved planks are used one avoids the possibility of losing small components through cracks caused by shrinking boards of the ordinary description.

Some workshops of the portable class have plain concrete floors, but in cold weather these strike very cold to the feet, and also prevent one from fixing benches or small machine tools securely to the floor when required.

Amateurs who have started with one of the tool cabinets described in the issue of June 30th, 1923, can transport these into the workshop, but the extra space available enables one to fix up a substantial bench which gives still better accommodation for experimental and constructional work. In the interests of tidyness and efficiency ample cupboards and shelves should be arranged and the racks for material described in a previous issue can be adapted as part of the workshop equipment, in addition to other pieces of apparatus to be dealt with later.

Whilst the erection of the shop is in progress proper arrangements can be made for fixing up an efficient aerial mast and also the opportunity for providing a first class "earth" should not be overlooked. If the shop is properly heated and lighted it may be used as a testing station, and therefore the earth and aerial leads can be connected with a special form of panel in the shop, the convenience of which will be fully appreciated by methodical experimenters.

Ventilation and Other Considerations.

The ventilation of the shop must be carefully considered, as otherwise one may be compelled to work in vitiated air, especially if the shop has been shut up for any length of time. If the design is tastefully selected the exterior can be made to harmonise with the style of the residence, and lend its walls to support creepers, rambler roses, or other forms of garden decorations, so that the natural beauties of a cultivated plot may not be spoilt by the presence of the workshop. The internal layout of the shop is largely a matter of taste, and as amateurs have so widely differing views on this point, the matter will be left for individual treatment.

REPLACING A DETECTOR VALVE WITH A CRYSTAL DETECTOR.

Sometimes the detector valve burns out or the battery runs down just at the time when it is most needed. With the very simple arrangement described, however, a crystal detector can be substituted easily so that reception can be continued. It is a good idea, too, to use the crystal detector for local reception, saving the audion for long distance work.

If you examine a valve detector circuit you will see that it is only necessary to connect a crystal detector across the grid and plate to put it in series with the telephones around the tuning circuit. This leaves the telephones open at the other side where they are connected to the positive terminal of the high tension battery. Therefore, it is necessary to put a lead between that terminal and the side of the low tension battery to which the other end of the tuning circuit is connected.

A simple crystal detector can be mounted on a small ebonite disc set in the base of a burned-out valve. One side of the detector should be connected to the grid contact pin and the other side to the place contact pin of the valve base. Then the detector unit can be set into the valve holder in place of the valve. This can be done very quickly and the lead put on the battery terminals.

If it is not convenient to adjust the detector when it is in the valve holder, put two terminals on the valve base in place of the crystal detector, connecting them as before. Then flexible leads can be run from those terminals to a detector conveniently located on the operating table.

HONEYCOMB INDUCTANCE COILS.

In the following article a description is given of the methods employed in the manufacture of honeycomb inductance coils at the works of the Igranic Electric Company.

By J. T. MOULD.

THE term "Honeycomb" as applied to this coil was originally intended to describe the cellular formation of the wires in the coil, but owing to later developments in the method of winding these coils, it was found necessary to amplify the term, and such coils are now spoken of as either Unilateral or Duolateral Honeycomb Coils.

Before describing the difference between these two windings, the general underlying principles of the two types of windings may first be considered.

The purpose in the design of these coils has been to provide a multi-layer inductance coil of the highest possible efficiency, of sound mechanical construction, readily adaptable to the tuning of any type of circuit, and capable of being easily included in any particular design of receiving apparatus. The maximum efficiency of a multi-layer inductance coil is obtained when the distributed self-capacity of the winding is low, its inductance value high, high frequency resistance and power absorption factor low.

To obtain such results it is essential that the various turns in the coil shall be spaced in relation one to the other, that closely adjacent turns shall be at an angle to one another, and that the insulating coating on the wire and any surrounding insulation used for forming the complete structure shall be of low self-inductive capacity value and have a low power absorption factor.

It is also desirable that air insulation should be utilised wherever possible, whilst at the same time the coil should be self supporting as far as possible without losing the properties of rigidity and durability.

Bearing in mind these requirements it is interesting to trace how these properties have been introduced in the manufacture of inductance coils under the De Forest patent No. 141,344.

The problem of arranging a sound mechanical structure while maintaining maximum efficiency was no simple one, but nevertheless it has been successfully tackled.

De Forest, in conjunction with The Universal Winding Machine Co., of Boston, U.S.A., employed a machine which, by cross-winding the various turns of wire, causes a coil to be formed in such a way that the various turns of wire lock one on to the other, thus forming a solid structure, each turn of wire helping to support the other turns. The spacing of the wires in the coil presented some difficulty as the method of producing this self-forming coil on the machine depended entirely on each turn of wire lying tightly against the previous turn of wire to give the necessary locking effect. A false foundation for the coil had therefore to be provided, and this took the form of a soft paper tube, over the edges of which the first layer of spaced turns was locked, the consecutive layers of turns being locked on this first layer of wires by the ordinary operation of the machine. The consecutive layers of wire are laid directly over the wires in the previous layers, the diamonds formed by the angular lay of adjacent wires forming the cells in the structure of the coil which has given rise to the name honeycomb coil.

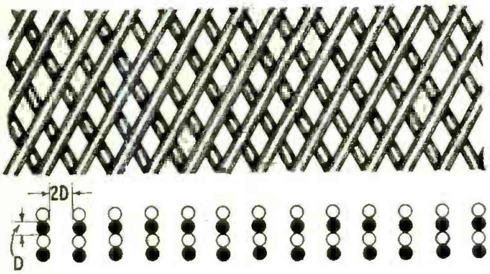
In the later development of this winding the adjacent turns in the layers are spaced twice the distance apart and consecutive layers were staggered so that the turns lie midway between the turns in the previous layer. This arrangement has improved the efficiency of the winding, and has introduced the term duolateral, the original form being termed unilateral.

Reference to Fig. 1 will clearly show the difference between these two methods of winding. In diagram A a section is shown through a unilateral coil where the white dots denote all wires of one angular disposition, and black dots denote all wires of the opposite angular disposition.

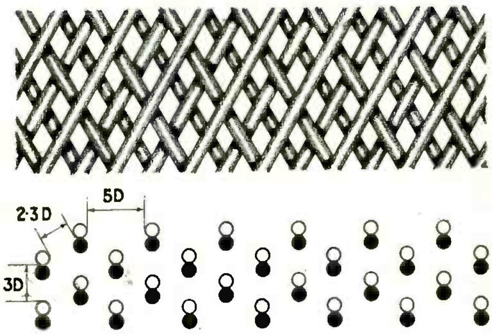
From this it will be seen that all wires of like angle, that is running parallel to each other, are spaced twice their diameter in their layer and their diameter apart in consecutive layers.

In diagram B a section is shown through duolateral coil, and here it will be seen at all wires of like angle are spaced five nes their diameter in their layers, two to ree times their diameter between interediate layers, and three times their diameter consecutive layers. By this means the istributed self capacity is reduced.

The machine which is used to wind these oils is very interesting, and a description ith illustrations should be of special interest.



A.—Illustrating unilateral winding.



B.—Illustrating duolateral winding.

Fig. 1. Diagrams illustrating the difference between duolateral and unilaterial windings.

The machine consists primarily of a winding spindle A, Fig. 3, which runs at a high speed, and is provided with a suitable friction clutch drive for putting the spindle into operation, and also to allow for the automatic stopping of the machine when the correct number of turns has been wound on the coil or in the event of the wire breaking. Combined with this winding spindle is a special gear-box and what is termed a gainer mechanism, which is interposed between the winding spindle and a separate camshaft.

The gear-box is shown in Fig. 2 with the cover removed. The camshaft carries a cam, which sets up a reciprocating motion in a guide, which feeds the wire on to the coil. The speed at which this reciprocating motion takes place depends entirely upon the angle at which the wire is laid upon the coil, and also upon the number of spaced turns of wire which go to represent one layer of wire on the coil. To obtain this particular formation of wire, the gear-box encloses a train of compound gearing, and in addition, an epicyclic gear operated through the medium of a slipping clutch and an eccentrically mounted ratchet wheel and pawl as shown at A. By means of this combination of mechanical motions, for every revolution of the cam the ratchet advances the epicyclic gear through the slipping clutch by a certain angular movement. This angle is adjustable by varying the eccentricity of the mounting of the ratchet wheel and pawl, so that very fine adjustment of gain can be obtained, enabling the wire in the alternative layers of the coil to be laid one above the other, spaced out the predetermined amount, and

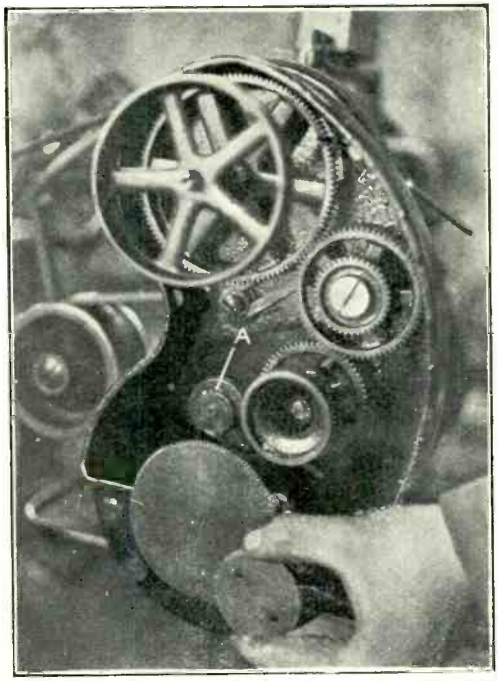


Fig. 2. A view of the gear-box with the cover removed.

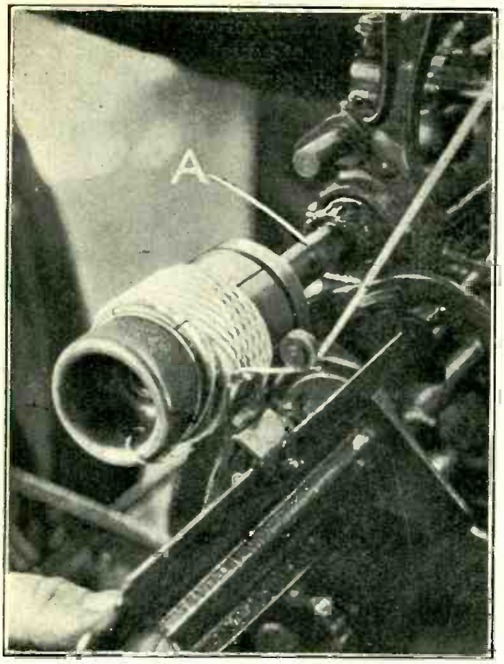


Fig. 3. A coil in process of winding on the machine.

the consecutive layers disposed midway between the wires of the alternative layers.

Figs. 3 and 4 show the progress and method of winding. By this means a coil perfectly spaced and self-supporting in every way can be speedily produced, one coil being identical with another from every point of view.

Such a coil, when completely wound, can be taken straight from the machine, all that is necessary to hold the outer turn of the wire being the fixing of a small sticky label. A special expanding type of mandrel has been designed to carry the coil during the winding operation on which the paper tube is mounted, a special registering stop being provided on the mandrel to bring the paper tube midway between the two extremities of the layer of wire, thus enabling each coil to be wound with the same degree of locking on the paper tube, eliminating any adjustment of the paper tube on the part of the operator, and thereby speeding up production.

This mandrel is split and is expanded by means of a large end core, see Fig. 3, which can be easily operated by hand, and so does not require the use of a spanner, which, of course, would lower the speed of this operation. Having completed the winding of the coil it is removed from the machine for mounting.

The second operation in connection with this coil is the definite fixing of the position of the leads, and impregnation. This is a simple operation, and consists of laying the lead wire in position along the coil and sticking them by the use of an adhesive paper band, the paper being of such a nature as to readily absorb the impregnating material which is applied later. By fixing the leads at this stage it ensures that the inner lead is isolated from the other turns of the coil, and also that the same direction of winding will be maintained in the whole of the coils, as indicated by the position of the leads.

The next operation is the impregnation of the coil. A special varnish is used for this purpose, which has a low inductive capacity, and has quick penetrating powers, to enable the operation of saturating the cotton to take place very rapidly.

After thorough drying in heated chambers, the coils are immersed in this varnish in tanks, and are then placed upon a centrifuge spindle, which is rotated at a very high speed, and brought to stop by means of a brake after a definite period has expired.

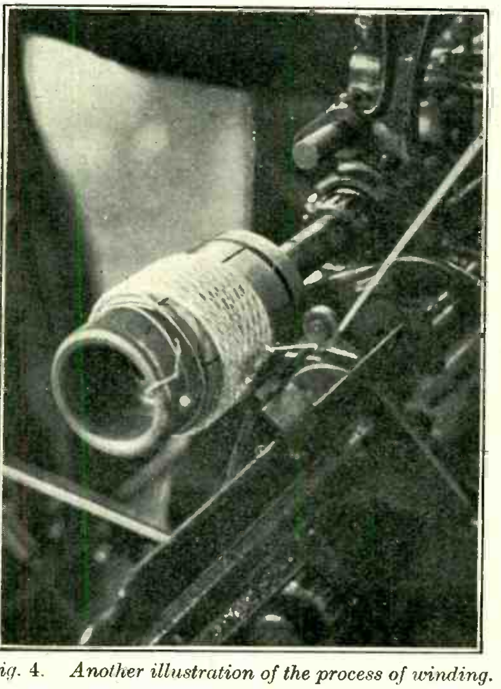


Fig. 4. Another illustration of the process of winding.

e coil has then sufficient varnish on every t of it to give a good coating, but has surplus, which would cause either soft ts in the coil, or would make the baking eration a lengthy one to harden out these t spots. The coils are then returned to e heated chambers until the varnish is rdened.

Mounting is the next operation, and where ssible, time-saving jigs which have been signed to suit the requirements of this rticular coil, are used. To each end of e coil a metal connector has to be soldered, nich, being much larger than the wire, kes considerably longer than the wire to lder. To overcome this variation, the nnectors are laid in a trough having an ectrical heating element in its base. By is means the connectors are brought up a temperature at which they can just be mfortably handled, and consequently the ctual time for the soldering is reduced by e difference in the time taken to raise the emperature from the atmospheric to a oldering temperature, and the time taken o raise it from a pre-heated temperature o the soldering temperature. This has een found to reduce the time for this peration by 50 per cent.

The pre-heated connectors are then dropped into the small jig which holds them in he correct position for soldering, and to prevent the solder running into a tapped hole which communicates with the hole for the

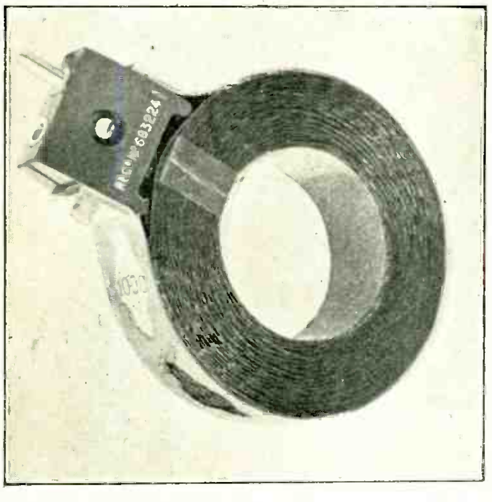


Fig. 5. A completed plug-in type of coil.

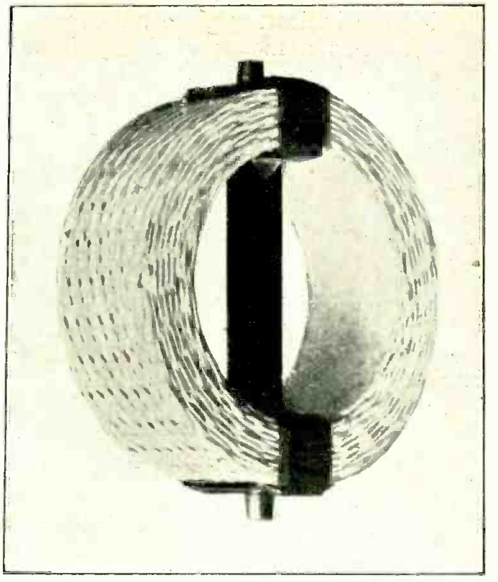


Fig. 6. A coil with the special gimbal method of mounting.

wire, a small screwed plug treated with French chalk is inserted in the hole. The actual soldering is carried out by the use of long tipped electric soldering irons, a non-corrosive flux and soft solder being employed. To set the solder quickly, a wet pad is placed directly on it, so reducing the temperature rapidly, at the same time washing off any surplus flux.

The coil, complete with its connectors, passes to the next operation, which is that of fitting the moulded insulator which separates the two connectors, and holds them together mechanically to form them into a plug connector for plugging in to the coil holder. Special stands with spring grip and rotatable on their bases, are provided for mounting the coils during this operation, in order to relieve the end wires of any strain, so that the two moulded insulators can be poised on the coil and the connectors can be slipped into their registers in the moulding, and the clamping screw between the mouldings pressed in easily. Screwed plugs, shaped as taps with knurled heads, are placed between the halves of the insulator and are unscrewed after assembly. By means of the revolving base, the coil can be turned from side to side, and the screwing and locking operations carried out very rapidly.

The final operation is the assembling of a band with the indicating plate on the coil. The band forms a means of firmly fixing the moulded plug on to the coil without interfering with or damaging the winding. This band is made of toughened leatheroid, treated with an insulating enamel, after moisture has been dried out. Similar stands to those used for mounting the mouldings are used for carrying out this operation as they enable the operator to pull the band tight with one hand, while screwing a fixing screw in with the other.

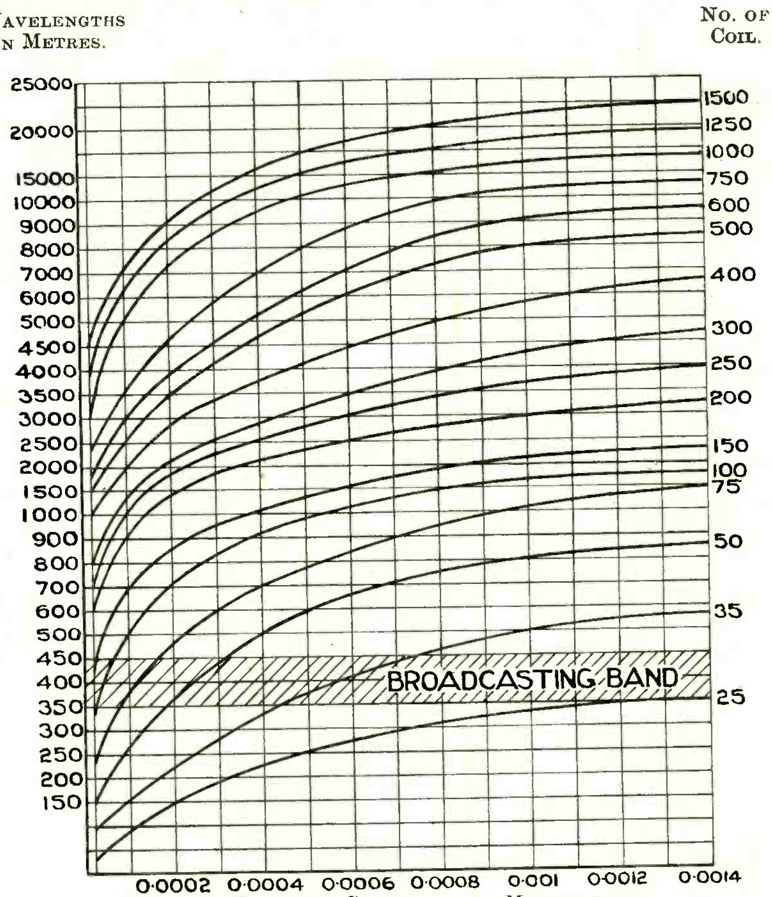
These operations complete the plug-type coil shown in Fig. 5, whilst another type shown in Fig. 6 is produced on similar lines, but in this case the plug and socket are replaced by Gimbal connectors mounted direct on to the coil, the advantage of this type of coil being that it can be used both as a variometer and vario coupler, whereas the plug-type coil can only be used as a vario coupler.

Batches of coils when complete are thoroughly inspected and tested for circuit inductance, and high frequency resistance against a set of standards which have been tested and calibrated by the National Physical Laboratory.

The latter test is essential, as variations in quality of wire, insulation of the wire, or manufacture of paper tubes, varnish or enamel would cause a large variation in the high frequency resistance of the coil.

The coils are made in sixteen sizes, and cover wavelengths of from 50 to 22,000 metres.

The chart given in the accompanying illustration shows the ranges of wavelengths which may be obtained with coils of this type when shunted with variable condensers of the values shown.



Value of Parallel Condenser in Microfarads.

Resistance and Reactance Capacity Coupling for H.F. Amplifiers.

By P. R. Thomas.

THE method of treating parallel circuits adopted by Mr. S. O. Pearson, B.Sc., in his article, "Electrostatic Capacity in Radio rcuits,"* can be applied to the case radio frequency amplifying circuits, ith either the resistance or reactance ıethod of coupling.

The grid potential of the amplifying valve so arranged that the valve operates on ıe steep part of its characteristic, and ıerefore, superimposed on the steady plate urrent, is an alternating current whose requency equals that of the incoming signal. he valve is essentially potential operated nd we must therefore make these alternating urrents produce alternating potentials which an operate the next valve. These alternatng potentials are produced by placing an mpedance in the plate circuit of the valve, hus producing a potential drop which is nstantaneously proportional to the current ınd the impedance. It is therefore obvious that this impedance must be large in order that the potential drop shall be a maximum.

The arrangement designed to produce this impedance is connected between the plate of the valve and the positive side of the high tension supply (H.T.+). Since the positive of the high tension supply is at a fixed potential, the voltage fluctuations will occur at the plate of the valve. The grid of the next valve is therefore connected to the plate of the amplifying valve by means of a condenser, a leak being provided to filament or potentiometer, since a leak across the condenser would connect the grid directly to the positive of the H.T. supply.

RESISTANCE COUPLING.

The obvious arrangement to produce the required impedance would appear to be a non-inductive resistance connected in the plate circuit. It must however be remembered that there is a small stray capacity between the wires and the capacity in the following valve. These capacities may be considered as a condenser connected from plate to H.T.+ and usually of about 0.000015 mfd. capacity.

The resistance of a condenser of C farads capacity to an alternating current of frequency $f = \frac{1}{2\pi f C}$ ohms. This is usually known as the reactance (X) of the condenser at frequency f, and is inversely proportional to f, and therefore directly proportional to wavelength.

We now have a parallel circuit composed of a resistance R, shunted by a condenser C_1 (Fig. 1), connected between plate and positive H.T.

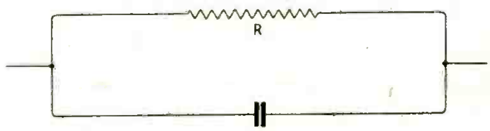


Fig. 1.

The impedance Z of this arrangement :—

$$Z = \frac{1}{\sqrt{\frac{1}{R^2} + \omega^2 C_1^2}}$$

ohms where $\omega = 2\pi f$. Z increases as R increases, and if R is infinitely large $Z = \frac{1}{\omega C_1}$, = the reactance of the condenser, and is a maximum. This maximum impedance is unattainable, since R must have some finite value in order that there shall be a circuit of reasonably low resistance for the steady plate current.

Considering actual examples, assuming $C_1 = 0{\cdot}000015$ mfd. (1) At 300 metres $f =$ 1,000,000 and $Z = 10{,}600$ ohms, when R is infinitely great.

(2) At 3,000 metres $f = 100{,}000$ and $Z =$ 106,000 ohms when R is infinite and equals 72,600 ohms when R is 100,000 ohms.

The above examples show the effect of frequency very clearly. At 300 metres the impedance is so low that no voltage amplification can be obtained, while at 3,000 metres we have ten times the impedance, and satisfactory amplification may be obtained.

* *Wireless World and Radio Review*, January 27, 1923.

Attempts to reduce C_1 by special valve designs, so that resistance coupling could be used on short wavelengths, have not proved very successful; although a reduction of capacity is obtained the impedance is still too low for amplification on wavelengths of the order of 300 or 400 metres.

In practice a resistance of from 60,000 to 80,000 ohms is used. A valve when working on the steep part of its characteristic has a steady plate current of about 0·7 milliampere which causes a steady voltage drop of $0{\cdot}0007 \times 80{,}000 = 56$ volts, when a resistance of 80,000 ohms is used. This voltage must be subtracted from the voltage of the high tension supply to find the effective voltage on the plate of the valve.

REACTANCE CAPACITY COUPLING (Tuned Anode).

Mr. S. O. Pearson, in the article previously referred to, shows that when an inductance is shunted by a capacity, the impedance of the circuit thus formed has a maximum value when the circuit is tuned. The impedance of a tuned circuit is given by the expression $Z = \frac{L}{CR}$ ohms, where L is the inductance, and R the resistance and C the shunted capacity.

It is clear from the consideration of the resistance coupled amplifier that we have a capacity. If now in the place of the resistance we put an inductance it is obvious that we can make this capacity tune or help to tune the circuit to any wavelength, and therefore produce a circuit of high impedance to the alternating currents.

A consideration of the circuit and the quantities present will show under what conditions an arrangement of this type will operate most effectively.

An inductance coil is wound with wire, and is therefore always associated with resistance. It has also a certain self-capacity and must therefore be represented by an inductance in series with a resistance and shunted by a capacity.

A variable condenser has always some minimum capacity and should be represented by a capacity which is variable from zero to a maximum, shunted by a fixed capacity.

The circuit which we have to consider can be represented by an inductance in series with a resistance, the whole shunted by a fixed capacity which is composed of the self-capacity of the inductance, the minimum capacity of the variable condenser, and the stray and valve capacities previously referred to. The circuit is also shunted by a variable capacity, which is variable from zero to a maximum. (Fig. 2).

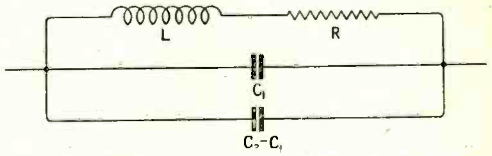


Fig. 2.

For the impedance to be large, both C and R in the expression $Z = \frac{L}{CR}$ must be as small as possible. If we rewrite $\frac{L}{CR}$ as $\frac{L}{R} \times \frac{1}{C}$ we can consider the problem very simply:

It is required to use a reactance capacity coupling by means of a series of coils and a variable condenser to cover a range of wavelengths, in such a way that the impedance never falls below some assumed value. If the ratio of inductance to resistance for these coils is large, a larger maximum value of capacity to tune them can be used, and each coil will therefore cover a larger wavelength band and still comply with the condition of minimum impedance. Thus fewer coils are required than if the ratio $\frac{L}{R}$ were small.

If $\frac{L}{R}$ is fixed, and Z must not fall below some assumed value, then the maximum value of C can be determined; let it be C_2. This is composed of C_1 the fixed capacity, and C_2-C_1 the maximum capacity of the variable condenser; this increases as C_1 decreases. Therefore the advantage of making C_1 as small as possible is that the maximum value of the variable condenser is increased and the effective wavelength range of the coil also increased.

When using the expression $\frac{L}{CR}$, if L is taken in henries C must be taken in farads, R in ohms; Z is also in ohms. Other units of L and C may be used but they must correspond. Thus if L is taken in microhenries, C must be in microfarads, and if L is in centimetres, C must be in milli-microfarads.

The value of R is not the direct current resistance but the resistance to alternating urrents of the frequency considered, and ; much higher due to skin effect.

Even after allowing for a considerable ncrease of resistance due to skin effect, it s found that a tuned circuit has a very high mpedance at frequencies corresponding to ;hort wavelengths and is therefore suitable 'or use as a coupling for radio frequency amplifying valves.

The resistance to the steady plate current is only the resistance to direct current, and the steady voltage drop is therefore negligible.

We see that the resistance coupling is not effective below about 2,000 metres; it has also the disadvantage of requiring extra plate voltage. It has however the advantage that for the range of wavelengths over which it is suitable it is absolutely aperiodic, if such an arrangement is required.

The reactance capacity coupling is suitable for all wavelengths, and when made up with a low resistance coil is very selective. It does not require extra plate voltage.

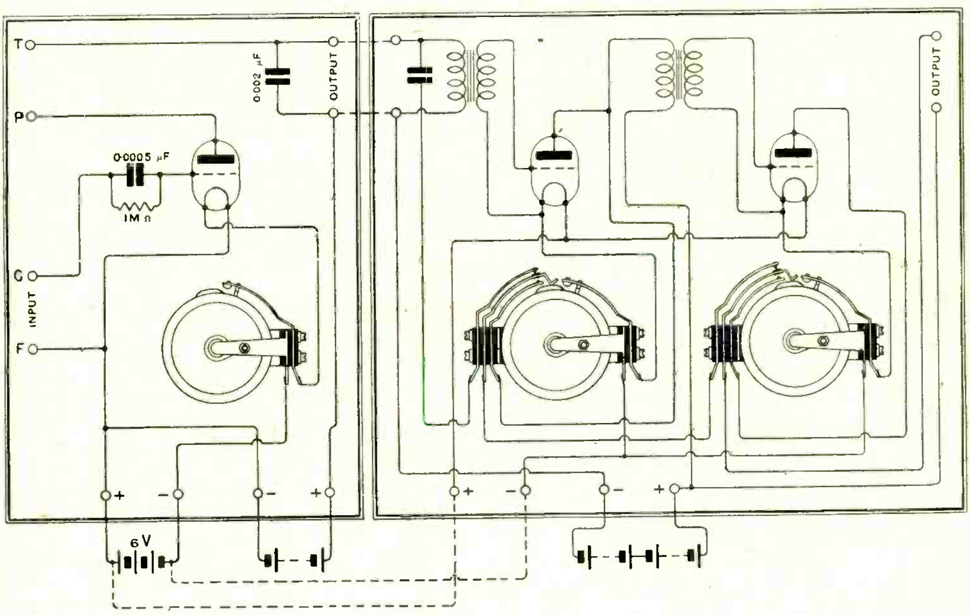
There are many amateurs who find great difficulty in obtaining satisfactory high frequency amplification below about 600 metres, and in many cases the main trouble is in the arrangement of the wiring and design of the coils.

The most satisfactory method of wiring is by means of tinned copper wire of sufficiently heavy gauge to be clear of the panel. The extra thought and trouble involved in designing and fixing a system of wiring in which the wires are well spaced is amply repaid by the superior results obtained.

Coils wound with fairly heavy wire, while more bulky are also a tremendous advantage, as are those wound on a reasonably large former.

Careful thought on the limitation of resistance and stray capacity to a minimum is always advisable if good results are required.

New Switching Device for L.F. Amplifiers.

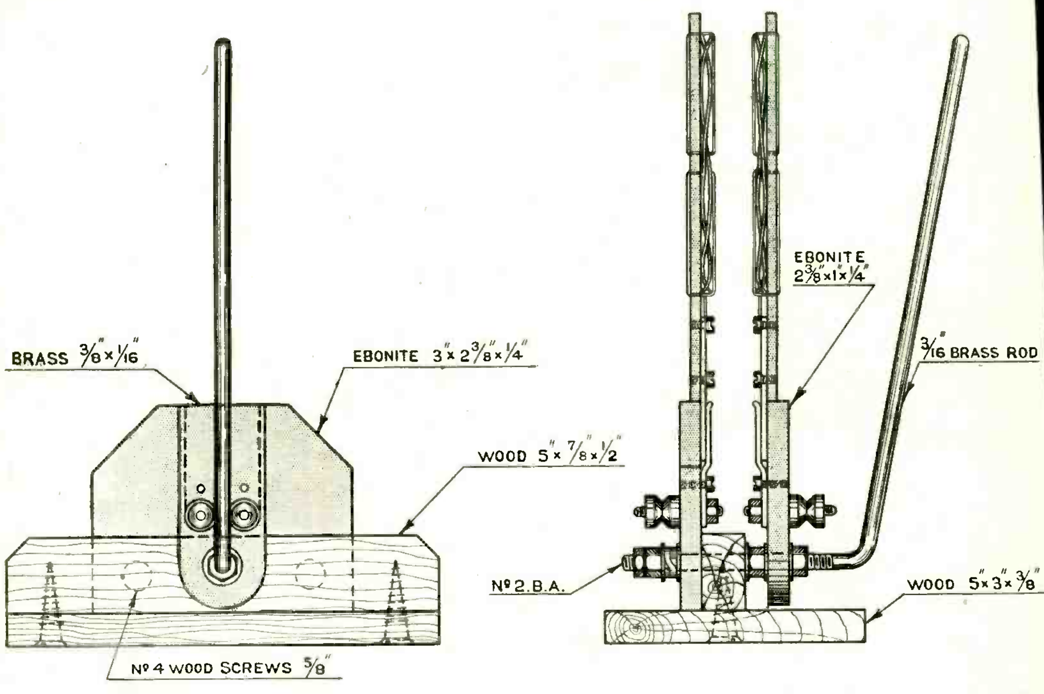


A particularly convenient arrangement for cutting in and out of circuit low frequency amplifiers is the provision of spring contacts operated by a projection on the revolving resistance winding. With the rotary arm type of filament resistance it is not difficult to attach contacts to the panel which engage on the arm when the resistance knob is in the "off" position.

Mounting Flat Coils and a Suitable Two-Coil Holder

By E. J. Dent.

THE accompanying drawings show a simple, effective, and cheap method of mounting and using the flat coils that are so deservedly popular. The coils can be bought ready made, but I have not seen a suitable holder advertised, and think my idea may be useful to others.



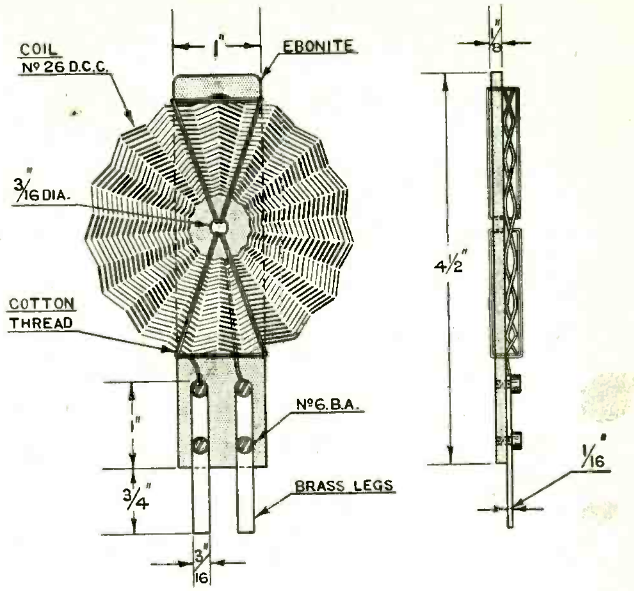
Scale drawing of simple yet effective coil holder.

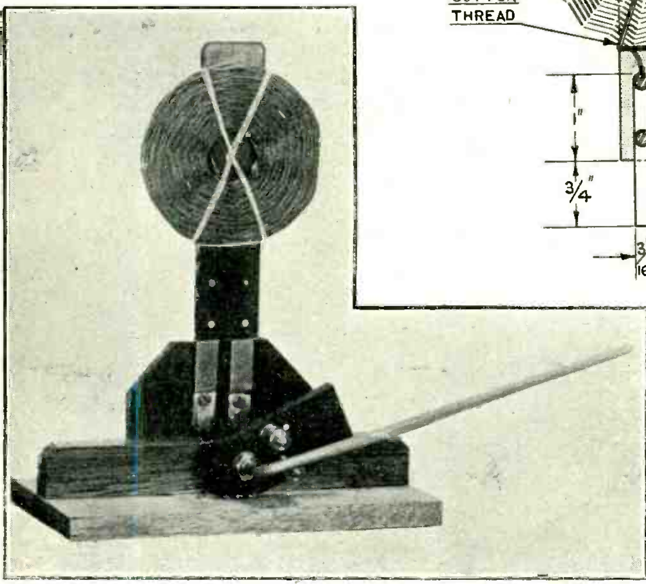
Each coil is fixed to a piece of ebonite by means of cotton thread, this being passed through a hole in the centre. To the ebonite are attached two legs of brass, and the ends of the coil are fastened under the set screws, or soldered. For larger coils the ebonite would need to be increased in length, and the thickness might with advantage be $\frac{3}{16}$ in.

The coil holder has a base of hard wood 5 in. by 3 in. by $\frac{3}{8}$ in. Along the centre is another piece 5 in. by $\frac{3}{4}$ in. by $\frac{1}{2}$ in. Attach to one side of this by two $\frac{5}{8}$ in. No. 4 scre is a piece of ebonite 3 in. by $2\frac{1}{4}$ in. by $\frac{1}{4}$ i and on the other side of the wood is a pie of ebonite $2\frac{1}{4}$ in. by 1 in. by $\frac{1}{4}$ in. This locked to the handle by two 2 BA nuts, t handle passing through a hole at the cent of the semi-circle. On the inner face of eac piece of ebonite are two pieces of stiff brass which form clips to hold the legs of the coil mounts. The clips are held to the ebonite by small screws, and the nut of the terminal which makes contact with each clip. If these clips are well made the holder can be used in any position.

If materials are bought the cost for mounting each coil ought not to exceed 6d., and 2s. ought to cover the cost of materials

The construction of the coil holder is clearly shown, whilst to those unacquainted with the reading of drawings, the photograph will convey the necessary details for coil holder and stand.





for the holder. In my own case most of the materials were already in my possession, and no doubt this will apply to most other beginners, who usually buy more material than they need.

Scientific or Vernier Time Signals in France.*

The "Union Astronomique Internationale," at its Conference at Rome in May, 1922, expressed a wish that investigations might be made to determine whether, in vernier time signals, it would be preferable to indicate the *zero* points by a dash instead of by the omission of a dot as at present, as the view was taken that the suppression of the dot might pass unnoticed owing to atmospheric disturbance.

Various experiments have accordingly been made by the "Bureau Internationale de l'Heure." With the co-operation of Commandant Jullien, Director of the Eiffel Tower Military Wireless Station, vernier signals in the manner suggested were issued from 1st to 8th March last, and a comparison made with the present method.

This was effected by notifying in advance a number of interested persons who were good enough to make the comparisons and give their opinions on the two methods.

After considering the reports, Professor R. A. Sampson, President of the "Commission de l'Heure," has decided to adopt the new method at the earliest possible date. Some little time may elapse before the necessary adjustments can be made to the pendulums of the clocks at the various wireless stations. Due notice will, however, be given of the change.

Furthermore, it is hoped that a further improvement in the transmission of these signals will be effected by an arrangement which has been made for installing pendulums in the B.I.H. office in Paris and connecting this office electrically and telephonically with Paris Central Wireless Station.

* *Extracted from Bulletin Horaire No. 8.*

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XIX.

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 circuits, damping, choke coils, and transformers.

By W. James.

38.—Intervalve Transformer.

It is proposed now to discuss the properties and behaviour of transformers employed to couple valves as shown in Fig. 94. Here E_{g1} represents the voltage applied to the grid (input side) of valve V_1. The valve has an average internal impedance (which at telephone frequencies is practically resistive) of Z_{p1} ohms. The voltage generated across the primary winding P is V volts, and that across the secondary S, V_{g2} volts. The input impedance of valve V_2 is Z_{g2} ohms.

There is a principle of great importance which it is well one should understand.

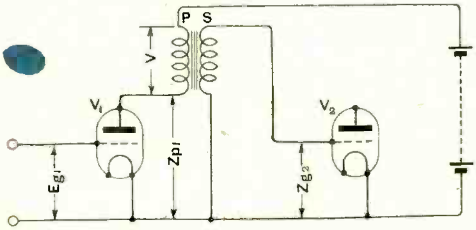


Fig. 94. Valves transformer coupled. E_{gi} = grid applied volts. Z_{pi} = average anode impedance. V = volts across primary winding P. Z_{g2} = impedance of grid circuit of valve V_2.

Suppose we have a source of power supply with an internal resistance of R_i ohms, and E.M.F. E volts connected to a load with resistance R_L ohms. The current which flows of course is $I = \frac{E}{R_i + R_L}$ amperes and the volts drop across the load which is equal to the potential difference across the supply $(E - R_iI)$ or R_LI. The power lost in the supply is then I^2R_i, and that in the load I^2R_L. If we vary the load resistance R_L, with one value the power supplied to the load will be a maximum. This is the case when $I^2R_i = I^2R_L$ or when the intern and load resistance are alike.

Take the simple case of dry cells supplyi power. If we have 10 cells, with an E.M. of 1·5 volts each, the total E.M.F. is 15 volt If each has an internal resistance of 2·5 ohm the total resistance is 25 ohms, and accordin to the above explanation the power utilise in the load will be a maximum when it resistance (R_L) is 25 ohms. One can se that this is the case.

$$\text{Current} = \frac{E}{R_i + R_L} = \frac{15}{50} = 0{\cdot}3 \text{ amperes}$$

Power in load = power lost in the cell $= 0{\cdot}3^2 \times 25 = 2{\cdot}25$ watts. Suppose no the load resistance is (a) 10 ohms and (b 40 ohms. In case (a), the current $= \frac{15}{25+10}$ $= 0{\cdot}43$ ampere and the power in the load $= 0{\cdot}43^2 \times 10 = 1{\cdot}85$ watts. In case (b) the current $= \frac{15}{25+40} = 0{\cdot}23$ amperes and the power in the load $= 0{\cdot}23^2 \times 40 = 2{\cdot}1$ watts. In both cases the power supplied to the load is less. It so happens that the difference is not very great unless the internal resistance and load resistance have a greater ratio than about three or four to one. If a curve is plotted showing the output for various ratios it will be found the curve has a flat top, but falls away quite rapidly.

The application is immediately seen in the case of Fig. 94. Here the requirement is that the power which is available through the operation of valve V_1, shall cause the biggest effect in the input of valve V_2. The ratio between the impedances Z_{p1} and Z_{g2} is very high (Z_{p1} may be 25,000 ohms and Z_{g2} 1,000,000 ohms), so that for the best operation a transformer with suitable windings is used to match the impedances. The transformer primary impedance should roughly equal Z_{p1}, the impedance of the tput of valve V_1, and the secondary pedance Z_{g2}, the input impedance of lve V_2. No great endeavour need be taken match the impedance exactly, an error 4 to 1 not being considered unreasonable.

In place of Fig. 94 we may use the quivalent circuit of Fig. 95, it being as-

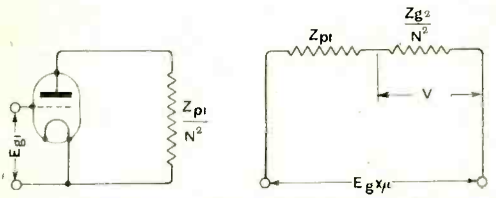


Fig. 95. Equivalent circuit of Fig. 94 when ideal transformer is used.

sumed the transformer is perfect. The resistance of the load R_{g2} is transferred to the primary by dividing by N^2 where N is the transformer ratio (turn ratio). The circuit may be further simplified by replacing the valve V_1 with its average impedance Z_{p1} and the voltage $E_{g1} \times \mu$; the quantity E_g being the grid voltage and μ the voltage amplification factor of the valve.

$$\text{Then } V = \frac{R_{g2}}{N^2 R_{p1} + R_{g2}} \times \mu E_{g1}$$

$$\text{and } \frac{E_{g2}}{E_{g1}} = \frac{\mu N R_{g2}}{N^2 R_{p1} + R_{g2}}$$

Now it is the ratio $\frac{E_{g2}}{E_{g1}}$ which is required to be as high as possible, and it is seen that this quantity depends directly upon the amplification factor of the valve μ, and varies with the ratio of the transformer as well as with the input resistance R_{g2} of the second valve. To make R_{g2} high, the normal potential of the grid of the valve must be such that whatever the voltage fluctuations caused by the transformer action, no grid current flows. In practice a cell or two may be connected in the grid circuit to make the grid negative, *and it is found that the signal strength in the case of a large number of receivers may be doubled simply by connecting the cells.*

The ideal ratio for the transformer is such that $N = \sqrt{\frac{R_{g2}}{R_{p1}}}$

By good design it is possible to keep the transformer losses small, but the effect of the magnetising current cannot be neglected. We may represent the reactance of the transformer at no load in the equivalent circuit by connecting a coil (coil X Fig. 96) across the load. It is seen immediately; the impedance of the equivalent load has now fallen, depending upon the magnitude of X. If X is low, the equivalent impedance will also be low. To ensure low losses, the iron is worked at low flux densities, which, together with the large inductance required, means that a large number of turns in the primary winding is necessary.

Some transformers which are manufactured have so few primary turns that the amplification per stage $\left(\frac{E_{g1}}{E_{g2}}\right)$ is not much more than one or two, *i.e.*, the amplification obtained is very small indeed. This is the case when the internal impedance of valve V_1 is considerably greater than the impedance of the transformer.

With ordinary valves such as the "R" type, the primary inductance ought to be in the neighbourhood of 10 henries, which is equivalent to a reactance of $6{\cdot}28 \times 800 \times 10 = 50{,}000$ ohms for a frequency of 800 cycles.

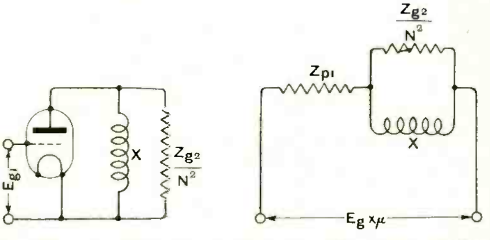


Fig. 96. Equivalent of Fig. 94 when transformer takes magnetising current (no load current).

Having sufficient primary turns to give the required inductance, one is faced with the problem of a suitable ratio. In order to keep the dimensions of the transformer small, fine wire such as Nos. 40 to 44 S.W.G. is employed; but we cannot go on increasing the number of turns on account of the capacity of the winding which may assume such dimensions that together with the inductance a resonant circuit is formed. Beyond a certain number of turns in the secondary, no voltage increase will be produced, and in fact the voltage may be decreased. The limit is generally reached when the ratio is of the order of 2 or 3 to 1.

The effect of capacity is to cause the transformer to behave in some respects similar to a tuned circuit—it will give a larger secondary voltage for a given input voltage for the frequency of the signal which is closely the resonant frequency of the transformer. To alter the resonant frequency, a condenser may be connected on the primary side which will operate as though a capacity equal to the condenser capacity reduced by the square of the ratio of transformation is connected across the secondary. Increasing the capacity reduces the resonant frequency. Also, changing the connections to one side of the transformer changes the effective capacity. Thus, if resonance effects are noticed, they may be varied by changing the connections. Another method is to connect a high resistance of the order of 1 megohm across the secondary. The points are brought out in the curves of Fig. 97. It will be at once evident that the transformer insulation resistance must be very high.

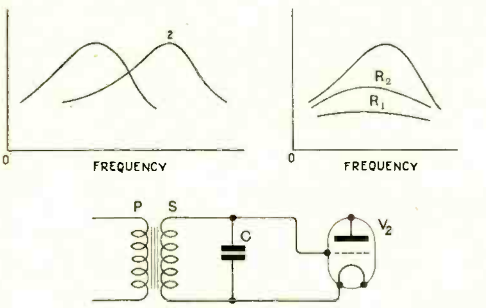


Fig. 97. The effect of transformer capacity is to give it a resonant frequency which may be shown by plotting frequency and amplitude of signal. The curve is moved to the left from say position 2 to position 1 by adding a capacity C across the windings. The effect of adding a resistance across the windings is shown. A high resistance produces a reduction in amplitude and a broader peak as at R_2. A lower resistance produces a flatter curve altogether, represented by R_1.

Any leakage, even though the insulation resistance is one megohm, will, besides greatly reducing the amplification by causing a lower effective grid impedance in valve V_2, act to prevent resonance effects, and while reduction of resonance effects is desirable, it is better not to have that reduction brought about through low insulation resistance. Resonance is sometimes helpful when dealing with signals having a definite frequency such as Morse C.W. signals, which may heterodyned to give a suitable frequency.

It is important to prevent resonan between the windings to prevent the gene tion of a continuous oscillation, which m be audible, causing a howl, or not, when t result will simply be a marked reducti in the efficiency.

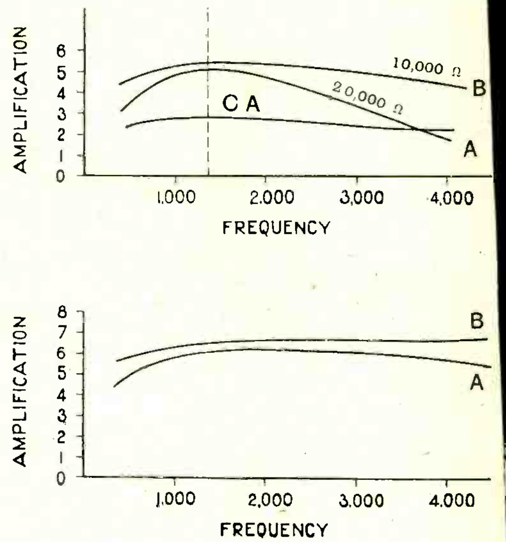


Fig. 98. Frequency characteristics of transformer coupled valves. In the upper curve, the transformer employed a 5 to 1 ratio. Curve A was obtained when employing a 20,000 ohm valve (i.e., its average plate impedance was 20,000 ohms). Curve B refers to the transformer connected to a 10,000 ohm valve. Curve C A shows the effect of connecting a resistance across the windings. Amplification is less, but the characteristic is flat. In the lower curves, the transformer had a 3 to 1 ratio. Curve A refers to a 20,000 ohm valve, and curve B to a 10,000 ohm valve.

There is a second important point which requires consideration. When dealing with speech, the apparatus should be such that it will deal with all frequencies equally well. For good music, the band of frequencies from 100 to 4,000 cycles is occupied, and not only must the apparatus amplify each frequency in this band, but each must be amplified equally well. It is clear that music would be distorted if some of the frequencies were amplified better than others. This flat frequency characteristic is difficult to obtain. Actual curves are shown in Fig. 98. Referring to the upper curves, curve A shows the amplification at various frequencies when a 5 to 1 ratio transformer is used, when e output impedance of the valve is 20,000 ms. It will be noticed there is decidedly eater amplification of frequencies round out 1,200 cycles. The amplification is ıch more uniform, (curve B,) when the ınsformer is used with a valve having an tput impedance of only 10,000 ohms. the lower curves it will be noticed the nplification is much more nearly uniform en in the case when the transformer working out of the 20,000 ohm valve. ne ratio is 3 to 1.

It is evident that resonance phenomena ust be avoided altogether, and in the case high ratio transformers, or those with ıfficient primary turns this may be secured y connecting a resistance of a few hundred ıousand ohms across the secondary. In oing this of course the amplification will e reduced as shown in curve C A, Fig. 98.

The important points may be brought ut as follows:—

(*a*) To obtain high amplification the primary winding should have a large number of turns.

(*b*) The ratio is limited by the self capacity of the windings.

(*c*) High amplification is secured through making the grid circuit impedance very high, *e.g.*, by using cells in the grid circuit to ensure grid current shall not flow.

(*d*) Resonance properties are useful when receiving morse signals, and the resonant frequency may be varied by changing the coil sometimes, or by connecting a suitable condenser across the windings.

(*e*) Resonance may be destroyed at a loss in amplification by connecting a resistance across either primary or secondary.

(*f*) A flat frequency characteristic, over the range of frequencies necessary for good music is necessary. This is secured through employing a large impedance primary, which limits the ratio to 2 or 3 to 1 because of the self capacity of the windings.

(*g*) To prevent distortion through the curvature of the valve characteristics, the transformer impedance should be about twice that of the valve. This point is taken care of by point (*a*) above.

(*The next instalment will deal with constructional details of intervalve transformers.*)

One of the assembly shops at the works of Marconi's Wireless Telegraph Co., Ltd., at Chelmsford. The component parts of transmitting, receiving and "Marconiphone" equipments are shown being brought together.

SELECTIVE RECEIVING APPARATU

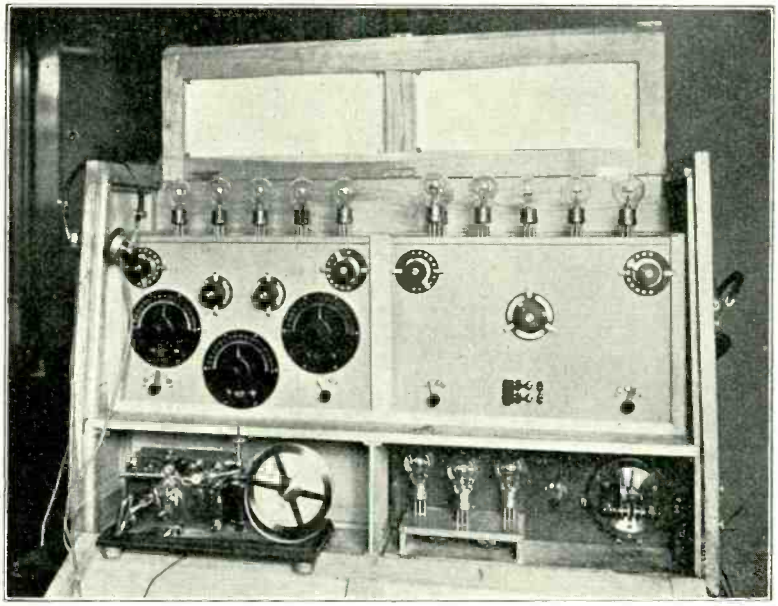
The following is the text of a short paper read by Mons. Y. Marrec, prior to a demonstration of his anti-atmospheric apparatus, at the meeting of the Radio Society of Great Britain, held on July 25th, 1923.

MY object to-night is to demonstrate an apparatus which I have invented for the elimination of atmospherics during the reception of long wavelengths. I shall not go into the matter of the causes of atmospherics or statics, as they are numerous. Atmospherics or statics can be classed in two section, *i.e.*, statics due to artificial causes, and statics due to natural causes, the latter being generally called atmospherics. As far as artificial disturbances are concerned, these can in many cases be eliminated, for example, by choosing the position of the receiving station and moving the receiving set to a distance from the disturbing centre, as long as those artificial disturbances do not act at their point of departure on an oscillating radiator.

As far as atmospherics are concerned, the problem is far more complicated on account of their great strength and the fact that at certain times they are so frequent. Their shape is immaterial, their effect identical. It has been established that atmospherics are very damped, whilst the continuous waves which we want to pick up are undamped. Anyone who has studied the question agrees that the number of atmospherics varies according to the time, season, and the country where the receivi apparatus is placed, and that generally speakin atmospherics are more numerous and power as one approaches tropical countries.

I have investigated these questions very carefull and without wishing to enter into all the phas of the study, I have come to the conclusion th atmospherics act by shock excitation on all wa collectors, and cause them to oscillate at the own natural period, and this irrespective of wheth they are frame aerials or open aerials.

It is evident that the effect of atmospherics on directional aerial will be less marked if the atmospherics are travelling in a direction perpendicular to this orientation, but nevertheless the action of atmospherics on the antenna will still be far greater than the signals, and will continue to cause the antenna to oscillate at its natural period.



The apparatus for the elimination of atmospherics during the reception of signals on long wavelengths.

In order to communicate in certain pre-determined directions, many people have tried to find a partial solution of the elimination of atmospherics by using combinations of wave collectors, which would be acted upon in a different way by the atmospherics, or would be acted upon in a certain manner by the atmospherics and in another way by the signals.

'or example, a system exists utilising two frames 'ced at half wavelengths from each other. other one using two frames tuned to the same velength placed perpendicularly to one another, e of them directed towards the transmitting tion, the other at right angles, with the object opposing identical currents and only receiving e signal. Unfortunately, however, the latter stem also blots out much of the signals to be re- ved.

My opinion is that the solution of the problem ll not be found by these combinations.

One knows that to modulate the frequency of ntinuous waves one utilises a heterodyne which per-imposes its own oscillations on the detected cillations. These local oscillations are also super- posed on the atmospherics, and therefore alter eir note, but as atmospherics are damped currents e note of the latter will be different from one ceived from signals. In other words, we shall ntinue to hear the atmospherics as noises, and the gnals in the form of notes.

If immediately after detection one uses sharply ned low frequency circuits, the atmospherics ill take on the note of resonance of these circuits, that the signals and atmospherics will both ke on the same note, and the ear of the operator n no longer select signals. This system is there- re to be avoided.

In my opinion a system which has any chance of creasing the selectivity of reception must satisfy he following conditions :—

(1) Receive the greatest amount of current with the smallest amount of distortion.

(2) Increase the amplification of detected currents without altering their shape. In this case it is necessary to use aperiodic amplifiers in order to limit the amplitude of atmospherics and bring them as near as possible to the amplitude of the signals which it is desired to receive, and without reducing too much the amplitude of the latter.

After this it is necessary to filter the currents by using a series of circuits unsuitable for all currents not having the periodicity of the signals to be received, so that for an equal amplitude, only signals will be received.

This system is employed in the apparatus which I hope to demonstrate to you, using a frame aerial, whilst no doubt with a suitable antenna we could obtain better results. We cannot say that the re- sults are perfect, for if that were the case, a very small power station would then be able to communi- cate at infinite distances as with the aid of amplifiers one would be able to increase the currents received at will. We are far from this point yet.

For my demonstration I have adapted my anti-atmospheric system to an ordinary five-valve apparatus of my make, to which I have added a low frequency amplifier to enable me to record the received signals, but the anti-atmos- pheric apparatus proper can be adapted conveniently behind any other system of reception without any alteration.

My receiving apparatus consists of two stages of high frequency amplification, tuned by variable condensers to the wavelengths which it is desired to receive, detector and two stages of low frequency amplification.

Following this usual system is the anti-atmos- pheric apparatus consisting of three valves utilising aperiodic transformers, the filament resistance of these valves being used to lower the saturation point and thus limit the amplitude of the atmos- pherics.

As by this reduction of filament current one reduces also the amplifying powers, one recovers this reduction by adding further stages of ampli- fication. This would not be necessary if one could use a limiting device which does not reduce the intensity of the reception.

Following the apparatus already mentioned, I use three stages of resonance low frequency ampli- fication, tuned to the note to be received. These circuits are controlled by another filament resis- tance. This resonance group is used not as an amplifier proper but as a filter to separate the atmospherics which have a different note from the signals.

A switch enables one to receive directly or to make use of the anti-atmospheric apparatus at will.

In addition a three-stage low frequency amplifier is used with a Siemen's relay, and finally the Morse inker.

Before starting my demonstration I desire to draw attention to the effect caused by atmospherics on such a system. You will be able to observe that between the signals the atmospherics are nil, but that on signals only, atmospherics cause breaks if they occur at the same time. The recording strip will therefore not show any atmos- pherics, and if the signals are broken one can remedy this to a great extent by tuning to the spacing wave of transmitting stations using such an arrangement. In this case the spacing wave will be picked up on another set tuned to the spacing note and working another recorder. Also in this case we may have breaks on the inverse signals which will be recorded on the strip by signals corresponding to the spacing. If for example in the case of direct manipulation one cannot read 50 per cent. of the signals, in case of the recording of the spacing, we shall also have 50 per cent. of unreadable signals, but as the atmospherics acting on these different wavelengths occur at different times, the unreadable signals in one system will not occur together, and therefore one inscription can be used to correct the other. I can therefore double the efficiency of my apparatus when dealing with a transmitting station employing spacing waves, and I believe I am improving very con- siderably the efficiency of any ordinary apparatus for all other C.W. transmissions not using the spacing wave system.

NEXT WEEK.

How to Build a Reliable Single Valve Armstrong Receiver.
Constructional Details of a Simple Device for Producing H.T. for a Low Power Transmitter by a New Principle.
Both Practical Articles describing well tried apparatus and embodying unique ideas.

OBSERVATIONS ON ATMOSPHERIC

By R. A. WATSON WATT, B.Sc., F.Inst.P., A.M.I.E.E.

(Continued from page 612 of previous issue).

DISCUSSION.

Mr. C. F. S. Hearn.

The lecturer has referred to atmospheric discharges in Sicily, and presumably those discharges were accompanied by rain. Would that be an indication that the disturbance was connected more with the discharge of rain than with lightning ?

Mr. R. Carpenter.

I should like to ask whether any attempt has been made to photograph the fluorescent curves. One realises that the camera would have to be left open until a disturbance occurred, and then the shutter would have to be closed. I suppose you would get trouble due to the zero line, but it is probable that that can be screened out in some way. It rather seems—although I speak without knowledge of the intensity of these curves—that it should not be impossible to photograph them, and so avoid the element of uncertainty introduced by human observation. There is another point I should like to mention. The unusual co-ordinates make these curves a little difficult to understand, and I do not know whether, if photographs could be obtained, such curves could be projected by means of parallel light on to a cylindrical surface, with automatic method of recording them, from their existing co-ordinates, in ordinary rectangular co-ordinates.

Mr. P. W. Harris.

There is one small point I should like to raise again having a bearing on the difficulty of interpreting the curves owing to their peculiar form. Has it been possible to take, for example, three simultaneous curves with three oscillographs ? Thus, a curve which in one oscillograph would show from the front, in the second would show at right angles, and it might be possible, by co-ordinating the three, to get something more approaching the type of curve we are accustomed to examine.

Mr. L. F. Fogarty.

I should like to ask whether there is any definite evidence that these atmospherics are always of long wavelength, or whether they may be of any wavelength. I was particularly struck with the lecturer's remarks as to the very large amount of energy associated with the lightning discharge, because that might have a bearing on another branch of electrical work quite apart from radio engineering. Some years ago it was suggested that lightning discharges might produce in overhead transmission lines a sufficient disturbance to bring about quite a large amount of harm, but electrical engineers in those days seemed to have an idea that there was very little energy associated with lightning discharges, and that no precautions were necessary.

Mr. Frank F. Betts.

Could the lecturer say whether, in his experien atmospherics are always accompanied by convecti weather ? In 1917, when I was in a small meteor logical office six miles south-east of Peterhead, noticed, on a tracing of a microbarograph, a numb of ticks very similar to those on the atmospher chart. These were nearly always followed, with 24 hours, by squally weather or rain, and whenev the ticks appeared on the graph we always used prevent the airships from going out, or, if the were out, call them in promptly. At the same tim the wireless people used to report atmospheric and whenever the ticks were very very noticeab on the microbarograph they were always ver disturbing in the telephone as well. We had n recording charts in the wireless hut, and I can onl speak from memory, but it certainly appears t me that it might be interesting to follow up investi gations on those lines.

Mr. Watson Watt, replying to the discussion said :

In reply to Mr. Hearn, one would say that, in general, lightning is almost invariably accompanied by rain, but that does not take us out of the difficulty about range, because it is very difficult to picture a non-lightning discharge, going with the rainfall, able to radiate better than a lightning flash. It is difficult to think of anything that will give you a stronger atmospheric than a full-dress lightning discharge, so that I should say definitely that the lightning flash is the thing which will give a big range. With regard to Mr. Carpenter's remarks, no attempt has been made to photograph the curves, because the exposure would be hopelessly inadequate ; an exposure of two minutes is required to get a good photograph. To obtain the extreme electrical sensitivity necessary for dealing with atmospherics so slightly amplified that we can be sure that they are undistorted, recourse must be had to a very slow electron beam, which gives very little photographic effect. The only possible means of applying photography to this method of studying atmospherics would be to have a very high aerial system, and high amplification, so that one could use high electron speeds, which give photographic sensitivity at expense of electrical sensitivity. But high amplification would, in the present state of amplifier design, involve distortion out of all proportion to the improvement in accuracy given by photography. I should like to say that the apparent gain in accuracy *is* only apparent, for this reason, that photography is necessarily a very complicated and tedious business. The complete photograph, I imagine, could hardly be produced in less than four minutes—even in America—whereas the pictures which we draw can be done at the rate of 100 per hour, even after rejecting doubtful traces. The statistical reduction of the large mass naterial thus made available gives an accuracy the mean greatly in excess of that which can be racted from relatively few, individually accurate, otographs. With regard to the sinusoidal time le, I hope I have not misled you to suppose that t is a troublesome thing. As a matter of fact, re is very little difficulty in interpreting the ves even on this sinusoidal scale, because we n, if we like, reject curves in which the important ents are taking place at the congested ends of e scale, and deal only with those curves which me in the middle of the base line, where the scale nearly linear. But, as a matter of fact, Dr. pleton, working in collaboration with Mr. Herd d myself, has produced a type of scale which is near, which gives us directly on the fluorescent reen a curve on an even time scale. I hope that e description of that will be published at quite n early date. As to whether all atmospherics o correspond to long wavelength, I think I should y it is too soon to reply, but that an enormous reponderance of the curves which we have obtained o correspond to long wavelengths in the case of e quasi-periodics or to damping factors in the periodics which are equivalent to long wavelengths. n a sense the wavelength and damping factor can e interchanged in considering the effects, and these, n a great majority of our observations, correspond o the order of wavelength I have mentioned. On he question of the energy contained in a lightning lash, being a good Scotsman, I found it desirable some time ago to get a different way of estimating what that energy really meant, and perhaps I may quote a figure which I evolved as the price which my local electricity undertaking would have charged me for a lightning flash; it was £900. (Laughter.) Again, on the last question as to convective weather, I can only say that the evidence is still insufficient, but that I know of no relation so definitely established as the 94 per cent. agreement between regions of rainfall, *i.e.*, regions of convection, and definitely located sources of atmospherics. That is one of the many things which have to be prosecuted further.

Mr. J. H. Reeves, in proposing a vote of thanks, said:

We have had a most interesting and instructive lecture. We have 25 minutes, in which the lecturer is going to demonstrate, and therefore, I think the best compliment I can pay him is to give him the fullest time possible in which to demonstrate. I move a very hearty vote of thanks to Mr. Watson Watt for his most instructive and interesting lecture.

Mr. G. G. Blake.

I think that wireless workers generally have a very strong antipathy to the "Smith-Jones X" family about whom our lecturer has told us so much. It has been very delightful to hear this interesting lecture from one who is so obviously a great friend of Mr. "X."

I believe Sir Oliver Lodge in pre-Hertz days, when conducting researches on the discharge of Leyden jars, surmised the oscillatory character of lightning discharges; and in 1895 or thereabouts Admiral Popoff was the first to record atmospherics. Using a coherer attached to an aerial he proved Lodge's surmise to be correct.

Mr. Watson Watt mentioned that Senatore Marconi in 1906 was the first to point out that one could detect the definite direction in which X's came.

I believe that previously to that Tesla (in 1904), when he showed that lightning discharges produced stationary waves on the earth's surface observed that as the thunderstorms moved away from the listener the receiving station passed through nodes and loops of signal strength. Such nodes and loops are apparently recorded on the chart of received X's taken at Farnborough during a storm which the lecturer showed to us in his first slide and also on the slide showing clusters of "X's" later in the lecture.

In 1912 or thereabouts, Dr. Eccles showed an exceedingly simple method of recording atmospherics which may be useful to any amateur who wishes to make rough and ready records.

With the phones on the head, you take a pencil and paper and make vertical strokes, long or short in length, to represent the degree of loudness of the statics heard in the phones, and the distance you place these vertical strokes apart along the lines of the paper represents roughly the time taken between the disturbances.

It gives me very much pleasure to second the vote of thanks to our lecturer for his admirable lecture.

The Chairman (Admiral Sir Henry B. Jackson)

I should like to make remarks myself, but the time is short, and I can only personally congratulate Mr. Watson Watt on his lecture. I think we are very fortunate to have heard him, and all persons interested in, and working at wireless will be thankful to Mr. Watson Watt and his colleagues for the work they have done. The work originated with Mr. Watson Watt, and he has carried it out; that is the great point. The actual measurement of these wave forms is a very important step forward, and it will remain now for the engineers to see if they can eliminate them. This is still a very difficult problem, and I do not look forward to perfect success at the present time, but I think this work will help.

Book Review.

"Wireless Really Explained." By P. J. Risdon, F.R.S.A. (London: W. Foulsham & Co., Ltd., 10-11, Red Lion Court, E.C.4. 99 pages. Price 1s. net.

Yet another addition to the literature of elementary wireless reaches us in the form of Mr. Risdon's compact little manual. Since the advent of broadcasting, ignorance of the elementary principles of wireless telegraphy and telephony is fast becoming a reproach, and it is to the man who would avoid such a stigma that this book should appeal. Beginning with a simple exposition on electricity and magnetism, the author initiates the reader into the mysteries of waves in the ether. The practical side of the science is not neglected, and two interesting chapters are devoted to the despatch and reception of wireless messages. In simple language the author deals with the construction of inexpensive crystal and valve receivers, concluding with useful hints and notes, and a well-written panegyric of the marvels of radio.

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.

Hounslow and District Wireless Society.*

On July 19th, Mr. Gordon Fryer, L.D.S., R.C.S., Eng., using the Society's new experimental apparatus, gave an interesting lecture on "Some Simple Valve Circuits, with Modifications for Increasing their Efficiency." This Society provides both for novices and advanced experimenters. All interested are most cordially invited to attend the Society's meetings on Thursdays, from 8 to 10 p.m., at the Council House, Hounslow.

Hon. Sec., A. J. Myland, 219, Hanworth Road, Hounslow.

Streatham Radio Society.*

At the meeting held on July 11th, a lecture was given by Mr. Dunham on "Amplification." The lecturer confined his remarks principally to high frequency amplification, dealing with the merits and demerits of all the systems now in use.

Seven new members were enrolled, bringing the total membership to over 70. A variable speed automatic buzzer transmitter has been lent to the Society by Mr. E. R. Batten, and will prove invaluable for the buzzer practice.

The Society are ceasing their activities during the month of August, resuming their weekly meetings on September 12th.

The Lewisham and Catford Radio Society.*

On Thursday, July 12th, a most interesting lecture was given by the Society's technical adviser, Mr. H. M. Stanley, entitled "Electric Motors and Dynamos."

A competition is now in progress for the design of a suitable receiving set for the Society's use, and every member is entering this with enthusiasm.

On Thursday, July 26th, Mr. Stanley continued his series of progressive talks with "How Ether Waves are Detected," and a very interesting evening finished with general discussions on wireless matters. A great deal of interest is being taken by members in dual-amplification circuits and it is hoped shortly to give a demonstration with sets using this principle.

At a recent garden party held at the headquarters, the Society was able to give an excellent demonstration of reception. In addition a receiving set has been taken through the local hospital, where the broadcasting was greatly enjoyed by the patients, especially by the children during their "hour."

Meetings are held every Thursday at 8 p.r at the new headquarters, 136, Bromley Roa Catford, and prospective members should call this time, or communicate with the Secretar F. A. L. Roberts, 43, Adelaide Road, Brockley, S.E.

North London Wireless Association.*

"The Manufacture of Wireless Sets" was th title of a lecture delivered by Mr. E. E. Wrigh on July 16th. The lecturer's remarks were special interest, inasmuch as they dealt with th construction of sets from the manufacturer's poin of view. Mr. Wright fully described the processe of mass production, from the preparation o drawings to the finished article.

As the Association will not meet during th month of August, enquiries should be addressed to the Hon. Sec., J. C. Lane, at his private address, 9, Cloudesley Mansions, Barnsbury, N.1.

The Leeds and District Amateur Wireless Society.*

At an instructional meeting held recently the President, Mr. A. M. Bage, described "The Construction of a Two-Valve Portable Receiver." Practically every essential to maximum efficiency was included in the outfit, the more important items being the use of a micro-variometer for fine aerial tuning, separate filament control, grid potential adjustments, etc. The set was very successful last winter on the reception of U.S. broadcast and amateur traffic.

At the thirty-eighth general meeting, held recently, the time was spent "gossiping" over many important questions. The Hon. Secretary described an aerial system. Mr. A. F. Carter spoke on the operation of a receiver, using numerous stages of R.F. amplification, and the members discussed the position of the amateur transmitter with relation to the effects of the broadcasting.

At a further instructional meeting held on July 6th, the Hon. Secretary lectured on "Maritime Wireless." The subject was considered historically, and the various kinds of apparatus used in the past and at the present time were described.

On July 13th Mr. W. G. Marshall lectured upon "The Propagation of Æther Waves." The lecture was one of the most valuable presented during the session. Mr. Marshall most successfully conveyed to the meeting the principles of the formation and propagation of waves in æther, and examined various theories relative to the subject. The effects of day and night, land and sea, substrata and atmospheric influences, were considered, and the problem of "fading" closely examined. The Chairman described the experiments made underground recently by the Sheffield Society.

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

Tottenham Wireless Society.*

A lecture on "Dual Amplification" was given by Mr. R. G. Ellis, on July 18th.

After introducing the theory and method of this branch of research, Mr. Ellis gave details of several ual amplification circuits he had used, and his practical operating notes were of great interest and assistance to all.

An animated discussion followed the lecture and it has been arranged to set aside an evening for further study of this subject.

On Wednesday, July 25th, an informal meeting was held, at which the Chairman read a paper of the Radio Society of Great Britain, on "High Frequency Amplification." Many difficult points were cleared up but others have been noted by members as the basis for further experiments. Several dual amplification circuits were set up with varying success.

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

Wolverhampton and District Wireless Society.*

On Wednesday, July 25th, members of the Society visited the Corporation main generating station, Commercial Road. The party was conducted over the station by Mr. S. T. Allen, M.I.E.E. (Chief Engineer and General Manager) and his staff and the various operations were described in considerable detail. The visitors were particularly impressed with the efficiency and economy of the modern generating plant. Many points of especial interest to wireless enthusiasts were enumerated by Mr. Allen, whose courtesy and experience provided the party with a most interesting and instructive time.

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

Battersea and District Radio Society.*

"Fundamentals of Radio Work" was the title of a lecture delivered before the Society on July 10th, by Mr. H. Bevan Smith, A.M.I.E.E. The lecturer introduced interesting methods of cutting out unwanted stations.

It is announced with pleasure that Captain Davis (**2 XL**) of the Pavilion, Lavender Hill, has kindly consented to become President of the Society and has offered the vestibule and aerial of the Pavilion Cinema for any special transmission.

Hon. Sec., A. E. P. Walters, 31, Holden Street, Grayshott Road, Lavender Hill, S.W.11.

Wimbledon Radio Society.*

At a meeting held on July 19th, Mr. C. E. Palmer-Jones gave a further interesting lecture on the "Construction of Valves." The Cossor Valve Co., and Marconi Osram Valve Co. kindly lent the lecturer numerous samples of their valves and the constituent parts used in their manufacture for the purpose of illustration. The Economic Electric Co. kindly presented the lecturer with samples of the Xtraudion Valve. The highly skilled operations involved in the assembly and pumping of valves were fully described.

The Hon. Sec., C. G. Stokes, will welcome applications for new membership.

The South Norwood and District Radio Association.

A discussion on "Broadcasting," opened by Mr. S. W. Butters (**5 VU**), took place on July 12th.

Mr. Butters spoke of the "good old days" of **2 MT**, and led up to the present day, comparing the British with the American methods of broadcasting. Mr. E. A. Saunders then gave his views on the subject, suggesting an "aerial hunt" by members, organised by the P.M.G., to run the "pirates" to earth.

After this discussion Mr. Butters and Mr. Saunders each spoke on the subject of "Television."

It is interesting to note that a member of the Society, Mr. A. Trill, was successful in winning a £5 prize in the "man hunt" recently organised by **2 LO**. Mr. Trill followed the "Uncles" on a cycle for half-an-hour, and only gave up the chase when the chain of his cycle broke.

Hon. Sec., C. H. P. Nutter, Radio Corner, Selhurst Road, South Norwood, S.E.25.

Doncaster and District Radio Society.

The second general meeting of this newly-formed Society was held in Mr. Goddard's room, Balby Road, on Thursday, July 12th. The Chairman, Captain Platt, reported on a visit to the official opening of the Sheffield Broadcasting Relay Station, which commenced experimenting about a fortnight ago. He understood that the station will operate on 100 watts, and when fully equipped and in working order will be able to broadcast its own concert as well as relay the concerts from London, Manchester, Newcastle, etc.

A provisional programme for the winter session was submitted and approved, and arrangements are being made to acquire a permanent home for the Society.

Mr. J. T. Storrow lectured on "Crystals and Crystal Circuits," giving an account of experimental work. The lecture was illustrated by several diagrams, and a dual amplification two-valve and crystal set was shown and its workings explained.

The Q.S.T. Radio Research Society.

The first general meeting of this new Society was held on July 17th, when the following officers were elected: Hon. Sec., R. Croxton; Technical Secretary, D. Bower (**5 WF**); Technical Adviser, C. Bradley, and Treasurer, R. Beresford.

There are still a few vacancies for membership, and any bona-fide experimenter wishing to join, should communicate with the Hon. Sec., R. Croxton, 68, Elsham Road, Kensington, W.14.

Clapham Park Wireless Society.

Lightning phenomena were studied in an unusually interesting fashion on June 27th, when the members were entertained with an instructive lantern lecture and demonstration by Mr. Alfred Hands, F.R.Met.Soc., M.I.E.E. Models of buildings struck by lightning were exhibited and the actual conditions reproduced. Mr. Hands, who is an authority on the subject, stated that thunderstorms occurred in these islands on an average, 97 days out of every year. On the question of aerials and lightning, the lecturer said that aerials, if running across the roof, should not be above the level of the top of the chimney-stacks. To attach poles to chimney-stacks, particularly if constructed of metal, was "asking for it." Listeners-in during thunderstorms ran grave risk, even when using the ordinary safety switches. To cope with a 5,000 million volt lightning discharge, said the lecturer, a break of at least 5 or 6 feet, would be required.

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

THE AMATEUR ORGANISATION

A Scheme for Closer Co-operation.

FOR the purpose of ensuring fuller representation of the affiliated societies on the Committee of the Radio Society of Great Britain, a scheme has been prepared whereby the country shall be divided into four groups :—

1. Scotland.
2. Wales and the West.
3. East.
4. South.

The accompanying sketch map indicates the dividing lines of these groups. Each group will provide, by election, a representative, who shall be a member of the Committee of The Radio Society of Great Britain, this Committee being increased from 8 to 12 in order to accommodate these additional representatives.

As it was anticipated that the election of representatives might take some little while, the Committee of the Radio Society have temporarily appointed representatives, but definite election will take place at the Annual Conference to be held next January.

The necessity for introducing some such scheme as this has been realised by the Committee of the Radio Society ever since the last Annual Conference, when proposals were made with regard to fuller representation of the affiliated Societies, but no definite scheme was adopted.

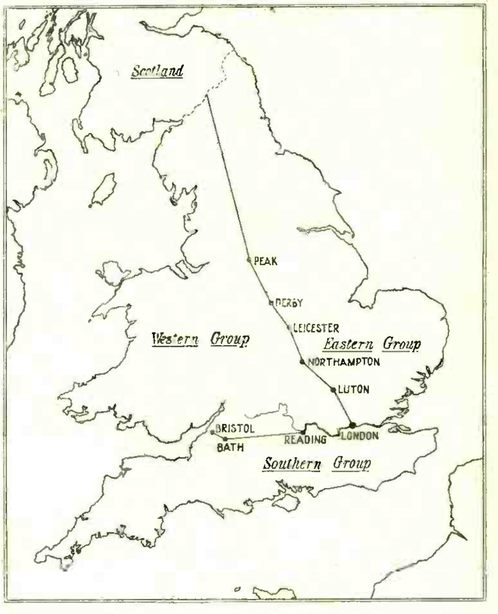
In order to ensure that a representative of each group shall attend Committee meetings regularly, it is suggested that an alternative representative, resident in the Metropolitan area of each group, should also be appointed.

Below is published the text of a letter which has been forwarded to the Secretaries of all affiliated Societies, and a list of districts where affiliated Societies are located, indicating exactly to which group each belongs.

Dear Sir,—You and your Committee will be aware that the Radio Society of Great Britain has always desired closer co-operation with its affiliated Societies and has raised the question at each Annual Conference in the hope of finding some means of giving the Provincial and Suburban Societies more effective representation in all questions affecting the general body of amateurs. As no solution of the problem was reached at the last Conference the Committee of the Radio Society of Great Britain have themselves formulated a proposal which I shall be glad if you will place before your colleagues.

It is proposed to increase the number of the Committee of the Radio Society of Great Britain from eight to twelve by the addition of four members to represent the Affiliated Societies, these members to be elected annually at the Conference customarily held in January.

It is suggested that for the purpose of the election the Affiliated Societies be divided into four groups, thus :—(1) Scotland, (2) Wales and the West, (3) East, and (4) South. A list of the Societies in each group is enclosed, from which it will be seen that the dividing lines are drawn approximately



from London to Bristol and from Kingsway to the Penine Range. Each group will elect its own representative, who must be a member of the Radio Society of Great Britain either individually or by virtue of the office he holds in an affiliated Society. Each group will form its own organisation for the purpose of election, but until such an organisation is formed, and in order that the scheme may be started without loss of time—so that some working experience of it may be had before the next January conferen e—we propose to make a temporary appointment of a representative of your group to act until you elect one of your own choice at the January Conference. A portion of the Metropolis is included in each of the groups (2), (3) and (4).

The Committee are anxious that the affiliated Societies should always be well represented on our ommittee. They suggest appointing an *alternative* epresentative from the metropolitan area of *each* roup. In the event of both the provincial and metropolitan representatives being able to attend the Committee Meetings, both would be welcome but only one would vote.

To give immediate effect to this proposal, the Committee are inviting the following gentlemen to represent the provincial affiliated socities by attending their meetings in London during the first half of the forthcoming session, *i.e.*, until January conference :—

(West) Mr. Y. P. Evans—Manchester Radio Society.

(East) Mr. F. Lloyd—Sheffield Radio Society.

(South) Mr. T. Hesketh—Folkestone Radio Society.

(Scotland) Not yet arranged.

Although these gentlemen have definitely undertaken to attend our Committee Meetings, we nevertheless propose to invite the alternative representatives from the Metropolitan Societies of each group and a further communication to the Metropolitan Affiliated Societies will shortly be sent out.

The publication of the P.M.G.'s Committee's report and the probability of new legislation within the next month or two may demand strong action by the general body of amateur experimenters. The Committee of the Radio Society of Great Britain, in submitting this scheme, believe that by having representatives of the affiliated societies directly in touch with them, they will more readily obtain the unanimous opinion of those they represent.—Yours faithfully,

L. McMICHAEL
(*Hon. Secretary*).

WESTERN GROUP.

Berkhamsted, Birkenhead, Birmingham, Blackburn, Blackpool, Bolton, Burton-on-Trent, Cardiff, Cheltenham, Cirencester, Coventry, Coventry (Humber), Darwen, Denton (near Stockport), Eccles, Evesham, Finchley, Glevum (Gloucester), Gloucester, Hall Green, Hendon, Hereford, High Wycombe, Hinckley, Liverpool, Malvern, Manchester (Wireless Soc.), Manchester (Radio Soc.), Merthyr Tydvil, Morecambe, Newport (Mon.), North Middlesex, Oxford, Preston, Preston (Dick Kerr), Powisland, Redditch, Shrewsbury, Smethwick, Southport, Stockport, Stoke-on-Trent, Stoke-on-Trent (North Staffs. Rly.), Stratford-on-Avon, Swansea, Wallasey, Wembley, West London, Willesden, Wolverhampton.

SOUTHERN GROUP.

Bath, Battersea, Bermondsey, Brighton, Bristol, Bromley, City and Guilds, Kensington Coll., City of London Electric, Cowes, Croydon, Dartford, Ealing, Eastbourne, East Sheen, Erith, Exeter, Folkestone, Fulham, Greenwich, Guildford, Hounslow, Kensington, Kingston, Lambeth Coll., L.C.C., Lyons' Radio, Maidenhead, Newbury, Paddington, Plymouth, Ramsgate, Reading, Redhill, Southampton, South London, Streatham, Sussex (Brighton), Sutton, Sydenham, Trafalgar, Vauxhall Metr. Gas, Wandsworth, Weston-super-Mare, Wireless and Exp. Assn., Woolwich, Worthing.

EASTERN GROUP.

(London to Luton, Northampton, Leicester, Derby to the Peak, putting the whole of Yorkshire in the Eastern Group, Durham, Northumberland also).

Aquarius, E.C.1., Barnsley, Bedford, Birkbeck College, Bishop's Stortford, Bradford, Cambridge, Cambridge (Lay's School), Chesterfield, Derby, Dewsbury, Durham, East London, Felixstowe, Grays (Essex), Grimsby, Hackney, Halifax, Harrogate, Heckmondwike, Hertford, Highgate, Holloway, Hornsey, Huddersfield, Hull, Ilford, Ilkley, Ingatestone, Ipswich, Leeds, Leicester, Lincoln, Luton, Middlesborough, Newcastle-on-Tyne, Northampton, North Lincs., Norwich, Nottingham (Boots), St. Brides (Fleet Street), Sheffield, Southend, South Shields, South Woodford, Sunderland, Sunderland (Scient. Ass.), Tottenham, Tynemouth, Wakefield, Walthamstow, Wanstead, Whitby, Working Men's College, N.W., York.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have read with interest the article on "Fading," by W. R. Burne and J. A. Cash. My experience of fading largely corroborates their remarks. As regards harmonics, I think no fading occurs when the harmonic is caused mainly by earth currents. As regards the periodic swing, although I have observed this for ranges under 1,000 miles, I have obtained slightly different times. For instance, 2 LO swings in periods of two or three minutes (I have not my notes with me at the time of writing), whilst an amateur at Birkenhead (about 180 miles) closely approximates to the New England stations mentioned in "Modern Radio Operation." It is very similar to a series of sudden gusts of wind, and, in fact, could almost be called a very low frequency oscillation. French amateurs swing in about 30 to 40 seconds, Dutch amateurs in about 15 to 20 seconds. The only case of double fade has been noticed with the Birkenhead transmission mentioned above, and is most remarkable.

I might add that my investigations have taken place during the spring and summer months from sunset to dark. Although I have received a station with an eighty-second swing, I have been unable to discover where it is located, as, at the best, using two H.F., speech was not intelligible.

E. A. ANSON.

Prestonpans, near Edinburgh.

Wanted : Lecturers.

The Radio Society of Great Britain asks that those willing to give lectures before affiliated societies on any subject allied to radio science, will send in their names, addresses, and titles of lectures. They should state the radius in miles from their home, within which they would be willing to lecture, and whether their services would be (1) gratis, (2) for payment, or (3) on payment of expenses only. Considerable success attended the efforts made last year in this direction.

All communications should be addressed to: L. F. Fogarty, A.M.I.E.E., Dene Cottage, Manor Way, Ruislip, Middlesex.

Notes and News

A wireless receiving set has been installed in the private room of Sir Laming Worthington-Evans (the Postmaster-General) at the House of Commons.

* * * *

Further experiments with wireless telephony for mine rescue work have been conducted with considerable success by two Ashington Colliery officials.

* * * *

For not having a wireless installation on his ship capable of transmitting 100 miles a Greek shipowner has been fined £50 and £20 costs.

* * * *

It is stated that the term "listener-in" is regarded with disfavour by the Postmaster-General's Broadcasting Committee. The substitution of "listener" is recommended.

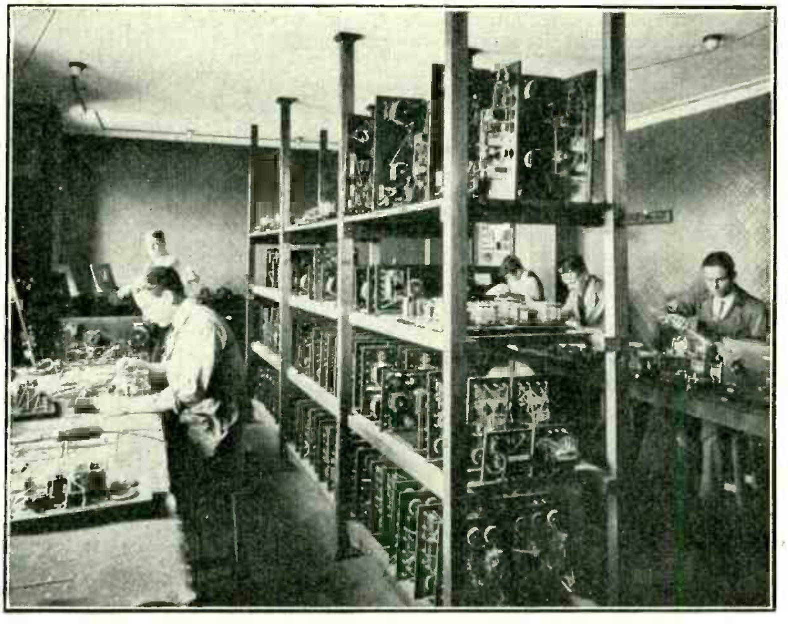
Experimental Transmission.

On or about August 15th, 2 WQ, Brierley Hill Staffordshire, will be commencing a series of experimental telephony transmissions on powers ranging from 20 to 50 watts. They will take place intermittently between 1230 and 1330, 1630 and 1700, 2300 and 2330 on weekdays, and 1130 and 1300 on Sundays. The transmissions, which will be on 440 metres, will be of about five minutes' duration, and will consist of speech and tonic train. Mr. C. H. Gardner, of the British School of Telegraphy, 179, Clapham Road, London, S.W.9, will be grateful to receive reports of reception.

Drastic Measures in Wandsworth.

The Wandsworth Borough Council, in banning wireless aerials on the houses of their tenants, has acted in a drastic and, we believe, unwarranted manner. Notices to quit were issued to those tenants displaying aerials, and were only withdrawn when the equipment was taken down and the damage (*sic*) made good.

With the lamentable obtuseness which characterises so many parochial bodies, the Wandsworth Borough Council has probably forgotten (if it ever knew) that practically all the leading insurance companies issue low-premium policies for damage directly due to wireless aerials, by lightning, breakage, or other calamities. It would be a simple matter to require all tenants to take out such a policy. Moreover, any damage to property incurred through the erection of a wireless aerial by a tenant could easily be provided for by the institution of a deposit system, a practice followed by a number of other borough councils. The



The Wiring Shop of Messrs. Burndept, Ltd., at Blackheath.

A wireless controlled aeroplane has flown from Paris to Tours and back—a distance of 280 miles.

Aerials and Lightning.

The vexed question of whether wireless aerials are peculiarly susceptible to damage by lightning is still under discussion in many quarters.

In order to submit the question to a practical test we should be glad if readers whose aerials have been damaged by lightning would be good enough to inform us by postcard, stating (*a*) the result where there was an arrestor and/or outside or inside earthing switch correctly adjusted at the time of the damage; (*b*) the result where there was no arrestor or earthing switch; (*c*) the result where the apparatus was actually in circuit or in use at the time of the mishap.

igh-handed action of the Wandsworth Borough Council cannot be regarded too seriously.

Wireless Operators' Wages Reduced.

The reductions referred to under the above heading in our issue of July 21st came into operation on and from May 16th, 1923, a fact not stated in our paragraph.

Correspondents Wanted.

Mr. H. E. Poland, of the Department of Marine and Fisheries, Prescott, Ontario, Canada, wishes to get into touch with any amateurs in England who would care to correspond with him.

Brentwood Receiving Station.

It has been drawn to our notice that in two recent references in this journal to the Marconi Company's long distance receiving station at Brentwood, Essex, the name of the station was erroneously given as Brentford. We greatly regret the mistake.

Ubiquitous GBL.

The origin of the Leafield—Karachi service of news messages, which has been in operation for twelve months, provides an interesting instance of wireless exceeding expectations. In a written reply to Sir Harry Brittain, the Postmaster-General (Sir Laming Worthington-Evans), states that the Leafield station was never intended for direct communication with India; but in view of the extent to which its signals were heard in that country, the Indian Government and certain Indian newspapers suggested that a unilateral news service should be instituted for the transmission of short news messages of special interest and urgency.

The many amateurs who could well dispense with the activities of **GBL** will wish that the service were also uni-directional.

Japanese Radio Plans.

According to a Reuter telegram from Tokio, the Premier of Japan, Mr. Kato, announced on July 27th, the Government's decision to permit private companies to work and operate international radio stations. The work is to be subsidised as occasion demands.

Broadcasting from Konigswusterhausen.

The regular transmissions from this station, referred to in our issue of July 14th, have been heard by a Welsh correspondent, Mr. J. H. S. Fildes, of Llandudno. Mr. Fildes, whose set is of his own construction, states that he received the concerts on three successive Sundays, commencing on July 8th. He adds that the station is difficult to receive, but when the set is brought right up to oscillation point, the music is clear though faint.

The set comprises: One H.F., detector and L.F. valves. The single wire aerial is 70 ft. long, including the lead in, being 18 ft. in height at the lead-in end, rising to some 35 ft.

Our correspondent's achievement is very creditable, inasmuch as his station is screened by hills in every direction except to the West and North-West.

FORTHCOMING EVENTS.

SATURDAY, AUGUST 11th.

Wireless Society of Hull and District. At 3 p.m. Visit to the Corporation Electricity Works, Sculcoates Lane.

MONDAY, AUGUST 13th.

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

Hornsey and District Wireless Society. At the Queen's Hotel, Broadway, Crouch End, N.8. Ordinary Meeting.

FRIDAY, AUGUST 17th.

Wireless Society of Hull and District. At 7.30 p.m. Lecture: "Magnetism." By Mr. G. E. Steel.

Hertzite.

Messrs. Russell & Shaw, of 38, Great James Street, Bedford Row, W.C.1, in a letter to the Editor, dated July 26th, point out that the article on "Hertzite" published in our issue of July 17th, under the name of W. J. Fry, may lead to erroneous ideas. They declare that Mr. Fry has never made their present *Hertzite* crystal, and that he is not aware of their formula for manufacture.

Year-Book of Wireless Telegraphy and Telephony, 1924.

The Editor of the "Year-Book of Wireless Telegraphy and Telephony" will welcome any assistance our readers can render him in revising and bringing up to date the information regarding Laws and Regulations, organization, administration and general data connected with Wireless Land Stations, especially those in remote parts of the world.

The information desired is briefly :—

1. The Laws and Regulations affecting Radiotelegraphy and Telephony in each country, now in force or likely to come into operation during the coming year, and the form of licences used for Radiotelegraphic and Telephonic Working.
2. The Department controlling the Wireless Stations and the names, administration titles and addresses of the principal officials.
3. The general working of Land Stations, especially with regard to Aviation, Direction-Finding, Weather Reports and Press News.
4. Amateur or Experimental stations and notes on any existing societies or clubs.
5. Stations in use, or contemplated, for broadcasting news, etc., by Radiotelegraphy.

Communications, which should be as concise as possible, should be addressed to the Editor of the "Year-Book of Wireless Telegraphy and Telephony," 12 and 13, Henrietta Street, W.C.2. It will also facilitate the systematic filing of information if correspondents writing about more than one country will use separate sheets for each.

R.S.G.B. Photographs.

Prints of the photographs taken at the recent outing of the Radio Society of Great Britain to Northolt and Wembley can be obtained at a nominal cost from the Hon. Secretary, L. McMichael, 32, Quex Road, Hampstead, London, N.W.6.

New Wireless Station at Warsaw.

The construction of the new Warsaw wireless station, which will be one of the most powerful of its kind in Europe, will be completed about the middle of August, says Reuter. The Radio Corporation of America is undertaking the work under the auspices of the Polish Government, the mechanics and workmen being of Polish nationality.

Radio Society of Great Britain.

An ordinary general meeting of the Society was held on Wednesday, July 25th, at 6 p.m., at the Institute of Electrical Engineers, the President, Dr. W. H. Eccles, F.R.S., being in the chair.

The minutes of the previous meeting having been read and confirmed, a paper by Mr. Lionel J. Hughes, of Mombasa, on "Resistance Capacity Coupled Amplifiers" was read by Mr. Philip R. Coursey, B.Sc., F.Inst.P. A demonstration of Neon Tubes by the last-named gentleman followed, and the meeting concluded with a demonstration by Mons. Y. Marrec of his apparatus for eliminating atmospherics and other interference. A special vote of thanks was accorded Mons. Marrec and Mr. Coursey for their valuable contributions to the programme of the evening.

The President intimated that the Society would not meet during August, and details of the September meeting would be made known in the usual manner. The Chairman further announced that the following members and associates had been elected :—

Members : A. Craven, R. Bertram, T. Ryce, J. B. Seymour, R. N. Hawes, C. F. Patterson-Mills, J. H. Ridley.

Associate Members : S. T. Anderson.

The following Societies were accepted for affiliation :—Radio Section of the B.T.H. Recreation Club, Harrow Radio Society, Wireless Section of the Abbey Athletic and Social Club, Doncaster and District Radio Society and North West Manchester Radio Society.

Calls Heard.

(Listeners-in are invited to forward to the Editor lists of experimental stations heard for inclusion under this heading.)

Shepherd's Bush, London.

2 AJ	2 AN	2 HD(?)	2 AH	2 BZ	2 DK
2 FQ	2 FU	2 MF	2 ID	2 JV	2 KV
2 KZ	2 LT	2 PA	2 MJ	2 MK	2 MO
2 OM	2 ON	2 XB	2 QQ	2 TI	2 TU
2 VJ	2 XA	2 ZO	2 XL	2 XZ	2 YS
2 YY	2 ZA	5 CB	5 AD	5 AQ	5 AR
5 AY	5 BT	5 LP	5 CP	5 DK	5 HY
5 IO	5 IS	5 VL	5 MA	5 OX	5 PB
5 PV	5 SU	6 IM	5 VM	5 VD	5 VP
5 VR	6 HD				

(T. G. Bowles).

Cressington Park, Liverpool.

5 BC 5 LL 5 LT

(These stations are unknown).

(James K. Wilkie).

South Norwood, London.

2 AJ	2 AW	2 BV	2 DF	2 FB	2 FN
2 FQ	2 JA	2 JE	2 KC	2 KE	2 KY
2 LT	2 NM	2 OD	2 QQ	2 QS	2 RZ
2 SB	2 SG	2 TP	2 VS	2 VT	2 WJ
2 XD	2 XI	2 XR	2 YR	2 ZT	5 BI
5 DN	5 DT	5 FR	5 FS	5 GS	5 ID
5 JS	5 KO	5 RB	5 OX	5 QV	5 WN
5 WR	6 AH	6 AY	6 CC	6 OZ	6 PP
0 AA	0 BQ	0 MX	0 NY	0 XL	8 AB
8 AQ	8 BF	8 BM	8 BN	8 BV	8 CC
8 CH	8 CS	8 ZZ			

(J. Ridley).

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. 0 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 ; 7.20 p.m., 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 and Sundays, 10 to 10.45 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, 1 p.m., Meteorological Bulletin. Daily, 5.50 p.m., Meteorological Bulletin ; Tuesday and Thursday, 10 p.m., Concert. Sunday, 7 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.

PAGES FOR BEGINNERS.

With the object of catering for the needs of the beginner, the following brief descriptions on matters of practical construction and theory are provided. Arranged in a concise manner, it is easily possible to grasp at once a complete understanding of the topic dealt with, while the wide ground covered will probably create general interest in the pages. The details given may be regarded as a summing up of the available information on the subject described.

Capacity of the Aerial Tuning Condenser.

THE maximum capacity of this component depends essentially upon the wavelength to which the circuit is to be tuned. For broadcast reception it may invariably be connected in series with the inductance and when used with a single or double wire aerial of the usual dimensions a maximum value of 0·0005 microfarads is most suitable. It may be thought that as larger condensers give low values near the zero position they should be suitable for short wave work, but it will be found that the wavelength change produced by a given movement of the condenser scale is too great, and fine tuning on short wavelengths rendered difficult. For 600 metres a maximum of 0·001 microfarad in series with the inductance is required, whilst for longer wavelengths 0·0015 mfds., with a switch for connecting condenser and inductance in series or parallel, is a good arrangement. It is difficult to procure variable condensers with air dielectric having a larger value than 0·0015 mfds.

* * * *

Capacity of the Closed Circuit Condenser.

The condenser connected across the closed circuit inductance of a tuner should have a maximum value of 0·0003 mfds. for tuning to wavelengths below 500 metres. For longer wavelengths 0·0005 mfds. is adopted. The lower the value of this condenser the greater will be the potential built up across it, and hence stronger signals will be obtained. Use the closed circuit condenser near its minimum position, and when a given signal is tuned in with the condenser near its maximum setting the value of the inductance should be increased in order that the value of the condenser may be reduced.

* * * *

Correct Value of Grid Condenser and Leak.

To obtain good results with a valve arranged to operate as a detector it is necessary to employ a grid condenser and leak having precisely suitable values. With the usual "R" type valve the condenser should have a value of 0·00025 microfarads, and the leak 2 megohms, to correct the grid potential and produce good rectifying effects. It is usual to employ a condenser of this value in a circuit operating on low wavelengths. A value of 0·0003 mfds. is more suitable for use on the longer wavelengths.

* * * *

How to Measure Resistance.

It is often useful to be able to measure the resistance of the windings of an intervalve transformer in order to be able to form some idea of the number of turns of wire with which it is wound. Connect the winding to be measured in circuit with a milliammeter reading to 10 milliamps (an instrument which every experimenter should possess), and a 4-volt accumulator. The voltage of the accumulator can be relied upon to be exactly four volts if it has been in use for a short while after a full charge. The resistance is calculated by dividing one thousand times the voltage by the reading in milliamps shown on the meter. To be precisely correct the resistance of the meter must be deducted from the figure obtained. The meter resistance is usually given on the scale and with medium priced instruments it is usually of the order of 40 to 60 ohms.

* * * *

Gauge of Wire for Receiving Inductances.

The tuning coils of crystal and single detector valve receivers should not be wound with finer wire than No. 24 S.W.G. For valve sets employing reaction or high frequency amplification No. 26 S.W.G. is a convenient gauge, for although a little resistance introduced into such circuits will have no serious effect, the gauge stated is durable, and permits of tappings being made without danger of breakage. In coupled circuits employing an inductance wound on a rotating former, it often becomes necessary to include a large number of turns in a limited space in order to provide a sufficient degree of coupling. In such cases use No. 30 S.W.G. The sizes 24 and 26 should be double cotton covered, and the No. 30 double silk.

* * * *

Soldering Fluxes.

The safest flux for securing the connecting leads of instruments is resin, and it is best applied in the form of resin-cored solder. As it is a little difficult to use, the merest trace of "Fluxite" may be employed in combination with it. For joining large brass surfaces such as may occur in the component parts of an instrument, "killed salts" (zinc chloride) is used. It is made by adding scrap zinc to strong commercial hydrochloric acid (spirits of salts) until no more will dissolve. The resultant liqu is poured off from the black deposit whic may be produced if certain impurities a present in the zinc, and diluted with a equal volume of water. Ammonium chlorid (sal ammoniac) in the form of a block often used for cleaning the iron, but it wi be found to rapidly act upon an iron whic is frequently made too hot, and "Fluxite will generally be found more suitable for th purpose.

* * * *

Paying Out Aerial Wire.

When unwinding aerial wire from a hank, it is essential to avoid the introduction of twist which may give rise to kinks, and in any case will not permit of the wire hanging in a perfectly straight fashion. While paying out, the coil should either be revolved or held in the hand, and three loops released from either side in turn, reversing the coil to do so.

(*Further items of interest to Beginners will appear in the next issue.*)

A New Telephone Receiver.

A NEW telephone earpiece design specially applicable to broadcast reception is a noteworthy novelty which has recently appeared. Owing to the distribution of its weight, the receiver can be simply hung on the ear, where it may remain for hours without causing any inconvenience to the user, leaving the head entirely free in its movements. A further great advantage possessed by the new phone is that, as the ear is enclosed on all sides, external noises are almost completely excluded. It is also claimed that owing to the special design of the air space between the diaphragm and the ear there is an improvement in the acoustic qualities, whilst the cushion acts as an acoustic filter. This receiver is made with resistances up to 2,000 ohms, or as a double receiver with a total resistance of 4,000 ohms. In the double type the head straps are dispensed with. The instrument should make a special appeal to ladies, who very naturally dislike wearing telephone head-bands.

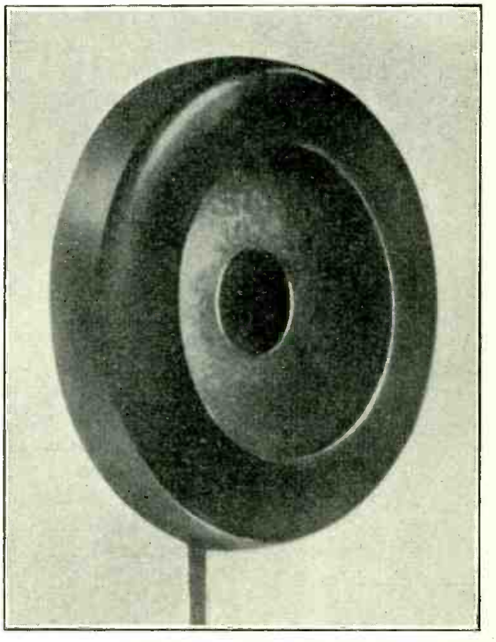


Photo: Benandi Telephone A.G., Zurich-Berlin.
The New Telephone Earpiece.

QUESTIONS AND ANSWERS

"C.H.J." (Cheshire) *asks* (1) *If it is necessary for the grid leak to be connected to earth when using H.F. amplification.* (2) *For a diagram indicating how it is possible for the correct grid leak connection to be kept when the H.F. valve is switched in or out.*

(1) The grid leak should be connected to positive L.T. (2) The grid leak connection will not be altered when the H.F. valve is switched out.

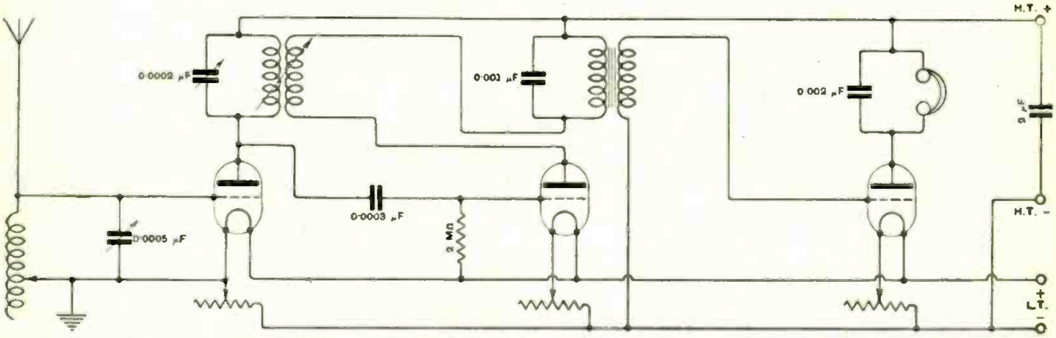


Fig. 1. **"A.C.H." (Tonbridge.)** *Three valve receiver with one H.F., detector, and one L.F. valves. Tuned anode H.F. coupling is employed, with reaction to the anode coil.*

"A.C.H." (Tonbridge) *submits a diagram of a three-valve set, one H.F., detector, and one L.F. valves, and asks* (1) *If the diagram is correct.* (2) *If the proposed method of connecting the H.T. and L.T. batteries is correct.* (3) *If the set, when constructed, would give satisfactory reception from* **2 LO** *with a small frame aerial at a distance of 30 miles.* (4) *If the proposed set would operate a loud speaker.*

(1) and (2) The diagram submitted is not correct. In Fig. 1 a suitable diagram is given. (3) The set described would probably require the addition of at least one more high frequency valve to give satisfactory reception of **2 LO** with the frame aerial. (4) It should be possible to operate a loud speaker satisfactorily with a good outdoor aerial.

"TALISMANIC" (Swinton) *submits three samples of wire, and asks us to identify them.*

No 1 is No. 41 S.W.G., D.S.C.; No. 2 is No. 38 S.W.G., D.S.C.; No. 3 is No. 32 S.W.G., D.C.C.

"ARFRYN" (Wales) *asks* (1) *What is the best actual ohmic resistance of a pair of telephones to be used with a crystal receiver.* (2) *What is the effect of employing telephone receivers with windings of different values of resistance.*

(1) With telephone receivers wound to a resistance of 4,000 ohms, and of a reliable make you will get entirely satisfactory results from a crystal set. (2) Receivers wound to a higher resistance may be slightly more sensitive, but, on account of the fine windings, are more easily damaged.

"R.H.D.F." (Kensington, W.14) *proposes to construct the three-valve set described in the issue of May 5th, pages* 133-136, *and asks the following questions with regard to it.* (1) *What is the combination of valves employed.* (2) *How a one-valve low frequency amplifying unit might be added to the set mentioned.* (3) *If there is any objection to mounting the three-coil holder on the panel of this set.*

(1) The arrangement of valves in this set is one H.F., detector and one L.F. valves. (2) A one-valve low frequency amplifying unit might be constructed to couple to this set, but an additional valve could not be included on the panel of the set without redesigning the whole. (3) The three-coil holder might be mounted on the side of the cabinet, but it could not be conveniently accommodated on the panel itself in the design given.

"F.W." (Horbury) *asks* (1) *For full particulars of the core and windings of a telephone transformer for use with telephones of* 120 *ohms resistance.* (2) *For the formula by which the capacity of fixed condensers may be calculated.*

(1) We suggest that you build up a core of No. 22 iron wire, 4″ long, and ½″ diameter. The primary winding may consist of 4 ozs. of No. 40 S.S.C. wire, and the secondary winding of 2½ ozs. of No. 34 S.S.C. wire. (2) We would refer you to the issue of June 9th, 1923, for full information on the capacity of small fixed condensers.

"O.F." (Fortis Green) *submits a diagram and particulars of a crystal set, and asks* (1) *For suitable values of the capacity required for variable condensers to tune the primary and secondary windings of the loose coupled tuner.* (2) *For instructions on the making of the variable condensers mentioned in question* (1).

(1) The variable condenser in series with the aerial tuning inductance should have a maximum capacity of approximately 0·001 mfd. The condenser in parallel with the secondary winding should have a maximum value of 0·0005 mfd. (2) We refer you to the article dealing with condensers in the issue of June 9th.

"A.D.I." (Maidenhead) *submits particulars of his five-valve set, one H.F., detector and three L.F. valves, with which he obtains wide variations in results with different methods of high frequency coupling. He asks* (1) *Why, in Fig.* 2, *page* 705, *of the issue of August* 26*th,* 1922, *a grid condenser and leak are shown with a high frequency valve, and in Fig.* 5, *page* 113, *of the issue of October* 21*st,* 1922, *no grid condenser or leak is shown with the high frequency valve.* (2) *With reference to the second diagram mentioned in question* (1), *if we would give this diagram with the addition of potentiometer control to the grids of the high frequency valves.*

(1) The diagram Fig. 2, page 705, August 26th, issue is arranged for high frequency amplification with either of two methods, (*a*) using high frequency transformers, or (*b*) using resistance capacity coupling. The grid condenser and leak is provided for the latter method. The diagram Fig. 5, page 113, October 21st issue, shows an amplifier coupled with high frequency transformers. No grid condensers and leaks are then required except for the rectifying valve. (2) We would refer you to Fig. 2, page 160, and Fig. 4, page 162 of the May 5th issue of this journal.

"C.N.M." (Putney, S.W.15) *asks* (1) *and* (2) *For particulars to enable him to make a high frequency plug-in type transformer, to tune from* 2,000 *to* 4,000 *metres with a* 0·0002 *mfd. variable condenser.* (3) *For values of the anode resistance, fixed condenser, and grid resistance for a single stage resistance capacity coupled high frequency amplifier to couple to a set in which the detector valve is of the Dutch type.*

(1) and (2) The transformer may consist of 1,500 turns of No 40 S.S.C. wire for each winding, on an ebonite former 2″ in diameter. (3) Anode resistance 80,000 ohms, grid condenser 0·0003 mfd., grid leak 2 Mω.

"A.J.M." (Windsor) *submits a diagram of a four-valve receiver comprising one H.F., detector, and one L.F. valves, and asks* (1) *If the receiver would give good reception of British broadcast transmissions.* (2) *For particulars of the A.T.I. required for reception on wavelengths from* 350 *to* 450 *metres.* (3) *If the H.F. coupling shown is correct.*

(1) A receiver wired according to the diagram submitted should give satisfactory reception of British broadcast transmissions. (2) On a former 3″ in diameter, wind a layer of No. 20 D.C.C. wire for a length of 5″. Take six tappings, the first one at the 20th turn, and the rest equally spaced along the remainder of the coil. (3) The method of H.F. coupling indicated in your sketch is known as the tuned anode method. The inductance may be a winding of No. 26 D.C.C., 3″ in diameter and 5″ long with fifteen tappings.

"L.T." (Cambs.) *asks* (1) *For advice on the use of* 220 *volt A.C. mains as a source of supply for the filament current of valves.*

(1) We would refer you to the articles entitled "Valve Current from A.C. Mains," and "The Tungar Rectifier," in the issue of January 20th, 1923, also "Notes on Rectified A.C. for Plate Circuits," page 718, March 3rd issue.

"K.M.L." (Petersfield) *asks* (1) *The identit of a station which was transmitting a musical pr gramme in French at* 12 *midnight on May* 11*th* 12*th, on a wavelength of* 450 *metres.* (2) *For sug gestions by which a circuit as submitted might b prevented from easy self-oscillation.* (3) *Wh with any setting of the* 0·0005 *mfd. variable condense in series in the aerial circuit tuning may be accom plished by adjustment of the closed circuit condenser and the coupling of the aerial and closed circu inductances.* (4) *For the identity of* **5 DO.**

(1) The station heard was l'Ecole Supérieure des Postes et Télégraphes, Paris. (2) Connect the grid leak of the detector valve to positive L.T. and make careful adjustments of both H.T. and L.T. values. (3) Adjustments of the aerial tuning condenser, and of the coupling between the aerial and closed circuit inductances both affect the wavelength of the two circuits in question. When the wavelength of the aerial circuit is adjusted to a certain value by means of the series variable condenser, the secondary circuit may be tuned to this value by adjustment of both the condenser across the secondary inductance and the coupling between the two coils. (4) This station is owned by Mr. E. J. Watts, 6, Ashley Road, Salisbury.

"G.H.S." (Nottingham) *asks* (1) *With reference to his aerial, which is at present a single wire* 100 *ft. long and* 30 *ft. high, if we think the range of his two-valve set would be increased by altering the aerial to one of three wires spaced* 3 *ft. apart and* 45 *ft. high.* (2) *Why the addition of a high frequency amplifying valve, tuned anode coupling, should decrease the strength of signals at present received with a detector and one L.F. valve. Also why, with the H.F. valve in operation, is he troubled with continuous oscillation.* (3) *For the times of transmission and wavelengths of* **WGY** *and* **WJZ.**

(1) An increase in the height of the aerial would, we think, be an improvement, but the effect of increasing the number of wires would merely be to alter the aerial capacity. (2) Without particulars of the tuning coil and condenser we cannot say exactly why the signals are reduced in strength. To receive the broadcast transmissions a No. 75 plug-in coil, or a coil with an equivalent inductance tuned with a 0·0002 mfd. variable condenser is satisfactory. If you are employing reaction, the connections to the reaction coil may require reversing when the H.F. valve is switched into circuit.

"F.H.H." (Romford) *asks* (1) *Why adjustments to his reaction coil have no effect on the reception of* **2 LO** *at a distance of* 12 *miles, when amplification of signal strength is obtained with all other stations.* (2) *Why a "QX" type valve will not give results equal to a M.O. "R" type valve.* (3) *What are the most suitable values of anode potential and filament voltage for a "QX" type valve used as a rectifier.* (4) *Which is more suitable for use as a H.F. amplifier—an "R" or a "V.24."*

(1) It may be your reaction coil is not a suitable size. On the other hand, when an efficient aerial is in use it is not always necessary to use reaction, especially when receiving signals such as those sent out by the broadcasting station. (2) Probably you are not using the correct H.T. and L.T. to get the best from the "QX" valve. Of course the

R " type valve is a good rectifier. (3) When the QX " valve is used as a rectifier the usual anode oltage is 25, the filament current 0·75 amps., and lament voltage 5 volts. When used as an amplifier ie anode voltage should be raised to 100. (4) An R " valve operates quite well as a high frequency mplifier, but many prefer to use a " V.24," which s specially designed for high frequency amplification.

" J.G.D." (Lewisham) *submits a diagram f a two-valve set, detector and one L.F. valves, and asks* (1) *Why it is impossible to tune out the ransmissions from the London broadcast station when receiving the transmissions from other broadcast stations, using a set constructed according to the liagram submitted.* (2) *Why the addition of a H.F. amplifying valve decreases the strength of signals received.* (3) *For a diagram of a one-valve H.F. amplifying panel, to include a switch for cutting out the valve when desired.* (4) *If various alterations to his aerial would be advisable.*

(1) The principal reason why you cannot tune out the transmissions from **2 LO** is because you are employing a single circuit tuner. We recommend that you employ a loose coupled tuner, the closed circuit coil being tuned with a 0.0005 mfd. variable condenser. (2) You have not given us particulars of the H.F. amplifier. We presume the H.F. circuits are capable of being tuned to the correct wavelength. If you are employing reaction

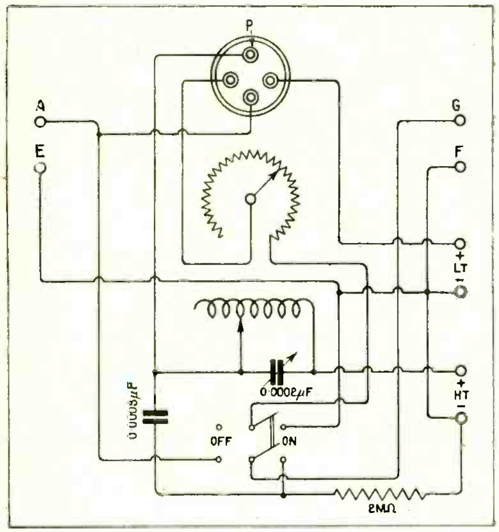


Fig. 2. **" J.G.D." (Lewisham).** *A H.F. amplifying unit is shown, with switch for cutting out the valve when desired.*

it is just as well to reverse the connections to the reaction coil when a valve is switched in between the detector and the aerial circuit. (3) A suitable diagram is given in Fig. 2. (4) We think that you would be well advised to retain your aerial.

" E.H.W.H." (Ilford) *asks* (1) *For a diagram of a three-valve set, including a three-coil tuner for plug-in honeycomb type coils.*

We would refer you to diagram No. 53 in " The Amateurs' Book of Wireless Circuits," by F. H. Haynes, The Wireless Press, Ltd., 2s. 6d. net, as well as recent issues of this journal.

" H.H.R." (London, N.5) *asks* (1) *For the number of turns of No. 28 D.C.C. copper wire required for an aerial tuning inductance, and an anode inductance to receive on 1,080 metres, using a honeycomb coil former which he describes.* (2) *If we think he is likely to receive American telephony using a two-valve set, one H.F. and detector.* (3) *If coils wound on the former mentioned in Question* (4) *were produced commercially, would this involve any infringement of a patent.* (4) *Having bought an ex-Army spark coil designed to operate on 6 volts and rated as 20 watts input power, if it is correct to assume that by operating this coil off a 4-volt supply the input will be 15 watts; also, what would be the effective range of a transmitter employing this coil as suggested.*

(1) Your aerial tuning inductance may have 100 turns on the former described, and should be tuned with a 0·001 mfd. variable condenser in parallel. The anode inductance may consist of 200 turns, and should be tuned with a 0·0002 mfd. variable condenser. (2) We do not think you should expect to receive American transmissions, although we believe the transmissions were all received with a two-valve receiver. (3) We cannot advise you upon patent matters. The coils described have been patented. (4) It is not correct to assume the coil will take a load of 15 watts. A good deal depends upon the adjustment of the coil. The range of the transmitter depends greatly upon your skill, as well as the efficiency of the aerial, and no reliable figures can be given.

" A.O.E." (Acton, W.3.) *asks, with reference to the single valve receiver described on pages 656 to 660 of the issue of February 17th, 1923,* (1) *When the set is used as a high frequency amplifying unit before a crystal set with a single slide inductance, if an adjustment of the inductance slider of the crystal set is necessary for every setting of the variometer in the high frequency unit.* (2) *When receiving from distant stations, why the speech and music are frequently distorted and the tuning extremely critical.* (3) *The probable wavelength range with small fixed condensers in series and parallel with the variometer.* (4) *If it would be possible to add another high frequency valve to this set, with a switch for cutting out the extra valve, without the use of any further components.*

(1) It will be necessary to make a fresh adjustment of the inductance slider for every setting of the variometer. (2) The speech distortion probably arises from wrong values of L.T. and H.T., together with unskilful tuning. The fact that the tuning is critical is characteristic of the set. The fitting of an extension handle to the variometer knob will greatly facilitate tuning in weak signals. (3) The wavelength of the variometer alone would be from 250-600 metres approximately. The maximum value could be increased up to approximately 1,000 metres by the addition of a small fixed condenser in parallel, the exact value of which would best be determined experimentally. (4) It would not be possible to add another high frequency valve to this set without the addition of components to constitute the intervalve coupling.

"C.S.C." (Derby) *asks* (1) *Whether the diagram of his five-valve receiver is correct.* (2) *Which Igranic coils should be used in the three-coil holder of the receiver.*

(1) The circuit diagram is correct, although you might try reversing the connections to the transformers. The usual method of connecting intervalve transformers is to connect O.S. to grid, I.S. to minus L.T., O.P. to plus H.T., and I.P. to plate. (2) To receive the British broadcast transmissions, use the following coils: Aerial circuit, No. 35; closed circuit, No. 50; reaction coil, No. 100. For the Radiola concerts use Nos. 200, 300 and 250 respectively. For the Hague, Nos. 100, 250 and 150. For FL Nos. 300, 500 and 200.

"W.H.T." (Gillingham) *asks* (1) *For details concerning the construction of small fixed condensers of various capacities.*

Full information on the construction of small fixed condensers appears in the issue of this journal of June 9th, 1923.

"B.A.T." (Beckenham) *asks* (1) *For constructional details of the variable condenser illustrated on page* 12 *of the issue of April 7th,* 1923. (2) *If it is possible to get satisfactory results with a crystal set at his address, using the electric light wires as an aerial.*

(1) Condensers of the type illustrated in the article referred to are not manufactured in this country. Upon referring to the illustration it will be noticed that by turning the dial round, the tinfoil is wound around one of the rollers. There is no particular advantage in constructing a condenser of this description, and the object of the illustration was to show a novel design. Anyone interested would be able to build a condenser of this description from the particulars which accompany the illustration. (2) We do not think you should expect to receive good signals with a crystal receiver without a good out door aerial.

"E.S.B.S." (Palmer's Green) *submits a diagram and particulars of his single valve receiver, and asks* (1) *Why the reaction will not function, after all adjustments to H.T. and L.T. valves have been tried.* (2) *If better results would be obtained with a larger value coil in the aerial circuit, and the* 0·001 *mfd. variable condenser in series.* (3) *If it would be possible to receive the transmissions from the other British broadcast stations with the addition of two-note magnifier valves, or if the addition of a single high frequency valve would be of more assistance for this purpose.*

(1) We suggest that you try a No. 75 or No. 100 Igranic coil for reaction. Your sketch does not indicate a grid condenser or leak, both of which are required with a detector valve. The grid condenser should have a value of approximately 0·0003 mfd. and the grid leak a value of 2 megohms. The method of connecting these in the circuit will be found in diagrams in practically every issue of this journal. (2) It is usual when receiving on the lower wavelengths, to use the aerial tuning condenser in series with the inductance. In this case, with an aerial condenser of 0·001 mfd. capacity, the inductance would be a No. 75 honeycomb plug-in type coil. (3) The addition of note-magnifier valves will not increase the range of your set, but merely magnify the strength of signa[ls] rectified by the detector valve. With the additio[n] of a high frequency valve, employing tuned anod[e] coupling, you should be able to receive from th[e] other British broadcast stations.

"CUAN" (Glasgow) *asks the followin[g] questions with reference to the four-valve experimenta[l] receiver described in this journal.* (1) *If two set[s] of coils are required, one for the H.F. amplifier, an[d] one for the tuning unit.* (2) *For the size of former, gauge of wire, and number of turns required for coils of the sizes mentioned.*

(1) Two sets of coils are required—one for the tuning unit, and one for the H.F. amplifying unit. (2) The numbers given to the coils indicate the number of turns of wire on each. Using No. 26 D.C.C. wire, and formers 2 ins. in diameter, wind coils for the sizes given.

"SIRIBHAIROH" (London, S.W.18) *asks* (1), (2), and (3) *For full particulars concerning the making and erecting of a tubular aerial mast,* 90*ft. high, including details of concrete base, if required. Also if we would suggest any other type of mast suitable for the height mentioned.*

(1), (2), and (3) We cannot supply the information you require in this section of the journal. We would advise you to look through the advertisement pages of this journal for the names of manufacturers of aerial masts suitable for erection to the height you require, from whom you would obtain detailed information. Also see the book "Mast and Aerial Construction," by Ainsley, price 1s. 10d., post free from this office.

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 GREAT BRITAIN

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Under the Supervision of W. JAMES.

CONTENTS

THE EDITOR will be glad to consider articles and illustrations dealing with subjects within the scope of the Journal. Illustrations should preferably be confined to photographs and rough drawings. The greatest care will be taken to return all illustrations and manuscripts not required for publication if these are accompanied by stamps to pay return postage. All manuscripts and illustrations are sent at the Author's risk and the Editor cannot accept responsibility for their safe custody or return. Contributions should be addressed to the Editor, "The Wireless World and Radio Review," 12 and 13, Henrietta Street, Strand, London, W.C.2.

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ON JOINING A WIRELESS SOCIETY

HOW THE SOCIETIES SUPPORT THE EXPERIMENTER.

"WHAT useful purpose can be served by joining a wireless society ? " is a question that at some time or other almost every amateur has asked. If he answers the question for himself, it is very probable that the reply will result in his decision that wireless societies are all very well in their way for those who care to interest themselves in them, but that, for his part, he does not propose to join.

But there is more in being a member of a wireless society than may appear at first, and those who have up to the present dismissed from their minds the idea of adding to the membership of their local society, should take the trouble to reconsider this decision, and see if, by standing aloof, they are not losing something worth while, or at least, to view the matter from a less egotistical standpoint, whether they are not depriving the amateur community of something which they are in a position to contribute.

There has been a good deal of talk, and some criticism regarding the futility of wireless societies, but those who are genuine amateurs and who take the trouble to reflect, will see that in the amateur wireless societies are represented the views of the amateur community, and that these views cannot be effectively expressed through any other channel. There are, especially at the present time, many interests bitterly opposed to the freedom of the amateur, and seeing that the amateurs' strength lies in the local societies working in close harmony on matters of mutual interest, if those who oppose such freedom could succeed in breaking the strength of the amateur position, it would be through the amateur societies that they would endeavour to bring this about. If the local societies ceased to exist and their work were discontinued, then the amateur would be left very much like a man who is suddenly deprived of the power of speech, because he would no longer be able to give voice to his views and demand recognition.

If, then, the amateur desires to assure the integrity of his position, he must reflect again on the advisability of supporting some wireless society.

Probably there are many who will read these lines who are not at present members of any amateur society where they can, as it were, record their vote and take their part in the management of amateur affairs. Nothing would do more to strengthen the position of the amateur at the present moment than if all those who have the welfare of the amateur community at heart were to take immediate steps to support some local society, however small, and so add their names to the roll of membership. Then, if the time comes when joint action on the part of amateurs is necessary, each name added to the membership of the amateur societies will help to support any recommendations or demands which may assist in maintaining the freedom of the amateur in the ether.

This of course is by no means the only work which the amateur societies have to do. Their purpose is to gather together all those who are interested in the study of wireless in order that they may support and assist one another individually and share amongst themselves what specialised experience or knowledge any particular individual members may possess.

Problems and difficulties may seem hard to one who comes up against them without the advantage of the advice or experience of others, and therefore discussions on technical points such as take place at the meetings of societies, are often extremely helpful.

If an amateur wireless society is not a success, the blame attaches to the members, but even more to those who should be members, but who stand aloof instead of giving their help and support.

AN ARMSTRONG SUPER RECEIVER

OPERATED WITH TWO DRY CELLS.

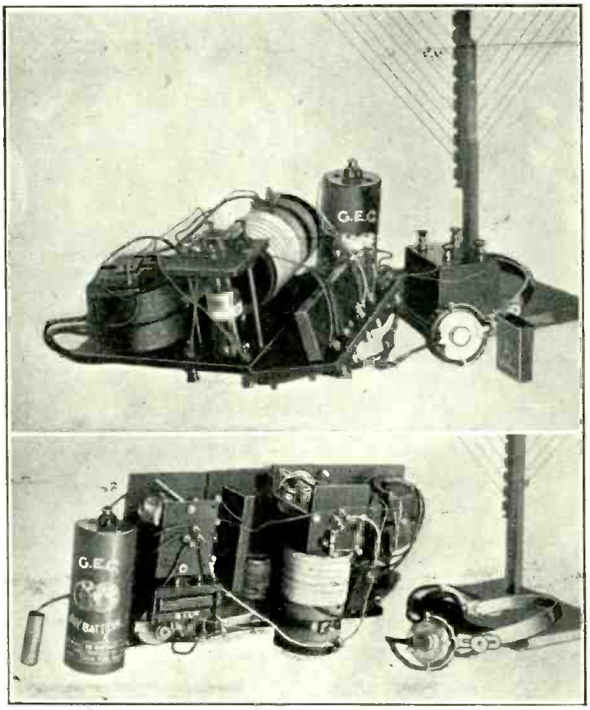
The constructional details given in this article should do much to clear up the difficulties which have been met with by many in building up a receiver on the super-regenerative principle. The author having thoroughly mastered the operation of the Armstrong super, proceeds to make the outfit easily portable by abandoning heavy accumulators and high voltage H.T. battery and substituting two dry cells.

By **5 HZ.**

My early interest in the super-regenerative receiver circuit, aroused by the publication of Armstrong's paper on June 7th, 1922, and fostered by practical details given subsequently*, was damped by the reports of other enthusiasts who had unsuccessfully tackled the three-valve circuit and it was not until details of an efficient one-valve circuit had been published† that the construction of an experimental receiver was decided upon. The theoretical circuit and some details of the components actually used are given below.

It will be seen that there is nothing novel about the circuit except as regards the values of the grid leak, H.T. battery voltage and tuning condenser.

The components were first laid out, connected up on the table and afterwards boxed up. The usual squawks and squeals which seem inseparable from this circuit were produced, tamed, and signals received on various sizes of frame aerials. Trials were made of different combinations of grid condensers and leaks. The distance between the "quenching" coils was varied and finally fixed with a piece of $\frac{1}{8}$ in. ebonite between them, and good signals obtained on all the valves available, *viz.*, "T.15," "V24," "QX" and "R" types — voltages up to 300 being used on the transmitter valve, but in general, best results were obtained using a variable grid leak and H.T. volts slightly higher than that usually employed on each type of valve. When using voltages of 80 and upwards, the howls and shrieks set up appeared to be due to overloading the valves, with a consequent waste of effectual power, rendering tuning-in very difficult, especially with the Armstrong coils fixed in position. Now it would seem that a stronger quenching oscillation is not essential for initially weak incoming signals, *i.e.*, in spite of the enormous amplification provided when the amplifier



The Complete Receiver.

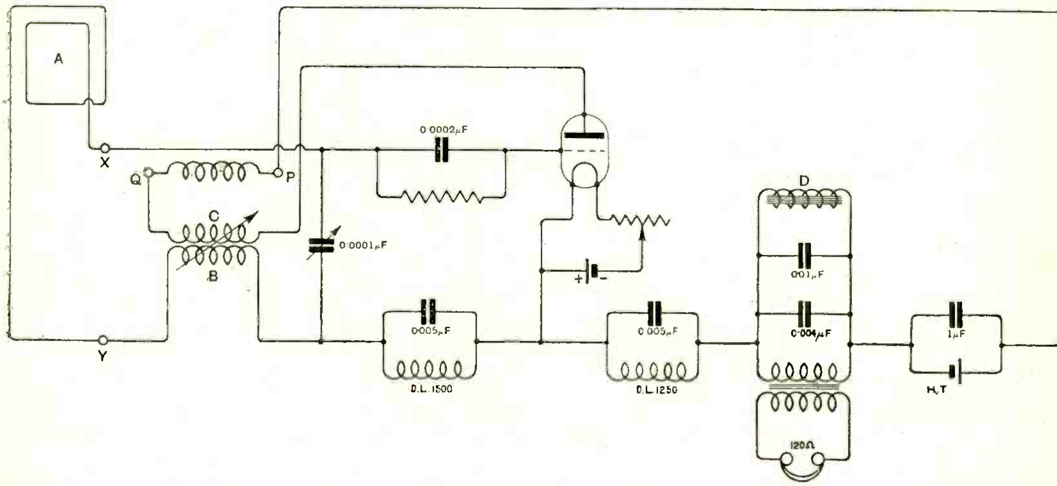
* *The Wireless World and Radio Review*, p.648, August 19th; p.711, Sept 20th; p.79, October 21st; p.118, October 28th, 1922.

† P.112, April 28th, 1923.

circuit tends to break into oscillation, the free oscillation does not build up from the tiny impressed signal E.M.F. in the time interval allowed by a 10,000 to 15,000 cycle quenching oscillation to such a value as may be the case with strong incoming signals. Therefore, at long distances from the source of signals, the use of high potentials to produce a powerful quenching oscillation was not regarded as necessary for good amplification, provided that the valve could be made to oscillate when using lower values, and experiments were continued with a view to reducing the power employed, the oscillator coils being kept fixed.

additional tuning capacity can be plac across the frame aerial terminals, if th is required and it will be found that variable condenser placed in this positio facilitates tuning operations, as there ar in effect, two distinct circuits, the fram aerial and inductance coil, each of whic are separately tuned to the incoming fr quency, broadening the band on which th best signals are obtained. Best results wer obtained when the coupling of the receive coils and the filament temperature were s adjusted that the valve was only jus oscillating.

Using a dull emitter valve and 0·0001 μF tuning condenser, the set func



Circuit arrangement.
A. Frame aerial 3′ 6″ sq. 9 turns No. 20 C.C., ¾″ apart. B. For broadcast reception may be an Igranic coil No. 75. C. Reaction coil for broadcast reception may be Igranic, No. 100.

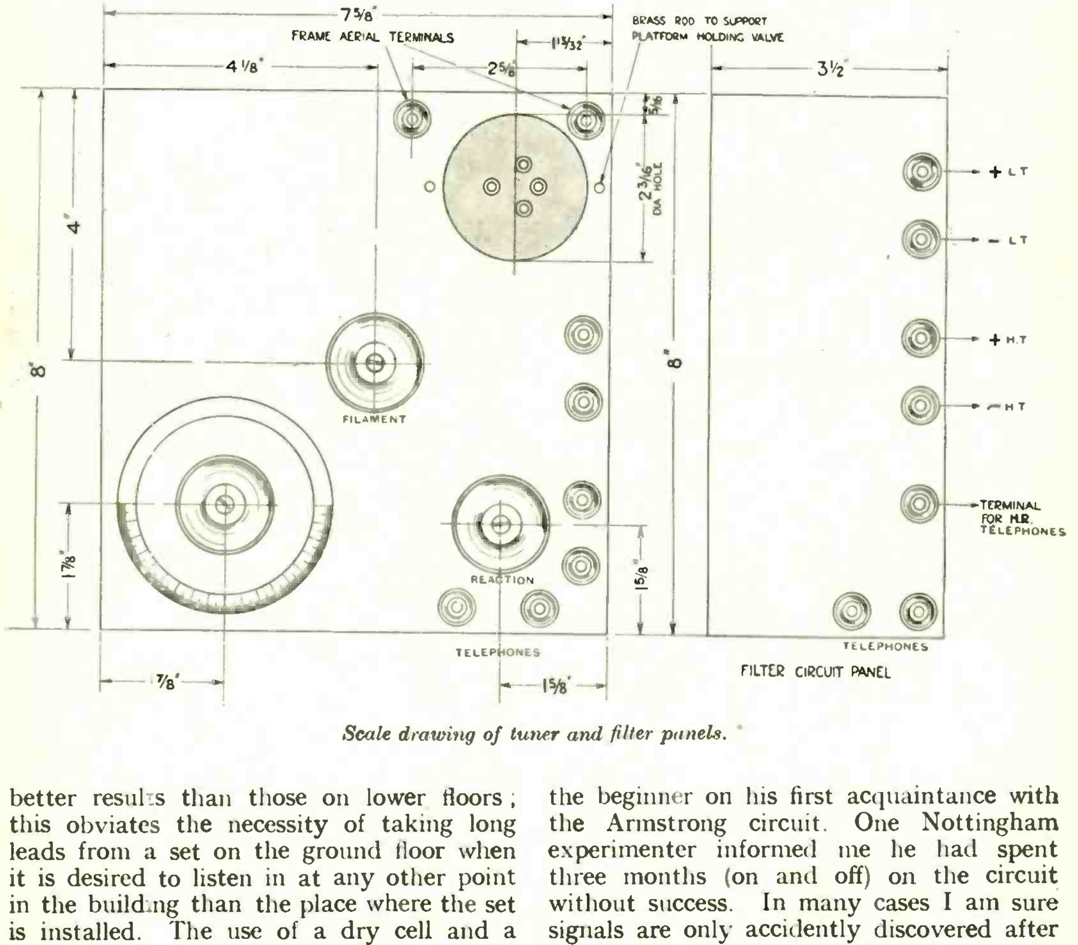
As the H.T. volts and filament temperature were reduced, difficulty was experienced in making the amplifier circuit oscillate. The close fixed coupling of the oscillator coils facilitated the production of the quenching frequency oscillation on low plate volts and no difficulty was experienced in this respect. The real trouble lay in making the receiver circuit oscillate. The first step necessary was the reduction in value of the tuning capacity, *viz.*, from 0·001 μF to 0·0005 μF and then to 0·0003 μF. With the latter value, the circuit functioned well and signals were received on the frame aerial from **5 IT, 2 LO, 2 ZY, 5 SC** and **5 WA,** using only 3 volts H.T. These results were obtained with the types of valves previously mentioned. It will be observed from the diagram that

tioned well with 2 dry cells, *viz.*, one to heat the filament and one in the plate circuit, involving a total expenditure of less than one watt of power. It should be noted, however, that a single accumulator cell is preferable to a dry cell for filament heating.

With the circuit shown, and using the smallest type of ever-ready flash lamp battery for H.T. on one valve, Cardiff comes in comfortably clear and distinct at Nottingham on a 3 ft. 6 in. square frame aerial, with no perceptible Armstrong whistle; a three-plate variable condenser (two fixed and one moving) being used across the A.T.I. With one stage of low frequency amplification, using the same batteries for the receiver valve, **2 LO** can be heard with the phones lying on the table.

The frame may be replaced by a length wire laid cn the floor, or hung in the air, ıe A and E terminals of the set being shorted" and the wire joined to one of ıem. The set has been used in the open ı this way, the wire being swung through 30°, directicnal effects being most marked. ..ny "earthed" conductor to which the wire an be attached can also be utilised, and ood signals obtained in this way. It has een observed that attachment to gas rackets, water taps, hot water and electric ight systems, etc., on upper floors give be content with the good results obtained by the use of a single cell from a flash lamp battery giving $1\frac{1}{2}$ volts for H.T., the grid condenser being shorted.

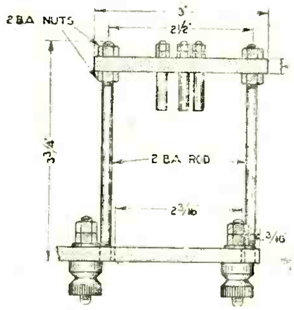
One of the reasons (apart altogether from the novelty of the idea of working a "super" on such low voltages in the face of published statements that high volts were necessary) for describing the construction of my apparatus, is in consequence of my experience that the howls and shrieks set up under normal conditions of working are apt to be disconcerting and discourage



Scale drawing of tuner and filter panels.

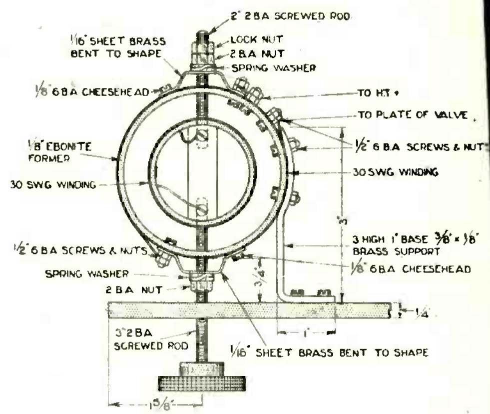
better results than those on lower floors; this obviates the necessity of taking long leads from a set on the ground floor when it is desired to listen in at any other point in the building than the place where the set is installed. The use of a dry cell and a single 2-volt accumulator cell makes the set very portable, and good signals have been obtained in a cellar, under a lead roof, and other places where reception is usually difficult. The writer was very disappointed when the set refused to function on the filament heating battery alone, and had to the beginner on his first acquaintance with the Armstrong circuit. One Nottingham experimenter informed me he had spent three months (on and off) on the circuit without success. In many cases I am sure signals are only accidently discovered after patient but weary search amongst the earsplitting howls. So I contend that if fair results can be obtained under conditions which more nearly approach those met with when using an ordinary regenerative receiver (which are obtained with the super by the use of small power, particularly when using dull emitter valves), success is more likely to be assured later when higher voltages —and perhaps more correct operating conditions—are used. With dull emitters and low voltages the Armstrong whistle is not so objectionable.

In general, it does not appear to be appreciated that by connecting a frame aerial in



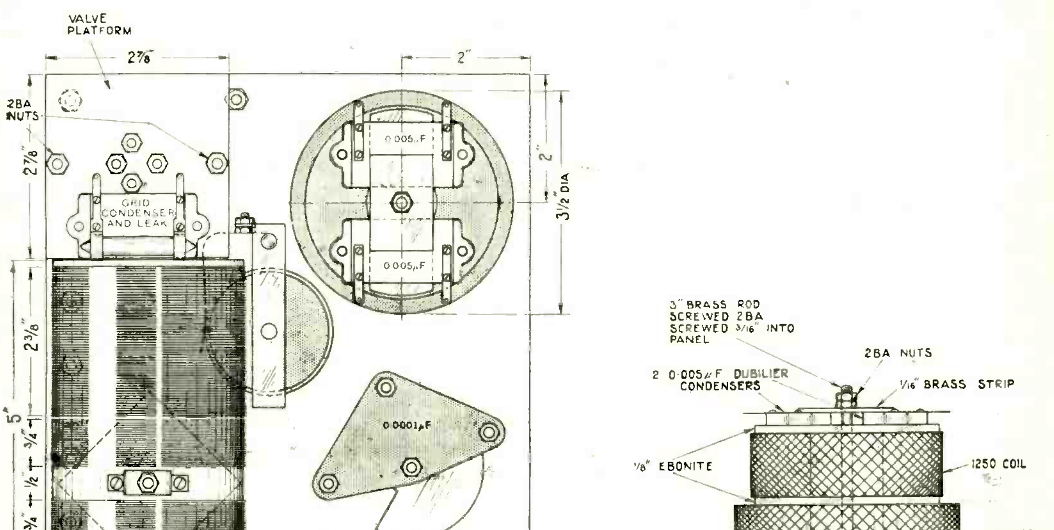
The valve-holder bracket.

parallel with a tuning coil, the wavelength, in comparison with either of them taken separately, is reduced ; this probably accounts for the frequent use of a 0·001 μF variable condenser across the coils. Here the use of such a comparatively large tuning condenser reduces the potential energy that would be otherwise available were tuning effected only on the inductance with a minimu of parallel capacity ; and so the use of coil in series with the frame aerial is to preferred, and with proper values, tuni is possible over a sufficiently large ran of wavelengths with quite a small variab



Constructional details of the reaction coupling.

condenser. With such an arrangement I get the Birmingham station (**5 IT**) at a distance of nearly 50 miles on an indoor frame aerial using an ordinary one-valve regenerative circuit. Thus the experimenter who is sure of his tuning arrangements has a

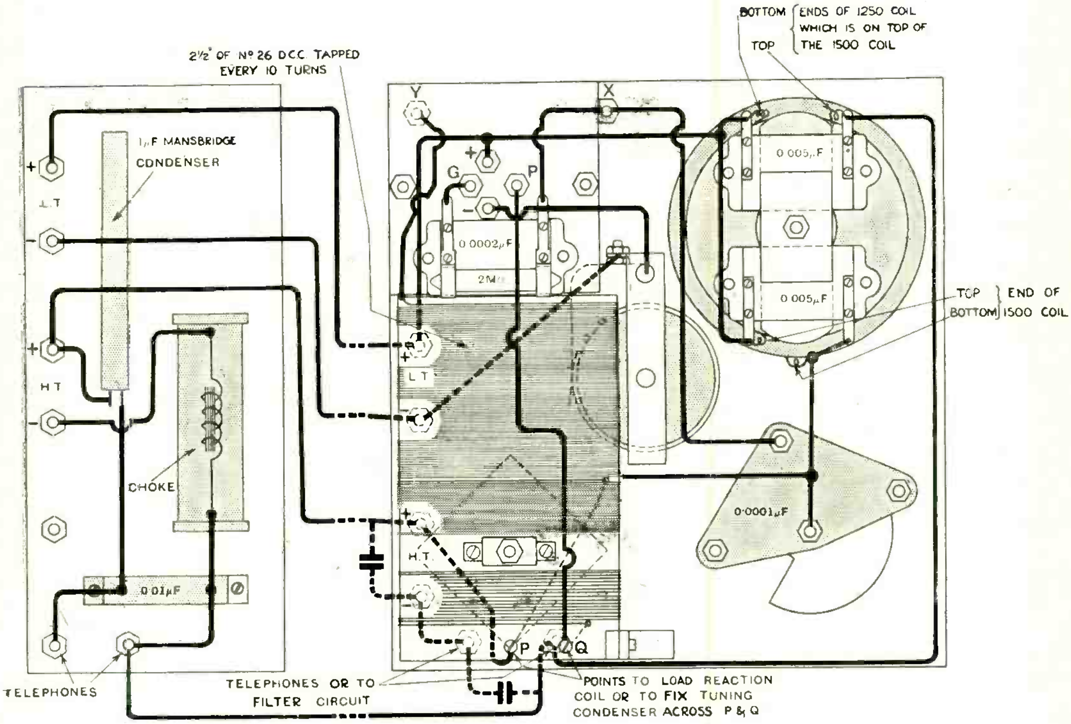


Underside of panel and the method of mounting the oscillator inductances.

certain foundation on which to build new gadgets. It will be seen from the theoretical diagram that provision is made at the terminals X Y for additional tuning capacity, if needed, to raise the wavelength.

When a single wire is used, attached to either X or Y instead of using a frame aerial, a loading coil connected across X Y is preferable to bring up the wavelength, and this has proved satisfactory up to 900 metres, using a 25 ft. length of No. 22 as a "collector." A condenser in series with coil for use in a regenerative circuit of course requires care in selection, and appears to be especially important in the case of a "super," for there is one optimum value of coupling which gives best results under given conditions, and this can only be found by experiment.

Having perfected the tuning arrangements, the experimenter has to ensure that his circuit is so designed that it will build up oscillations as rapidly as possible at the signal frequency, *i.e.*, say 400 metres, using



Wiring diagram of filter and tuner panels.

the wire may be used for short wavelengths.

Provision is made at the points "P" and "Q" for connecting a tuning condenser across the reaction coil or additional inductance may be added as the wavelength of the grid circuit is increased.

Where plug-in coils are used these arrangements are not so necessary—a higher number in the series usually sufficing for a reaction coil, *i.e.*, if a Burndept No. 75 is used for B.B.C. wavelengths, a No. 100 should be used for reaction. The reaction voltages not sufficiently big as to overload the valve; he must see that the valve is operated near to the "threshold" value where the circuit is on the point of generating oscillations—a condition obtained by the use either of a grid bias or leaky condenser, which also ensures rectification. On the low wavelengths for which the super circuit is so particularly efficient, a condenser of 0·0002 μF capacity is suitable, and a variable grid leak is almost indispensable. The values will vary with different valves and H.T. employed.

The conditions for maximum amplification having been obtained, arangements must be made to just quench the oscillations, using no more power than is necessary, so as immediately to leave the circuit in a sensitive condition for amplification of the next incoming signal. If the quenching frequency is 10,000 cycles, one half cycle which performs the quenching operation, occupies 1/20,000th second. It is interesting to note that if the signal frequency is 750,000, corresponding to a wavelength of 400 metres, then $37\frac{1}{2}$ speech modulated oscillations may be wiped out, and if the quenching oscillation does not do its work cleanly, *i.e.*, takes longer or paralyses the normal action, more than $37\frac{1}{2}$ will be effaced with consequent distortion of the received signals. On a wavelength of 200 metres, although double the number are wiped out, the distortion effect is the same, since the period of effacement is still 1/20,000th second, but a gain results owing to the increase in signal frequency.

Finally it is very evident in operating the circuit on low power that when the circuit is tuned exactly to the signal frequency, although loudest signals are obtained, distortion of speech modulated frequencies occurs, a slight adjustment on the "vernier" condenser is necessary to give clear speech with a consequent slight diminution of signal strength, a state of affairs which all "reaction" users will recognise.

In conjunction with the drawings, which are shown to scale, a list of materials is all that the experimenter requires to proceed with the construction of the outfit.

The complete outfit.

Receiver and Oscillator Panel—

- 2 coils, 1,250 and 1,500, and 2 0·005 μF fixed condensers.
- 1 sheet ebonite $8'' \times 7\frac{5}{8}'' \times \frac{1}{4}''$.
- 1 piece odd ebonite $3'' \times 3'' \times \frac{1}{4}''$.
- 2 pieces odd ebonite $3'' \times 1\frac{1}{4}'' \times \frac{1}{8}''$.
- 1 ebonite former, $5'' \times 3''$ diameter.
- 1 ebonite rotor, $2\frac{1}{2}''$.
- 8" brass rod to screw, 2 BA.
- 6" brass rod screwed, 2 BA.
- 1 ebonite knob, 2 BA.
- $4\frac{1}{4}'' \times \frac{3}{8}'' \times \frac{1}{8}''$ brass.
- 3 sq. in. 1/16" brass strip.
- 1 variable condenser, 0·0001 μF.
- 1 0·0002 μF. fixed condenser.
- 4 valve legs, nuts and washers.
- 14 nuts, 2 BA.
- 2 spring washers.
- 1 filament rheostat.
- 6 terminals.
- 1 doz. cheese-headed screws and nuts, 6 BA.
- 1 doz. 6 BA screws and nuts.
- Bare tinned copper, No. 18.
- Systoflex
- 2 ozs. No. 26 D.C.C.
- 1 oz. No. 30, S.S.C.
- 1 (dull emitter) valve.
- 1 flash lamp battery, $4\frac{1}{2}$ volts.
- 1 dry cell, large capacity.

Filter Circuit Panel.

- $\frac{1}{4}''$ebonite, $8'' \times 3\frac{1}{2}''$.
- 1 Mansbridge condenser, 1 μF.
- 1 Dubilier condenser, 0·01 μF.
- 6 terminals and 12 nuts & washers.
- 2 ozs. No. 40 S.S.C.
- 6" iron core.
- Insulating tape, connecting wire and systoflex.
- 6 cheeseheads, $\frac{3}{8}''$, 6 BA.
- 6" brass strip, $\frac{3}{8}''$.

L.F. Amplifier Unit.

- Ebonite $8'' \times 3\frac{1}{2}'' \times \frac{1}{4}''$.
- Ebonite, $2\frac{1}{2}'' \times 3'' \times \frac{1}{4}''$.
- 8" brass rod, to screw 2BA.
- 4 2 BA nuts.
- 5 terminals, nuts and washers.
- 1 rheostat.
- 1 L.F. transformer.
- 1 valve.
- Connecting wire and systoflex.
- 4 6 BA screws, $\frac{3}{8}''$ and nuts.
- 4 valve legs, nuts and washers.

The Flewelling circuit with its bank of condensers in place of the large Armstrong coils offers such facilities for the construction of a compact little set combined with wonderful efficiency that it is not surprising it is receiving so much attention. The successful employment of small powers with the Armstrong circuit was an inducement try similar arrangements on the Flewelling cuit, and a set was made measuring ns. by 4 ins. by 3 ins. over all, including valve—pencil lines being employed leaks in the grid and plate circuits—the ter measuring about 2 megohms. In th cases the line was thickened and thinned til the desired effects were obtained. sing a small power valve, **5 IT** can be heard th telephones on the table, and **5 NO** is comfortably loud on a frame aerial. At the time of writing, signals have been obtained on most types of valves with from 9 to 12 volts H.T., and experiments are proceeding with a view to a further reduction in value.

It is hoped that these notes may lead others to try the effect of small powers. The problem should offer less difficulty to those situated within 20 miles range of a B.B.C. station.

'erminating Board at 2 LO of the Lines from the Microphones of the Broadcasting Stations.

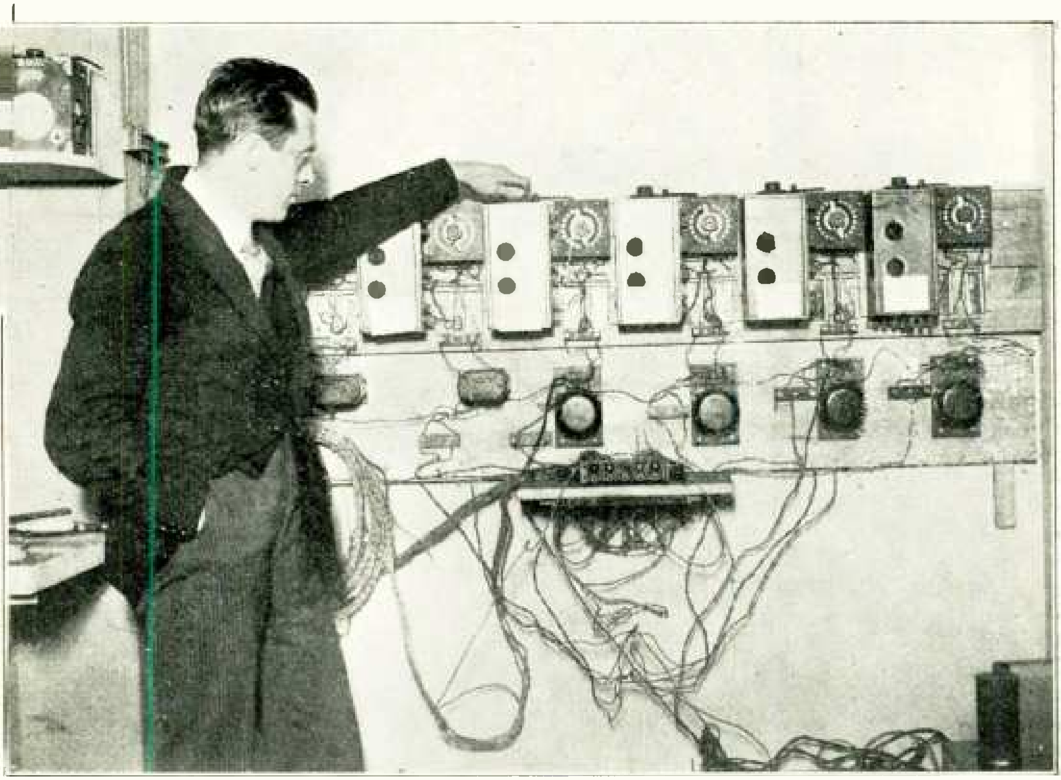


Photo: Barratts.

Installed in the new studio at 2 LO is the equipment connected with the relaying of the transmissions of the various stations by land wire. Captain Eckersley, Chief Engineer to the B.B.C., is shown inspecting the apparatus.

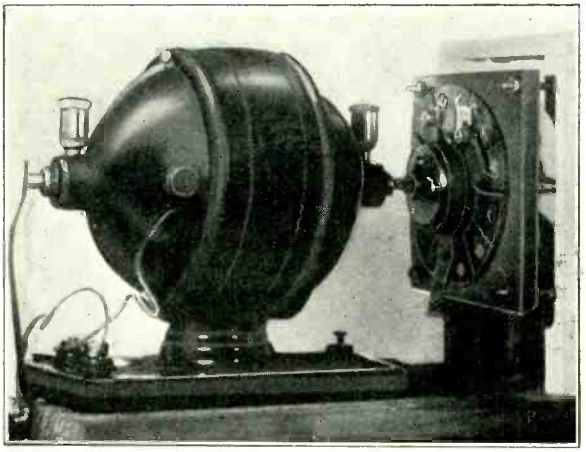
Voltage Raiser for Valve Transmitter

Before installing transmitting equipment one is usually faced with the problem of devising a method of obtaining a suitable high voltage. This new method, applicable to stepping up the voltage of direct current mains, is particularly simple, and the apparatus easy and cheap to construct. The principle can be applied for obtaining a smooth high voltage direct current from an induction coil of the Wilson type having an interrupter sychronised with the distributor and deriving current from a low voltage accumulator battery. The author, using the machine described below, is heard at a good strength and regularly on a two-valve receiver at Orleans, France.

By Marcus G. Scroggie, B.Sc. (5JX).

THE machine to be described is an attempt to solve the problem of providing a suitable H.T. supply for a low-power valve transmitter. Most of those who work with transmitters are faced with the difficulty of accomplishing this without considerable expenditure. Such experimenters fall into three groups—those with access to an A.C. supply, those with a D.C. supply, and those with no supply laid on at all. Where a supply exists it is nearly always about 200 to 250 volts. The man who has access to A.C. is usually regarded as being the most fortunate, owing to the ease with which the supply voltage may be stepped up to any desired extent without the use of rotating machinery of any sort. The disadvantage lies chiefly in the rectifier, of which it may be said that no really satisfactory type is available; chemical rectifiers are uncertain, and their efficiency depends on a great many details being carefully attended to; valve rectifiers are expensive to equip and run, and may burn out. Further, elaborate smoothing circuits are usually essential.

The D.C. man is well off where only a very small power of, say, 3 or 4 watts is required, as he can run his valves off the mains at no expense whatever for H.T. supply, and little or no smoothing is require[d] even for telephony. As domestic suppli[es] are nowhere in this country of above 2[5]... volts, this method is unsatisfactory f[or] higher powers as the filaments of the valve[s] have to be run very brightly to get th[e] necessary anode current, resulting in a rapi[d] disintegration of the filament, or else [a] number of valves must be used in paralle[l], leading to low effi[-]ciency all round. To those wh[o] cannot afford [a] motor generator to give 500 to 1,000 volts, or to be continually buying batteries, the following description may be of interest. The method which has been worked out consists in connecting a number of condensers in series and charging these at frequent intervals from the D.C. supply so as to maintain the voltage.



The motor-driven distributor.

In Fig. 1 if C_1, C_2, etc., are a number of condensers and the supply voltage, which will be assumed to be 230, is connected in turn across each condenser, the voltage across AB will be 920. If now AB is connected up to a valve transmitter, the condensers will discharge through it, and the voltage will gradually fall. To avoid this the condensers are recharged from the mains, and so on rapidly.

It will be seen that however often the condensers are charged, their voltage must rop to some extent in the interval between ccessive charges if they are supplying urrent; in other words, the output is not erfectly smooth, but it can be made very early smooth by suitably designing the harging device.

The first thing to fix on is the number of condensers in series, which, of course,

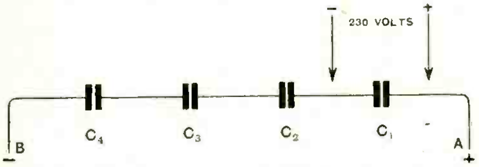


Fig. 1. Condensers in series and arranged to be charged separately.

determines the step-up effect desired. If the supply is at 230 volts, and it is desired to step up to about 900 volts, four banks of condensers should be used. It must be remembered that lower voltages can be easily obtained at any time by connecting the output terminals across only a part of the condensers.

As previously explained, there is a drop in voltage during discharge, so that in

$C = \frac{Q}{V}$ where C is the capacity in farads and Q is the quantity of electricity which passes in or out when the voltage is altered by an amount V. Assuming the flow of current, I amps, is practically constant during time t seconds of discharge, this may be altered to $C = \frac{It}{V}$.

If the average value of the output voltage on load is 90 per cent. of that on no load, then approximately the minimum voltage across any condenser is 80 per cent. of the maximum, or V is 20 per cent. of the supply voltage, so if the interval t between charges is 0·02 secs. and the output current is 0·02 ampere (representing about 16 watts), the required capacity of condenser is

$$\frac{0{\cdot}02 \times 0{\cdot}02}{230 \times 0{\cdot}2} = 0{\cdot}0000087 \text{ farad, say } 10\ \mu F,$$

to allow a little margin.

The charging is accomplished by the machine to be described, the design of which may be varied considerably, but this particular one charges each condenser once per

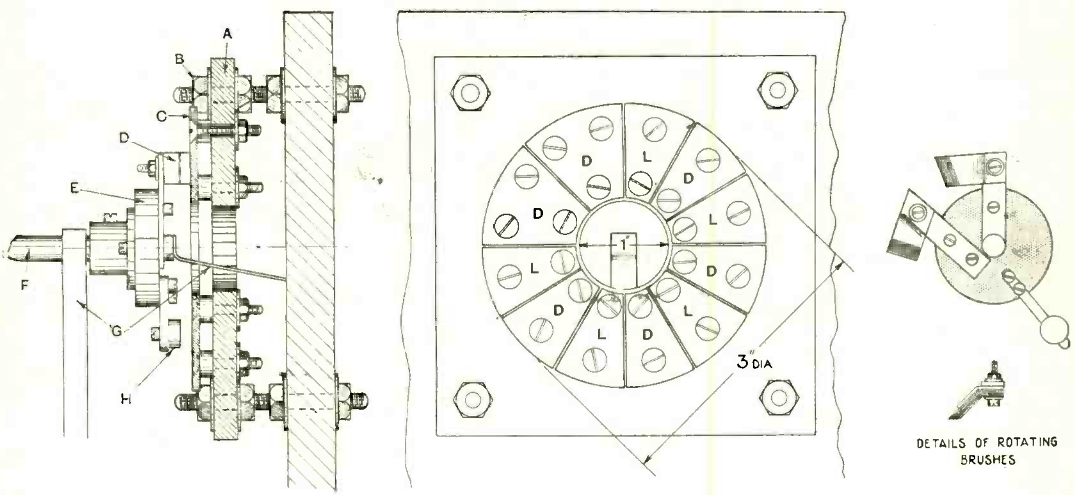


Fig. 2. Constructional details.

practice the output is somewhat less than as indicated above. With a suitably designed machine it is about 90 per cent., so that with four condensers in series the average output voltage is about 830.

To find the size of condensers for a given power, allowing this 10 per cent. drop, the fundamental equation for condensers is used

revolution of a small fan motor worked off the 230 volt supply. When running at 3,000 R.P.M., the interval between charging any condenser is nearly 0·02 seconds, as stated above.

The shaft of the motor bears a small ebonite disc to which are fastened two rotating brushes and a balance weight to prevent vibration. The brushes consist of a number of phosphor bronze strips as used for rotary switches, bent over by a stiff piece of metal and bolted to the end of a metal arm as shown in Fig. 2. One arm has a contact stud screwed to it which makes contact with a fixed brush connected to one side of the input. The other supply line is connected through another fixed brush bearing on the motor shaft and through a screw fixing the second rotating brush to the small pulley or other metal disc attached to the shaft. Care must be taken to prevent the two rotary brushes or their connections making contact anywhere, for obvious reasons. To limit the current, in the event of a short circuit developing in the machine, a resistance of about 15 ohms is connected in one of the leads, preferably in the one not earthed. This passes enough current to blow the fuse, but prevents the burning up of the contacts, as would happen if a dead short took place.

The brushes make contact with a stationary radial commutator, one type of which is shown in Fig. 2. The design may be modified by using twice as many sectors, thus charging each condenser twice per revolution, and giving a smoother output. In this case, "live" sectors 180° apart are connected together. In a "single cycle" commutator, as shown, there is one live sector in excess of the number of condensers in series. A dead sector is placed in between each live one, making nine, and finally two sectors, each 50 per cent. larger than the others, are placed between the two end live sectors. This arrangement of sectors is to prevent short circuiting.

The sectors are formed from a copper ring not less than 1/16 in. thick, which is cut up as shown in the diagram, and screwed down to an ebonite panel with countersunk screws. The connections from the condensers are soldered to the screws. As the maximum allowable voltage between the segments of an ordinary commutator is about 30, the usual method of insulation is obviously impossible where the voltage across the gaps may be nearly 500, as a flashover would take place at once. This difficulty is got over by raising the copper sectors from the panel by means of small condenser spacing washers leaving a large surface for metallic dust, etc.

Originally, ordinary contact studs were used instead of copper sectors, for ease in constructing, but it was difficult to preve either the studs or the brushes wearii rapidly away, and when this took plac sparking became serious, with loss of powe

The connections are as in the wirin diagram, Fig. 3. Small fan type motors ca often be obtained secondhand at a very lo cost, while 2 mfd. Mansbridge condensers a about 15s. per dozen are advertised by severa dealers. The condensers in use are ol army stock at 4s. per dozen. As they d not require to stand more than 230 volts Mansbridge condensers are very suitable some which were tested stood 500 volts without breakdown.

Where a tonic train effect is no disadvantage the size of condensers may be reduced very considerably below that indicated, but for telephony this would be almost as difficult to smooth as rectified A.C.

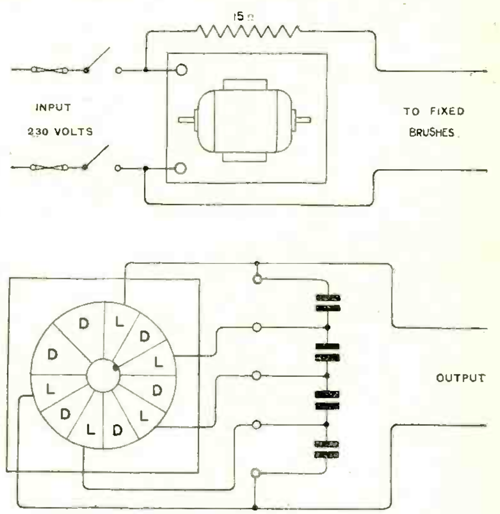


Fig. 3. Motor distributor connections.

It may be mentioned that a little oil on the commutator leads to smoother running, and does not seem to impair the electrical contact. Also, before mounting, the whole face of the commutator should be ground down smooth on an emery wheel or cloth. Where it is to hand, the side face of an emery wheel is much less tiring to use.

The actual method of mounting may be left to the constructor, but attention is drawn to the nuts supporting the ebonite panel, which allow the pressure of the bushes to be evenly regulated over the surface of the commutator.

Another point to observe is that D.C. ains are earthed either on positive or egative, and hence the output terminals e at an alternating potential with respect earth, so that care must be taken to revent any part of the transmitter being arthed except through a condenser capable f standing the full output voltage, and not arger than about 0·005 μF, or the action of he machine will be interfered with. An rdinary Dubilier condenser is very compact nd stands about 1,000 volts. The small nes can pass all the H.F. current most mateurs are likely to be dealing with.

If any trouble is experienced with vibration, even with a carefully arranged balance weight, the noise may be reduced by standing the machine on several layers of thick felt in a cupboard or other shut-in position.

The machine already built, though very roughly put together for experimental purposes, is very satisfactory, and delivers about 30 watts at 800 volts.

Intending constructors should have no difficulty in adapting the principle to meet their requirements, at any rate up to 100 watts, and for this reason full details of this particular machine have not been enlarged upon, as it is believed the method of construction is sufficiently obvious to be modified as desired.

[*An obvious modification to allow for deriving H.T. from a low voltage accumulator is to feed the primary of an induction coil with current interrupted by a segmented drum mounted on the same spindle as the condenser distributing contacts. The interrupter drum and condenser distributor can be arranged by means of adjustable brushes so that charges are passed to the condenser when the secondary voltage of the induction coil is at maximum value.* F.H.H.]

A SLOW-MOTION ATTACHMENT FOR CONDENSERS

By H. E. Adshead, B.A.

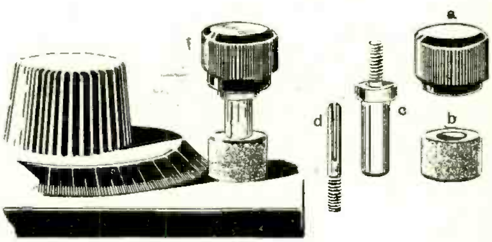
In order that a circuit shall be capable of being accurately tuned, it is the practice to provide a vernier condenser across the main condenser, or else in some more expensive models an auxiliary worm-drive is incorporated in the dial.

The accompanying drawing is a very simple design of the latter type. All the materials required are :—

1 valve leg.
1 valve pin.
1 ebonite terminal top.
Piece of rubber tubing, such as is used for acetylene gas connections.

The position of the valve pin is chosen such that the rubber is squeezed slightly against the edge of the dial. If the condenser moves very stiffly it should be eased somewhat, or the rubber will slip. The valve pin will provide sufficient additional friction to hold the dial stationary. The leg being free to turn, there is nothing to obstruct the rotation of the dial when turned in the ordinary way, and so the fitting can be always in contact. The simple attachment quite does away with the need for a vernier condenser.

It will probably be found that the valve leg stem is screwed 4BA, while the terminal top is tapped 2BA. The leg should be thickened up with solder and a 2BA die run down it. Do not solder up the nut, as it will very likely melt. Not all valve legs are bored truly, so it will be advisable to select a good one before starting work on it.



Details for assembling the slow-motion attachment.

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. 15.

To demonstrate the principle of reaction or regeneration.

The apparatus required is :—

1 3-contact tuner.
1 Fixed condenser 0·0003 mfd.
1 Fixed condenser 0·001 mfd.
1 Vernier variable condenser 0·0001 mfd.
1 2-megohm grid-leak.
1 " R " valve.
1 Filament resistance.
1 Variable H.T. battery.
1 Telephone transformer.
1 6-volt accumulator battery.
1 Filament resistance 8-10 ohms.
1 Pair 120-ohm telephones.

The apparatus must be joined up as in Fig. 24.

Before proceeding to describe the methods to be adopted in making the experiment, the writer feels that a few words on the theory of reaction may be useful.

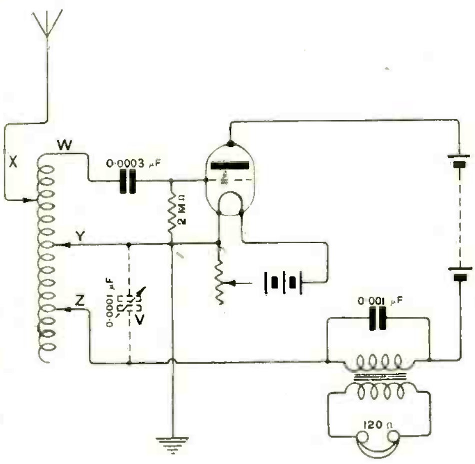


Fig. 24.

The valve in Experiment 12 has been employed for the purpose of amplifying high frequency oscillations, these amplified oscillations occurring in the plate circuit. The energy of the amplified oscillations is derived from the H.T. battery, and the purpose of reaction is to utilise some of this energy for augmenting that in the circuit to which the grid of the valve is attached. It will be noticed in the diagram (Fig. 24) that the plate circuit battery causes a current to flow from the positive pole to the plate of the valve, through the valve to the negative end of the filament, along the wire marked " Y," through the inductance coil to " Z " ; through the primary of the telephone transformer, and so to the negative pole. (Some writers prefer to speak of the electron flow, in which case, of course, the circuit can be traced the other way round.) If, therefore, high frequency variations of the normal plate current take place in that part of the coil between the contacts " Y " and " Z," the oscillating magnetic field thus set up in the coil will superimpose extra E.M.F.'s between " Y " and " W," and consequently the very small initial E.M.F.'s due to the received oscillations between " X " and " Y " will be considerably augmented by the repeating action of the valve. Increased plate current change in the telephone transformer will result.

A little consideration will show, however, that there must be some limit to which this amplification can be carried, and this limit is reached when induced E.M.F.'s applied to the grid from the coil between " Y " and " Z " contacts are of such a value that sustained oscillations take place in the aerial circuit with consequent *radiation of energy*. It follows therefore that this circuit should only be used purely for experiment and not for regular reception unless great care is taken to avoid energy radiation which can interfere with other users of the ether. There is no reason why the experimenter should not employ it for the purpose of amplification on wavelengths outside those allotted to ıdcasting, and there is much in practice ›e gained. Except for the reception of ːinuous wave signals, however, oscillas must not continuously take place. For purpose of regular reception of the C.W. .als, it is not the most efficient type of uit to employ, and later an experiment be suggested for this specific purpose.

'he procedure to be followed in making ; experiment is as follows :—

'lace the contact "X" close to "W," l slide the two contacts "Y" and "Z," ether to such a position on the inductance responding to the wavelength required. is, of course, must be ascertained in the ıal way by means of the wavemeter.

Now slide the contact "Z" towards the e end of the coil, and it will be found that a certain position a slight hissing sound heard. Oscillations are now continuously king place and the aerial is radiating; e contact "Z" should be at once moved ain towards "Y" until silence is restored. ı signals being received, their strength ın be increased up to maximum by a ıa! adjustment of the vernier condenser V." The maximum strength obtainable is hen the whole circuit is just at the point f oscillation. It may be pointed out that ıe effect of this reaction is to neutralise any ›sses in the aerial circuit due to resistance in ıe earth lead, inductance coil, or aerial self and its radiation resistance; hence ıe selectivity of the apparatus is very much reater.

It may be possible on certain wavelengths o bring the contact "X" further down the oil with the corresponding adjustment of "Y" and to a certain extent of "Z." This should result in gaining increased strength. As in previous experiments, a variable condenser of 0·001 mfds. capacity may be placed between "X" and earth for the purpose of longer wave reception.

Novel Ideas and Inventions

Abstracted by PHILIP R. COURSEY, B.Sc.

REDUCING THE SELF-CAPACITY OF TUNING COILS.

The self-capacity of various types of coil windings arises from the proximity of adjacent wires to each other, and any means of spacing such wires without adding materially to the physical dimensions of the

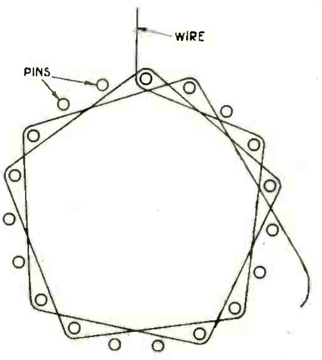


Fig. 1.

coil will usually result in a reduction of the self-capacity. By lacing the wire winding in and out around a number of supporting pins—much as is usually done in "basket" coils—the self-capacity can for this reason be reduced. A solenoid type of coil can be built up on these lines if the pins on which the winding is placed, instead of radiating from a central hub or boss, are arranged in the form of a cylinder from some suitable support. A further reduction in the self-capacity can be obtained if the wire winding instead of passing round successive pins, is arranged to zig-zag in and out around pairs of pins, or around three at a time.* The end elevation of a winding of this type is sketched in Fig. 1, in which for simplicity only a very small portion of the winding is shown. Various combinations in the numbers of pins round which the wire passes either inside or outside, are obviously possible, and the coil can also evidently be made of a conical shape as well as cylindrical if desired.

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* British Patent No. 196986, by C. B. Kersting and U. Beaton.

THE NEW SIGNAL CODE.*

In this article a system of signalling introduced by General G. O. Squier is described, in which differences of amplitude of the dot and dash are made use of to obtain greater speed and accuracy.

By LOUIS COHEN, Ph.D.

IN the art of electrical communication we are concerned with the production and transmission of signals and the character and combination of the signals for the interpretation of intelligence; therefore a comprehensive study of electrical communication must take account of these two aspects of the art which are so closely related and interdependent.

The methods and means which are employed for the production and transmission of signals should necessarily depend upon the character of the signals transmitted; a change in one will necessarily involve a change in the other. Any study looking toward the increase in efficiency of electrical communication must take into consideration these two aspects of the problem, and this, of course, is true, irrespective of the methods employed for the transmission of the signals, whether it is radio, line telegraphy or submarine telegraphy. In the different methods of signal transmission, different equipment and methods have to be employed, but in each case the development of any new methods and means for the production of signals will depend on the character of the signals, and any development, therefore, should logically proceed along these two lines simultaneously; a change in one may require a change in the other.

As a matter of fact the efforts of engineers have been directed almost exclusively to the development and improvement of methods for the production of signals without any regard to a possible change in the character of the signals themselves. In all methods of communication, radio or line telegraphy, we are still using the Morse code, based on the combination of the dot and dash in exactly the same form as proposed by Morse some eighty years ago. It looks as if engineers have taken it for granted that no possible improvement on the Morse code could be made, and th therefore have not given the subject a attention whatsoever. It is remarkab indeed, that so much engineering ingenui should have been spent on improving, the minutest detail, the methods of produ tion of signals, and no consideration at given to any possible change in the charact of the signals themselves.

A new method of signalling has recent been described by Major-General Georg O. Squier. In it the dot and dash signa of the Morse alphabet are differentiate by a difference in *intensity*, instead of difference in *time-interval*, as is the practic now.

The difference in the two methods is greatest importance in effecting econom in time of signalling. In the present practice every dash and signal occupies a time interval three times that of a dot signal and in the Squier method the dash signal doe not require any more time than the do signal. General Squier accomplishes thi by the use of an alternating current in which each half cycle, or even multiple thereof, represents a dot or a dash, the two being distinguished by a difference in intensity. In the case of land lines or submarine telegraphy, an alternating current of the desired frequency is directly impressed on the line and the signalling accomplished by varying the intensities of the half cycles, or multiples thereof. For radio signalling the carrier high frequency current is modulated by a low frequency alternating current, and here again the modulating alternating current is varied in amplitude to produce the desired signals. It is clear that in the case of submarine telegraphy only low frequencies can be transmitted, and therefore to obtain any speed at all in signalling it will be necessary to make every half cycle represent a signal, a dot or a dash. On the other hand, in line telegraphy where higher frequencies may be employed, considerable speed in signalling may be

*Extracted from *Popular Radio.*

btained by using several half cycles for ach signal; that is to say, we could use, ay, a 60-cycle alternating current or even oo-cycle alternating current if desired, nd assign for each signal a certain number of half cycles, depending upon the speed of signalling desired. The advantage of using several half cycles for each signal s that greater accuracy is thereby insured, because even if during the time-interval of each signal anything should occur to disturb the character of the signal, there s the possibility that some of the half cycles would retain their character, and the signal could therefore still be interpreted.

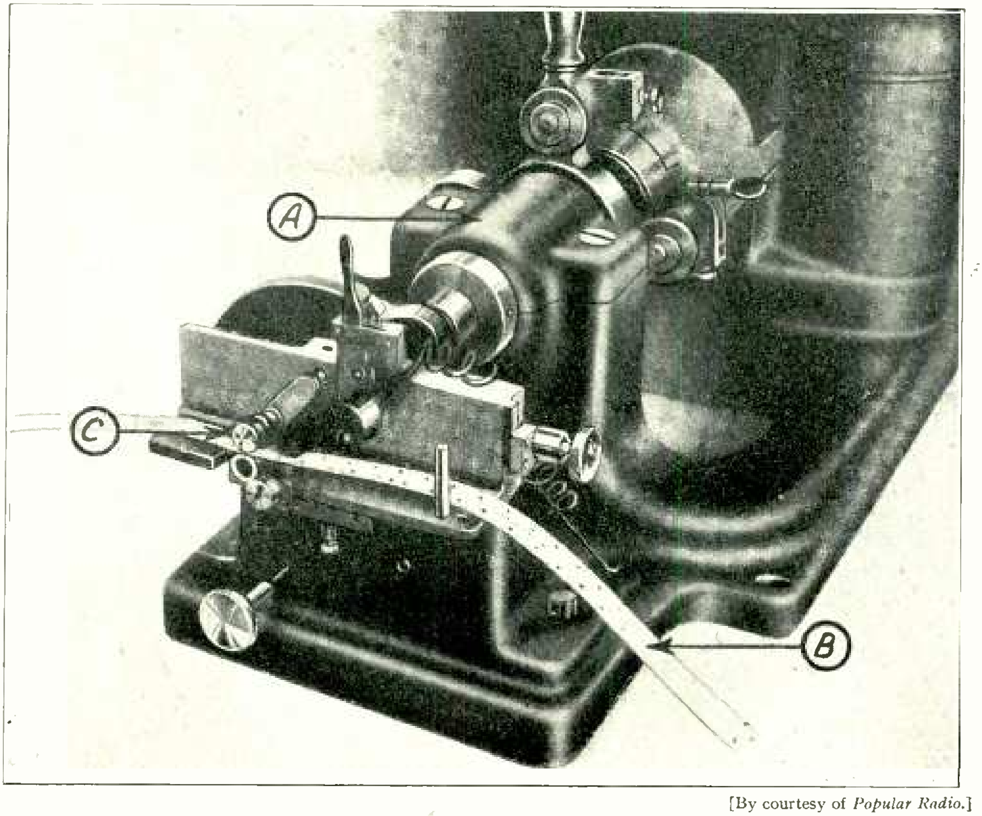
The same reasoning applies also to radio signalling. Here again we can modulate the carrier high frequency current by a low frequency alternating current of any desired frequency and assign to each signal a certain number of half cycles, depending upon the modulating frequency employed and the speed of signalling desired.

It is believed that this method offers among others, two great advantages:

First, an increase in speed of signalling, which means of course an increase in the efficiency of the system.

Second, greater reliability and accuracy. If we remember that by this method we can assign, say, six or eight or even ten half cycles for each signal, the possibilities of errors in interpreting the signals are greatly reduced. Even in the case of static disturbances some of the half cycles of each signal may be affected in character, but there is still the possibility that some of the half cycles will retain their identity, thus enabling the operator to recognise the signals.

It is true, of course, that in varying the amplitude of each succeeding half cycle, or changing the amplitude of a group of oscillations, a transient effect is produced which must be carefully taken into consideration. This is a problem which



[By courtesy of *Popular Radio*.]

Mechanical Transmitter for signalling by the system in which differences in amplitude are employed. "A" is the bearing of the driving motor, "B" the punched tape, and "C" the feed roller.

can be investigated and is now being investigated mathematically, and it is hoped the results will be available before long. But it must be remembered that the change in amplitude required in order to distinguish between a dot and a dash need not be large. A change of the order of magnitude of ten per cent. will probably be sufficient, and therefore the transient effect produced by this small change in amplitude will not be large. Hence it would appear that the general considerations of this method, as outlined by General Squier, will not be upset seriously by these transient effects accompanying the changes in amplitude in signalling.

Another advantage of this method is that a much higher degree of selectivity can be obtained. In the present method the variations produced by the dot and dash signalling are irregular in their character; the time interval required for the dot and the dash are of the ratio of 3 to 1, and therefore no tuning to the signalling frequency is at all possible. But in the method proposed by General Squier, the signalling frequency is fixed, and the character of the signals is uniform, the variations following practically sine-wave form, and therefore it should be possible to tune both mechanically and electrically to the signalling frequency, which in the case of radio signalling would be the modulating frequency. We can by this method, in the case of radio signalling, effect a double tuning, first tuning by the usual means to the carrier frequency, and then again tuning mechanically and electrically to the low modulating frequency. It would seem that this method should offer possibilities of remarkably sharp selectivity, which is, of course, an advantage which can hardly be overestimated.

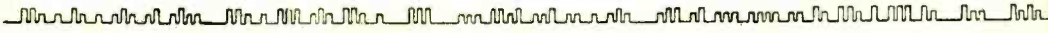
This method also offers a solution to the problem of multiplexing. There does not seem to be any reason why we could not, with advantage, modulate the carrier frequency by several different modulating frequencies and transmit several messages simultaneously on the same carrier frequency. At the receiving stations the messages could be easily separated by tuning to the modulating frequencies. This is a matter which is of pressing importance in rad signalling because of the limited numb of wavelengths available.

At the present time, when the demand f wireless transmission is increasing from da to day, the problem of finding enough wav lengths to satisfy all the demands is a urgent one.

Now it would seem that by changing th character of the alphabet, and the adoptio of the method proposed by General Squie the speed of signalling would be increase and also the use of one carrier frequenc for transmission of several messages woul be made possible. Thus the number of wave lengths available for handling the radi traffic of the world would be increased

A question may be raised in regard t the methods of interpreting the signals at the receiving end. The present methods will not do, since the operator could no differentiate the small difference in intensity between the dot and dash by receiving the signals in the ordinary telephone. The difficulties, however, are not of any serious consequence. In the first place, it must be remembered that if any great speed in signalling is desired, mechanical sending and receiving must be resorted to, and this method lends itself readily for machine operation, the signals being transmitted by tape in the usual way and received at the other end either by recording the signals, or by having them operate a page printer. But even if, for some reason, it is desired to transmit the signals by hand and receive them by audition, this can be accomplished in various ways. One of the methods which has been suggested is to have the two signals of different intensities; that is, the dot and the dash operate local circuits in which audible notes of different character are continuously generated, and thus the operator will hear two notes of different character which he could learn quickly to interpret as the dot and the dash.

This new method of signalling does not offer any serious problems which could not be met by present-day engineering practice, and at the same time it offers the advantages of increased speed, higher efficiency, and greater selectivity.



Tape record of message signalled by producing dots and dashes of different amplitude.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XX.

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.

Recent sections deal with series and parallel circuits, damping, choke coils, and transformers.

By W. James.

39.—The Construction of Intervalve Transformers.

(a) Iron Core.

The iron core is, of course, laminated, or constructed of fine iron wires. To reduce eddy current and hysteresis losses the laminations are thin and well insulated, and in the case of iron wires, the wires may be waxed or varnished. Only best quality special alloy steel or soft iron wires should be employed. The normal anode current may reach a comparatively high value, and to prevent changes in the transformer characteristics on this account it is wise not to use a closed core. A small air gap should be left. It is better to use no more iron than is required. Hysteresis and eddy currents, as well as magnetic saturation, cause distortion of the wave form, and the provision of the air gap reduces their ill effects. The core should be securely fastened.

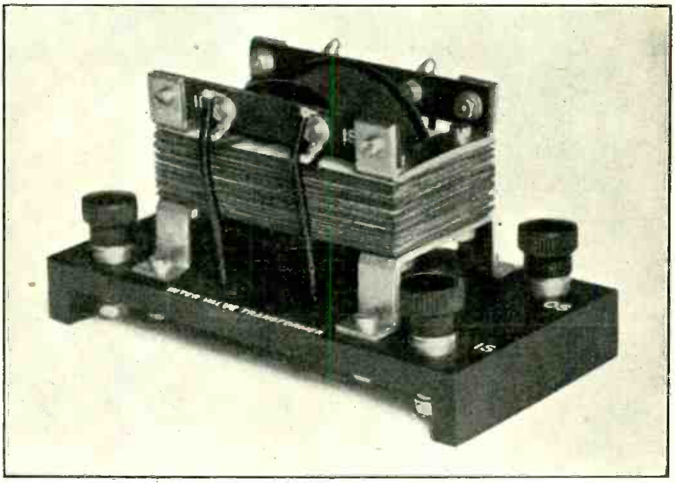
(b) Primary Winding.

This winding carries the normal anode current upon which is superimposed the signal current. The wire should therefore be of sufficient cross section so that it will not overheat, and the insulation must be such that there is no danger of breakdown between turns or layers. The whole winding is carefully insulated from the core and the secondary. To keep the internal capacity low, the turns are often spaced, and cotton is a good material to employ, on account of its low specific inductive capacity, and at the same time the wire should be wound quite tightly. The wire usually employed varies from No. 40 to No. 45 S.W.G. insulated with enamel and/or silk.

(c) Secondary Winding.

This winding only carries a negligible current, and the size of wire is chosen principally from the cost point of view. It requires the same attention as the primary. The flux leakage between the windings should be low, and the windings given a moisture proof covering.

The transformer is preferably shielded magnetically. It is generally realised that quite large voltages and currents may be generated in the windings under certain conditions; for example, when oscillations are set up, and for this reason insulation should be very carefully attended to. An insulation resistance of a few megohms is not good enough and a transformer should



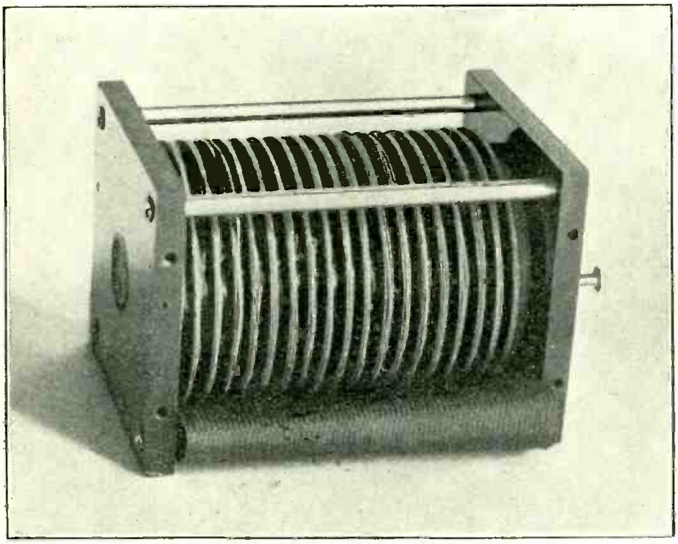
[Sterling Telephone and Electric Co., Ltd.

Fig. 99. An intervalve transformer showing the general construction.

be tested with about 1,500 volts. The desirable insulation resistance should not be less than 500 megohms.

40.—Particulars of Various Transformers.

In Fig. 99 is a photograph of an intervalve transformer from which the general construction can be clearly seen. Fig. 100 illustrates a transformer employed to couple power valves such as used in a power amplifier. The construction of this instrument is shown in Fig. 101. It will be noticed that the windings are interleaved one with the other. The turns ratio is unity. Each section is wound with 1,200 turns of No. 40 enamelled wire, and there are nine sections for the primary and nine for the secondary. The advantages of sectionalised windings are obvious. The core consists of a bundle of iron wires $\frac{5}{8}$ in. diameter and 4 ins. long; 1 and 2 are ebonite end plates held in place with the rods 5; 3 an ebonite disc used in conjunction with the screws 4 to hold the winding tightly in position. Each section of winding is carefully insulated from the next. The design is good, and the characteristic such that it may be recommended for use in an amplifier employing power valves. It should not, of course, be employed to couple a rectifier with a note magnifier.



[Sterling Telephone and Electric Co., Ltd.

Fig. 100. Power intervalve transformer. Ratio 1 to 1. Wound with 11,000 turns of No. 40 enamelled wire in each winding.

The construction of an intervalve transformer which the writer has employed with great satisfaction is shown in Figs. 102 and 103. The core consists of a bundle of soft iron wires, each carefully insulated. The bobbin is made up of a thin cardboard tube and end cheeks. The primary winding consists of 14,000 turns of No. 44 S.S.C. with a resistance of 2,000 ohms. Over the primary is a double layer of empire cloth. The secondary has 33,000 turns of No. 44 S.S.C. with a resistance of 12,000 ohms. The turn ratio is $2\frac{1}{3}$ to 1, and the resistance ratio 6 to 1. The centre portion of Fig. 103 shows the transformer with the core wires bent in place. The brass rod through the centre is for the purpose of holding the ebonite end pieces, brass case and feet, in position.

The two types of instruments described in detail give excellent results in operation. It will be noticed that the turn ratio in each case is very low, and the primary resistance and turns high. These factors account for the results, which are not to be obtained with transformers having fewer turns with a higher ratio.

Below are given details of a number of transformers as at present manufactured.

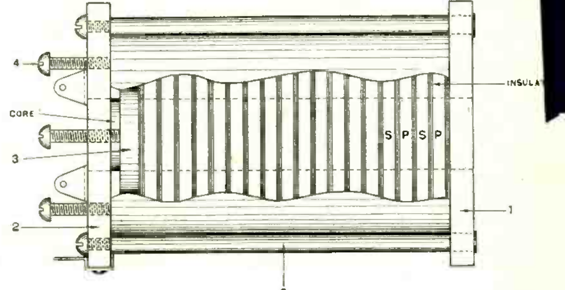


Fig. 101. Construction of the transformer illustrated in Fig. 100.

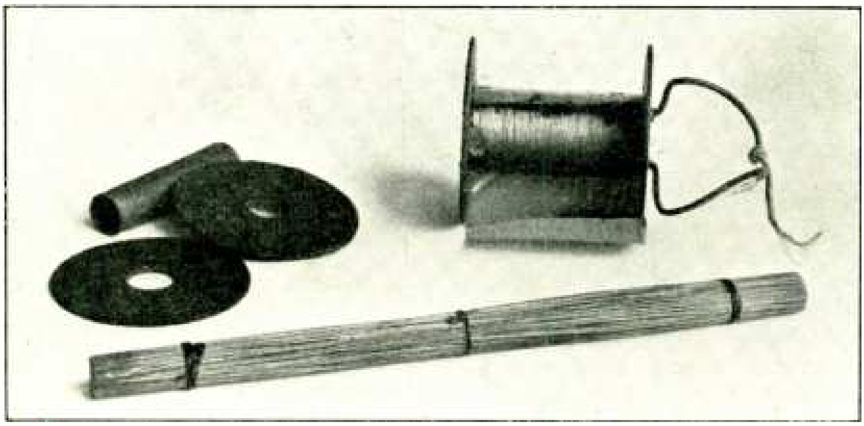
(1) Designed for a frequency of 500 cycles. Primary winding 3,000 turns of No. 42

amelled and single silk covered. Secondary nding 12,000 turns of No. 42 enamelled nd single silk covered. Turn ratio 4 to 1. he winding resistances are low, corresponding with the low number of turns. nsulation resistance at least 400 megohms. ested with 1,500 volts between windings nd windings with core.

(2) Army transformer. Primary winding

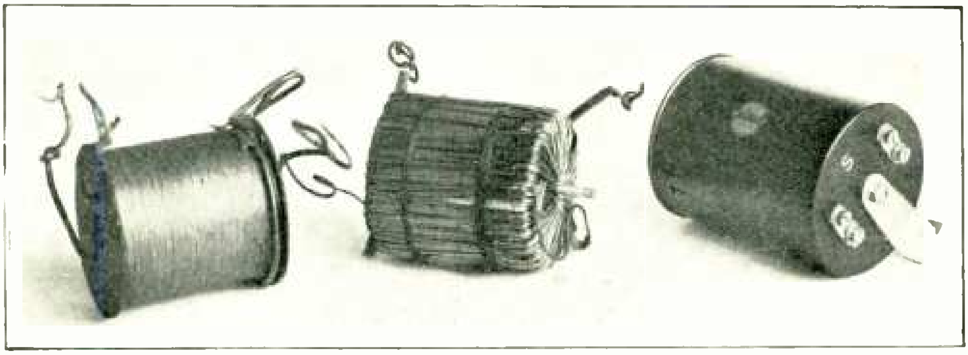
The secondary winding has about 50,000 turns with a resistance of 36,000 ohms. The instruments were totally enclosed in an iron box. Sometimes two coverings were provided, one of copper and the other of iron.

(4) Core 7·5 ins. long, No. 24 iron wire, $\frac{3}{8}$ in. diameter. Bobbin $\frac{1}{2}$ in. diameter, with cheeks $2\frac{3}{8}$ ins. diameter placed $2\frac{1}{4}$ ins. apart.



[Marconi Scientific Instrument Co., Ltd.

Fig. 102. Construction of an intervalve transformer. The portions shown are the iron wire core, tube and end cheeks, and bobbin with primary wound.



Marconi Scientific Instrument Co., Ltd.

Fig. 103. Here the secondary is wound, the core wires secured, and the right-hand picture shows the finished instrument.

4,000 turns of No. 47 enamelled. Secondary winding 16,000 turns of No. 47 enamelled. Turn ratio 4 to 1. The primary has a resistance between 1,500 and 2,000 ohms, and the secondary about 10,000 ohms.

(3) German Transformers. These transformers, as used in amplifiers built during the war, have a primary winding of about 15,000 turns with a resistance of 5,000 ohms.

Primary winding, 15,000 turns of No. 44 S.S.C. Resistance 2,000 ohms. Diameter over primary 1 in. Secondary winding, 45,000 turns No. 46 S.S.C. Resistance 20,000 ohms. Diameter over secondary $2\frac{1}{8}$ ins.

(5) American transformer used to couple 20,000 ω valves. Primary winding, 4,500 turns of No. 44 S.S.C. Resistance 1,100 ohms. Inductance, 8 henries at 1,000 cycles.

Secondary winding, 1,000 turns of No. 44 S.S.C., Resistance 3,700 ohms. Inductance 50 henries, core ¾ in. diameter iron wires. Bobbin 1½ ins. long.

(6) American transformer. Primary winding 5,500 turns of No. 36 S.S.C. Secondary winding 27,000 turns of No. 40 S.S.C. Core ⅜ in. diameter. Bobbin 3 ins. long, with an outside diameter of 2¾ ins.

(7) Federal transformer. Primary winding, 3,900 turns of No. 46 enamelled wire, with a resistance of 2,200 ohms. Secondary winding, 12,000 turns of No. 46 enamelled wire with a resistance of 9,500 ohms. The bobbin is ¾ in. long. Diameter over primary ⅞ in., and over secondary 1⅜ ins. The core is built up of E-shaped stampings.

(8) Primary winding, 10,000 turns of No. 44 S.S.C., with a resistance of 1,700 ohms. Secondary winding, 10,000 turns of No. 44 S.S.C., with a resistance of 2,600 ohms. Bobbin 2¼ ins. long, ½ in. diameter, cheeks 1¼ ins. diameter, core ⅜ in. diameter, of iron wires and 7½ ins. long.

With transformers having a high ratio such as 4 or 5 to 1, the characteristics may be improved by connecting a resistance across the primary or secondary windings, and by making an air gap in the core. Sometimes it is beneficial to connect the core with another part of the circuit, such as earth or negative of the filament battery. In all cases the windings should be joined up in a particular manner for best results. Generally the beginning of the primary IP is joined with the anode, and the end of the primary winding OP with positive high te sion. The grid is joined with OS and negati low tension through the grid cells with I

41.—Determination of Impedance of Transformers.

The effective impedance of the primar when the secondary is loaded or not loade may be found by the method shown i Fig. 104. The terminals marked input ar

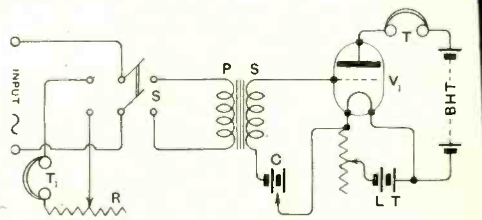
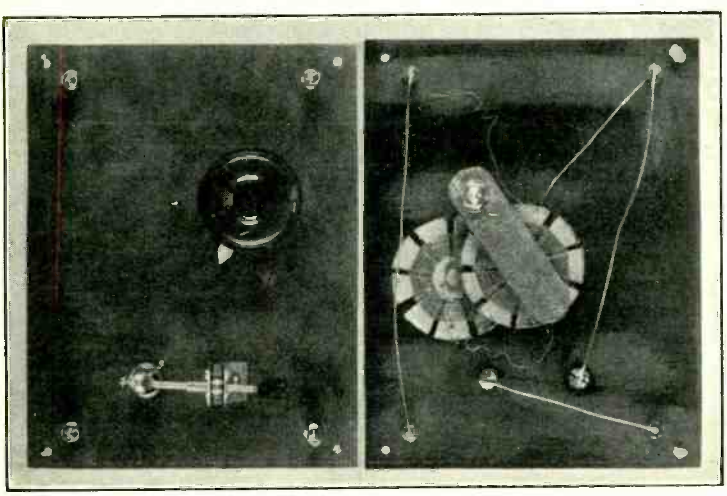


Fig. 104. Method of measuring the effective impedance of primary of transformer. R = variable known resistance up to about 100,000 ohms. T and T_1 = telephones. S = throw-over switch. P and S = transformer. C = grid battery. The voltage of known frequency is applied to the terminals marked input.

connected with a low voltage supply of the desired frequency, and the resistance *R* is varied until the signal strength heard in the telephones is the same with the switch S either connected to the resistance or to the transformer primary. When the signal strength is the same with each position of the switch, the value of resistance *R* is equal to the impedance of the transformer.

The supply may be obtained from a valve generator.



Crystal Broadcast Receiver.

Of very simple construction, this small receiver embodies a reliable tuning principle and gives first-class results. Details for building the compact receiver can be easily gleaned from the photograph. The inductance cards are 1½" in diameter, each wound with forty turns of No. 36 S.W.G. double silk-covered wire. H.J.C.

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.

Liverpool Wireless Society.*

The Society was honoured, on July 26th, with a visit from Mr. Lucy, a representative of Messrs. S. G. Brown, Ltd. Mr. Lucy interested the members with an historical survey of wireless receivers and relays, and gave a demonstration of the Company's latest loud speaker, the "Frenophone." In this latest model the purity of tone was very marked, particularly with a few stages of amplification.

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

The Kensington Radio Society.*

At the Society's July meeting, Mr. F. H. Haynes, Assistant Editor, *The Wireless World and Radio Review*, delivered a lecture on "Low Power C.W. Transmission and Telephony." The lecturer dealt with many points of special interest to amateurs, and his remarks were well illustrated with lantern slides.

The next meeting of the Society will be held in September, due notice of which will be sent to members.

The Hon. Sec., J. Murchie, 33, Elm Bank Gardens, Barnes, will be pleased to hear from anyone desirous of joining the Society.

Ilford and District Radio Society.*

Some thirty members paid a visit to the Ilford Generating Station on July 12th, when a most interesting time was spent.

On July 26th, Mr. J. F. Payne lectured on "C.W. Transmission." A practical demonstration, using the Society's call sign 2 OU, was afterwards carried out, communication being established with other amateur transmitters.

Hon. Sec., L. Vizard, 12, Seymour Gardens, Ilford.

The Southampton and District Radio Society.*

On Thursday, July 26th, the Society was privileged to have as lecturer Mr. A Parsons, A.M.I.R.E., Stud. I.E.E., who dealt with high frequency, low frequency and dual amplification.

After his lecture, Mr. Parsons answered several questions relating to radio matters.

Six new members were elected.

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

Wireless Society of Hull and District.*

"Pitfalls in Wireless for Amateurs," was the title of an instructive paper delivered before the Society on July 20th by Mr. J. Brazendale. The lecturer emphasised the importance of good aerial and earth systems, and illustrated his points with numerous sketches on the blackboard. Precautions against lightning were discussed, and high and low frequency methods of amplification received attention.

On July 27th, through the courtesy of Mr. Holmes, manager of the new Automatic Telephone Exchange, members of the Society were able to spend an interesting and instructive evening in inspecting the installation under the guidance of two capable operators.

Hornsey and District Wireless Society.*

"High Frequency—Tuned Anode and Other Methods," was the title of an interesting lecture delivered by Mr. J. A. Price on Monday, July 23rd. Mr. Price stated that he had experimented with all the known methods of radio frequency amplification, and had come to the conclusion that the "tuned anode" was the most satisfactory method of obtaining high frequency amplification on all wavelengths. A discussion on the subject followed, which, combined with the lecture, proved of valuable assistance to those whose ambition is to obtain high frequency amplification "without tears."

Particulars regarding membership will be gladly forwarded on application to the Hon. Sec., H. Hyams, 188, Nelson Road, Hornsey, N.8.

Ipswich and District Radio Society.*

By kind permission of the Air Ministry, members of the Society visited Pulham Aerodrome on Sunday, July 22nd. The journey was made by charabanc, and on reaching their destination the visitors were met by the Officer-in-Charge, proceeding at once to the transmitting station. Much interest was taken in the array of apparatus, particularly in the R.A.F. transformer.

The direction finding station was next visited, and its principles were fully explained. The Hon. Secretary, Mr. H. E. Barbrook, was invited to call up Croydon, and speech was received for five minutes, greatly to the interest of the visitors.

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

North Middlesex Wireless Club.*

On July 25th, at a well-attended meeting of the Club, Mr. L. C. Holton, late wireless officer in H.M. Forces, gave a very interesting lecture on "Earth Current Telegraphy." The use of a power buzzer for communication over a few miles was described and illustrated by experiments. In this form of wireless, it was explained, no aerial is necessary, the earth itself being utilised to convey the electric current from the transmitter to the receiver. The lecturer described how to arrange the base lines of the two stations to get the best results, and the adjustments necessary to compensate for changes in humidity of the soil. A practical demonstration of spacing wire ropes followed, and Mr. Holton concluded with some useful hints on the erection of masts. At the close of the lecture, t e Chairman, Mr. A. J. Dixon, announced that he had prevailed upon Capt. P. P. Eckersley, Chief Engineer of the British Broadcasting Company, to give a lecture to the Club in the Autumn. Members of the Club will look forward with pleasure to Capt. Eckersley's visit.

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

Barnet and District Radio Society.

Amongst the new members enrolled on July 25th, was Mr. W. R. Kent, a member of the Urban District Council and formerly Postmaster of Barnet. He is the second local councillor to join the membership of the Society.

The Society's membership now amounts to fifty, and the number is steadily increasing.

Hon. Sec., J. Nokes, "Sunnyside," Stapylton Road, Barnet.

Cricklewood Radio Club.

An interesting evening was spent on Thursday, July 26th, when by the kindness of one of the Committee, Mr. Lowe, a Tingey Five-Valve Unit Receiver was brought and tested. A somewhat heated argument ensued as to the exact manner in which the choke couplings between the valves amplified, conflicting views being expressed as to whether the valves were amplifying at high frequency or at low frequency. A number of different types of valves were experimented with, including three German Telefunken valves, which proved to have some rather peculiar properties. The first unit of the Club's set was tried out and found to be satisfactory, and further units are being proceeded with.

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

Derby Wireless Club.

There will be no meeting of the Club during August and September, the next meeting being arranged for an early date in October. The Committee has now arranged for the tenancy of a new club-room at Derby Chambers, St. Peter Street, Derby, where it is hoped that the Society will hold its future meetings. The Hon. Secretary would be grateful if members who are willing to contribute articles of furniture, viz., chairs, tables, etc., towards the equipment of the new headquarters, would communicate with him.

Hon. Sec., R. Osborne, The Limes, Chellaston, Derby.

Darlington Photographic and Radio Society.

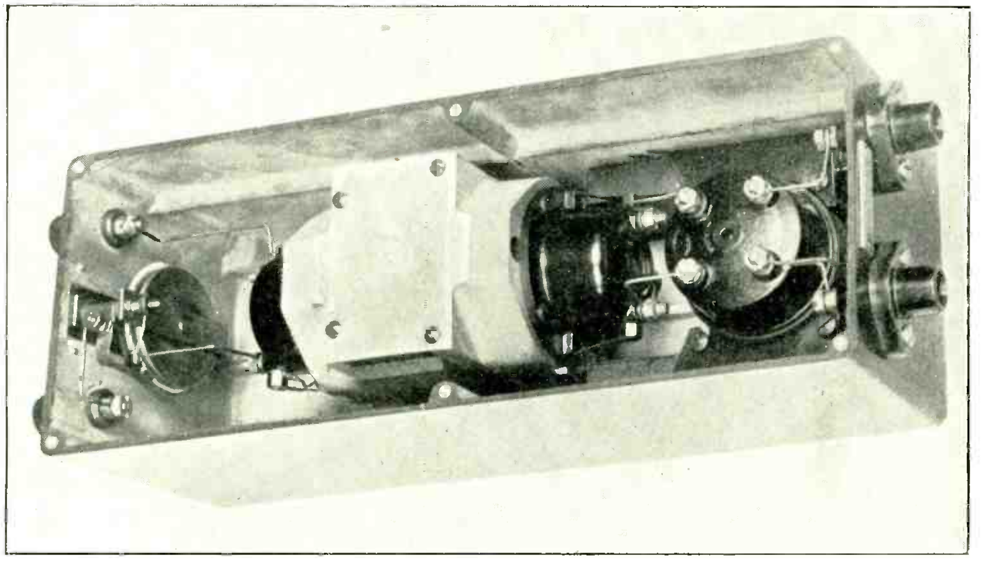
A radio section has been formed in connection with the Darlington Photographic Society, and the Society's name has accordingly been changed as above.

The first meeting of the new branch was held on July 19th, and a good number of wireless enthusiasts was present. An interesting programme is in course of preparation for the winter session. Fuller details will be gladly supplied on application to the Hon. Secretary of the Radio Section, H. Glover, 72, Thornton Street, Darlington.

Oldham Amateur Radio Society.

The Society has now changed its headquarters, and in future meetings will be held on the premises of the Oldham Equitable Co-operative Society, Waterloo Street, Oldham.

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



This instrument, manufactured by the M. L. Magneto Syndicate, Ltd., is for the purpose of providing valve H.T. current from a low voltage source, such as the accumulator battery used for filament heating. The outfit consists of variable resistance, motor generator and smoothing inductances and condensers. It is constructed in three types with outputs of 70, 120 and 300 volts, and passes 1·0, 1·1 and 1·25 amperes on no load, which is increased on load approximately by the output current multiplied by the voltage ratio. All types give a normal output of 25 milliamperes. The excellent design and high-grade finish can be readily seen from the photograph.

Notes and News

Vigorous protests are being made against the suggested erection of a wireless station at Avebury, Wilts. The locality is noted for its Druidical remains.

* * * *

The adoption of chess by wireless during the coming winter is predicted by a prominent chess club official.

* * * *

At a sitting of the Jersey States on Saturday, August 4th, it was agreed that steps should be taken for the installation in Jersey of a wireless receiving and transmitting station.

* * * *

A Scottish National Radio Exhibition is to be held in Glasgow next month.

* * * *

Radio: Who was the first radio engineer?

Wireless: Adam, because the first loud speaker was made from his spare parts.—*From "Q.S.T."*

Wireless and the Motor Cycle.

To the youth of the land there is an undoubted kinship between the attractions of wireless and motor cycling. The root fascination in both pastimes is the conquest of time and space. In the speed trial the motor cyclist endeavours to transport himself over the greatest distance in the minimum amount of time; in the Transatlantic communication test the wireless experimenter seeks to do the same with his signals.

Probably realising that many wireless enthusiasts are also motor cyclists, the British Broadcasting Company has recently included several items of motor cycling interest in their programmes. On Monday, July 23rd, Major Vernon Brook broadcast from the Birmingham station a ten minutes' talk on "Keeping a Motor Cycle in Trim," while on the following day, from **2 LO**, Mr. Richard Twelvetrees spoke on motor cycles. Major Watling lectured on "The Motor Cycle Industry" on July 25th.

The Wandsworth Borough Council.

The Wireless World and Radio Review has been asked to contradict the report recently circulated to the press, that the Wandsworth Borough Council has given notice to quit to all tenants who have erected wireless aerials, with the alternative of dismantling the equipment.

"What has actually occurred," states an official of the Wandsworth Borough Council Housing Department, "is that several tenants were asked to pay 10s. deposit until their aerial had been removed, in case of damage to Council property, the money to be, of course, returnable."

FORTHCOMING EVENTS.

FRIDAY, AUGUST 17th.

Wireless Society of Hull and District. At 7.30 p.m. Lecture: "Magnetism," by Mr. G. E. Steel.

SATURDAY, AUGUST 18th.

Ipswich and District Radio Society. Visit to Felixstowe at invitation of Felixstowe Wireless Society.

Wireless Society of Hull and District. Field Day at Cottingham (Provisional).

Hornsey and District Wireless Society. Visit to G.E.C. Laboratories at Wembley.

FRIDAY, AUGUST 24th

Gorton and District Wireless Society. Ordinary Meeting.

The New French Wireless Regulations.

According to the latest regulations governing wireless in France, the full text of which is now made public, wireless receiving stations are divided into three classes, viz., (1) Those installed by Government Departments, Municipal Authorities, and public establishments, for the reception of gratuitous performances; (2) Those installed by private individuals for public performances; and (3) Those not intended for public performances.

As in Great Britain, wireless is under the control of the Postal Administration. An applicant for a receiving licence must produce evidence of nationality, and is required to pay a nominal sum of one franc towards the Statistics Tax. The reradiation by receivers is strictly forbidden.

Broadcasting stations may be used only for the transmission of artistic productions and lectures of general interest, no advertisements or publicity propaganda being permitted.

For the establishment of a private transmitting station, application has to be made to the Under-Secretary of State for Posts and Telegraphs, and the applicant must hold a certificate granted by the aforesaid official, testifying efficiency in radio-telegraphy or telephony. The number of transmitting stations may be limited within a certain area in order to avoid interference.

The power of amateur transmitting stations may not exceed 100 watts, and the wavelength is restricted to between 180 and 200 metres.

2 KA.

We regret that ownership of the above station was erroneously ascribed to N. Curtiss in our issue of July 7th. **2 KA** is the call sign of the transmitting station belonging to the Brighton and Hove Radio Society.

Burndept, Ltd.

The Administrative and Executive departments of Burndept, Ltd. (comprising Advertising and Sales) have removed to Aldine House, 13, Bedford Street, Strand, W.C.2. All correspondence should be sent to this address. Returned packing cases, etc., should, however, be sent to Aerial and Eastnor Works, Blackheath, S.E.3.

Reduction in Telephone Prices.

Messrs. The British L.M. Ericsson Manufacturing Company, Ltd., have intimated to us that they have made a big cut in prices, which now run as follows:—120 ohms, 24s. 6d. 2,000 ohms, 25s. 6d. 4,000 ohms, 26s. 6d. 8,000 ohms, 35s. The quality of the telephones will be unaltered.

CORRESPONDENCE : Coincidence of Time Signal

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I was rather interested in Mr. Trott's letter in this week's *Wireless World and Radio Review.* I too have noticed the difference he refers to, but think that it is due to "lag" in transmission from the Observatories to respective stations.

Thus, in the "Year Book of Wireless Telegraphy and Telephony" a note in the Time Section states that the "lag" of the Annapolis Time Signal is 0·08 seconds (constant). Presumably Lyons suffers less from "lag" and so appears earlier than **NSS.**

This seems more feasible than that our ears can detect differences of 1/70th of a second, as the "lag" is nearly 1/10th second.

No figures are given relating to the Lyons "lag," if any.

Wishing *The Wireless World and Radio Review* continued success.

F. C. LISTER.

Grimsby, *July* 13*th*, 1923.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I was interested in the article by Mr. Trott in *The Wireless World and Radio Review* of July 14th, on the coincidence of the **NNS** and **YN** time signals.

Using a single valve detector with reaction, some months ago, whilst listening to the 0955 time signals from **NBA** Panama, 10,100 metres, I could hear the scientific time signals of Paris on 10,400 metres—obviously a harmonic of 2,600 metres. **NBA** was approximately one beat out in 200 seconds.

Also while listening to the time signal beats from Moscow on 5,100 metres at 2200 G.M.T., Paris was again heard, this time on a harmonic of 5,200 metres. In this case the beats coincided approximately every 60 seconds.

From these comparisons the difference in time between **NBA** and **FL** would be only 1/200th second, whilst the difference in time between Moscow and **FL** would be 1/60th second. I wonder if any other readers have noticed these differences.

WILF. R. ORLANDO BRIDGEMAN.

London, *July* 16*th*, 1923.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to Mr. T. B. Trott's interesting letter in your issue of July 14th, it may interest your readers to have some additional figures. I made enquiries of the authority on the subject at the Royal Observatory, Greenwich, and I will quote from the reply he kindly sent me :—

"The land line lag between Washington, where the transmitting clock is placed, and Annapolis W/T station amounts to 0·08 seconds. The travel time of a signal from U.S.A. to England would not be less than 1/60th second, say 0·02. Consequently from these two causes the American signal would be 0·1 second late when received in England.

"For the period January to March, 192 the mean error of the signal sent from Washingt was ±0·03 second. This figure results fro observations made at Washington, and m be considered as the difference resulting betwe provisional and concluded clock errors at t Washington observatory.

"Unfortunately, the errors of the Lyons 9 time signals are not given by the French Burea publication. . . . . . For the perio January to March, 1923, the mean error of t Eiffel Tower 10 h. 45 m. time signals was ±0·0 seconds. As you know that a clock is use at Lyons which has been previously set to Pari time, it is safe to assume that the mean erro would not be less than that at Paris. Th figure 0·07 seconds is the same difference as i the case of Annapolis, *i.e.*, the difference betwee the provisional and concluded clock errors a Paris.

" . . . . Mr. H. R. Morgan, discussing observations made at Washington, i of opinion that a time determination made with a large fixed instrument in an observatory may be liable to a discrepancy amounting to 0·1 second from purely instrumental causes. In final reductions this error would be eliminated, but it may be possible for it to affect provisional clock errors such as would be used in sending out W/T time signals."

In a further communication received this morning he says :—

"The figures are means, and errors of the magnitude you mention" (I had referred to a discrepancy amounting to 0·5 second which I had occasionally noticed between Paris and Nauen) "do occur occasionally (and sometimes much larger even than that). A mean taken, however, over 90 days readily reduces a few outstanding discrepancies.

"A further point of consideration is that the figures give errors admitted by the transmitting stations, and the agreement or otherwise with a time determination made at a station receiving the signal is another question."

I have quoted from my Authority's letter at some length, as it answers definitely the question which I have often heard raised as to the reliability of these W/T time signals. It also shows, I think, that it is highly improbable that the difference noticed by your correspondent is only due to the time taken from the signal to cross the Atlantic. From considerable experience with the "rhythmic signals" from **FL** I think it quite impossible that the human ear could detect a difference between two dissimilar signals of as little as 1/70 second. It is not by any means easy to be sure (without some form of automatic recording) of the exact second at which the **FL** dot coincides with a clock beat, and here the difference concerned is as much as 1/44th second.

MAURICE A. AINSLIE, F.R.A.S.
(*Instructor Captain, R.N.*)

Blackheath, *July* 19*th*, 1923.

Calls Heard.

ngavie, By Glasgow.
DF, 2 FN, 2 GG, 2 GN, 2 JF, 2 KF, 2 NA, JM, 2 OD, 2 OM, 2 ON, 2 TB, 2 TX, 2 VN, 'S, 2 VT, 2 WK, 2 XR, 2 YT, 5 BV, 5 CX, ON, 5 GS, 5 JW, 5 KO, 5 OD, 5 WN, 5 WV, 'M, 7 JS, 8 AQ, 8 AW, 8 BA, 8 BM, 8 BF, CF, 8 CS, 0 MX, 0 NY.

(D. Ronald Reid.)

orley, Surrey.
2 KZ, 2 OM, 2 QU, 2XR, 2 XZ, 5 LP, 5 SU, XR, 6 IM.

(E. H. Brown.)

ork.
2 AO, 2 DF, 2 DS, 2 FN, 2 GG, 2 JF, 2 IJ, KF, 2 KW, 2 NA, 2 NK, 2 NM, 2 QJ, 2 VN, VO, 2 WA, 2 ZK, 5 BG, 5 CK, 5 CX, 8 AS, BM, 8 BV, 8 CS, 8 CZ.

(A. Cooper.)

Broadcasting Topics.

LO's Wavelength.

During the past week, until August 17th, the morning programmes from the London station have een transmitted on a 400 metres wavelength. The xperiment has been made to ascertain whether aising the wavelength increases the range and mproves reception in distant parts. Reports will be welcomed by Capt. Eckersley of the B.B.C.

The New Birmingham Studio.

The new studio, situated at 105, New Street, was opened on Saturday, August 11th. Mr. Joseph Lewis, a well-known Midland conductor, has been appointed Musical Director. A station choir and repertory of soloists has been formed and these will be responsible for the vocal music of **5 IT.** Thursday, August 15th, is to be a "special request" night, when the station orchestra will play items "requested" by listeners-in. An Elgar programme is to be given on Friday, August 16th, with an augmented orchestra.

Who are the Announcers at 2 LO?

Mystery sometimes attaches to the identity of the announcers at the London station. The reason for the many changes of late is that the Company has recently engaged a number of new announcers for the provincial stations and these are first "broken in" at 2 LO.

Coming Items at 2 LO.

August 15th Mr. Archibald Haddon: "Dramatic Criticism," 7.15 p.m.; Prof. A. J. Ireland: "History," 9 p.m.

August 16th Mr. Percy Scholes: "Musical Criticism," 7.15 p.m.; Talk on the Duke of York's Camp (Provisional), 9 p.m.

August 17th Mr. G. A. Atkinson: "Cinema Criticism," 7.15 p.m.; Mr. F. G. Bristow: "The Relation of Broadcasting to the Motor Industry," 9 p.m.

B.B.C. Time Signals.

Every care is being taken by the British Broadcasting Company to ensure the accuracy of the regular time signals transmitted from the various broadcasting stations. As announced in our issue of August 1st, the Synchronome master clock system is being installed in the existing stations of the Company. With the same object in view, the new stations at Aberdeen, Bournemouth and Manchester are to be equipped with "Pulsynetic" Electric Impulse Clocks, made and supplied by Messrs. Gent & Co., Ltd., of Leicester.

Broadcasting for the Army.

Broadcast music is filling the gap at Mill Hill Barracks caused by the demobilising of the band on the grounds of economy. A Marconiphone amplifier is employed, several loud speakers being in operation, and officers, N.C.O.'s and men now enjoy the programmes in various parts of the barracks.

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; 7.20 p.m., 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 and Sundays, 10 to 10.45 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, 1 p.m., Meteorological Bulletin. Daily, 5.50 p.m., Meteorological Bulletin; Tuesday and Thursday, 10 p.m., Concert. Sunday, 7 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.

A PAGE FOR THE BEGINNER.

Insulating Materials.

THE insulating material most generally employed in wireless constructional work is, of course, ebonite. In the form of sheets 3/16 in., ¼ in., 5/16 in. and ⅜ in. in thickness, it is used for the purpose of mounting components between which a high degree of insulation must be maintained, whilst in the form of tubes, which can be obtained up to a diameter of about 3¾ ins., and with a wall thickness of not much more than 5/32 in., it is employed as inductance formers. It can be obtained as rod, which is useful for supporting purposes and turning work. Ebonite varies very considerably in quality, and it should only be obtained from firms of repute who can be relied upon to supply nothing but the best. Good ebonite should machine well, by which is meant that it should not easily fracture on the edges of the holes while drilling or along the sides during cutting or filing. It should be free from flaws on the surface, perfectly flat and highly polished. Inferior grades of ebonite may be manufactured from recovered rubber, which may contain a great deal of unsuitable material as well as possessing metallic contamination. It is not meant by this that pieces of scrap metal may be found in the ebonite, which, however, is not uncommon, but that combined metals in the form of double sulphides may be present, and such compounds tend to destroy the insulating properties. The polished surface of ebonite is frequently produced by rolling with tin foil and the surface contamination which results will have no detrimental effects if the surface is well rubbed down before the components are assembled.

Fibre, or vulcanised fibre, must not be used for constructing valve apparatus. Its insulating properties vary with the humidity of the atmosphere, and it can never be relied upon where high insulation is required.

Wood can sometimes be made a very good insulator by thoroughly drying it out in a hot oven and liberally impregnating it with shellac varnish and baking. Strawboard and strawboard tube treated in this way forms quite a good insulator, and when used as an inductance former may have very slightly better electrical properties than ev ebonite, though it has disadvantages fro a mechanical standpoint.

Slate must not be regarded as an insulat for wireless purposes, and even the be grades, selected as being free from metall grain, do not possess the high degree c insulation that is required. Beginners a sometimes induced to use slate becaus they see it employed for switchboard work but it must be remembered that a lo insulation of a few megohms between tw points would be unobserved in low voltag power work, and yet might very seriousl affect the working of a multivalve receiver

Other insulating materials such as may be employed as dielectrics are dealt wit separately.

* * * *

Tuning the Reaction Circuit.

It is not usual to connect a condenser across the reaction inductance, yet if a variable condenser is available improved adjustment can be obtained. The undesirable effect by which a receiver suddenly bursts into oscillation as reaction coupling is advanced can usually be remedied by critically tuning the reaction circuit. The use o the condenser also obviates the necessity of reversing the connections of the reaction coil when switching an intermediate high frequency amplifying circuit in or out of use.

* * * *

Spacing of Aerial Wires.

In the case of two-wire aerials it is necessary that the wires should be spaced at least six feet apart. Suitable spreaders are rather heavy, however, and if made of wood may be tapered at the ends to reduce weight. Stiff bamboo makes a very good spreader. If the distance between the points of suspension is longer than required, do not arrange a spreader away from one of the masts, and thus produce a considerable sag in the aerial, but substitute cord for aerial wire, connecting light insulators between cord and wire at some distance from the spreader. It is most important for the two wires to be identical in length, both from a point of view of tuning and in order that the aerial may hang level.

Questions and Answers

"R.L.S." (Geneva) *asks* (1) *If an aerial rected according to the sketch submitted would be atisfactory.* (2) *For a diagram of a circuit which ve would recommend for the reception of the broadcast ransmissions from the Eiffel Tower at a distance of 300 miles, using the minimum number of valves.* (3) *If the results obtainable by using 4,000 ohm telephones with a transformer having a 1 : 1 ratio would be equal to those obtainable by using 120 ohm. telephones with a transformer of 5 : 1 ratio.* (4) *If 3/18 bronze wire is suitable for use in aerial work.*

(1) An aerial erected according to your sketch should give quite satisfactory results. (2) A suitable diagram is given in Fig. 1. Three valves are employed, two operating as high frequency amplifiers and the other as a detector, the method of H.F. coupling being by tuned anode. (3) The fine wire with which the majority of 4,000 ohms telephone headpieces are wound, renders them liable to injury when used in the anode circuit of a valve. This danger is reduced by the employment of a transformer of 1 : 1 ratio. The usual method is to use a transformer of approximately 6 : 1 ratio, and telephones of 120 ohms resistance, the heavier gauge wire employed in the windings of the latter being much less liable to damage. (4) The wire that you mention should be satisfactory for use in an aerial.

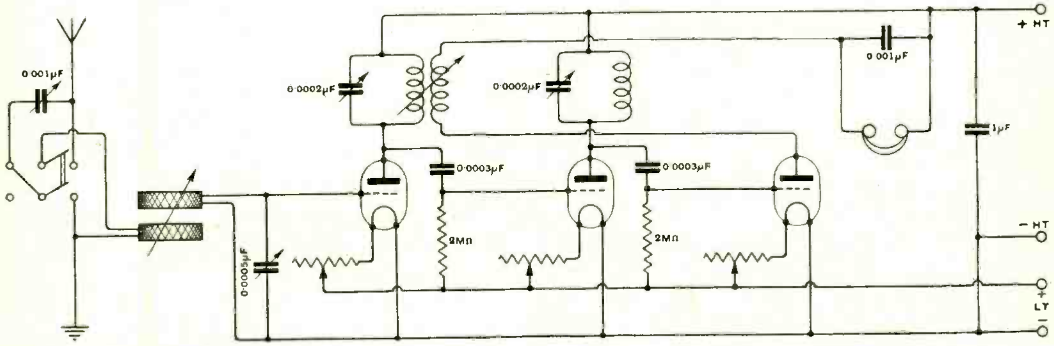


Fig. 1. **"R.L.S." (Geneva).** *A three-valve receiver is shown, employing two H.F. amplifying valves and detector. Tuned anode H.F. coupling is used, with reaction to the anode coil of the first valve.*

"D.G." (London, W.1) *asks* (1) *For suggestions indicating how he may use plug-in type coils with a variometer type tuner in order to receive the French broadcast transmissions.* (2) *For a diagram indicating a method by which he may add one H.F. amplifying valve to a set consisting of detector and two L.F. valves.* (3) *If we consider that he should be able to receive American telephony transmissions with the set mentioned in Question* (2), *including the H.F. valve, with a twin aerial 20 ft. long and 80 ft. high.*

(1) and (2) A suitable diagram is given in Fig. 2. Tuned anode H.F. coupling is employed. (3) We think that, under favourable conditions, you may be able to receive American telephony.

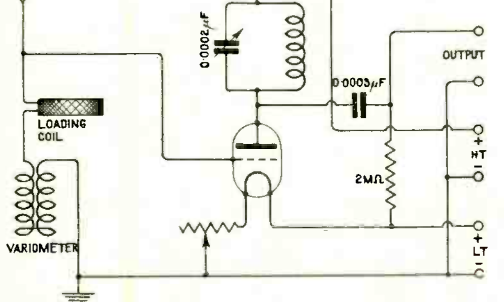


Fig. 2. **"D.G." (London, W.1).** *Here we give a diagram indicating how a H.F. amplifying valve may be added to a receiver.*

"F.J.F." (West Bromwich) *asks* (1) *For a circuit diagram of a four-valve receiver, two H.F., detector, and one L.F., with tuned-anode H.F. coupling, approved form of reaction and optional reaction to aerial circuit. A switch for cutting out one H.F. valve is also required.* (2) *If it would be easier to operate a loud speaker on the transmissions from* **5 IT** *at a distance of 10 miles with a set comprising two H.F. and detector valves, or with a set comprising one H.F., detector, and one L.F. valves, using reaction in each case.* (3) *For the most suitable circuit diagram in accordance with the reply to question* (2). (4) *For advice on the most suitable type of coil to use for an approved form of reaction.*

(1) A suitable diagram is given in Fig. 3. Reaction is effected by means of a coil coupled to the anode tuning inductance or to the aerial inductance. Switches are provided for cutting out

the H.F. valve and for cutting out the reaction coupling to the aerial circuit. (2) The preferable circuit of the two would be one comprising one H.F., detector, and one L.F. valves. (3) We would refer you to diagram No. 53. "The Amateur's Book of Wireless Circuits," by F. H. Haynes, The Wireless Press, Ltd., 2s. 6d. net, also see Fig. 6, Page 398, June 23rd issue. (4) When the tuned anode form of H.F. coupling is employed, the plug-in honeycomb type coil is very suitable for use as an anode inductance, and for the reaction coil which couples to it. In this case the usual form of two-coil holder may be conveniently employed for the purpose.

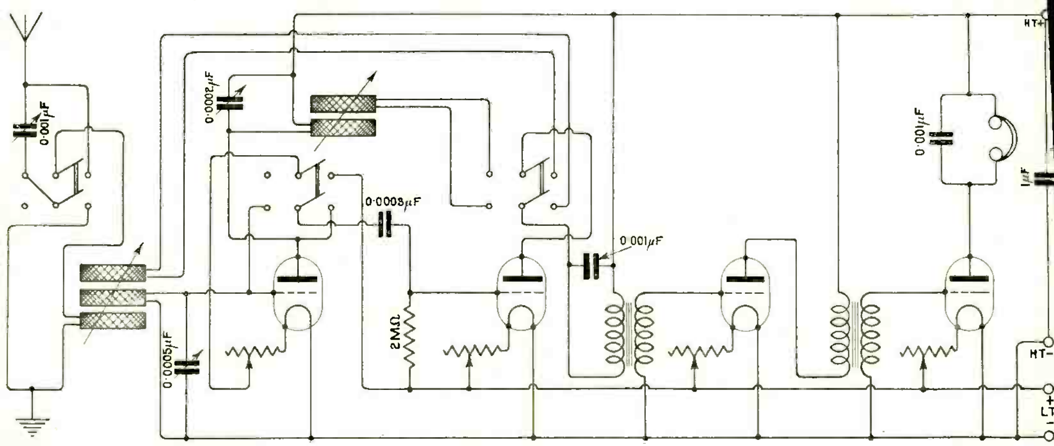


Fig. 3. **"F.J.F." (West Bromwich).** *Connections of a four-valve receiver employing one H.F., detector and two L.F. valves. Switches are provided for disconnecting the H.F. valve, and for employing reaction on either the closed circuit or anode coils.*

"E.A.A." (West Ham) *asks for a circuit diagram of a four-valve set, two H.F., detector and one L.F. valves. It is desired to have one H.F. valve transformer coupled, and the other resistar capacity coupled with switches to cut out all valv except the detector.*

A suitable diagram is given in Fig. 4. T first H.F. valve is transformer-coupled, wi reaction to transformer.

"W.R." (Lee, S.E.12) *asks* (1) *With referen to a variable condenser which he has bought as 0·0005 mfds. capacity, if this value is not incorrect from the particulars of the condenser which he gives, and his own calculation of its capacity.* (2) *If the free end of his single wire transmitting aerial should be provided with better insulation than at the lead-in end.* (3) *For an explanation of the fact that excellent results are obtained with a crystal detector in a simple circuit as indicated in a sketch submitted.*

(1) Your calculation of the capacity of the

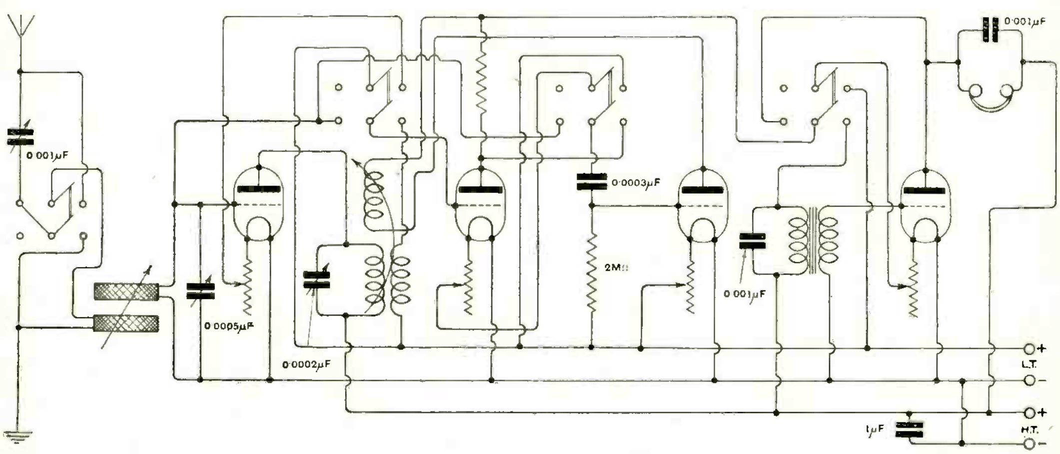


Fig. 4. **"E.A.A." (West Ham).** *Diagram of a four-valve receiver employing two H.F., detector and one L.F. valves. The reaction coil is coupled to the H.F. transformer, and switches are provided for cutting out any valve except the detector.*

ndenser is correct. The low capacity is due to e relatively large spacing between the vanes.) The voltage at the free end may be much eater than at any other part of the aerial, but e think that if you take ordinary care with the sulation at each end, you will experience no ouble on this account. (3) The sketch accompany-g question (3) shows that you have a simple cillatory circuit, in which aerial and earth con-itute the condenser, and your coil the inductance. uring the reception of signals, an alternating urrent of high frequency flows in the circuit com-rising aerial wires, coil and earth. This current ould also flow in that part of the circuit comprising he crystal detector and telephones but for the resence of the crystal, which, being a rectifying evice, only permits a uni-directional current to

"C.M.H." (Brockley, S.E.4) *asks for the correct method of connecting up a L.F. transformer.*

The terminal marked O.P. is usually connected to positive H.T. I.P. is connected to plate of valve, O.S. to grid, and I.S. to negative L.T. Transformers are wound in a variety of ways, and it is quite simple to try out the different methods of connecting up.

"EXPERIMENTER" (Edinburgh) *submits a sample of insulated wire, and asks* (1) *and* (2) *Can it be used for making wireless instruments.* (3) *What is the description of the wire, and why is it tinned.*

(1) and (2) Yes. (3) The wire is No. 36 D.S.C. tinned copper twin. Copper wires for electrical purposes are tinned to facilitate making soldered connections.

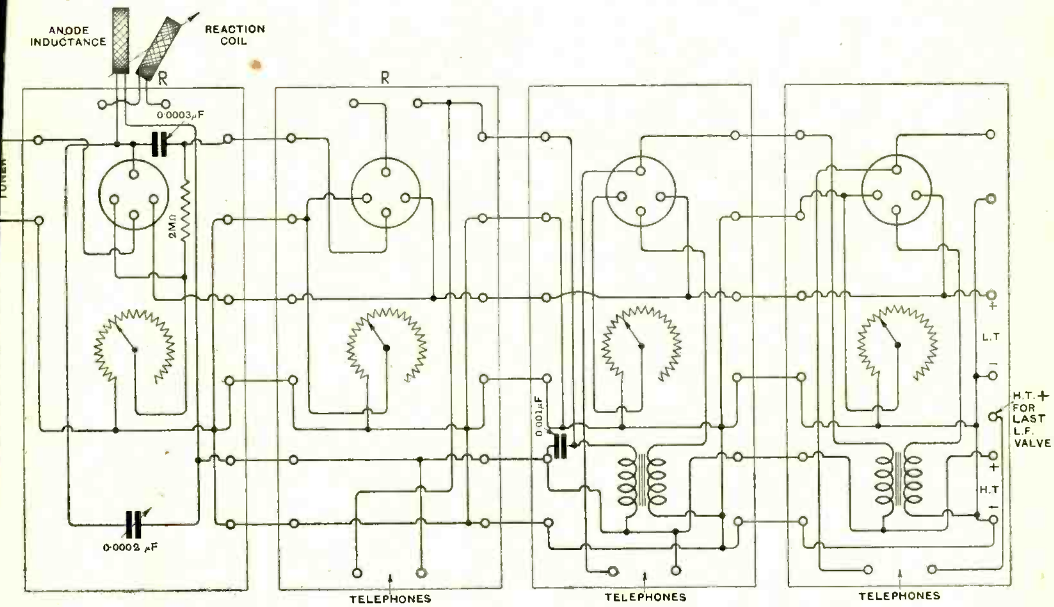


Fig. 5. **"G.C." (Burton-on-Trent).** *A four-valve receiver arranged on the unit system. One H.F., detector and two L.F. valves are used. The tuned anode method of H.F. coupling is employed.*

flow in this part of the circuit; as the telephones can only be actuated by a uni-directional low frequency current, signals will be heard when they are connected up in this manner.

"G.C." (Burton-on-Trent) *asks* (1) *For a diagram of a four-valve experimental set, one high frequency, detector, and two low frequency valves, arranged on the unit system, and a separate H.T. positive lead for the last L.F. valve.* (2) *If it would be any disadvantage in the H.F. unit to locate the tuning condenser between the valve holder and the filament resistance.* (3) *For suggestions concerning the origin of disturbing noises.*

(1) A suitable diagram is given in Fig. 5. (2) There is no great objection to the suggested arrangement of components. (3) We cannot say what is causing the disturbance. It may be due to a near-by cinema, power lines or electrical plant.

"S.K." (Chiswick) *submits particulars of a crystal receiver he has constructed, and asks* (1) *and* (2) *For details to enable him to construct a loading coil which will increase the maximum wave-length from* 600 *to* 2,600 *metres.* (3) *Would the diagram given in reply to* **F.W.S. (Redditch),** *in the issue of April* 21*st,* 1923, *be suitable for the construction of a receiver to tune out* **2 LO,** *and receive from the other British broadcast stations.* (4) *Can the loose-coupled tuner consist of plug-in type coils.*

(1) and (2) The loading coil may consist of a winding of No. 26 D.C.C. wire on a former 3″ in diameter and 9″ long. Ten tappings should be taken, equally spaced along the coil. (3) The diagram mentioned will give selective tuning in a receiver, but we cannot say definitely whether you will be able to cut out **2 LO** at your address. (4) Plug-in type coils may be used in a loose-ooupled tuner.

"W.H." (Liverpool) *submits particulars of a crystal receiver which he has constructed, and asks (1) When adding a H.F. valve to this receiver, employing basket coil variometer H.F. coupling, should this variometer be similar to the aerial tuning variometer. (2) Is No. 36 D.C.C. wire suitable for winding the basket coils for the variometers, and, if so, what size formers and number of turns should be used for each. (3) Will the addition of a H.F. valve increase the signal strength, or only increase the receptive range.*

(1) In general, the second variometer will have different windings from the aerial tuning variometer. (2) The wire is quite suitable. The aerial tuning variometer may consist of two basket coils wound on formers 1½″ in diameter, and of 45 turns each. The anode variometer for the H.F. valve may consist of one coil of 100 turns on a 1½″ diameter former, and one coil of 100 turns on a similar former. (3) The addition of the H.F. valve will increase the receptive range, and will give an increase in signal strength.

"W.F.S.J." (Romford) *submits a diagram of a single-valve and crystal receiver which he has constructed, employing three variometers. He asks (1) For criticism of the diagram. (2) Would plug-in type coils be suitable for use as loading coils in this receiver. (3) What are suitable dimensions of basket coils for the reception of the Hague and Eiffel Tower transmissions.*

(1) The diagram is correct. (2) A plug-in type coil might be used as a loading coil by placing it in series with the aerial and the aerial tuning variometer. (3) We suggest that you wind a number of basket coils with No. 26 D.C.C. wire, on a former 1½″ in diameter, and having 60 turns each. Two of these will probably be required in series for the A.T.I. when receiving the Hague transmissions and three for the Eiffel Tower.

"J.E." (Arbroath) *asks, with reference to Fig. 2 on page 614 of the issue of February 3rd, 1923, would we give a diagram of this circuit, with switchi arrangements, so that the first valve may be used as rectifier in place of the crystal, the second remainin a low frequency amplifier.*

A suitable diagram is given in Fig. 6. Whe using the first valve as a high frequency amplifie and the crystal as rectifier, both switches will b to the left. When using the first valve as rectifie and the second remaining as low frequenc amplifier, both switches will be to the right. Th crystal is then disconnected.

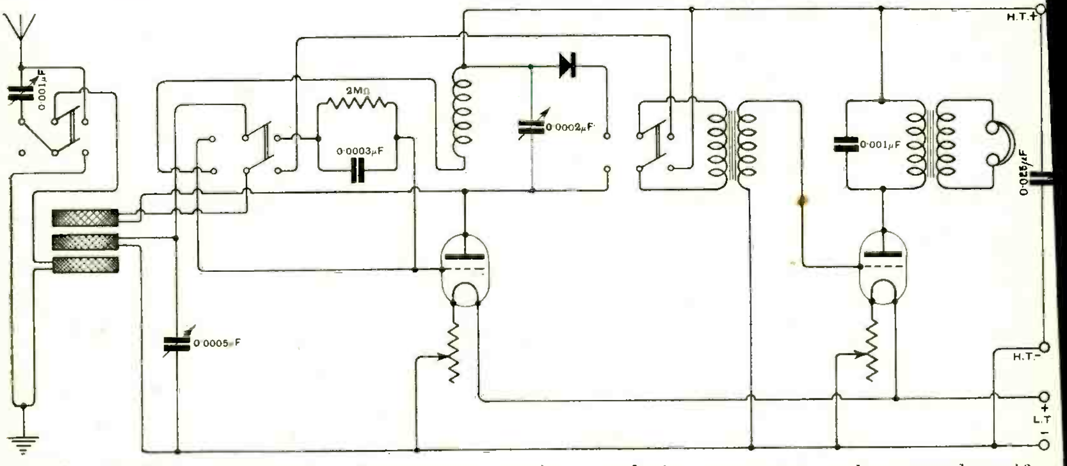


Fig. 6. **"J.E." (Arbroath).** *Experimental receiver employing two valves and a crystal rectifier. Switches are provided so that valve or crystal rectification may be used. When the latter method is employed, both valves may operate as low frequency amplifiers.*

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 GREAT BRITAIN

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Under the Supervision of W. JAMES.

CONTENTS

THE EDITOR will be glad to consider articles and illustrations dealing with subjects within the scope of the Journal. Illustrations should preferably be confined to photographs and rough drawings. The greatest care will be taken to return all illustrations and manuscripts not required for publication if these are accompanied by stamps to pay return postage. All manuscripts and illustrations are sent at the Author's risk and the Editor cannot accept responsibility for their safe custody or return. Contributions should be addressed to the Editor, "The Wireless World and Radio Review," 12 and 13, Henrietta Street, Strand, London, W.C.2.

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ON BEING AN AMATEUR

A YEAR or so ago when one spoke of Wireless Amateurs, there was never a difficulty in understanding what was meant, and further definition w unnecessary. Later on it was found that the word " Experimenter " began be substituted in some instances to identify in particular those amateurs w not only regarded wireless as their special hobby, but who also conducted serious experiment work instead of being content merely with developing one good station and listening f distant signals.

The introduction of broadcasting has resulted in a further sub-division of the gener term " Amateur," for now we have to differentiate between the listener-in who takes n interest in the science of wireless, and the listener-in who wants to learn how his set operates between the constructor who only desires to build one set for the purpose of listening t broadcasting, and the constructor whose principal interest is over when the set is finishe Then there is the amateur who is not content to follow cut-and-dried designs for apparatu but who prefers to evolve something new on his own account ; and, lastly, we have tho who are experimenters, always devising and trying out new circuits and arrangements many of whom, if they take an interest in broadcasting, do so principally because it is convenient transmission on which to test new devices.

Prior to the advent of broadcasting there were in this country at least 15,000 activ amateur workers whose sole aim was to study the technicalities of the science, and exce in design and manipulation. They had not at heart any pecuniary gain or profit, and pursued the science for the immense pleasure it afforded them ; yet in many instances their efforts have been rewarded by the development of designs and patents for which the introduction of broadcasting afforded a market.

The point we must bear in mind is, that the 15,000, and probably many others, are desirous of continuing their investigations without being attracted in their labours by broadcasting, and in fact they might even work all the harder were there no broadcasting at all.

The experimenter of the type which existed long before broadcasting naturally does not expect to fall under some new category in the matter of licences or licence fees. He does not look forward to an increase in the present charges in order that he may contribute to the broadcasting service. It is true that broadcasting has helped him in the development of certain designs, but on the other hand it has robbed him of the use of the ether for the purpose of conducting other experimental work.

There are many experimenters who, twelve months ago, devoted every moment of spare time to their hobby, but who now rarely pick up the headphones. The activities of this class of individual cannot be further hampered ; he must be regarded as a research worker just as much as the large research establishments of the bigger companies, for in each case they are working in the hope of achieving something new, and possibly profiting thereby.

For those who have taken up wireless since broadcasting, it may be interesting to point out that the Post Office has already intimated that they are not in a position (even should they so desire) to refuse to grant licences to those who wish to conduct experiments in wireless telegraphy, but it seems to us extremely probable that, when any new regulations are formed (perhaps as a result of the recommendations of the Broadcasting Committee of Enquiry), that an effort will be made to define officially the title of " Experimenter." When such a definition has been arrived at, it will probably affect the issue of licences and the renewal of licences which have been granted in the past.

Anything in the shape of an examination of proficiency is not likely to be instituted, but, nevertheless, those who wish to remain under the category of " Experimenters," will probably have to show good reasons for being so classified, and therefore they should take steps to ensure the integrity of their position by improving their knowledge, and taking a conscientious interest in experimental work, thus qualifying for the title of " genuine experimenter."

CONSTRUCTION OF A ONE-VALVE DUAL AND CRYSTAL RECEIVER.

By P. G. A. H. Voigt, B.Sc.
(Member of the Wireless and Experimental Association.)

The author has contributed a number of articles on the subject of dual amplification to this journal during the past two years, and his original work in this direction has made him an authority on the design of dual circuits. The principles in this instance are new and novel, and represent considerable thought and research work.

In this article it is proposed to describe the construction of a simple one-valve dual and crystal set, which will be found especially suitable for distant telephony.

The first circuit described has a limiting action on very loud telephony stations.

Fig. 1 shows a photograph of the complete set, while Fig. 2 is the actual circuit.

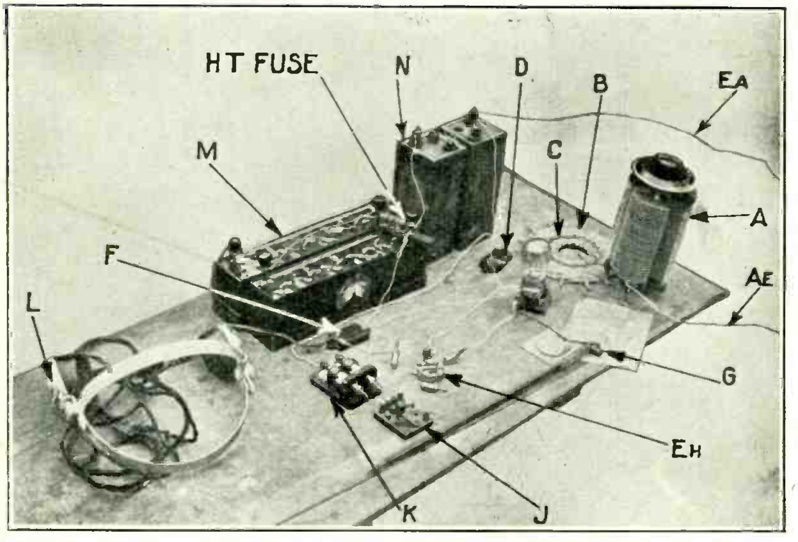


Fig. 1. The layout of the components of a dual amplification receiver with crystal detector. Wired up as shown, it is possible to demonstrate the action of the circuit, after which it is quite simple to design a boxed-up outfit if desired, to suit the requirements of the reader.

The components should be laid out on a board in exactly the positions shown in the circuit diagram.

A is the series tuning condenser having a capacity of 0·0003 μF or over. B C is the high frequency transformer which is preferably made interchangeable for different wavelengths. Particulars of a transformer suitable for 350 metres upwards are as follows. Primary basket coil wound with 50 turns of No. 22 S.W.G. D.C.C. wire on a former, inside diameter 4 cms. with 15 spokes, the outside diameter will be about 13½ cms. The secondary is another basket coil wound with 80 turns of fine wire such as 36 to 42 S.W.G. S.S.C. on the same basket winder, but with a cardboard ring, outside diameter 8 cms. between the spokes so that the inside diameter of the secondary is 8 cms.

The primary and secondary are stuck or tied together so that the windings run in opposite directions, that is, if you follow the wire from the outside to the inside, one winding should go round clockwise and the other counterclockwise. The secondary being tightly coupled requires no condenser.

D, the blocking condenser, may have almost any value from 0·0002 to 0·005 μF, and I generally use 0·002 μF.

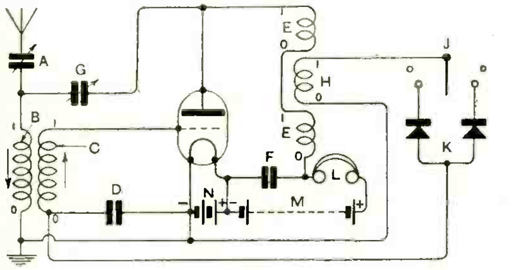


Fig. 2.

The variable condenser G controls the reaction. This condenser consists of two pieces of metal 2 ins. square, one of which is fixed to the board and the other is fixed to a long handle. A small lead weight is useful to keep the moving vane down. A layer of waxed paper or some other insulator separates them, and it should be possible to slide them at least an inch from one another. Reaction must be used with care as interference is caused as easily as usual.

E H is a valve to crystal coupling. The one shown in the diagram is a very convenient three-basket coil coupling. This is aperiodic over a wavelength scale from 200 to 500 metres, and can be used on longer wavelengths if shunted by a variable condenser.

The baskets each contain 150 turns of 42 S.S.C. wire wound on a 2 cms. former with seven spokes. The outside diameter will be between 3 and 3½ cms. They should be fixed together with the directions of winding the same. A piece of silk between the coils prevents contact. The middle one is connected to crystal and filament, while the outer ones are in the plate circuit. The connections are shown in the diagram.

This coupling can be replaced by many others such as, for example, another H.F. transformer exactly similar to the aerial circuit transformer. Its fine wire secondary being connected in the plate circuit while the thick wire primary is connected to the crystal, and is tuned by a variable condenser P.

This arrangement is shown in Fig. It is rather more selective than Fig. 1, b contains another variable condenser.

For wavelengths up to 3,000 metres, t following aperiodic coupling may be use Two basket coils of 600 turns of 42 S.S. wire are wound on a 4 cms. former with spokes. The outside diameter will be abo 9 cms. The inner ends which are connecte to the plate and crystal are also connecte to a small coupling condenser of 0·000 or 0·0001 μF.

F is another blocking condenser of an convenient value from 0·0003 to 0·003 μF 0·002 again is the value I generally use.

J is a switch. Only two contacts ar really necessary. The extra stud on th left remains open. Putting the switch o that stud converts the circuit to a valv detector arrangement. The extra stud on the right is connected to a terminal so that other crystals can be tested without disturbing the set.

K is a double detector of any type having light but rigid moving parts, and a "cat whisker." A crystal not requiring a potentiometer such as Hertzite, Rectarite, Permanite, etc., should be used.

L is the telephones, loud speaker, telephone transformer or intervalve transformer if a note magnifier is used.

M is the H.T. battery of the usual value of 20 to 100 volts depending upon the valve,

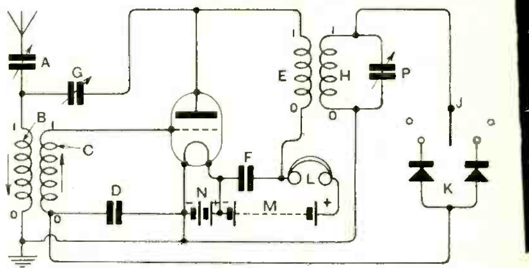


Fig. 3.

and N is a 4-volt accumulator which is connected direct to the filament, no resistance being required.

Marconi-Osram "R," Mullard "Ora," Ediswan "AR," French "R," especially those marked "Metal," and most other hard valves work well in this circuit.

The results obtained with this set should be slightly better than with standard two-valve sets, but not quite so good as with three valves. It should receive all the B.B.C. stations comfortably.

If the set is not working properly, the llowing tests should be made to locate he trouble.

1. Pull out and put back the H.T. plug while the valve is switched on. A healthy click indicates that the plate circuit is complete. Verify by tapping the valve, when a slight ringing noise should be heard.
2. A slight click should be heard when setting the crystal? If so it indicates that your grid circuit is probably in order.
3. Test the H.F. transformer by setting the series condenser at 0. Switch out the crystal. Gradually increase G. Beyond a certain point on G a slight hissing should be heard. C.W. may now be received, the hiss

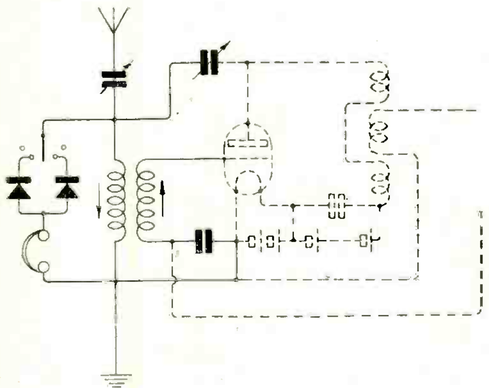


Fig. 4.

being an indication that the circuit is oscillating.

4. If this is in order, tune in the local B.B.C. station. If this station comes in best with the condenser A not too near its maximum or minimum, the transformer will do. But if the condenser has to be very near the minimum value, take a few turns off the transformer.
5. Should the transformer not be in order, set up the circuit shown in Fig. 4, the valve being switched out and G being at minimum. The part shown dotted need not be removed. This circuit is just a crystal set, and the transformer can then be adjusted till perfect. The best ratio of secondary to primary may be

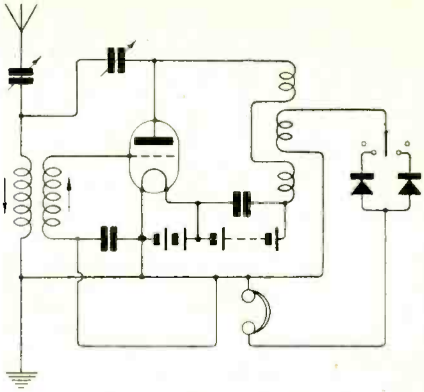


Fig. 5.

found by trial when the transformer is used in the dual circuit.

6. If the telephones are then put back in their correct place and the valve switched on, the valve detector circuit should work well.
7. Put the crystal back in its proper place, and if the H.F. is reaching it, there should be a big increase in strength with weak stations.
8. To test if the H.F. is reaching the crystal, connect up the circuit Fig. 5, which is a single valve H.F., and crystal circuit. This should be a little better than the valve detector circuit. It is now easy to make sure whether the valve to crystal coupling is efficient.
9. Changing back to the proper dual circuit, signals should be almost five times as good as with the one valve H.F. and crystal circuit on a weak signal.

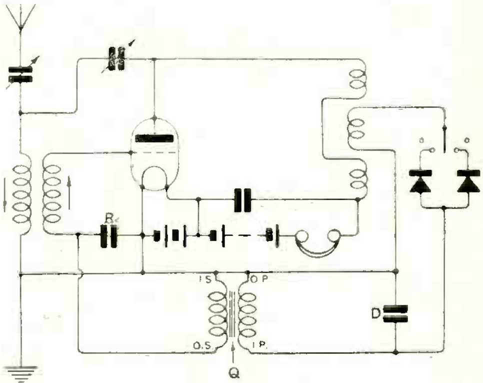


Fig. 6.

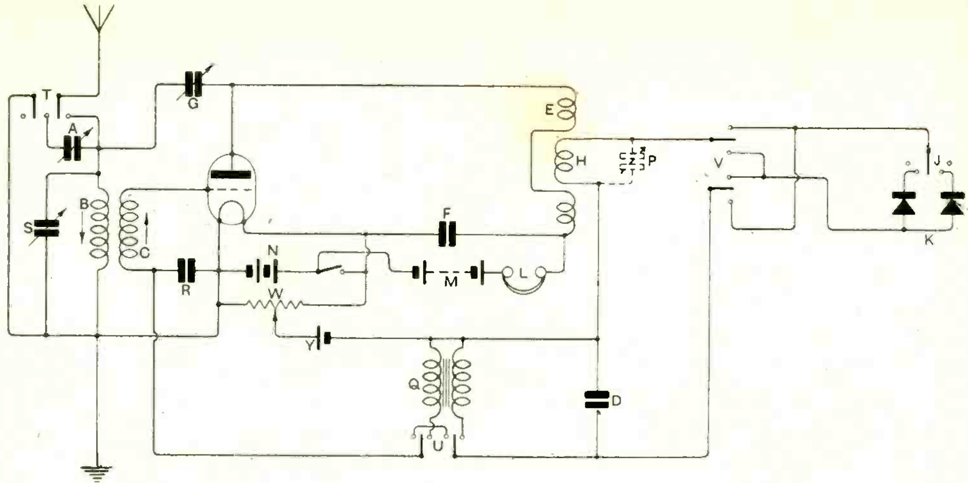


Fig. 7.

The crystal should be tried both ways round; one way generally gives smoother reaction, while the other is best on loud stations.

Grid control, so that the grid can be made slightly negative, generally improves results, while a L.F. transformer Q, as shown in Fig. 6, is the simplest way of cutting out the limiting action and making the set equally efficient on loud stations. (Note that position of D is changed, and condenser R is introduced. The capacity of R should be kept down, and 0·0001 μF is suitable.)

Reaction should not be used near oscillation point while this transformer is in circuit, or all kinds of growls, howls, squeals and other noises may be caused.

For tuning, I normally use also a condenser S in parallel with the A.T. transformer, while the condenser is fitted with a series parallel switch T for long waves. A second switch U cuts out the L.F. transformer when not required, while a third switch V reverses the detector. The potentiometer W and cell Y control the grid voltage.

The full circuit diagram is shown in Fig. 7, while Fig. 8 is a photo of my own one-valve dual and crystal set.

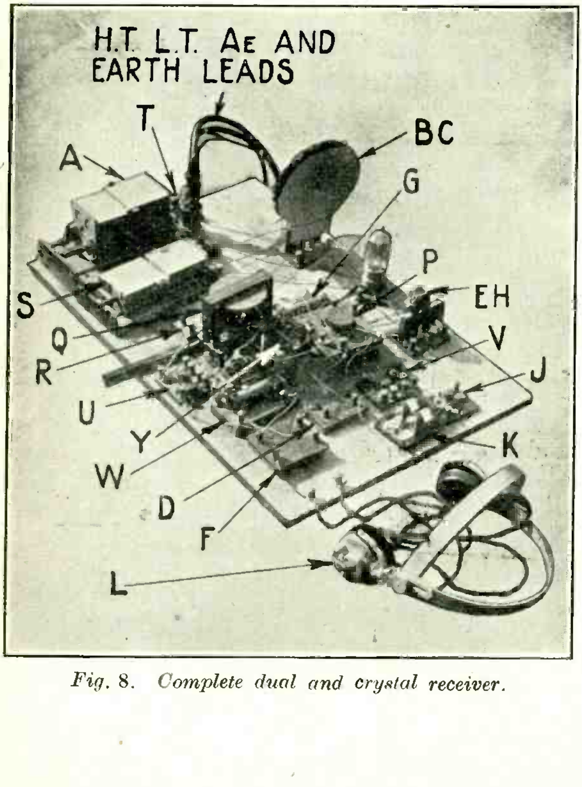


Fig. 8. Complete dual and crystal receiver.

On this set with the L.F. transformer in circuit to cut out the limiting action, I can run two big Brown's 120 ohms loud speakers in different rooms at comfortable strength on **2 LO** (6 miles away) on a 100-ft. single wire aerial. With the transformer cut out (*i.e.*, the Fig. 2 circuit plus grid control), Cardiff and Birmingham can be received.

After dark, all the B.B.C. stations can be ceived, providing that **2 LO** is not orking. In fact this circuit is so sensitive at if while receiving Glasgow (after **2 LO** and **5IT** have shut down) reaction is reduced slightly so that the circuit is not so selective, it is possible to hear **2 ZY** and **5 NO** breaking through.

NOVEL IDEAS AND INVENTIONS

Abstracted by

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

A Simple Form of Loud-Speaking Telephone.

MANY simple devices have been devised from time to time to enable the ordinary forms of head-telephone receivers to be adapted for loud-speaking uses. Of these a simple form consists of an attachment to which both earpieces may be fastened so that they both discharge their sound into a common outlet pipe which may be provided with a horn to magnify the sound.* The outline of such an attachment is sketched in Fig. 1, and consists of a double tube into

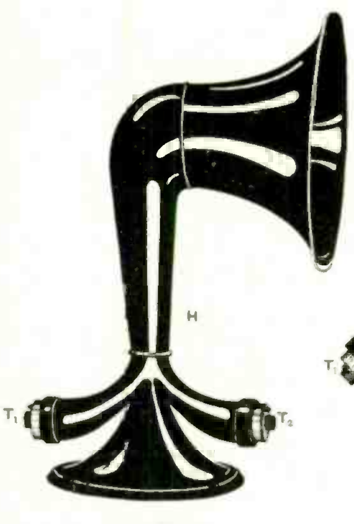


Fig. 1.

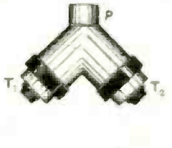


Fig. 2.

which telephone receivers T_1T_2 are fitted. The junction of the double tube is fitted with a horn H. A somewhat simpler arrangement is sketched in Fig. 2. In this case the outlet P from the junction of the two side tubes to which the telephones T_1T_2 are attached, can be adapted for fitting on to the tone arm of a gramophone, so that the horn of that instrument can be used for loud-speaking purposes.

* British Patent No. 197435, by G. R. Judge.

Condensers for Radio Receivers.

Condensers may be constructed in many ways, but there are certain advantages to be gained by adopting certain constructions. For instance, when the condenser unit is mounted in a hard moulded case* it may be handled with ease and readily mounted in a receiving set or other apparatus. If the terminals of the condenser are provided with spring clips, such as CC as sketched in Fig. 3, it is easy to connect a grid leak resistance across the condenser, as it is often desired to do in many receiving circuits. By holding the condenser unit

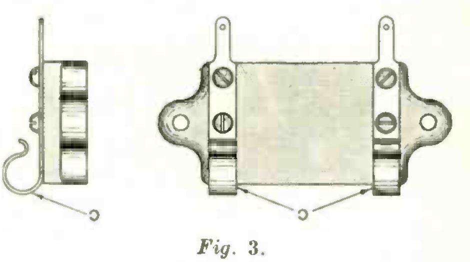


Fig. 3.

inside the moulded case under appropriate compression by means of a metal clamp, it is possible to ensure a greater constancy of capacity value than is otherwise possible.

*British Patent No. 197536, by W. H. Goodman and Dubilier Condenser Co., Ltd.

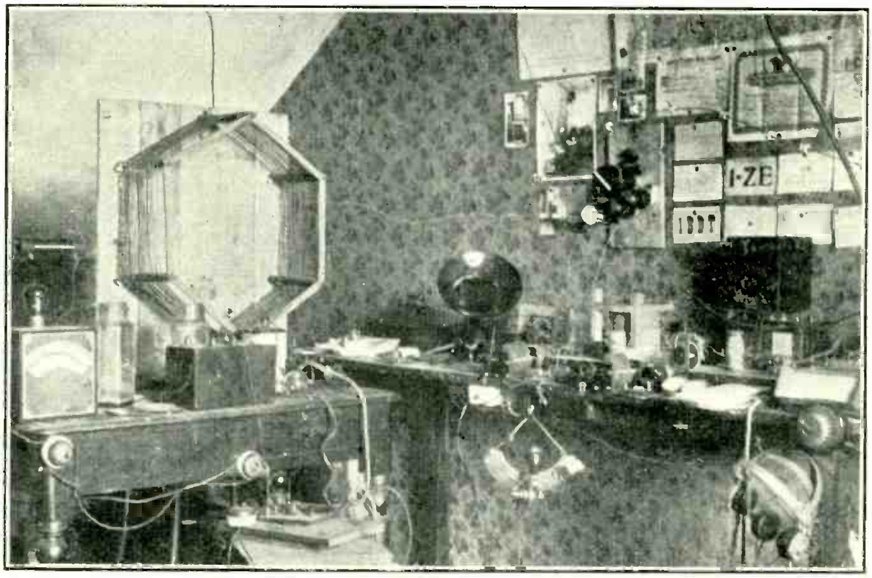
EXPERIMENTAL TRANSMITTER 2SH

The activities of this station are well known, and the results of range tests and other specific experiments have been observed by all those who take interest in short-wave amateur transmissions.

By Frederic L. Hogg.

THE transmitting station **2 SH** is situated in Highgate, North London. It is in a high part of the district—about the same height as the top of St. Paul's, on the side of a hill.

The aerial system consists of a four-wire aerial, counterpoise, and earth. The aerial is 15 ft. above the house at the lead in end, making 45 ft. in all, and is about 3 ft. above a 30 ft. tree at the other end. It is 70 ft. long and the four wires are each spaced 3 ft. apart. Its capacity (low frequency) is 0.00034 mfds. and resistance at 200 metres, approx. 5 ohms. The counterpoise is more or less directly underneath the aerial, and is 50 ft. long. It has six wires spaced 1 ft., these wires being bunched for lead in purposes at one end, and carried up the side of the house to the operating room—a distance of about 60 ft. There are three earth leads, each over 70 ft. long, to water pipes, etc. The aerial resistance when no[t] using the counterpoise is 38 ohms at 20[0] metres. The counterpoise also lowers the high frequency capacity from 0.0007 mfds. to a value only slightly greater than the low frequency capacity, at 200 metres. It will be seen that the aerial system is by no means as good as it might be, as it is screened on all sides by houses, etc., being such a small height above them.

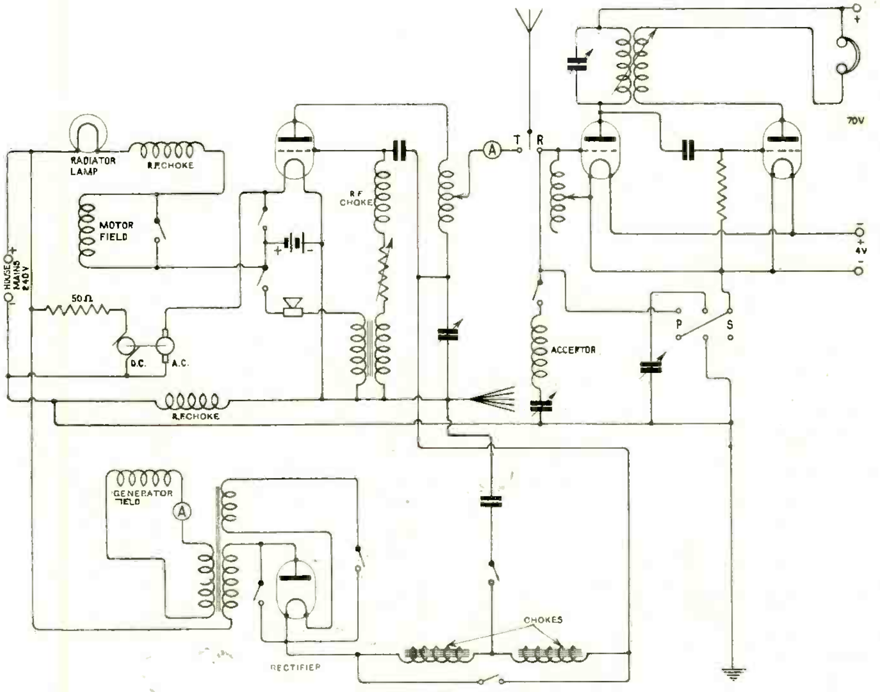


Experimental apparatus at **2 SH.** *The manner of assembling the instruments does not suggest a beautifully finished commercial station, but rather that the owner is a careful experimenter not content with a standard arrangement.*

The transmitter itself uses the " Colpitt " capacity coupled oscillating system. This circuit is not much used in England, but those who do use it have far greater radiation on a given power than those that do not. The aerial coil, as can be seen in the photograph, is of very large diameter (20 inches), and is wound with No. 7/22 aerial wire, 3 turns per inch, on ebonite rods. The reason for this ge erection is shown by the fact that on given input, etc., the radiation was 0.3 nperes with this coil, but with a coil wound th No. 18 D.S.C. on a 5-in. tube, turns uching, and of exactly the same inductance, c., the radiation was 0·2 amperes. The rial condenser consists of a five-and-six-nny set of parts for a 0·0005 mfds. air ndenser carefully built up, and immersed paraffin in a jam-jar. It is seen directly front of the aerial coil. The only other oint to notice is the grid leak. The two ottles standing on the table contain water

when the efficiency is higher, the wave is not of true sine form, or near enough to pass as such in practice, and bad harmonics arise.

The high tension supply is taken from an aircraft 11 volt 500 cycle alternator. The field exciter of this machine is run as a motor at 6,000 r.p.m. off 240 volts D.C. through a resistance (seen over the receiver bench), giving about 40 volts across the armature. The field of the exciter is in series with two large radiator lamps and the transmitter accumulator, across 240 volts, so that the



An experimental circuit employed at **2 SH.**

and a glass tube with two copper wires, one dipping into the water through the bore of the tube, and the other outside. By altering the length of wire in the water, the grid leak value is altered. This value of leak is very critical for best results. Tap water is used, but it has to be changed about once a week. The wavelength usually used is 195 metres, and the aerial current is 1.2 amperes on 10 watts and 2·2 amps on 30 watts, I.C.W. or pure C.W. It is found, however, to be of advantage in practice to keep the efficiency down to 75 per cent., as

accumulators are charging all the time. A switch is fitted to short circuit the field when only charging. The field of the A.C. side is excited by a 6-volt accumulator. The voltage is actually about 18 A.C., and this is passed to a step-up transformer which transforms up to 1,000 or more volts according to load. There is a U.30 rectifier valve, and smoothing condensers for use when required for telephony. The generator is suspended from the ceiling just to the left of the transmitter, with the rectifier underneath it on a small table. Modulation is either by means of a transformer in the grid circuit or by choke control, but no trouble has been expended on getting speech as this is only used for local conversations, etc. Various types of 30 and 40 watt valves are used, with the same results.

The transmitter has been heard all over England, in France, Spain, Holland and Belgium, and I am always pleased to receive reports from anyone hearing my transmissions.

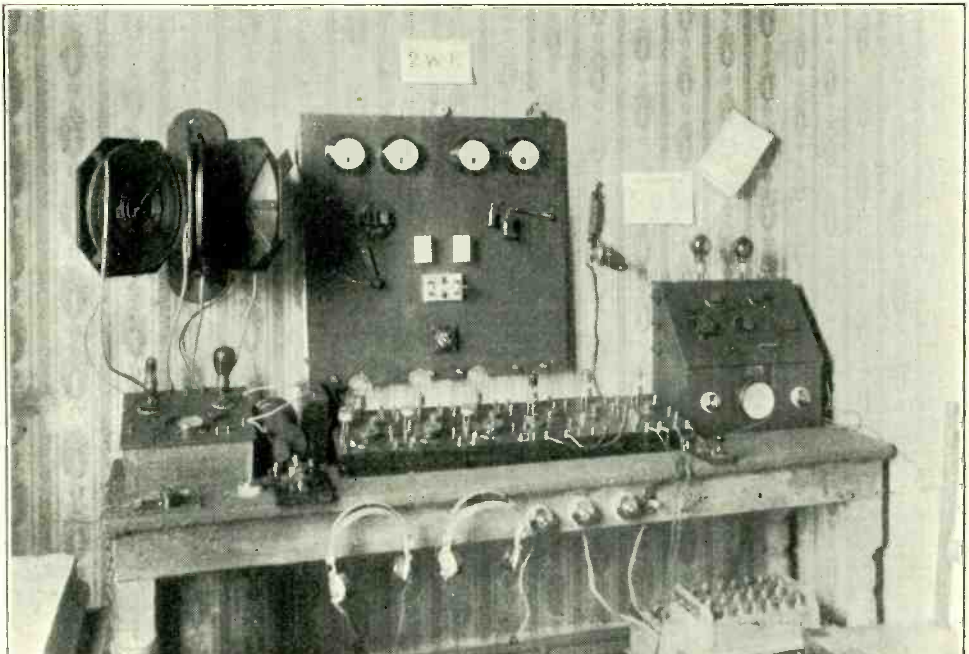
The circuit of the transmitter is shown below. It will be noticed that no direct earth is used except through chokes.

The receiver uses two valves, one high frequency and one detector, using the tuned anode circuit. With it eight American broadcasting stations have been definitely logged, including **WDAF** of Kansas City (5,000 miles). **WJZ** and **WGY** have been heard more than fifty times. American broadcasting was first received in Octobe[r] 1922. During the Transatlantic Tests, wat[ch] was kept only till 0230 each mornin[g] except one day, during which time Northol[t] 8 miles away, is working, and so only abou[t] sixty U.S. amateurs have been heard. The[se] include **5 ZA** in New Mexico, 500 miles fro[m] the Pacific Coast and **2 CXL** New Jerse[y] heard on spark.

Any of the British broadcasting station[s] can be selected under good condition[s] through **2 LO**, four miles away, but to mak[e] certain, an acceptor circuit is kept hand[y] which cuts him out entirely. The card[s] seen adorning the wall are from variou[s] Americans whose signals have bee[n] heard.

I hope these particulars will be of interes[t] to other experimenters, and I am alway[s] pleased to fix up long distance tests with anyone.

TRANSMITTING STATION AT MANCHESTER.



The experimental transmitting and receiving equipment at **2 WK**, *the station of Mr. G. R. Lewis.*

ELIMINATION OF INTERFERENCE.

THE following idea for the elimination of jamming will probably be of interest to experimenters. It is extremely simple, but the iter and several friends have found it ry effective.

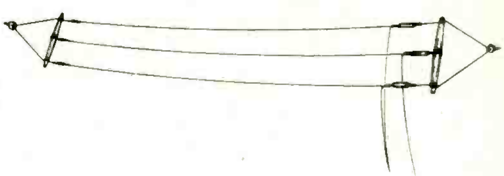
In the centre of the ordinary twin wire rial (whose spreaders should be at least t.) run another wire parallel to the main res. Bring this down and pass it through separate tuned circuit direct to earth. should be kept well away from the main lead in," and suitably fixed so that it nnot sway towards and away from the ain aerial.

The method of operation is to tune this rcuit to the wavelength of the undesired gnal. If now this signal is tuned in the main set, the condenser (or inictance) value for this particular wavength will be found to have altered onsiderably from the normal. Hence if "A" the undesired signal, and "B" the desired gnal, 5 metres higher in wavelength, rdinarily the condenser value to tune in A" would be, say, 35 degrees, and to tune n "B" would be, say, 38 degrees. With he "third wire aerial" circuit tuned to A," the condenser value for "A" on he main set will now be found to be, say, 5 degrees, and for "B," to be still 38 degrees, r somewhere very near it. In effect the two signals ordinarily very close together, are, with the "third wire aerial" in operation, very much further apart.

Given a reasonably selective set to start with, serious jamming may be entirely eliminated, or at least reduced. In the writer's case, using one tuned anode H.F. valve, rectifier and one L.F. valve at a distance of 10 miles from **2 LO**, all the other broadcasting stations can be received without the faintest trace of **2 LO**, whereas without the "third wire aerial" it is difficult to separate **2 LO** from Manchester.

The tuning is very critical both on the tuned anode and aerial circuits of the main set, and reaction (to the tuned anode) plays an important part in the elimination of the jamming signal. The "third wire aerial" is apt to make the set rather unstable, but a correct adjustment of the filaments and of the grid potential of the first valve overcomes this with a little care.

The coil used in the "third wire" circuit should be of the plug-in type or some form of untapped coil free from dead end effect, and preferably may be a plain solenoid. The condenser value of the circuit should be kept as low as possible by the choice of a suitable coil.



Arrangement of the third wire.

Although the difficulty of tuning is considerably increased by the use of this "third wire aerial" it is well worth the trouble and there appears to be no loss of efficiency.

The idea was the outcome of a series of experiments carried out by the writer and his next door neighbour, the purpose of which was to discover the effects on the two aerials situated only 20 ft. apart and running exactly parallel.

Briefly these may be summarised as follows :—

For the sake of illustration, suppose "Set A" to be tuned to **2 LO**, 10 miles away.

"Set A."	"Set B."
1. No H.F. or set switched off but left tuned.	Considerable reduction in signal strength on **2 LO**, but **2 LO** much easier to tune out.
2. One H.F. valve with set switched on.	Increase above normal of signal strength on **2 LO**, but **2 LO** almost impossible to tune out.

The explanation of No. 2 result is obviously slight re-radiation. No. 1 result leads to the "third wire aerial."

The circuit is effective on any interfering signal which is not a highly damped spark signal, the broadcasting stations being taken merely as an example. M. J. G.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XXI.

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.

Recent sections deal with series and parallel circuits, damping, choke coils, and transformers.

By W. James.

42.—Mutual Inductance.

If two coils, A and B, Fig. 105, are placed together and an alternating current flows through coil A, the magnetic field generated will link with coil B, producing an E.M.F. in that coil. The E.M.F. induced in coil B may be varied by changing the position of the coil relative to coil A, or altering the number of turns so that the number of lines of force which link with coil B is varied.

If the current in circuit A is changing at the rate of one ampere per second, and the pressure induced in coil B is one volt, the circuits are said to possess a mutual inductance of one henry.

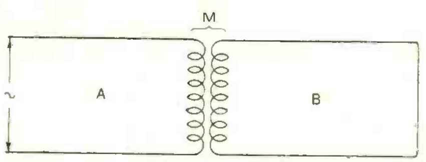


Fig. 105. Two circuits magnetically coupled.

The coils of an iron-cored transformer are very tightly coupled, and their mutual inductance is therefore high. In the case of wireless circuits, the mutual inductance between coils is generally made variable by the use of coils, the position of one of them being variable with respect to the other.

In the case of low frequency transformers the inductance of either coil by itself is very high, but when the transformer is on load, the apparent inductance of either winding is much less. If the inductance of coils A and B measured separately is L_A and L_B henries, and they are then placed as in Fig. 105, so that their mutual inductance is M henries, the effective inductance of coils A and B will be changed. If the magnetic field set up b coil B through the induced current is su that it directly opposes the flux generated b A, the effective inductance of each coil reduced by the amount M, *i.e.*, the effectiv inductance of coil A is now $L_A - M$, an that of coil B, $L_B - M$ henries. If the magneti field set up by both the coils A and B a in phase and assist each other, the effectiv inductances are $L_A + M$ and $L_B + M$. Th relationship between the fluxes is determine by the nature of the circuits, of which th coils A and B form parts.

43.—Coupling.

When two or more circuits are relate so that one is able to affect the other they are said to be coupled. There are three general methods of coupling—direct

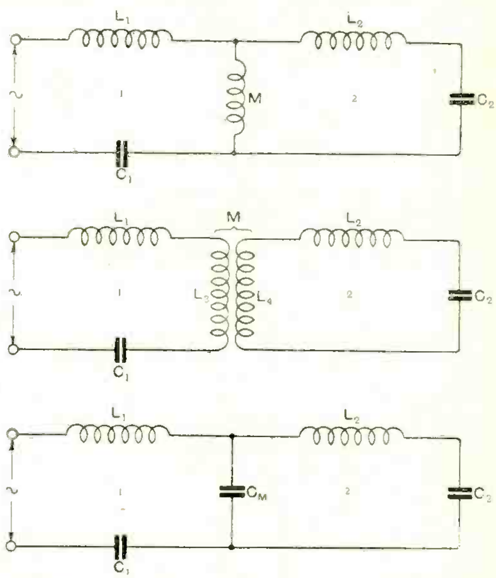


Fig. 106. The upper diagram (**A**) *shows direct coupling ; the centre diagram* (**B**) *shows magnetic coupling ; and the lower diagram* (C) *capacitive coupling.*

gnetic and electrostatic, shown respec-ely at A, B and C, Fig. 106. In place of l M, Fig. 106 A, a resistance could, of ırse, be used, but is not greatly used practice.

-efficient of Coupling.

The extent to which circuits are coupled denoted quantitatively by the co-efficient coupling (k). If X_1 is the total inductance one circuit, and X_2 that of the other, ıd X_M the mutual reactance or reactance mmon to both circuits

$$k = \frac{X_M}{\sqrt{X_1 X_2}}$$

It should be noticed that the reactances ıay be inductive or capacitive, and that $_1$ and X_2 are the *total* reactances of the ircuits.

In Fig. 106 A, the total inductance of circuit is $\omega(L_1+M)$, and that of circuit 2 is (L_2+M). X_M, the mutual reactance is M. Therefore for the case of direct coupling ig. 106 A,

$$k = \frac{\omega M}{\sqrt{\omega(L_1 + M)\omega(L_2 + M)}}$$

$$\text{or } k = \frac{M}{\sqrt{(L_1 + M)(L_2 + M)}}$$

In the case of Fig. 106 B, in which the circuits are magnetically coupled,

$$k = \frac{M}{\sqrt{(L_1 + L_3)(L_2 + L_4)}}$$

If we let $(L_1+L_3) = L_A$ and $(L_2+L_4) = L_B$

$$k = \frac{M}{\sqrt{L_A \times L_B}}$$

This relationship is the same as in the direct coupled case, and inductively coupled circuits may be considered as equivalent to direct-coupled circuits, having the same values of capacity and mutual inductance if we make L_1 Fig. 106 A equal to (L_A-M) and L_2 Fig. 106 A equal to (L_B-M).

For the case of capacitive coupling

$$k = \frac{\frac{1}{\omega C_M}}{\sqrt{\left(\frac{1}{\omega C_1} + \frac{1}{\omega C_M}\right)\left(\frac{1}{\omega C_2} + \frac{1}{\omega C_M}\right)}}$$

where $\frac{1}{\omega C_M}$ = mutual capacity reactance.

$\left(\frac{1}{\omega C_1} + \frac{1}{\omega C_M}\right)$ = capacity reactance of circuit 1,

and $\left(\frac{1}{\omega C_2} + \frac{1}{\omega C_M}\right)$ = capacity reactance of circuit 2.

If C_a = total capacity of circuit 1 $(=C_1+C_M)$
C_b = total capacity of circuit 2 $(=C_2+C_M)$

$$k = \frac{\sqrt{C_a C_b}}{C_M}$$

The coupling of circuits similar to Fig. 106 A is varied by changing the inductance of coil M. If the inductance of M is increased, and the total inductance of the circuits 1 and 2 held constant, the coupling is increased or tightened. In the case of capacitive coupling Fig. 106 C, to increase the coupling the value of C_M should be reduced.

When the coupling is very close, k is almost unity. If the coupling is negligible k is, of course, zero.

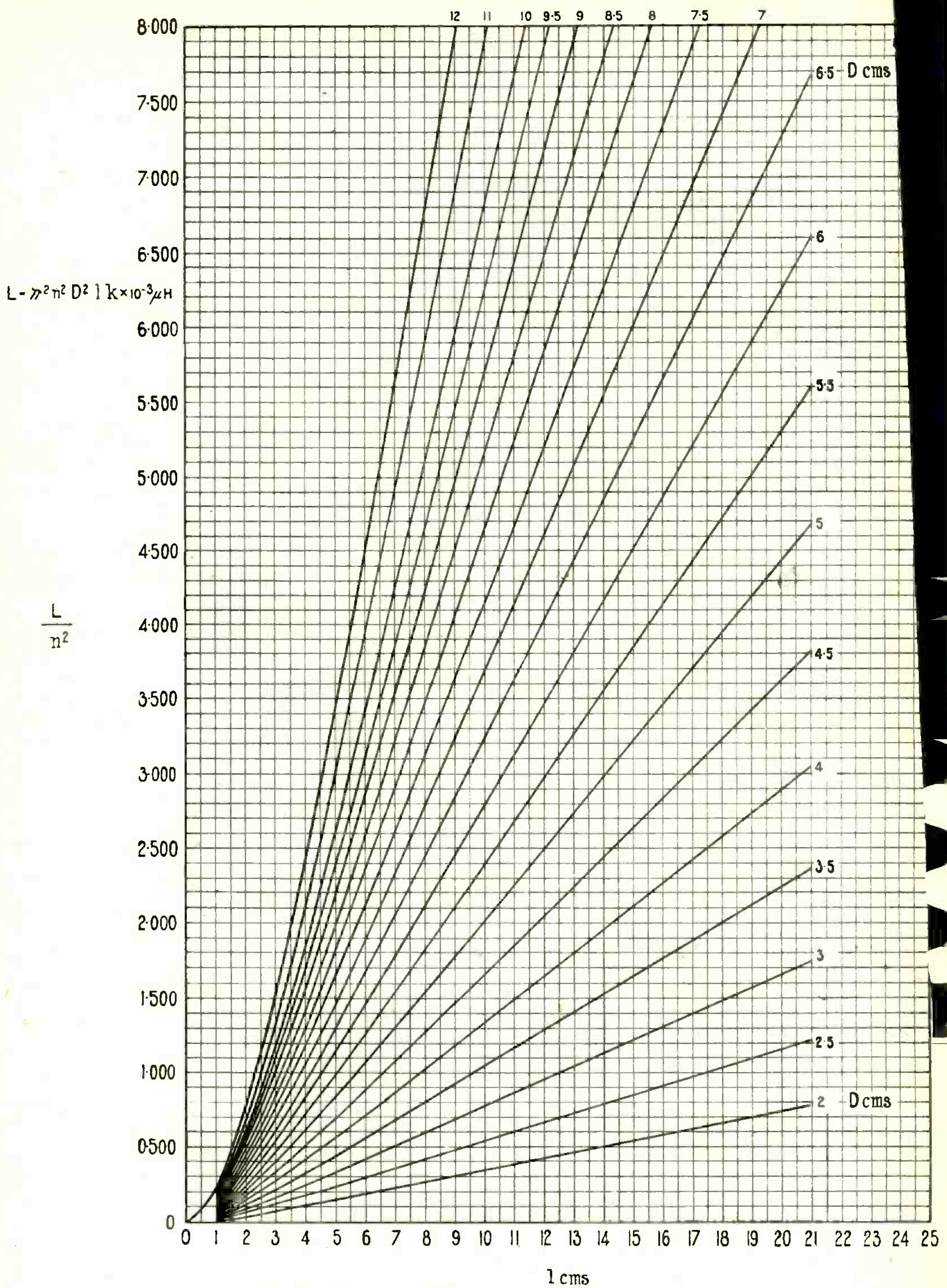
INDUCTANCE OF SINGLE LAYER COILS.

THE inductance of a single layer coil may be calculated with the following formula.

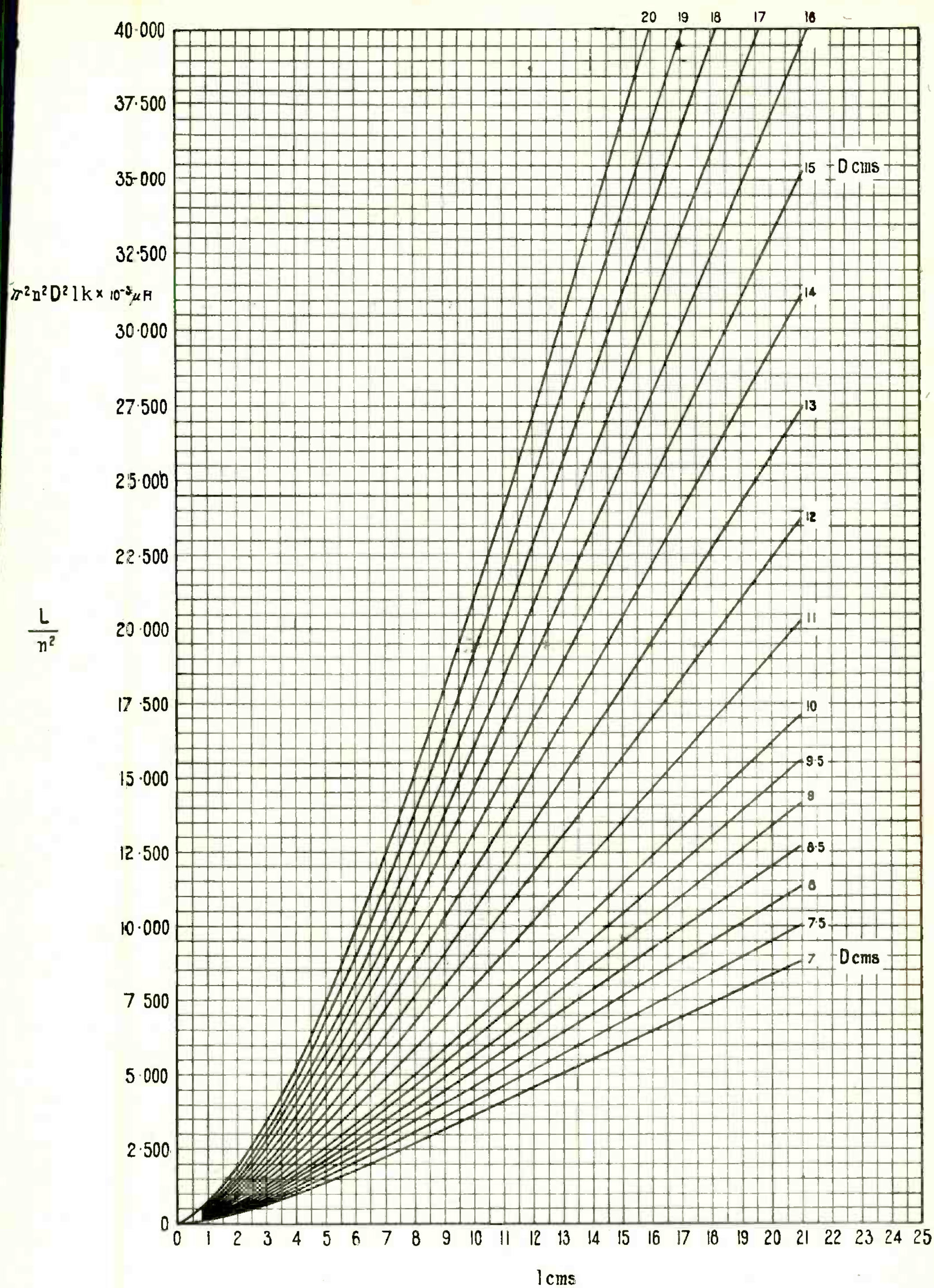
$L\text{cms} = \pi^2 n^2 D^2 l k$ where

- π = 3·1416
- n = the number of turns of wire wound per cm. length of coil.
- D = the mean diameter of the coil in cms.
- l = the total length of the winding in cms.
- k = a factor which depends upon the ratio of the diameter to the length of the coil.

If the ratio $\frac{D}{l}$ is zero, the value of k is unity; if $\frac{D}{l}$ is unity, the value of k is 0·6884. Other



INDUCTANCE CURVE, SHEET 1.



INDUCTANCE CURVE, SHEET 2.

values are obtainable from specially prepared tables. To bring the inductance (which in the above formula is given in cms.) to microhenries, μH, it is necessary to divide by 1,000.

To design an inductance coil with the aid of the above formula is a bit of a problem, on account of the number of variables, and it is the object of the two sets of curves to enable anyone to design a coil, or to find the inductance of a given coil with ease.

Upon referring to the curves it will be seen the horizontal line is divided to represent the length of the coil in cms. (l cms.). Each curve has marked against it the diameter (D cms.) of the coil to which it refers. The vertical line is marked $\frac{L}{n^2}$. The quantity L represents the inductance of the coil in microhenries; the quantity n^2 represents the number of turns of wire per cm., squared.

Curve sheet 1 should be used for coils of small diameter, and curve sheet 2 for coils of larger diameter. The longest coil which may be dealt with is 21 cms., and the largest diameter 20 cms.

Examples will show the use of the curves quite clearly.

(1) Suppose we have a coil 5 cms. in diameter and 7 cms. long, and it is wound with wire 10 turns per cm.

$l = 7,\ D = 5,\ n = 10,\ n^2 = 100.$

Refer to the curve marked 5 (D cms.) and notice the point where the vertical line marked 7 (l cms.) cuts it. Look along this point and read off the value of $\frac{L}{n^2}$ in this case 1·31. Then the inductance is given by this quantity times n^2 or $1{\cdot}31 \times 100 = 131\,\mu H$.

(2) Suppose the coil has the following dimensions $l = 16$ cms., $D = 12$ cms., $n = 10$ per cm. Referring to curve sheet 2, we find the value of $\frac{L}{n^2} = 1{\cdot}70$, then $L = 1{\cdot}70 \times 100 = 1700\ \mu H$.

(3) We require a coil with an inductance of 1,000 μH, and it is decided to use wire which will wind 10 turns per cm. What would be suitable sizes for the coil?

$$L = 1{,}000 \text{ and } n^2 = 100.$$

$$\therefore\ \frac{L}{n^2} = \frac{1{,}000}{100} = 10.$$

Referring to curve sheet 2, the horizon[tal] line joining the value of $\frac{L}{n^2} = 10$ cuts throu[gh] the diameters 20, 19, 18, 17, etc., down [to] 7·5 cms., and we may therefore choose a[ny] of these diameters. Suppose we decide [a] diameter of 12 cms. is suitable, then t[he] point where $\frac{L}{n^2}$ cuts the 12 cms. line, co[r]responds with a length (l cms.) of 10·6 cm[s.] If we prefer a diameter of 8 cms., the lengt[h] required is 18·8 cms.

We now know that a coil with a mea[n] diameter of 8 cms. and a winding length o[f] 18·8 cms., wound with wire 10 turns per cm[.] will have an inductance of 1,000 μH, or o[f] course the coil may have any other diamete[r] and length taken from the curves. W. J.

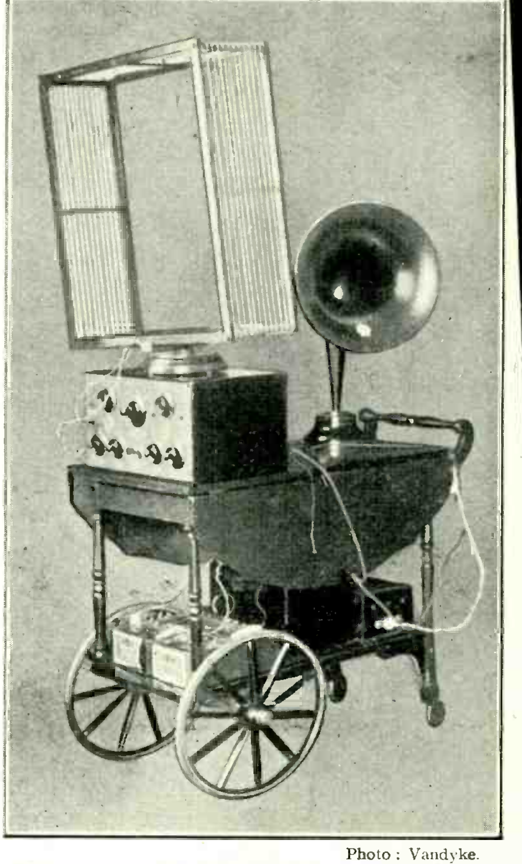


Photo: Vandyke.

The compact wireless receiving set owned by H.R.H. The Duke of York. It is installed at White Lodge, Richmond Park.

BIRMINGHAM'S NEW BROADCASTING STATION.

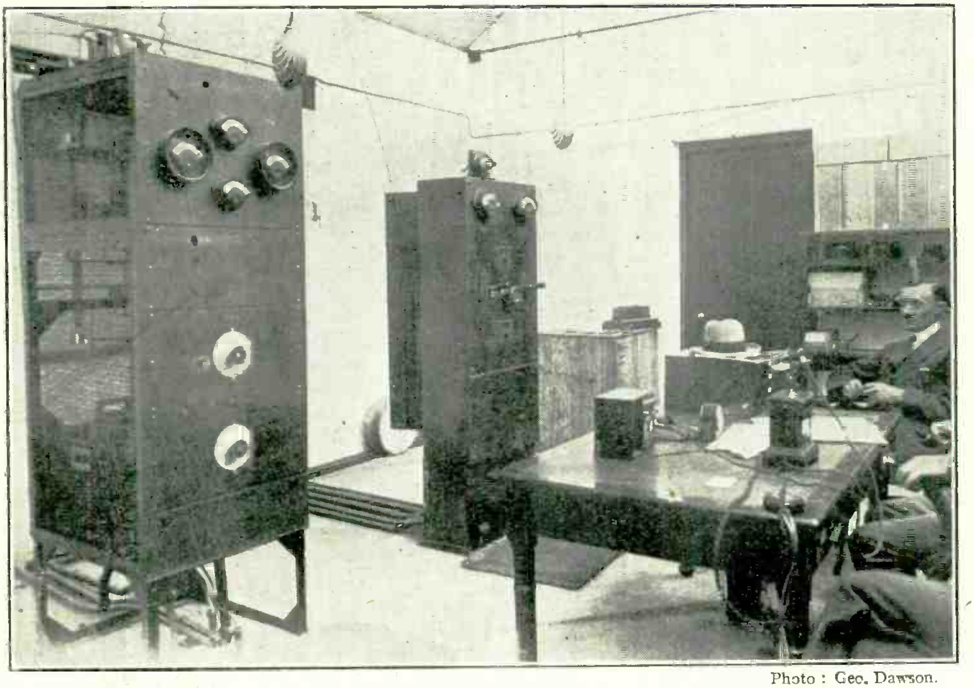


Photo : Geo. Dawson.

The new studio and transmitting station of **5 IT** *were formally opened on Saturday, August 11th, by Sir Herbert Austin, M.P. Our illustration depicts the control panels at Summer Lane Power Station, where the transmitter is installed. Other photographs, showing the interior of the studio and the aerial, appear on pages 709 and 710.*

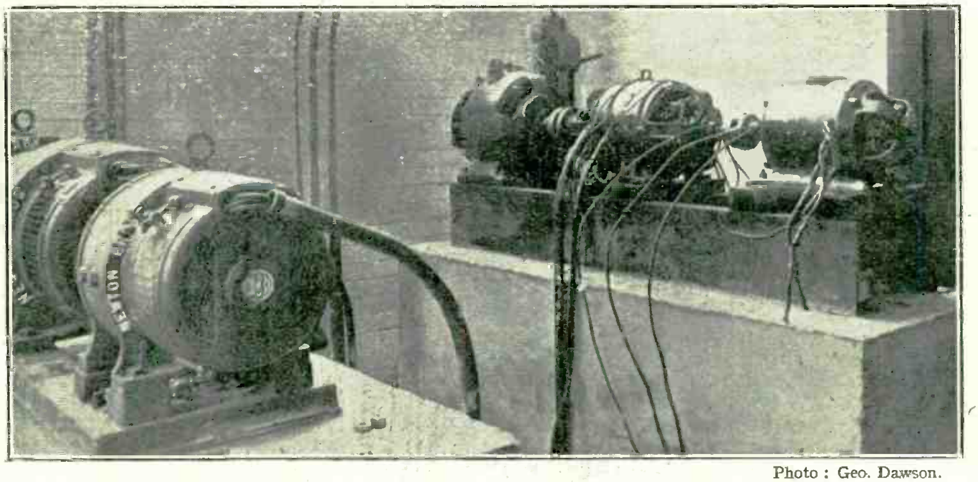


Photo : Geo. Dawson.

The duplicate generator set at the new **5 IT**. *The transmitter is situated a mile away from the studio.*

C

Some Experiments Illustrating the Electrical Properties of Neon Lamps.*

By PHILIP R. COURSEY.

NEON lamps are, of course, well known for many commercial purposes, such as lighting and for advertising purposes, both in small sizes — as in the case of the well-known Osram "Osglim" lamps — and in larger sizes, which are now coming in for big street display advertisements (Fig. 1). Probably many present are aware of some of the properties of these neon lamps, but, as far as I am aware, nothing about them has been brought to the notice of the members of this Society at one of our meetings. Therefore, it may be of interest to try to demonstrate some of their properties, and to point out what an interesting field one has in connection with them for experimental work. I am afraid it will not be possible this evening to show many of their properties, as such an attempt would take far too long, and would involve the use of rather more apparatus than is easy to fit up for a short lecture.

The use of neon lamps as indicators of fairly small voltages, of high or low frequency, is, of course, not new. Professor J. A. Fleming long ago—*i.e.*, long ago as we count time in radio matters—used long tubes containing

Fig. 1.

neon gas as detectors for his cymometer, or early pattern of wavemeter. The ordinary forms of "Osglim" lamps—the neon gas-filled lamps, such as are used for advertising purposes, and for some illuminating purposes, and can be obtained with various designs inside them—can also be used as simple indicators of high frequency voltages. The neon-filled lamps have the advantage over some simple indicators that they do not require very much voltage to make them function. About 140 volts across their terminals is sufficient to start a glow in the gas, and they can be used as resonance indicators for simple forms of wavemeters.

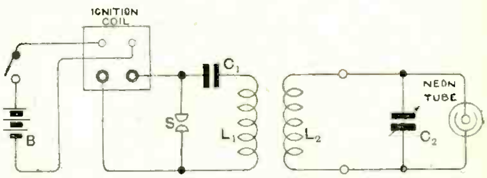


Fig. 2.

I have fitted up here a simple spark transmitter, with which I will try to show that effect. It consists simply of an ignition coil, a spark gap, a condenser and an inductance as in Fig. 2. The wavemeter circuit consists simply of a coil of a standard plug-in type, connected in parallel with a variable air condenser, across the terminals of which the neon lamp is connected. In Fig. 2, L_2 is the plug-in coil, and C_2 the variable condenser. For wavemeter purposes the condenser C_2 should of course be calibrated, so that when used in conjunction with the calibration of the inductance, the wavelength can be found. By changing the plug-in coil, the wavelength tuning range can be altered at will.

For the purposes of the demonstration damped waves from the spark gap S, and the oscillation circuit LC were used, but the method is even more readily applicable to C.W. transmissions, as in such cases the tuning becomes so much sharper.

The neon lamp is connected across the terminals of the tuning condenser, so that it indicates resonance by glowing with the voltage induced in the wavemeter circuit, which voltage is of course greatest when the wavemeter circuit is in tune with the transmitter.

In this way a very simple form of wavemeter or wave tester for transmitters can be made, and this is possibly the simplest way of using these lamps.

In order to show, if possible, some of their physical properties, or rather their electrical properties, I will connect a lamp up with a milliammeter to show the current which passes through it under different conditions.

A 220-volt D.C. supply circuit was used for this purpose, and was connected up with a lampholder,

* The account of an experimental demonstration before the Radio Society of Great Britain on Wednesday, July 25th, 1923.

o which the neon lamp could be inserted, and moving-coil indicating instrument which was unted so as to indicate on an appropriate scale e milliamperes flowing in the circuit, as sketched Fig. 3.

The neon lamp was inserted into the lampholder st in one direction and then reversed, and it as shown that in one case the current was much rger than the other. The ratio of the two currents r the particular lamp that was used was pracically 1 to 4.

Fig. 3.

The difference is due to the difference in the areas of the two electrodes, since in one case the glow is spread over a much larger electrode area than it is in the other. From that one would expect that if the lamp is put on to an A.C. circuit, t would act as a rectifier. It will, in fact, do so.

This was shown by connecting the previously used circuit arrangement on to a 220 volt, 50 cycle A.C.circuit instead of on to D.C., with the result that the milliammeter indicated a direct current of about 6 milliamperes. This direct current is really of course a pulsating one—or rather an alternating one having a larger wave in one direction than in the other.

Hence the lamp can be used as a rectifier.

It would be possible to charge small accumulator batteries through these lamps off A.C. mains. The method might be useful for experimental purposes, or for charging small cells for a high tension battery, for instance. That is simply a possible use rather than a necessarily very practical use for the lamps, but it serves to show their property of passing more current in one direction than in the other.

The lamps also have another interesting property, which is that the voltage at which the glow commences in the gas is different from that at which it goes out. In other words, once you have started the glow, you can reduce the voltage on the lamp, and it will continue to glow. The luminosity in the lamp is due to the ionisation of the gas by the discharge passing through it, and it is a simple glow discharge.

This effect was shown by arranging a circuit in the manner sketched in Fig. 4. A resistance R and a potentiometer P were joined in series across a 220-volt D.C. circuit, the resistance R being adjusted so that about one half of the supply voltage was dropped across R and about half across P. Hence by moving the slider of P along, the voltage in the lamp circuit, as read by the voltmeter V, can be varied between about 110 and 220 volts. With the slider over to the left and only 110 volts on the lamp no glow was visible in the lamp. On moving the slider to the right the glow suddenly commenced when a voltage of about 140 was reached.

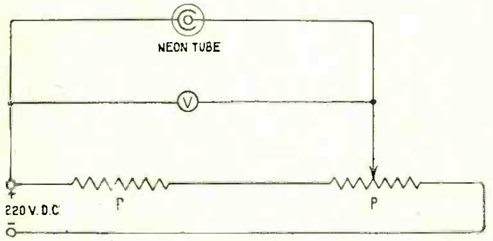


Fig. 4.

On reducing the voltage again by moving the slider of P back towards the left, the glow in the lamp persisted until the voltage had been reduced to about 120 volts, when it went out.

The exact values of the striking and extinguishing voltages differ slightly in different lamps—depending probably upon the gas pressure in the bulb—but they are usually of about the values given above.

There is therefore a pronounced difference between the voltage at which the lamp commences to glow, and that at which it goes out. That difference can be turned to some useful account, and one way in which it can be used is to make these lamps produce interrupted currents. If we make up a circuit consisting of one of these lamps connected through a resistance on to D.C. supply mains, and connect a condenser across the lamp, we can see in the lamp the phenomena of the condenser actually taking an appreciable time to charge up and an appreciable time to discharge.

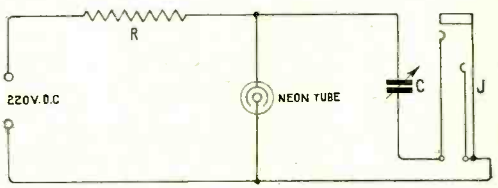


Fig. 5.

If we make the resistance and condenser values suitable, that effect can easily be seen. In the instrument shown, I have in the box an ordinary variable condenser, having a maximum value of about $0{\cdot}001\mu F$, and a resistance in the supply circuit of about half a megohm. It is connected to a 220-volt D.C. circuit. The arrangement is sketched diagrammatically in Fig. 5, in which R is the large series resistance in the supply circuit, and C is the variable condenser connected in series with R. The fundamental circuit is obviously R and C in series across the supply voltage, the effect of R being to cause the condenser C to charge up much more slowly than it otherwise would. The time taken for the condenser to charge up is determined by the product of C and R, this product determining the "time-constant" of the circuit.

In series with the condenser C, was connected a telephone jack J, into which telephones could be plugged, or alternatively if desired, a coil or other apparatus could be similarly connected into circuit by the same means.

When the circuit was switched on, a steady note was heard from the loud speaking telephone which was plugged into J, the pitch of the note varying with the position of the condenser adjustment C.

These changes of pitch are not a tuning phenomenon of the ordinary kind, in which one is altering the capacity in an oscillation circuit, as the alteration in this case is an alteration of the time-constant of the circuit. With the arrangement shown, a 120-ohm loud speaker was used without telephone transformer.

The production of an interrupted current by the neon lamp is due to the fact that, when the supply voltage is first switched on, the condenser, although only a small one, takes an appreciable time to charge up through the large resistance R, and nothing happens in the lamp until the condenser is charged up to a voltage across its terminals of about 140. At that stage the glow starts in the lamp. The lamp then glows, and the discharge through the gas draws the charge out of the condenser, and discharges it until the voltage drops to about 120, when the glow stops. The condenser is now free to charge up again until its voltage rises to about 140, and then the discharge starts again. This process goes on a number of times per second, which number is determined by the product of the capacity C and the resistance R.

Actually, you see in the lamp what is apparently a steady glow, but the glow is really an intermittent one as may be seen by increasing the value of the condenser C. The bigger the capacity, the longer it takes to charge up, and the smaller the capacity, the less time it takes to charge up. By making C small extremely high frequencies can be produced, and, in fact, values right up into the radio frequency regions can be reached even with such a simple arrangement as that shown. It has been stated that these lamps have been used to produce several watts of C.W. energy for a 10-watt transmitter by using them in some such way as this.

This arrangement of apparatus for generating intermittent currents has also another property which is quite useful at times, and that is that the current pulse that passes through the circuit is not a sine wave one; it has more of a square-shaped wave form—it starts suddenly, dies down somewhat, and then suddenly stops—and, owing to this fact, it has a lot of harmonics. Although we are apt to dislike harmonics sometimes when they occur in transmitting stations, they are often useful in laboratory experiments, and by making use of such a circuit arrangement, which is producing many harmonics, one can carry out some quite interesting experiments. Beats can be set up between the oscillations in circuits carrying currents produced by these lamps; and beats can be produced between these neon-lamp maintained currents and three-electrode valve circuits. All the phenomena associated with such effects can thus be reproduced in this way; while as a result the lamps can be employed in conjunction with many receiving and similar circuits which depend upon the use of such phenomena. Super-regenerative and other circuits depending upon the modulation of the incoming wave oscillations at some frequency other than their own are included in this category.

The effect of the capacity across the lamp, and the fact that the discharge is intermittent can be seen by connecting a larger condenser across the variable condenser C in Fig. 5. By increasing th capacity from 0·001 to 0·1 μF, the frequency interruption becomes very much lower and c be seen by the eye. The pitch of the interruptio has now been reduced from an acoustic note to very low frequency buzz. By using a still larg condenser, a considerable time elapses befo anything happens—the time taken for the con denser to charge up now being several second By increasing the capacity to about 3 microfarad and the resistance R to several megohms, th charging time can be made very long, and th lamp merely flickers once every few seconds.

In this way, one gets a very simple visua appreciation of the time constant of a circuit, *i.e.* the time the current takes to rise up and to di down again.

Electrical circuits of long time constants hav been used in connection with relays and valves and these lamps could possibly be used for makin selective arrangements for relays at a receivin station, so that they will respond only to signal of a pre-determined number of seconds in length, and not to shorter or longer ones. That is merely one suggestion for the possible application of that effect in some practical way.

Another way in which these lamps can be employed is to make use of their falling or negative characteristic. If the current passing through the lamp is measured for different voltages across the terminals, one can plot out the characteristic of the lamp. Unlike the characteristic of an ordinary resistance, these lamps have a slightly negative characteristic; in other words, increase of current means, not an increase of voltage, but a slight decrease. The smaller the current through the lamp, the higher the voltage across it. This effect can be used by connecting one of these lamps in series with the plate circuit of a valve; while it can also be used directly to produce oscillations if a sufficiently high D.C. voltage is applied to the circuit.

We can, however, with a D.C. voltage of about 200, connect one of the lamps into the plate circuit of a three-electrode valve and make use of this effect to amplify the current changes which take place in the plate circuit of the valve. The fact that the lamp has a slightly negative characteristic makes it act as an amplifier when employed in this way, because if the plate current of the valve tends to decrease, that automatically makes the lamp take more than its previous share of the available H.T. voltage, and this tends to further reduce the current passing through the three-electrode valve.

This effect is made use of in the Anson relay, some details with regard to which have been published recently *

The neon lamp may, however, be used in conjunction with a three-electrode valve to produce a somewhat different effect. It is well-known that when a potentiometer is included in the grid circuit of a three-electrode valve, so as to render the grid more negative with respect to the filament, the normal plate current can be reduced either near to or actually to zero. Under these conditions the valve can be used to operate a relay, since the

* *Wireless World*, 12, pp. 35-37, April 14th, 1923.

cidence of a signal impulse will cause an increase the anode current which may be sufficient to erate a relay or some similar form of recorder.

When special valves are used for this "relay alve," having the shape, size and disposition of eir electrodes properly proportioned (such as the case with the "QX" and similar valves) it is ossible to bring the anode current down very early to zero by the application of a few volts nly to the grid circuit; but with most ordinary orms of receiving valve the negative voltage that must be applied to effect this result amounts sually to a considerable number of volts—15 volts r more. The valve is then rendered rather nsensitive to signal impulses, since these must be f very considerable intensity before they will produce on the grid sufficient voltage to bring the grid potential anywhere near zero—which condition is necessary if the signal impulse is to give rise to an increase of anode current which will be sufficient to operate any relay in a reliable manner. Expressed in other words, this means that if the negative grid voltage is retained within reasonable limits so as to retain a moderate degree of sensitivity for the valve, there will still be a by no means inconsiderable flow of anode current. This will render difficult the operation of a relay.

By connecting a neon lamp in series with the anode circuit of the valve, it is easily possible to suppress most if not all of this anode current which flows when no signal is received. This can be done without sacrificing sensitivity to the signal impulses, and while retaining a sufficiently large signal current to operate a relay easily.

This effect was demonstrated by arranging a two-valve receiver consisting of a detector and a note-magnifying valve to supply signal impulses to a "relay valve" having a neon lamp in its anode circuit. The arrangement of this apparatus is sketched diagrammatically in Fig. 6. It consists essentially of two parts—the receiver proper which is drawn in *above* the dotted line running across the diagram; and the relay valve and auxiliary apparatus which is represented in the lower part of the diagram below the dotted line. The source of signals is represented diagrammatically only in the upper left-hand part of the diagram. For the purposes of the demonstration a Townsend wavemeter was used for this source. The receiver consisted of the detector valve V_1 provided with tuning circuit L_1 C_1, and the usual grid condenser and leak C_2 R, and reaction coil L_2. Its anode circuit includes the primary winding of the intervalve transformer T_1, the secondary of which is connected in the grid circuit of the note magnifying valve V_2. Terminals marked XX are the output terminals of this second valve. The anode circuit H.T.battery B_2 was 60 volts, and B_1, 6 volts. Ediswan type "AR" valves were used for V_1 and V_2.

The intervalve transformer T_2, coupled the output circuit of the receiver to the grid circuit of the "relay valve" V_3, which grid circuit also included the potentiometer P, fed from the 15-volt battery B_3. In the anode circuit of this valve V_3, was the milliammeter mA, the neon lamp, and the winding of the Weston relay R_1. This circuit was fed from the 220-volt D.C. supply mains.

The contacts of the Weston relay R_1 were included in a local circuit consisting of the 15-volt battery B_4 and the windings of a second, and more robust relay R_2. Merely for convenience, in order to provide a simple indicator, the local contacts of the second relay R_2 included a 40-watt, 220-volt lamp fed from the 220-volt 50-cycle A.C. supply drawn from a motor generator. This particular

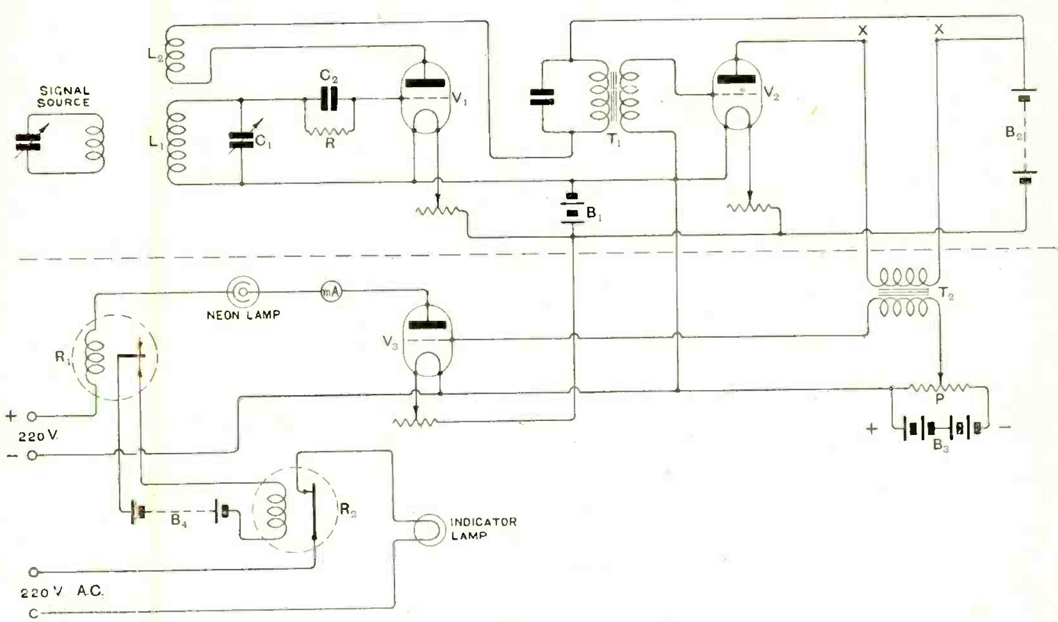


Fig. 6.

arrangement was used for convenience only, since providing the insulation of the relays is good, the same 220-volt D.C. supply could be used for both the neon lamp circuit and the indicator lamp of the second relay.

The indicator lamp was employed as being symbolical of any apparatus that it might be desired to operate from the relays.

When the buzzer of the Townsend wavemeter was started up, and the receiving circuit L_1 C_1 brought into tune, the milliammeter mA indicated a signal of 2 milliamperes, whereas prior to the signal the steady current flowing through the relay R_1, was much less than 0·1 milliamp. This large change in anode current due to the signal easily operated the relays R_1 and R_2, and caused the indicator lamp to light up.

A further visual indication is also provided by the neon lamp, which lights up brightly on the passage of current through it when a signal arrives.

In setting up this apparatus, the potentiometer P is first adjusted when no signals are being received, until the plate current of V_3 as read on the milliammeter is reduced almost to zero. The receipt of a signal of quite moderate strength then suffices to set up a considerable current flow through the relay valve V_3 and the relay windings.

In the demonstration, a Mullard "Ora" valve was used for V_3, although other valves can, of course, also be employed for this purpose.

With this apparatus the neon lamp serves not only as a species of amplifier in conjunction with the valve, but also as a suppressor of the "zero" or "spacing" current through the relay when no signal is being received. A more effective change of current through the relay due to the signal is obtained in this way.

These lamps can be used as oscilloscopes to limited extent. For instance, if one puts j enough voltage on to the lamp through a hi resistance just to start the glow (so as to get of the "zero" of 140 volts), and speech current applied in addition, the amount of glow can made to rise and fall with the intensity of t speech and with the wave form of the speec The other evening I had it working on 2 LO, t speech currents being provided by a 3-val receiver, and the neon glow light was flickering u and down in the lamp from a mere spot of ligh at the bottom to lighting up the whole electrode Some idea of the wave form of the speech curren can be obtained in this manner by viewing th glow through a rotating mirror. The scheme indicated in Fig. 7.

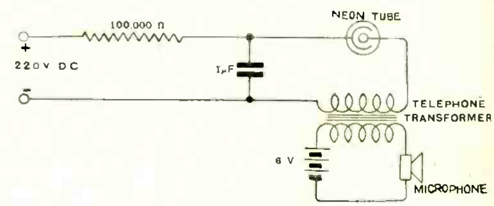


Fig. 7.

I do not claim any particular novelty for these experiments which I have shown this evening but I merely put them forward as a means of drawing them to the notice of the members of this Society, and, I hope also, as a means of inducing them and others to follow up what is an extremely interesting line of experiment and research.

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.*

The Society's third demonstration evening was held on Wednesday, August 8th, when interesting and instructive experiments were conducted to determine the characteristic curves of members' valves. Various voltages were applied, readings taken, and the resultant curves drawn. Thanks are due to Messrs. Copsey and Ellis for the loan of various measuring instruments, panel and batteries.

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

Edinburgh and District Radio Society.*

Thanks to the kindness of the Director of the Glasgow station of the B.B.Co., members of the Society had an opportunity of visiting 5 SC on Saturday, July 28th.

First the studio was invaded by the 48 visitors, and the microphone and amplifier examined.

The party then passed on to Port Dundas, where the transmitter is housed, and were shown the system employed in the production and modulation of 13 amps. of aerial current.

The Society takes this opportunity of expressing its gratitude to the B.B.Co. and to the members of their staff at Glasgow who took so much trouble to make the visit the entire success which it undoubtedly was.

Hon. Sec., W. Winkler, 9, Ettrick Road, Edinburgh.

The Southampton and District Radio Society.*

On Thursday, August 9th, the lecturer was Mr. Geo. Sutton, A.M.I.E.E., Secretary of the Experimental Wireless Association, Dulwich, whose subject was "Wireless Gadgets." This proved a very interesting and instructive topic, as was pparent by the variety and number of questions sked relative to the ingenious contrivances xhibited.

Mr Sutton showed how such common objects s empty cream cartons, ordinary rubber balls, meat skewers, etc., could be utilised for wireless purposes, with results equal to those obtained by more orthodox and expensive articles.

Two new members were elected.

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

Brockley and District Radio Association.

A most interesting lecture was delivered before the Society on July 27th, when Mr. G. A. Saunders lectured on "A Few Considerations of Aether, Electrics and Material Phenomena." The lecture was highly instructive and greatly appreciated by all present.

Hon. Sec., R. O. Watters, "Grove House," Brockley Grove, S.E.4. (Letters only.)

The Q.S.T. Radio Research Society.

This Society has just been formed for the benefit of *bona fide* experimenters, and the membership is to consist of twelve. The organisation is under the management of three officers, viz., the Hon. Secretary, Technical Secretary, and Technical Adviser.

Experimenters wishing to become members should write to the Hon. Sec., 68, Elsham Road, Kensington.

The German Radio Club.

That experimental wireless has caught the German imagination was well demonstrated at a meeting of the above club on June 27th, when 550 members and friends assembled at the Technical High School, Berlin, to hear a lecture by Mr. Schade on "The Theoretical Elements of Radiotechnics."

The lecturer dealt experimentally with the elementary principles of the subject, demonstrating the influence of magnetic lines of force on coils and the induction of a current in a coil by means of a bar magnet.

A demonstration was given by Mr. Riepka of the construction of a simple receiver.

Hon. Sec., Dr. Albert Neuberger, Neue Winterfeldstr 24, Berlin, W.30.

Ipswich and District Radio Society.

On Monday, July 31st, a number of members enjoyed the first demonstration at headquarters of receiving without an aerial.

The lecturer for the evening was Mr. F. J. Dyer, who devoted his remarks to wonderful accounts of the super-regenerative circuit devised by Major E. H. Armstrong. The results obtained from this circuit might well induce the experimenter to scrap his existing set and construct an Armstrong Super. Using no aerial or earth, but simply the set as it stood on the table in the club-room, the audience clearly heard the London Broadcasting station. The lecturer employed the blackboard frequently, much to the satisfaction of the members, and at the conclusion, questions were asked and answered.

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

FORTHCOMING EVENTS.

FRIDAY, AUGUST 24th.

Gorton and District Wireless Society. Ordinary meeting.

MONDAY, AUGUST 27th.

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

FRIDAY, AUGUST 31st.

Wireless Society of Hull and District. At 7.30 p.m. At the Co-operative Social Institute, Jarratt Street. Lecture: "Ebonite," by Mr. C. B. Snowden (President).

Brockley and District Radio Association. At 8 p.m. At "Gladstone Hall," New Cross Road, S.E. Lecture by Mr. J. F. Stanley, B.Sc., A.C.G.I.

SATURDAY, SEPTEMBER 1st.

Ipswich and District Radio Society. Visit to Parkeston Land Station and Oversea Boats Wireless Station.

The Orange Free State Radio Society.

Readers will be interested to know that a radio society has been formed at Bloemfontein under the above title. Although the membership is still small, it is hoped that a wide circle of radio enthusiasts will soon be included.

There are many difficulties in connection with experimental wireless in South Africa, but it is hoped that the majority will be overcome ere long.

At present the Society possesses no apparatus of its own, but is using a set lent by the Hon. Secretary, Mr. Percy F. Symons. The set in question is quite efficient, and works exceptionally well on wavelengths over 3,000 metres. The stations most frequently heard are **PKX** (Bandoeng), **WSO, POZ, UFT** and **NPL.**

The officers of the Society are as follows:—President, Mr. Schwartz, c/o D.P.S., Bloemfontein; Secretary, Mr. Symons, c/o Railway Telegraphs, Bloemfontein; Treasurer, Mr. Shaw, c/o D.P.S., Bloemfontein.

Barnet and District Radio Society.

The Society was fortunate in having Mr. W. A. Saville, of New Barnet, as lecturer, on Wednesday, August 8th. Mr. Saville, who has been an ardent experimenter for several years, is now engaged in the manufacture of wireless components, and his lecture on "The Making of Coils" proved both entertaining and instructive. With the help of the necessary apparatus he demonstrated the methods of preparing basket, slab and honeycomb coils, at the same time speaking of the merits, or otherwise, of each type of coil.

Mr. Saville brought with him a fine four-valve set which he had recently made, and during the evening several successful demonstrations were given. He also showed an efficient single-valve set on which he consistently receives the time signals from Annapolis, U.S.A., and a neat crystal set, both of his own design and construction.

The lecture was preceded by the usual Morse class, which has now become quite a feature of the Society's gatherings.

Hon. Sec., J. Nokes, "Sunnyside," Stapylton Road, Barnet.

Midhurst and District Radio Society.

On July 17th the Hon. Secretary read a paper on the essentials of a receiving station, and an interesting discussion took place in which Mr. S. F. Broadway took a leading part.

Hon. Sec., H. J. Dyer-Cossins, "Hunsdon," Midhurst.

New Radio Club in Antwerp.

British amateurs will be interested to lea[rn] of the inauguration of a wireless club in Antwer[p] which took place on July 29th in the Salons de [la] Croix-Blanche in that city.

At the opening meeting, M. Robert Van Cast[e] explained the aims of the Club. It has bee[n] founded by ten youthful enthusiasts with th[e] idea of uniting the numerous amateurs in Antwer[p] and to increase their knowledge of the latest achievements of the science. Lectures, discussions an[d] practical working with apparatus will take plac[e] from week to week, and it is hoped that gratifying results will ensue.

At the first meeting those present were abl[e] to enjoy broadcasting from the Eiffel Tower, Valloy, London and the Hague.

Amateurs in this country will wish the new venture every success.

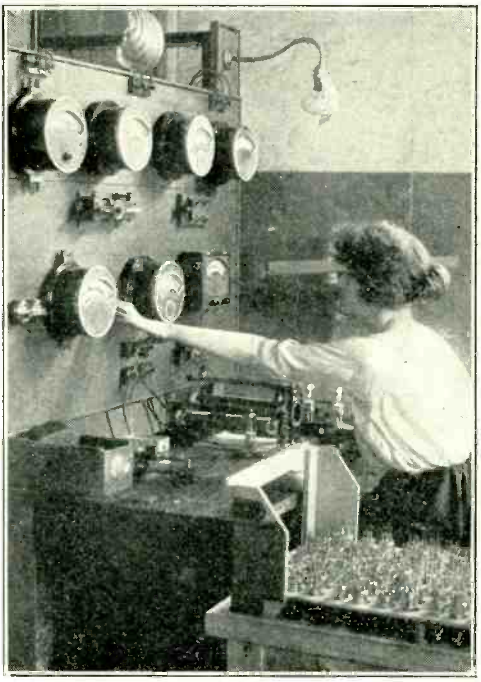
The Secretary is M. Maurice Meens, 17, Plac[e] de la Comédie, Antwerp.

Ediswan Valve Manufacture.

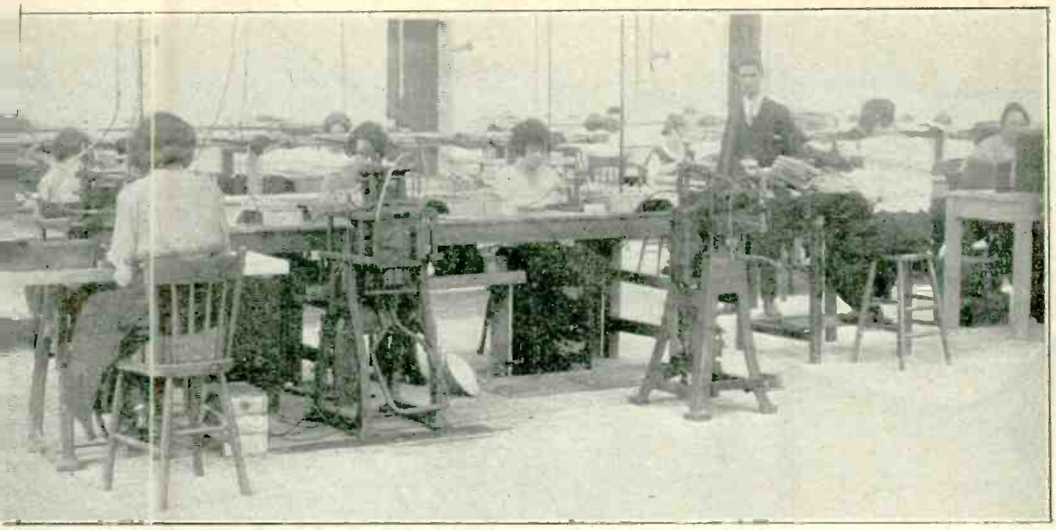
THE valves manufactured at the works of the Edison-Swan Electric Co., Ltd., called Ediswan valves, possess excellent characteristics and are well known to those who employ valve amplifiers. It will be remembered that Dr. Fleming, the inventor of the two-electrode valve, conducted his early experiments at the works of this Company, and during the war large numbers of valves were manufactured.

The accompanying illustrations show portions of the valve assembly room, pumping plant and valve testing apparatus. The glass portion of the valve is manufactured in the Company's glass works. In the assembly room the valve elements are mounted on the stem, which consists of a glass tube carrying the supporting and connecting wires. The bulb is sealed at one end to the stem and at the other to a small glass tube. The pumping plant operator deals with a batch of about 20 valves at a time. The tubes are sealed to other tubes connected with the exhaust plant. During pumping the bulb is heated, and the filament and anode are each connected to a power supply so that the filament is burning brightly and the anode has a high temperature. The operator is able to control the temperature of the elements and is responsible for obtaining the required degree of vacuum.

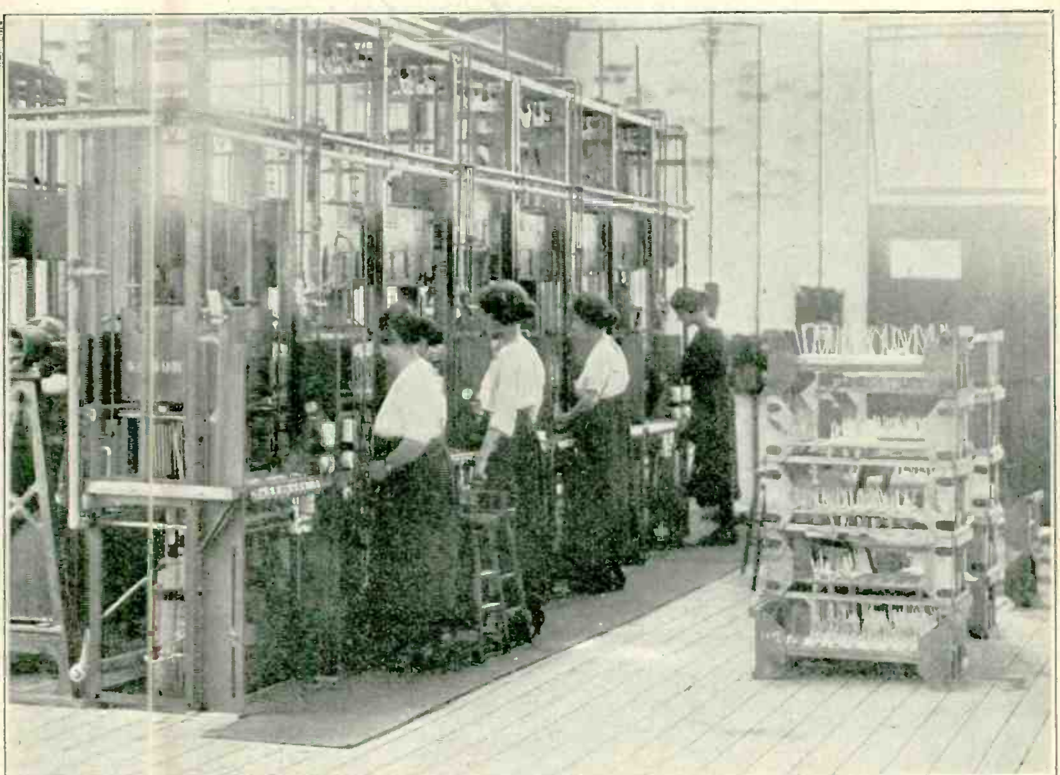
Valves are tested for filament current emission at definite anode voltages. The grid current is measured and serves to indicate whether the vacuum is good.



Valve testing.



One corner of the valve assembly room. Here the filament is connected to its supports, the grid is wound and mounted and the anode is welded to its support.



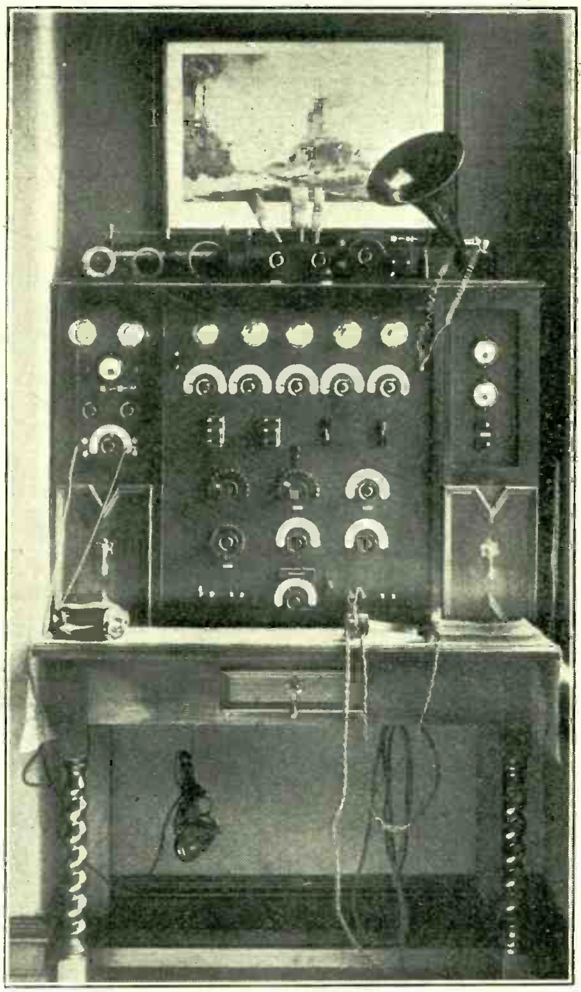
The valve pumping plant. Each operator deals with a batch of about 20 valves. The filaments are run at a high temperature and a high voltage is applied to the anodes. The filament current of each valve is adjustable by the operator, and during the pumping the current is varied according to the degree of vacuum.

MY EXPERIMENTAL RECEIVING SET.

By G. S. WILSON ENDERBY, A.M.I.E.E.

WE all have our own ideas as to what we think is the best way of laying out our receiving stations. By describing our outfits and inviting criticism we obtain an exchange of ideas which after all is the root of the tree of progress.

The "layout" of the writer's set is made fairly clear by the photograph. The loose coupled Burndept coil holder is placed on the top of the set. The valves, two H.F., detector, and two L.F., at the top of main panel, are controlled by a separate filament resistance. Beneath valves and resistances are the switches which enable any number of the valves to be used. Below these again are switches for controlling the H.F. transformers, and the secondary tuning condenser, and lower still is the variable H.T. battery switch, alongside which are the aerial and vernier condensers. At the bottom of the panel are potentiometer, reaction condenser and switch for providing reaction either on the aerial or the H.T. transformer.



The upper panel on the left is at prese a crystal set with two note magnifie below which is situated the H.T. batte On the right is the instrument panel whi provides the filament heating current.

The tab cabinet has be arranged to li up with the fu nishing of th room, and is fitte with a sma drawer which extremely usefu

The set is wire to a diagram give in *The Wireles World and Radi Review,* som minor alteration having been made

When first pu into commissior on an aerial only 20 ft. high, and with one or two adjustments no great difficulty was experienced in cutting out 2 ZY barely one mile away. This was very different when the aerial was raised an additional 30 ft., when it was found necessary to employ a filter and variable condensers for the H.F. transformers in order to cut out the local station.

The programmes from all the British Broadcasting Co.'s stations can be heard at will. Paris and the Hague are received regularly.

Notes and News

Following British practice, the German Government is instituting a service of wireless letters from Germany to New York.

* * * *

Stating that it is "not a house of mirth," the Warden of Sing Sing Prison (New York) has prohibited the installation of a broadcast receiver in the condemned cell.

* * * *

The Irish Dail has been approached by several firms anxious to form a broadcasting company. The position is at present indefinite.

* * * *

A Radio Society has been formed by the combined staffs of the T.O.T. group, comprising the London omnibus, tube and tramway companies.

* * * *

Experimental Working at Norddeich.

It will be of interest to experimenters to know that Norddeich W.T. station, Germany, is now available for experimental long distance working between the hours of 0230-0430, 0800-1000, 1600-1800 and 2330-0100, G.M.T. The station receives on a wavelength of 2,050 metres, and transmits on 2,250 metres.

Broadcasting in Cape Town.

The *Cape Times* states that the City Council is considering a scheme of municipal wireless broadcasting, and that in this connection Sir David Graaff has offered to erect at his own expense a complete six kilowatt Marconi broadcasting station which he is willing to present to the city on certain conditions.

Photo: Geo. Dawson.

The opening ceremony at **5 IT**. *Sir Herbert Austin, M.P., is seen delivering his inaugural speech. On the extreme left is Mr. Percy Edgar, Director of the Station. Mr. Joseph Lewis, Musical Director, appears on the extreme right.*

Another Obstruction Case.

A loud speaker demonstration at a chemist's shop in Neath, Glamorgan, brought a large crowd, and caused obstruction. The proprietor, Melville Thomas, was summoned on August 7th, but the charge was dismissed with costs, the prosecution being the first of its kind in the locality. It will be remembered that a similar case recently occurred in London, with the same result.

British Association Meeting, September, 1923.

The Annual Meeting of the British Association for the Advancement of Science will take place this year at Liverpool from September 12th to 19th inclusive. The inaugural General Meeting will take place on Wednesday evening, September 12th, when the President, Sir Ernest Rutherford, F.R.S., will deliver the Presidential Address on "The Electrical Structure of Matter." In Section G (Engineering) there will be a discussion on "Vocational Tests for Engineering Trades," while the address of the President of the Section, Sir H. Fowler, K.B.E., is to be devoted to "Transport and its Indebtedness to Science." Among other lectures or discussions of more topical or local interest which appear in the provisional programme issued by the Association, we notice an address by the President of the newly-formed Section M (Agriculture) on "Science and the Agricultural Crisis." Sir W. H. Beveridge, K.C.B., Director of the London School of Economics, will speak on "Unemployment and Population," and Dr. W. L. Balls will add local colour to the deliberations with a lecture on "Cotton."

As in previous years, the Meteorological Department of the Air Ministry will give a demonstration of the preparation of a synoptic weather chart. These charts form the basis of all modern weather forecasting (as has been pointed out in articles in this magazine), and the data for the charts will be received locally by W/T from the routine weather messages in code issued from the Air Ministry and other sources.

It is hoped during the meeting to release a pilot balloon carrying recording instruments, such as is used in investigating the upper air currents of the atmosphere.

Société Francaise d'Etudes de T.S.F.

A laboratory has been opened for the use of the members of the Société d'Etudes de Télégraphie et de Téléphonie sans Fil, the headquarters of which are situated at 7, Rue Paul-Louis-Courrier, Paris. A full equipment of experimental apparatus has been installed, and the members are thus given an excellent opportunity for research work.

Experimental Wireless in South Africa.

An extremely interesting account of difficulties encountered and overcome by wireless experimenters in South Africa has reached us from Major

S. G. Swart, resident in Middelburg, Cape Province.

Major Swart arrived in South Africa in 1921, and at the earliest opportunity erected a receiving set. Having obtained a licence for transmitting and receiving, he got into touch with a Mr. Bolus, farming eight miles from the town, who soon constructed a five-valve receiver.

After many failures, our correspondent and his friend succeeded in receiving the weekly concert transmitted on Thursday evenings by Mr. Streeter, of Cape Town, a distance of over 400 miles, the intervening country being alternately mountain and veldt. This result is very creditable in view of the fact that the input at the transmitting station was only 30 to 40 watts.

On the publication of this achievement numerous amateurs from all parts of the country signified their desire to carry out experiments with Major Swart's station. Special efforts were next made to transmit to Port Elizabeth, where Mr. A. O. Harvey possessed a valve transmitter. An obstacle to this project was the fact that only 90 to 100 volts could be raised, with the aid of dry batteries. Eventually, however, Major Swart was able to make up a 180-volt H.T. accumulator by utilising the town D.C. supply. The two stations are now able to communicate by telephony.

The next ambition of our correspondent is to organise a series of tests with the object of communicating by relays to the Rand. Several amateurs are anxious to co-operate.

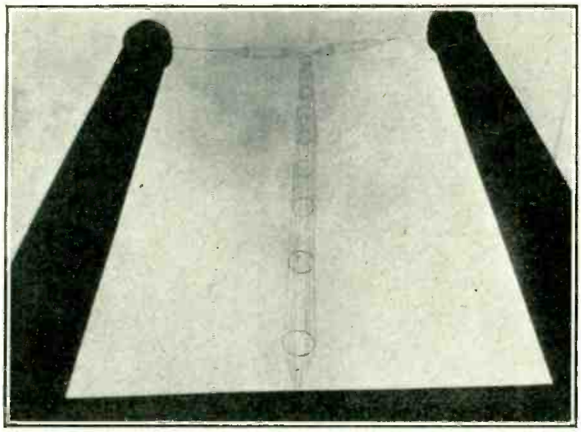


Photo: Geo. Dawson.

The aerial of the new Birmingham broadcasting station. It is attached to the chimney stacks at Summer Lane power station.

The greatest bugbear for the experimenter is the prevalence of atmospherics. During certain times of the day, European stations are plainly audible, but generally these signals are almost entirely obliterated.

Loud Speaker at Motor Cycle Trial.

At the motor car and cycle speed trials which were held recently at Eastbourne, an interesting feature was the use of a "Sterling" loud speaker to announce the results, the apparatus being fitted up by Messrs. Caffyns, Ltd., 56, Terminus Road, Eastbourne.

The useful range was about 300 yards, with two stages of amplication (one "R" valve and one "L.S.3" valve with 120 volts on the plates). The result was considered excellent, and it is proposed to use the same loud speaker for future trials.

Spanners for Wireless Experimenters.

A cleverly designed set of spanners, also incorporating a screwdriver and inch-rule is being, marketed by Messrs. F. Line & Co., of Buckingh Street, Birmingham. Five spanners to fit all si of B.A. nuts are included, and are held toget by a central screw. The price is 1s. 6d.

British Products at Canadian Natior Exhibition.

We hear that Burndept wireless manufactu will be a prominent feature in the exhibit of Brit Products in charge of the British Trade Co missioner, Mr. F. W. Field, Toronto, at the Canadi National Exhibition, August 25th to September 9 1923. We take the opportunity of reminding o Canadian readers, that the address of Burnde of Canada is 172, King Street West, Toronto.

Books and Catalogues Received.

The "Electrician" Electrical Trades' Directory and Handbook, 1923. The Blue Boo 41st edition. (London: Benn Brothers, Ltd 8, Bouverie Street, E.C.4. 1,367 pages+cvi Price 25s. net.)

Falk, Stadelman & Co., Ltd (Efesca Electric Works, 83, 85 an 87, Farringdo Road, E.C.1. Catalogues No. 49 and No. 500, de scribing Efesc Wireless Com ponents and Efes caphone Valve and Crystal sets.

Formo Company, 22, Cricklewood Lane, N.W.2. Catalogue of "Formo" Wireless Components, which include Intervalve Transformers, Variometers, Filament Resistances, etc., etc.

The Ever Ready Company (Great Britain), Limited. (Ever-Ready Works, Hercules Place, Holloway, N.7.) Catalogue of Dry Cells and Batteries of every description, including those suitable for wireless work.

The Wholesale Wireless Co., Ltd. (103, Farringdon Road, E.C.). "Economy by Wireless." An illustrated catalogue describing the Company's sets.

The Electric Appliances Co., Ltd. (7 and 8, Fisher Street, Southampton Row, W.C.1.) An ingenious folder, capable of taking additional information, illustrating and describing "Eureka-phone" wireless instruments.

Radio Instruments, Ltd. (12, Hyde Street, New Oxford Street, W.C.1.) A 48-page illustrated catalogue giving particulars of the Company's extensive range of wireless apparatus for every purpose.

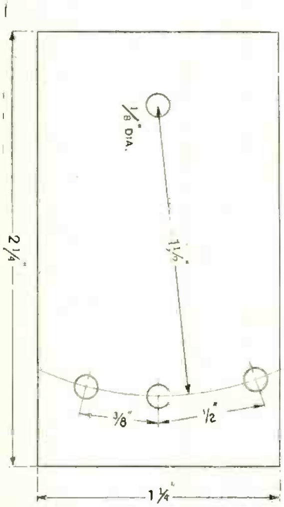
The Bowyer-Lowe Co., Ltd. Leaflets illustrating and describing the new Bowyer-Lowe Wavemeter, Mark I, and giving detailed instructions for use.

PAGE FOR THE BEGINNER.

illing a Panel to take a Multi-contact Switch.

WHERE it is required to place the switch-arm centre, drill one 6 BA clearance hole. Now secure the jig on to the ebonite nel, through the hole marked A, with e of the contact ıds, or a screw and ıt. The next point be considered is e number of studs to used. Should the ımber be odd, set ıe jig so that the hole comes immediately elow the hole A. fow drill through the ole C, insert another ontact stud to secure he jig in position, nd drill hole B. Now emove the stud from C and move the jig ound, so that C corresponds with the ıole just drilled, and drill through B again. The reason for stating that for an odd number of studs C must be immediately below A is because should an even number of studs be used, the jig must be placed for the first stud hole, so that the centre line comes exactly between holes B and C. The jig has been set out for drilling both $\frac{3}{8}$ in. and $\frac{1}{2}$ in. between studs, using the holes B and C for $\frac{3}{8}$ in. centres and C and D for $\frac{1}{2}$ in. centres. The radius from A to B, C or D is $1\frac{1}{2}$ ins. By the use of this jig any number of holes for contact studs can be accurately drilled. Should the contact studs be 5 BA or 4 BA, the jig, of course, will have to be drilled to suit.

The template.



Setting out of the holes.

M. L. F.

* * * *

The Vernier Condenser.

In order to facilitate the adjustment of short wave receivers it is customary to employ a small variable condenser connected in parallel with the main tuning condenser. When the tuning condenser is connected in series with the aerial circuit of a receiver employing reaction the whole system is particularly susceptible to minute capacity changes. This is most marked when the hand is brought near to the tuning condensers, and the effect is accentuated owing to the fact that neither set of plates is at earth potential, unless the tuning condenser is connected in the earth lead, which is not usually to be recommended.

The difficulty may be overcome to a considerable extent by connecting the vernier condenser in parallel with the tuning inductance, joining the movable plates to the earthed side of the inductance. An extension handle is a further refinement, and is advisable for wavelengths below about 200 metres.

PAUL D. TYERS.

* * * *

Ebonite.

We are told that the shiny surface of ebonite sheet should be removed, because this surface is produced in manufacture by tinfoil sheets, which leave a partially conducting surface. Why do the dealers go to manufacturers who use such methods? I generally make a point of enquiring the origin of materials I buy, but I think the public have a right to expect well-known firms to offer them tested and approved stuff. Now, it appears, we shall have to go about armed with a twist drill, a test tube and a phial of nitric acid. I can imagine at the next wireless exhibition the panels gradually assuming the appearance of Gruyere cheese before the show closes.

H. E. ADSHEAD.

Correspondence.

To the Editor of The Wireless World and Radio Review.

Sir,—As a member of the old Wireless Society of London since 1914, as well as the holder *pro tem.* of what is probably the most comprehensive experimental licence in the country, I regret that it should be necessary to enter a protest against the arbitrary "selection" of so-called representatives on the Committee of what is in name only the Radio Society of Great Britain. The reason given that election would take time, appears somewhat inadequate, as nobody, whether Radio Society members in the provinces or affiliated Societies, were ever consulted as to whether they desired any election. We are now bound in the eyes of the Post Office by a decision taken by London, and affecting to represent the Provinces. If I only speak for one area, I feel quite certain that such representation could never be recognised.

In addition to the above, it is necessary to point out that in a Society which affects to represent Great Britain, the proportion of 8 London to 4 Provincial members in a Committee of 12, is hardly a true proportion of interests; it should be pointed out in this connection that the decision was again made in an entirely arbitrary manner by London.

The extremely great representation of the Trade as against other members on the present Committee of the Radio Society of Great Britain is a matter on which considerable comment has been made already with no apparent result. As no statement has ever been made to account for this preponderance of trade members, others are left to draw their own conclusions.

It is with regret that I have to point out that whilst a suggestion from the R.S.G.B. that they selected members *pro tem.* "might" have been passed, at the same time the present dictation can hardly pass without comment.

H. C. H. Burbury, Lieut. R.N.

Crigglestone, Wakefield.
August 13th, 1923.

Calls Heard.

Hammersmith.

2 AJ, 2 AM, 2 AN, 2 AQ, 2 BM, 2 BV, 2 BZ, 2 CP, 2 DC, 2 DF, 2 DP, 2 DT, 2 DY, 2 DZ, 2 FG, 2 FQ, 2 FU, 2 GL, 2 GP, 2 HT, 2 ID, 2 KF, 2 KN, 2 KT, 2 KV, 2 LI, 2 LU, 2 MF, 2 MI, 2 MK, 2 MO, 2 MR, 2 MT, 2 NH, 2 NM, 2 NQ, 2 OD, 2 OM, 2 ON, 2 PO, 2 PY, 2 QI, 2 QQ, 2 QS, 2 SH, 2 SI, 2 SN, 2 SQ, 2 SS, 2 SX, 2 SZ, 2 TA, 2 TI, 2 TQ, 2 UC, 2 UV, 2 VJ, 2 VP, 2 VW, 2 WD, 2 WZ, 2 XL, 2 XQ, 2 XT, 2 XZ, 2 YH, 2 YN, 2 YX, 2 ZO, 2 ZZ, 5 AC, 5 AP, 5 AQ, 5 BT, 5 BV, 5 CB, 5 CP, 5 DK, 5 IO, 5 HK, 5 OP, 5 HY, 5 OQ, 5 LF, 5 KS, 5 VP, 5 VM, 5 PU, 5 VR, 5 PD, 6 IM, 6 HD, 6 HY.

(H. Eade, Jr.)

Twickenham.

2 AH, 2 AJ, 2 AS, 2 BZ, 2 FQ, 2 FU, 2 H 2 KF, 2 KV, 2 KZ, 2 MF, 2 MI, 2 MO, 2 M 2 OM, 2 QQ, 2 SF, 2 TI, 2 VJ, 2 VS, 2 V 2 WJ, 2 XL, 2 XO, 2 XZ, 2 YJ, 2 YR, 2 Z 2 ZZ, 5 AC, 5 BT, 5 CB, 5 CP, 5 FR, 5 F 5 HY, 5 IO, 5 IS, 5 KS, 5 LK, 5 LP, 5 L 5 MA, 5 NO, 5 ON, 5 OP, 5 OX, 5 PD, 5 P 5 PR, 5 PU, 5 SU, 5 TB, 5 VD, 5 VM, 5 V 6 IM, 6 KI.

(R. H. Ralls

Sunderland.

2 AW, 2 BR, 2 CN, 2 DF, 2 FN, 2 FU, 2 G 2 GR, 2 HF, 2 IJ, 2 IN, 2 IP, 2 IQ, 2 JF, 2 J 2 JZ, 2 KF, 2 KW, 2 MF, 2 NA, 2 NM, 2 O 2 OM, 2 PX, 2 QP, 2 TA, 2 VI, 2 VR, 2 V 2 VX, 2 WK, 2 XR, 2 XU, 2 YQ, 5 BA, 5 B 5 BV, 5 CU, 5 CX, 5 DT, 5 GS, 5 HD, 5 K 5 LC, 5 MO, 5 QI, 5 RB, 5 RZ, 5 VH, 5 V 6 GI, 6 GO, OMX, OXA, OXY, OYB, OY OYS, 8 AC, 8 AQ, 8 AW, 8 BM, 8 BV 8 CF, 9 AN.

(I. Harrison)

Ben Rhydding, Nr. Leeds.

2 AC, 2 AD, 2 AN, 2 AW, 2 AY, 2 BA, 2 BF 2 CV, 2 DM, 2 FN, 2 FP, 2 FQ, 2 FX, 2 FY 2 FZ, 2 GG, 2 GJ, 2 GU, 2 IN, 2 IQ, 2 JO, 2 JP, 2 JZ, 2 KD, 2 KF, 2 KW, 2 KX, 2 LA, 2 LB, 2 LF, 2 LG, 2 MB, 2 NA, 2 NM, 2 OD, 2 OM, 2 ON, 2 OW, 2 PX, 2 QK, 2 RB, 2 RM, 2 RY, 2 SH, 2 SP, 2 SZ, 2 TA, 2 TB, 2 TC, 2 TJ, 2 TV, 2 UO, 2 US, 2 UT, 2 UV, 2 UW, 2 UZ, 2 VO, 2 VT, 2 VW, 2 WK, 2 WP, 2 XR, 2 YF, 2 YK, 2 YT, 5 AJ, 5 AZ, 5 BH, 5 BV, 5 BX, 5 CH, 5 CT, 5 CU, 5 CX, 5 DF, 5 FT, 5 GT, 5 GX, 5 HI, 5 ID, 5 IQ, 5 KO, 5 KZ, 5 MT, 5 NN, 5 NQ, 5 NS, 5 OD, 5 QM, 5 RI, 5 RY, 5 TS, 5 UD, 5 US, 5 YN, 5 YS, 5 YY, 6 BR, 6 GV, 8 AA, 8 AB, 8 AD, 8 AQ, 8 AS, 8 AV, 8 BF, 8 BM, 8 BN, 8 BV, 8 CK, 8 TT, 9 XB, 0 MX, 0 NY, 0 RD, 0 XA, 0 YS.

(E. Shackleton).

West Bridgford, Nottingham.

2 AW, 2 CK, 2 CZ, 2 DX, 2 FR, 2 GG, 2 GJ, 2 HF, 2 JO, 2 NM, 2 NP, 2 PD, 2 PP, 2 QH, 2 TL, 2 TV, 2 VY, 2 VN, 2 WM, 2 XP, 5 CK, 5 DN, 5 FU, 5 GS, 5 KC, 5 LT, 5 PU, 5 ZV, 8 AA, 8 BA, 8 BM, 8 BV, 8 CS, 8 ZZ, 0 MX, 0 NY.

(A. S. Gosling).

Tamworth, Staffs.

2 EB(?), 2 FH, 2 GZ, 2 HF, 2 HW, 2 IQ, 2 KO, 2 KQ, 2 NA, 2 NO, 2 TM, 2 TN, 2 UQ, 2 UY, 2 VC, 2 WM, 5 FU, 5 IY(?), 5 KY, 5 YF.

(Raymund W. Edwards).

Who hears 6 QV?

Mr. A. Rich **(6 QV)** of 16, New Road, Ponders End, Middlesex, welcomes reports of the reception of transmissions from his station. Letters should be addressed to him at his private address.

6 OZ.

Mr. H. Thompson **(6 OZ)** of 7, Rye Street, Chorlton, Manchester, would be glad to receive reports from those who have heard his transmissions. He thereby hopes to detect a transmitter who has been making illicit use of his call sign.

Broadcasting Topics

st Play Broadcast in France.

ı selecting the first complete play to be broad- in France, L'Ecole Supérieure des Postes et graphes showed excellent taste. On August this well-known station transmitted a per- nance of Molière's "Le Médecin Malgré Lui." w many British listeners-in heard the play nplete ?

thcoming Items at 2 LO.

uesday, August 21st.—9.0. Major G. C. Horne, .A.Scot., "Roman Britain."

Vednesday, August 22nd.—7.15. Mr. Archibald ddon, "Dramatic Criticism"; 9.0. Mr. D. lden Shipway, L.D.S., R.C.E., "Industrial ntistry"; 6.45. Mr. Ed. Salmon, Editor of the icial publication of the Royal Colonial Institute, Topical Empire Chat"—not attending in person.

Thursday, August 23rd.—7.15. Mr. Percy Scholes, Musical Criticism."

A SMILE FROM HOLLAND.

The above photo comes from Amsterdam, where **2 LO** *has been clearly received on 2 valves (Detector and L.F.)*

Swedish Broadcasting.

A new broadcasting Company—the Svenska Rundradiobolaget—is being founded at Stockholm with a capital of Kr. 1,000,000 minimum and Kr. 3,000,000 maximum, says Reuter. Among the founders are :—Allmaenna Telefonaktiebolaget L. M Ericsson, Allmaenna Svenska Elektriska Aktiebolaget, A.E.G., and Nordiska Kompaniet.

Birmingham's New Broadcasting Station.

The new studio of **5 IT** which, as already announced, was opened on August 11th, is situated in New Street, in the centre of the city, and the convenience of the site will be appreciated by artistes and others who had formerly to proceed to Witton, three and a-half miles distant. The accommodation at New Street consists of a studio some 25 feet square, a reception room, rooms for the band and the modulator panels, together with offices for the Director (Mr. Percy Edgar), the Assistant Station Director (Mr. H. G. Casey) and the Musical Director (Mr. Joseph Lewis).

The transmitting plant, which is installed at the Summer Lane Power Works, is about a mile from the studio and is contained in two rooms, one housing the motor generator sets and the other the control panels.

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 ; 7.20 p.m., 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 and Sundays, 10 to 10.45 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, 1 p.m., Meteorological Bulletin. Daily, 5.50 p.m., Meteorological Bulletin; Tuesday and Thursday, 10 p.m., Concert. Sunday, 7 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").

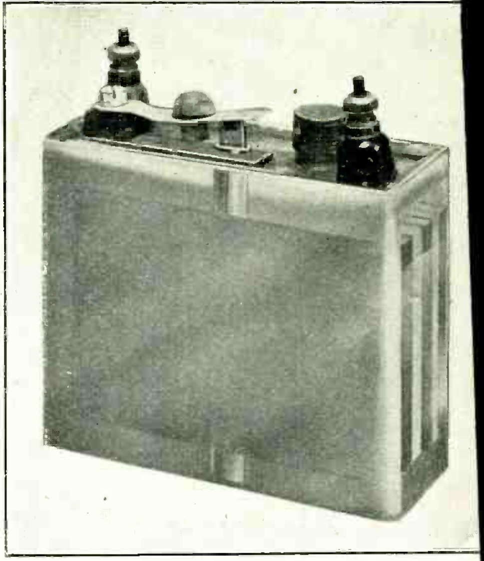
LAUSANNE, HB 2, 1,350 metres. Daily, 6 to 8.30 p.m., Concert ("Utilitas").

* British Summer Time is given in each case.

NEW DEVICES.

Unspillable Accumulator.

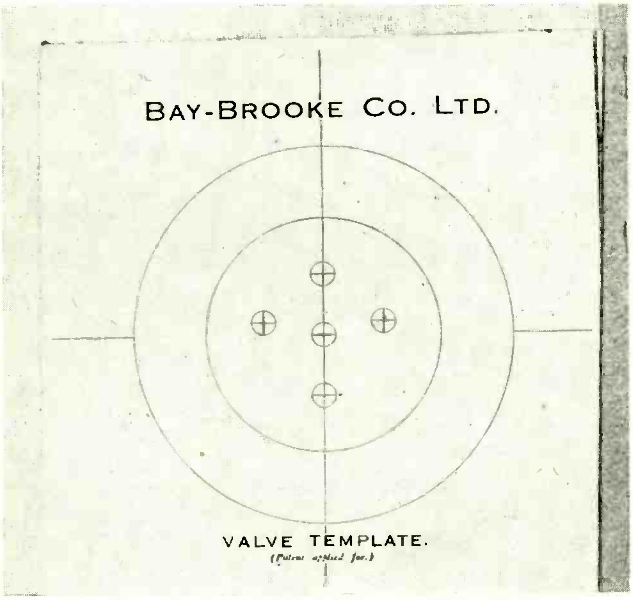
THE problem of rendering unspillable an accumulator containing liquid electrolyte may be solved as shown in the accompanying photograph. A celluloid tube is passed through the case and between the plates from top to bottom of the cell. A celluloid rod standing in this tube is arranged to press against a spring, to which a rubber cork is attached. When the accumulator is stood upon the bench, the cork is raised, thus uncovering the vent hole, whilst when the accumulator is carried in the hand, or should it fall over on to one of its sides, the rod under the pressure of the spring permits the cork to seal the vent.



The unspillable accumulator.

A Paper Template.

The illustration below is of a template which, when attached to the face of an ebonite panel, permits of accurately setting out the location of the legs of a valve holder. An important point to bear in mind in the use of paper templates for the precision working such as is necessary in wireless instrument work, is that if paper is moistened for the purpose of attaching it to the ebonite, serious contraction and distortion takes place. True one often finds instances where paper templates are used by the beginner, and even recommended in the press, yet if the amateur instrument maker takes a serious interest in his work he soon learns that the use of moistened paper is a hopelessly inaccurate method which is never adopted by the skilled worker, and rather indicates a lack of acquaintance with instrument making or disregard for accuracy. The Bay-Brooke Co., realising this difficulty, supply the template attached to a linen backing. The paper is held to the backing by means of a rubber-like compound which does not permeate into the paper and thus cause distortion. The template can be pulled off from the linen quite easily and attached to the panel, from which it can be peeled away when the location of the holes has been centre-punched. The two circles shown represent the space which must be allowed for the tubular and spherical type of valves. The introduction of this device should prove a great help to the experimenter who builds his own apparatus. Templates are supplied for setting out the drilling positions for various instruments and components.



Template for setting out the location of valve legs.

Cross lines are provided which must be arranged parallel to the sides of the work. A complete template suitable for constructing a multi-valve receiver should prove of great help to those experimenters who do not possess the elaborate equipment necessary for accurate marking out.

Questions and Answers

"A.A.B." (London, N.W.8) *asks* (1) *For a agram of a five-valve receiver, employing three gh frequency, detector, and one low frequency valves ith switches for cutting out each of the high frequency ılves. The set is required for use with a frame aerial.* (2) *What is the difference between a large frame aerial ith a small number of turns and a small frame aerial ith a large number of turns.* (3) *If the three coils ormally used in a three-coil holder are for the aerial node and reaction inductances.* (4) *If the conruction of an article, the design of which has been atented, constitutes an infringement of the patent hen the article is not made for sale.*

(1) A suitable diagram is given in Fig. 1. The uned anode method of high frequency coupling s employed, with reaction to the first anode nductance, and double pole change-over switches are provided for cutting out the high frequency valves. (2) To receive short wavelength transmissions, the frame should be as large as convenient. The object should be to make the natural wavelength of the frame as near as possible equal to the wavelength of the signal to be received. If a small-sized frame is used, obviously a large number of turns will be required. If a large frame is used a smaller number of turns will be required. The turns should be placed about ½″ apart. We would refer you to the "Radio Experimenters' Handbook," Part 2. (3) The three-coil holder is intended, as a rule, to accommodate the aerial, closed circuit, and reaction coils. (4) Under the circumstances, we believe no infringement of a patent is involved.

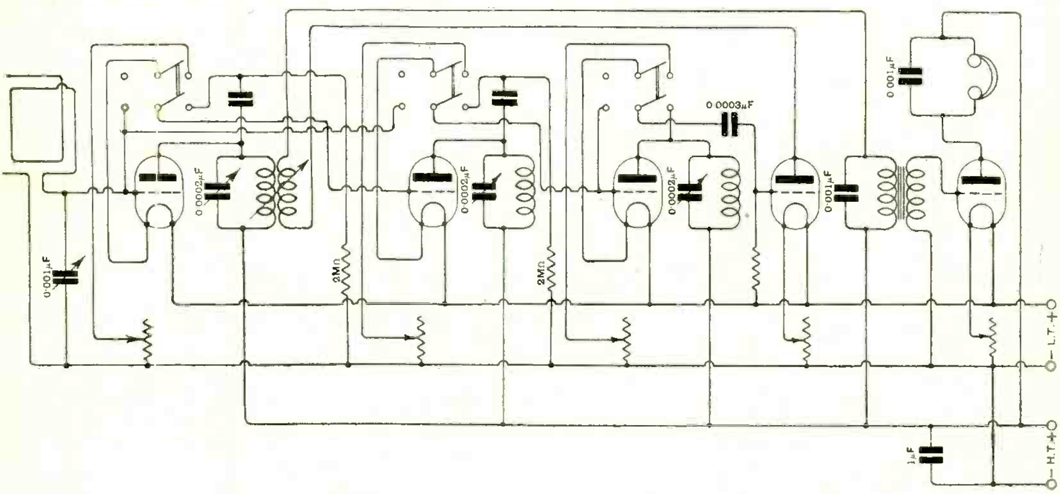


Fig. 1. **"A.A.B." (London, N.W.8)**. *A five-valve receiver for use with a frame aerial. Three H.F., detector, and one L.F. valves are employed, with switches for varying the number of valves in circuit.*

"E.A.P." (Whitkirk) *asks* (1) *For particulars of an aerial tuning inductance of the cylindrical, single layer type, fitted with a dead-end switch, which, when tuned with a* 0·0005 μF *variable condenser, will have a wavelength range of* 150 *to* 3,000 *metres.* (2) *For particulars of a single-layer cylindrical anode coil, with tappings, to cover a wavelength range of* 150-3,000 *metres when tuned with a* 0·0002 μF *variable condenser.* (3) *What will be suitable dimensions for a reaction coil to couple with this anode coil.* (4) *What is the best H.T. voltage for the Ediswan "A.R." and M.O. "R" type valves when used as H.F. amplifiers.*

(1) We suggest that you wind two layers of No. 26 D.C.C. wire on a former 4″ in diameter and 7″ long. Take 10 tappings, the first from the twentieth turn, and the rest equally spaced along the coil. (2) We suggest that you wind a layer of No. 30 S.S.C. wire on a former 3″ in diameter and 8″ long. Ten tappings should be taken, the first from the fifteenth turn, and the rest equally spaced along the coil. (3) A suitable reaction coil might be constructed by winding a layer of No. 30 S.S.C. wire on a former 2½″ in diameter and 6″ long. This should be arranged to slide inside the anode coil. (4) For the Ediswan "A.R." type, a suitable value would be up to about 60 volts, and for the M.O. "R" type, about 70 volts.

"CHARDON" (Glasgow) *asks for an explanation of a defect in an accumulator.*

Provided that the accumulator has been charged at the correct rate, the trouble to which you refer probably arises from impure acid. We advise you to thoroughly clean the interior of the case, and refill with pure acid, diluted to the correct specific gravity with distilled water.

"AERIAL" (Southport) *asks* (1) *Which Igranic coils are required in a receiver employing a single circuit tuner, with one H.F. valve, tuned anode coupled, in order to tune from* 1,000 *to* 2,800 *metres.* (2) *Which coils of the same type will be necessary for wavelengths from* 450 *to* 1,000 *metres.* (3) *How is a potentiometer connected to two H.F. valves.* (4) *When satisfactory reception from all the British broadcast stations can be obtained with an indoor aerial, would a good outdoor aerial be an improvement.*

(1) A No. 250 coil will cover this range when a series parallel switch is used in conjunction with an aerial condenser of 0·001 mfd. capacity. Two anode coils will be required, a No. 200 and a No. 300. A No. 150 or 200 will be suitable for the reaction coil. (2) The aerial inductance will be a No. 100 or No. 150 anode inductance. (3) The method of connecting a potentiometer to H.F. valves is indicated in Fig. 3, page 226 of the issue of May 19th, 1923. (4) The use of an outdoor aerial will make a great improvement.

"S.B." (Norway) *asks* (1) *For a diagram of a seven-valve receiver employing* 3 *H.F., detector, and* 3 *L.F. valves, the H.F. valves to be tuned-anode coupled. Switches are required for cutting out all valves.* (2) *How is it possible to shield the H.F. stages.*

(1) The diagram is given in Fig. 2. (2) The different stages of H.F. amplification may be enclosed in metal boxes, which should totally

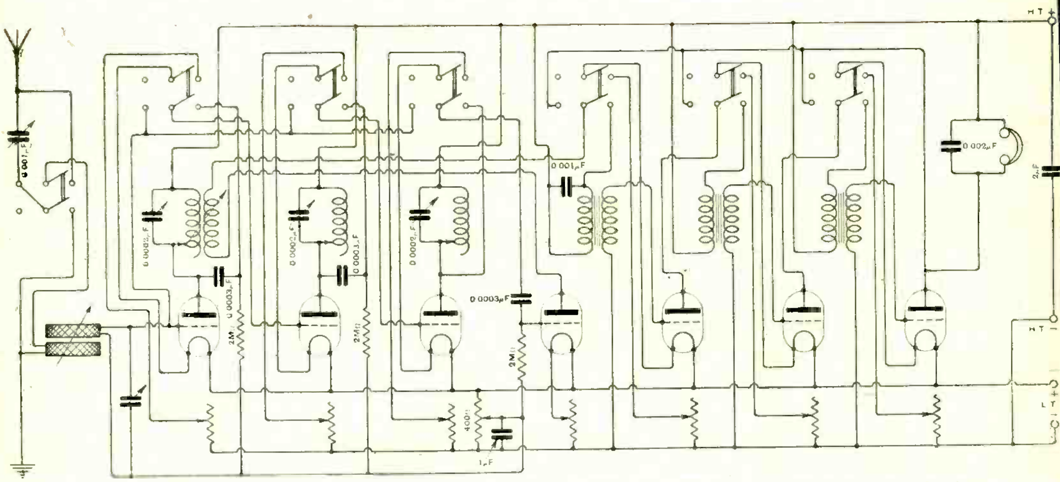


Fig. 2. **"S.B." (Norway).** *Diagram of receiver with three stages of H.F., rectifier, and three note magnifiers.*

enclose each stage apart from the small spaces required for connections. Spacing is usually quite effective.

"A.P.C." (Catford) *has a loose coupler, particulars of which he gives. He desires to use this loose coupler for the anode and reaction inductances and asks* (1) *For dimensions of a suitable A.T.I. to use with this coupler.* (2) *What valves do* [you] *advise for use as L.F. and H.F. amplifiers. How should the coils mentioned in question* (1) [be] *connected for the purpose mentioned.*

(1) We suggest that you wind a layer of No. D.C.C. wire on a former 3½″ in diameter and long. Take ten tappings, the first at the 2C turn, and the rest equally spaced along the co (2) The "R" type valve gives satisfactory resu as a low frequency amplifier. For H.F. amplific tion we suggest that you employ the "V.24 type, which is specially designed for this purpo (3) The outer coil should be connected in series the anode circuit of the H.F. valve, and the oth coil in series in the anode circuit of the detect valve, the coils being magnetically coupled. S Fig. 4, page 331, of the issue of June 9th, 1923.

"F.I.V." (Keighley) *asks* (1) *With referen to the diagram given on page* 293 *of the issue June 2nd, which are the input and output termina of the intervalve and telephone transformers.* (2) *Which terminal of the high resistance telephon should be connected to positive H.T.* (3) *To whic terminal of the telephone transformer should th positive terminal of the low resistance telephone be connected.*

(1) and (3) The primary windings of the inter valve transformers are those connected in serie with positive H.T. The terminal marked O.P. is connected to positive H.T., O.S. to grid, I.S. to negative L.T. The terminal marked O.P. of the telephone transformer is connected to positive H.T., I.P. to plate, O.S. to positive terminal of L.R. telephones. It is really not very important. (2) The positive terminal of the telephones should be connected to positive H.T.

"ZUNT" (Cheshire) *asks* (1) *For a diagram a seven-valve receiver employing one H.F., detector, nd five L.F. amplifiers, using only two L.F. ansformers.*

(1) Your query is not at all clear, and it is not ossible to give you a circuit such as that asked or. If you desire to use five L.F. valves, it will be ecessary to obtain five L.F. transformers. We hink you will have considerable difficulty in btaining satisfactory results with five stages of .F. amplification. In general, we do not recommend the use o more than two stages of transformer .F. amplification, which when correctly arranged will produce all the amplification required.

"A.K.J." (Woolwich, S.E.) *asks for the identity of* **5 RN.**

We regret we have not received the authority of the licensee to publish particulars of this station.

similar to that described in the reply to **"East Boldon" (Newcastle),** *in the issue of May 12th,* 1923. (2) *Which types of valves are suitable for use in this receiver.*

(1) The L.F. transformers may be constructed as follows: On an iron wire core ½″ in diameter and 3″ long, wind 15,000 turns of No. 42 S.S.C. wire for the primary winding, and 40,000 turns of No. 44 S.S.C. wire for the secondary winding. Care should be taken in the insulation of the primary winding from the core, and of the secondary winding from the primary winding. (2) The H.F. valve may be of the "V.24" type, and the two L.F. valves of the "R" type.

"J.S." (S.S. "British Advocate") *asks a number of questions.*

You should consult a good wireless textbook. There are a number of such textbooks available, and a catalogue will be sent you post free on application to the Wireless Press, Ltd., 12-13, Henrietta Street, London, W.C.2.

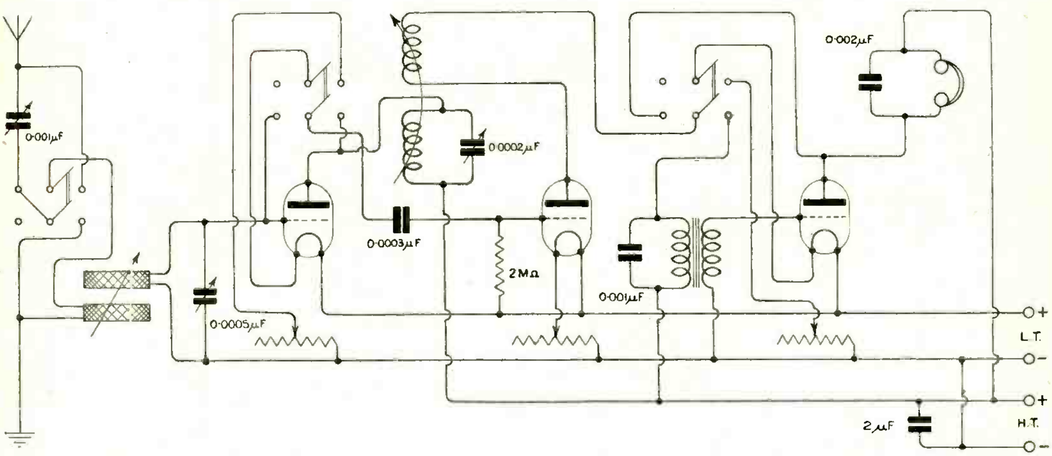


Fig. 3. **"E.J." (Brondesbury N.W.6.).** *A three-valve receiver employing one H.F., detector, and one L.F. valves. The H.F. and L.F. valves may be switched out of circuit by means of double pole change-over switches.*

"A.A.E." (Bath) *submits a diagram of a two-valve receiver employing double magnification, and asks* (1) *For criticism of the diagram.* (2) *Will the reception with this receiver be as loud as with a four-valve receiver employing single magnification?*

(1) The diagram is correct. (2) When properly adjusted, the results obtainable with the double magnification receiver should equal those obtainable with a normal three-valve arrangement.

"E.J." (Brondesbury N.W.6) *asks* (1) *For a diagram of a three-valve receiver employing one stage of H.F., tuned anode coupled, detector, and one L.F. valve, with reaction to anode inductance or aerial tuning inductance as required. Switches are required for cutting out the H.F. and L.F. valves, also a stand-by tune switch.*

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

"T.T." (Wednesbury) *asks* (1) *For details of the construction of transformers for use in a receiver*

"H.J.E." (Sutton Coldfield) *submits particulars of a three-valve receiver he is using, and asks* (1) *Would a receiver constructed on the "Neutrodyne" principle, as described in the issue of April 21st,* 1923, *give results equal to his present receiver, and equal to the three-valve receiver described by Mr Ferguson in the issue of May 5th,* 1923. (2) *With reference to the H.F. transformer described on page 71 of the issue of April 21st,* 1923, *how is the primary winding wound relatively to the secondary.* (3) *What is the most effective way of eliminating atmospherics.*

(1) A receiver carefully constructed on the "Neutrodyne" principle will give equal or rather better results than either of the two receivers mentioned. (2) The windings are wound in the same direction. (3) We would refer you to the articles which have appeared on atmospherics

from time to time in this journal. See issues of July 7th and 14th and August 1st, 1923.

"J.F.L." (Norwood) *gives details of one method of insulating the wiring of the H.T. leads in a receiver which he proposes to adopt, and asks* (1) *Is the method suitable, and would it be advantageous to employ it for the whole of the wiring in the receiver.*

(1) The proposed method of insulation will be quite suitable. It is not necessary to use such elaborate insulation for the whole of the wiring of an ordinary receiver.

"J.O.S." (London, N.6) *asks* (1) *With reference to the wavemeter described by* **5RL** *in the issue of May 19th, 1923, what is a suitable size for the rotor.* (2) *What is a suitable winding for the air core choke coil.* (3) *What are suitable windings for a microphone transformer.*

(1) and (2) The rotor may be 3″ in diameter. It should obviously be so large that it just clears the inside of the stator. The choke coil may be two or three basket coils of 60 turns of No. 30 S.S.C. each, or a three-pile winding of No. 28 S.S.C. on a 2″ diameter ebonite, former 1″ in length. (3) On an iron wire core ½″ in diameter and 4″ long, wind 200 turns of No. 22 S.S.C. wire for the primary winding, and 20,000 turns of No. 40 S.S.C. wire for the secondary winding.

"RADIOPULGAR" (Fulham, S.W.) *asks* (1) *When using a three valve H.F. amplifier with tuned anode coupling, should the reaction coil be coupled with the first or third anode inductances.* (2) *If the reaction coil is coupled to the first anode inductance, is there any objection to putting an anode resistance in the third anode circuit, and connecting a crystal detector and the telephones across this resistance. If so, what is a suitable value of the resistance when using D.E.R. type valves.* (3) *To make the receiver as selective as possible, which of the following two methods of tuning would be more suitable—a two-circuit tuner and one tuned anode H.F. coupling, or a single-circuit tuner and two tuned anode H.F. couplings.* (4) *Are certain switches as advertised in this journal satisfactory.*

(1) The reaction coil should preferably be coupled to the first anode inductance. (2) The resistance capacity method of coupling valves is not recommended for short wavelength work. (3) It would be preferable to employ a two-circuit tuner, and one tuned anode. (4) The switches are satisfactory.

"J.P.G." (Shrewsbury) *asks* (1) *and* (2) *For details of the windings required on a frame aerial, 3 ft. square, using No. 16 wire, which will tune to a wavelength of 400 metres with a* 0·001μF *variable condenser in parallel.*

(1) and (2) We suggest that you wind the frame with 10 turns of the wire mentioned, the spacing being ¼″.

"S.B." (Midhurst) *asks* (1) *With reference to Fig. 61 in "The Amateurs' Book of Wireless Circuits," would we give this circuit with the following alterations: Reactance to first H.F. valve, and switch to cut out second valve if required.* (2) *To which terminal of the L.T. battery should the grids of the L.F. and H.F. valves be connected. Also would it be preferable to use a potentiometer for the H.F. valves, and grid cells for the L.F. valves.* (3) *Is it possible to use a variable grid condenser in conjunction with a variable grid leak.* (4) *W[ith] reference to Fig. 56 in "The Amateurs' Book [of] Wireless Circuits," is the switching of the H.F. val[ve] correct, or should the grid leak and condenser [be] disconnected when switching out a H.F. valve.*

"J.M." (Manchester) *asks* (1) *For a diagram [of] a receiver employing one H.F. valve, with cryst[al] rectifier.* (2) *Which is the more selective form [of] tuner to employ of the basket and honeycomb co[il] types.* (3) *Which type of crystal detector will [be] suitable for use in the circuit mentioned in question (1[).]*

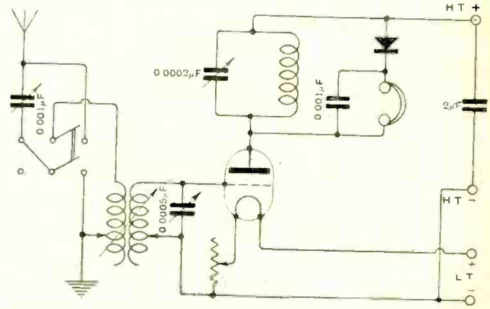


Fig. 4. **"J.M." (Manchester)** *A receiver with one H.F. valve, and employing crystal rectification.*

(4) *Is it possible to energise the aerial when using this receiver.*

(1) The diagram is given in Fig. 4. (2) Either type of coil will give satisfactory results. (3) A carborundum or perikon detector will be found quite suitable. (4) It is possible to energise the aerial when using this type of receiver, but with ordinary care in handling, no trouble will be caused.

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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Under the Supervision of W. JAMES.

CONTENTS

THE EDITOR will be glad to consider articles and illustrations dealing with subjects within the scope of the Journal. Illustrations should preferably be confined to photographs and rough drawings. The greatest care will be taken to return all illustrations and manuscripts not required for publication if these are accompanied by stamps to pay return postage. All manuscripts and illustrations are sent at the Author's risk and the Editor cannot accept responsibility for their safe custody or return. Contributions should be addressed to the Editor, "The Wireless World and Radio Review," 12 and 13, Henrietta Street, Strand, London, W.C.2.

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PASSED BY THE POST OFFICE

A FEW OF THE DIFFICULTIES MET WITH IN CARRYING OUT THE REGULATION

IT is quite obvious that the Post Office meant well when it decided to test receivin apparatus in order to make sure that in use it would not cause interference. Th task has proved an exceedingly difficult one, as it is not possible to so restrict the use that he cannot change a valve or a coil, and by so doing he may so modify th action of the apparatus that it oscillates vigorously. There is no high frequency amplifie yet designed that will not energise the aerial circuit.

The problem of judging the technical ability of an individual to determine his suitabilit for the award of experimental facilities, would be an even more formidable task thar deciding whether or not manufacturers' receiving apparatus is capable of causing inter ference. It is doubtful if the issue of experimental licences can be restricted in any way even though many amateurs may agree that it might be desirable. Just as full experimenta facilities are awarded to the manufacturers and research companies who are working fo the purpose of satisfying their shareholders, so must a private individual be permitted to conduct research at home, for he is labouring in the hope of finding something new which may, perhaps, mean a considerable gain to him. As the experimenter will go ahead, while the non-technical home constructor may in the near future be restricted, everything turns upon the definition of the qualifications of an experimenter, and to define the necessary qualification is extremely difficult. Up to the present, the Post Office has taken every care to satisfy itself as to the ability of the applicant before an experimental receiving or transmitting licence is granted to him, but with the existing method of award of the experimental licence the task must be rather difficult. It is a common occurrence for this Journal to receive a request from a person who is making application for such a licence asking that he may be informed as to suitable replies he can make to the questions on the application form. Every experimenter must have been asked at some time or other by a would-be experimental licence holder: "What line of research did you tell the Post Office you were going to take up and what do you think I might say to indicate that I have a good knowledge of the subject?"

The issue of experimental or any other form of licence which may be desirable, has no doubt received the serious consideration of the Broadcasting Committee, and one would not envy the position of the Post Office authorities in enforcing any legislation which might limit the activities of experimenters, home constructors, and others.

Reports received from many districts would indicate that the Post Office is now active in carrying out the inspection of experimental stations, and it appears that this is being done by members of the telegraph or telephone services who in many instances have little or no wireless knowledge. In addition it is observed that the inspectors are required to complete forms giving details of the experimental station, and apparently there is very little change in the particulars required now from those asked for in 1914. For instance, the inspector is asked to determine the source of power, its voltage, and the current taken. It may so happen that the experimenter is deriving his power from public supply mains at 240 volts, and in order to obtain a suitable working voltage, it may even be necessary to employ a potentiometer across the power leads in order to get a much lower D.C. voltage. The resistance wire of the potentiometer may perhaps pass as much as 5 amperes, which leads to the conclusion that the experimenter is using something like a kilowatt. He is not questioned as to the anode current of the oscillator valve, while the inspector has no means for determining the voltage applied to the anode, and perhaps does not understand the principles of the circuit or the system of the modulation. He makes enquiry as to the type, size, and maximum discharge rate of the accumulator battery used for filament heating, though one cannot see what this has to do with the power used, or in any way to what extent the user is conforming to the terms of his licence.

ISTORTION IN VALVE RECEIVING CIRCUITS

The problem of the elimination of distortion in valve receiving circuits is of great importance at the present time. Quality of speech or music is a first consideration, and necessitates careful design of the tuning and amplifying circuits.

By S. O. Pearson, B.Sc.

(1) High Frequency Circuits.

T seems to be a very common belief that no distortion of speech can possibly occur in a high frequency amplifier, but this is far from being the case. Anyone o has used reaction must have noticed at the quality of received speech or music seriously impaired when the reaction is justed so that self-oscillation is just on e point of occurring. No doubt this ljustment gives the loudest signals and e most selective tuning, but the speech ses its crispness. Of course if self-oscilla- on does actually occur, the speech becomes ite unintelligible unless the receiving set quite close to the transmitting station. elf-oscillation must not be permitted to ke place under any circumstances whatever hen receiving telephony.

We shall first consider the cause of dis- ortion which occurs when reaction is used nd critically adjusted. In order to under- tand this clearly it will be necessary first o consider briefly an ordinary D.C. circuit ontaining resistance and inductance in eries and then to make a comparison with tuned oscillatory circuit (Fig. 1). It is well- nown that if a steady voltage E is suddenly pplied to the ends of a circuit containing esistance R and inductance L, the resulting urrent does not reach its full value E/R t once, but builds up gradually. This is sually explained by the fact that the ncreasing magnetic field linked with the ircuit generates a back E.M.F. which opposes the growth of the current, this self-induced E.M.F. being proportional to the rate at which the current is increasing. Thus if e is the back E.M.F. at any instant, the current at that instant will be $i = (E-e)/R$, that is, the current is proportional to the difference between the applied voltage and the back E.M.F. The curve of Fig. 1 (*b*) shows how the current varies with time after first switching on. The building up of the current is most rapid at the start and if this initial rate of increase were maintained, as indicated by the straight line OA, the full value would be reached in a time $T = OB$ seconds. This is known as the Time Constant of the circuit and it can be shown that $T = L/R$ seconds. During this interval the current rises to 0.632 of its full value. Note that the final value is quite independent of the inductance.

Before we can apply the analogy of the D.C. circuit to an oscillatory circuit it is necessary to consider the gradual growth of the current from another point of view, namely, the energy stored in the magnetic field. The building up of a magnetic field involves the expenditure of a certain amount of energy which is stored in the magnetic field, and returned again to the electric circuit when the field is destroyed. It can

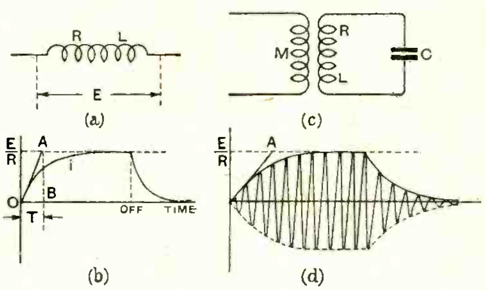


Fig. 1

be shown quite easily that the energy stored in the magnetic field of a circuit of inductance L, is $\frac{1}{2}Li^2$ watt seconds or joules, where i is the current producing the field. Now the rate at which this stored energy is being accumulated at any instant is equal to the power being supplied to the circuit at that instant less the power wasted in heating the resistance, that is, equal to $(Ei-i^2R)$ watts. If the stored energy were assumed to be accumulated instantaneously, it would mean that the power supplied to the circuit would have to be infinitely great for an infinitely short interval of time; but the voltage E is fixed and the current could not possibly be greater than E/R amps. Thus the stored energy must be accumulated gradually and therefore the current must build up gradually. For similar reasons the same time lag is introduced when stopping the current. We see then that the current cannot be changed suddenly, but that a time lag is introduced. The higher the inductance and the lower the resistance the more pronounced will this time lag be.

We are now in a position to consider an ordinary tuned oscillatory circuit as shown in Fig. 1 (*c*). Suppose that an alternating voltage E, of frequency f cycles per second is induced into the coil LR by means of the coupling coil M, connected to the source of A.C. supply. The effect is exactly the same as that which would obtain by connecting an A.C. generator in series as in Fig. 2.

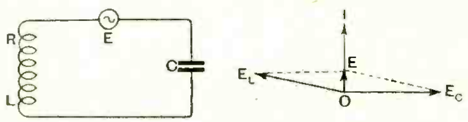


Fig 2.

Suppose further that the circuit is tuned to the frequency f so that $f = \frac{1}{2\pi\sqrt{LC}}$. When the circuit is adjusted to resonance in this manner, the reactance due to the inductance is exactly neutralised by the equal and opposite reactance due to the capacity and thus the alternating current flowing through the circuit is given by $I = E/R$, just as if there were no inductance or capacity present. This is only true when the circuit is exactly tuned to resonance.

According to the well-known laws of the simple oscillating circuit, the voltage across the circuit passes through its zero values when the current is greatest, and the current is zero when the voltage has its maximum value. Let I and E represent the maximum or peak values of the current and voltage respectively. Then at the instant when the current is greatest the energy stored in the inductive portion of the circuit is $\frac{1}{2}LI^2$. As the current in the coil falls the voltage across the condenser builds up, so that the energy of the magnetic field is being reduced and electrostatic energy is being stored in the condenser. Actually the energy is being transferred from the inductive coil to the condenser, but not all of it—for a certain amount is wasted as heat in the resista of the circuit. However, in a circuit wh continuous oscillations are maintained t resistance loss is exactly compensated by energy drawn from the supply.

When the current has fallen to zero, a the voltage across the condenser has ris to its maximum value, the whole of t stored energy has been transferred to t condenser, its value now being given $\frac{1}{2}CE^2$. Since the power lost in the resistan is at every instant equal to the power tak from the supply, it follows that *the tot stored energy in the oscillatory circuit constant for a given amplitude of oscillatio* that is, at every instant the sum of th energy stored in the coil and that stored the condenser is constant for a given ampl tude and is proportional to the square the amplitude of the oscillation.

Referring back we see that this is exactl the same law as for the D.C. circuit excep that we are now considering the maximu values of an alternating current instead the actual values at every instant. Henc for the same reasons given above for th D.C. circuit, the stored energy in the oscilla tory circuit must be accumulated graduall and so the oscillations must be built u gradually, even though the oscillating E.M.F induced into the circuit be suddenly applie and kept constant in amplitude. But a this point we must be careful to note tha we are dealing with the peak values of the successive waves and not the effective values. In a sine wave the effective value is $\frac{1}{\sqrt{2}}$ times the peak value. Now the average value of the power supplied to the circuit is equal to the product of the effective values of volts and amps, *i.e.*, to $\frac{E}{\sqrt{2}} \times \frac{I}{\sqrt{2}}$ or $\frac{1}{2}EI$ watts. Thus as compared with the D.C. circuit the energy will be accumulated at only half the average rate, and so the time constant will be twice as long for the oscillatory circuit, namely, $2L/R$ seconds. Apart from this difference, all of the laws are exactly the same as for the D.C. circuit—the final steady value of the maximum amplitude of the current is given by $I = E/R$—the circuit has a time constant of magnitude $2L/R$ seconds—and when the induced or applied E.M.F. is suddenly removed the oscillations die down according to the same

·. Fig. 1(*d*) shows how the oscillations ld up and how they gradually die away ain when the supply is cut off.

Most experimenters are quite familiar h the dying away of an oscillation, and ow that the lower the resistance of the cuit the longer will be the time taken for e oscillations to die out, and we now see at the same laws apply to the building up oscillations. Thus the amplitude of the cillations in a tuned circuit *cannot be anged suddenly*, and it is on this account iat distortion can and does occur in high equency circuits.

The radiation from a telephony transitting station consists of a carrier wave of onstant radio frequency but whose amplide is being varied at audio frequency in ccordance with the wave shape representing he speech. This modulated radiation inuces in the receiving aerial an oscillating E.M.F. whose magnitude is at every instant proportional to the amplitude of the carrier wave. But the current oscillations in the aerial and through the tuner (and thus the oscillation of potential across the tuner) will not necessarily be proportional to the E.M.F. induced in the aerial for the reasons given above, particularly if the resistance of the circuit is very low.

An example will make this clear. Suppose for instance that we were to receive a signal where the carrier wave is modulated in the manner shown by the upper curve of Fig. 3, that is, the audio frequency component is a rectangular wave; then if the resistance is very low, the time constant of the tuned aerial circuit will be correspondingly large, and for the reasons given above, the current oscillations will vary in amplitude according to the lower curve of Fig. 3. This shows that the actual oscillations produced in the receiver are not a true copy of the modulated carrier wave, the audio frequency component being seriously altered in shape or distorted. Of course, in the transmission of telephony, one is not likely to find an instance where the low frequency component of the wave is rectangular in shape, but the example serves to show how distortion does occur. In all cases where the audio frequency wave exhibits sharp peaks and sudden corners, these peaks and corners will be rounded off on account of the time lag in the circuits.

In an ordinary tuned circuit the resistance is sufficiently large compared with the inductance to make the time lag quite negligible and no distortion is noticed. A circuit which has a high resistance is said to be *highly damped* because free oscillations are rapidly damped out, the stored energy being quickly dissipated as heat in the resistance. Reaction is used in a valve circuit to replace this loss of energy, so that in effect the use of reaction is equivalent to reducing the resistance, and so the damping, of the tuned circuit. Thus if the reaction is adjusted so that the energy transferred from the reaction coil to the tuned circuit is almost equal to the energy being lost in the resistance, the circuit will behave as though there were practically no resistance present. Under these conditions the tuning will be particularly sharp and the time lag in the circuit will be very large, causing serious distortion of the received speech. When the reaction is increased sufficiently to produce self-oscillation it means, in the light of the foregoing discussion, that the resistance losses have been completely compensated for, and the equivalent resistance of the circuit has become zero, so that the time constant is now infinitely great. Thus, if oscillations are once started they will persist.

The above considerations apply to any tuned high frequency circuit, including tuners and tuned intervalve couplings.

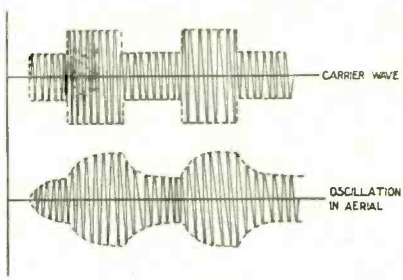


Fig. 3.

There is another source of distortion in high frequency circuits quite apart from the time lag discussed above, but the fault in this case does not lie entirely in the receiving circuit, the trouble originating at the transmitter. This relates to *change of wavelength at audio frequency* at the transmitting station and loss of quality is only noticed when the receiver is sharply tuned.

In an ordinary valve oscillator, such for instance as a heterodyne wavemeter, it will be noticed that if the H.T. voltage is varied, the wavelength will be slightly changed. As the modulation of the carrier wave at a transmitting station is often effected by varying the voltage on the plate of the transmitting valve, it follows that the wavelength will vary slightly in accordance with the low frequency variations of the amplitude of the carrier wave. For each particular value of the amplitude of the carrier wave then, there will be a corresponding definite wavelength, that is, a band of wavelengths is produced. If the receiving circuit is v sharply tuned, it will select one portion this band of wavelengths to a greater ext than the rest with the result that the qual of the speech suffers. The writer has fou that, even when using a single valve circ without reaction, the quality of speech fr a broadcasting station is decidedly bet when received on a tuner wound with th wire than on one wound with thick w or " Litz " where the tuning is much sharp

(Further articles will deal with distortion in detecting and low frequency amplifying circuit

The E.J.H. Circuit.

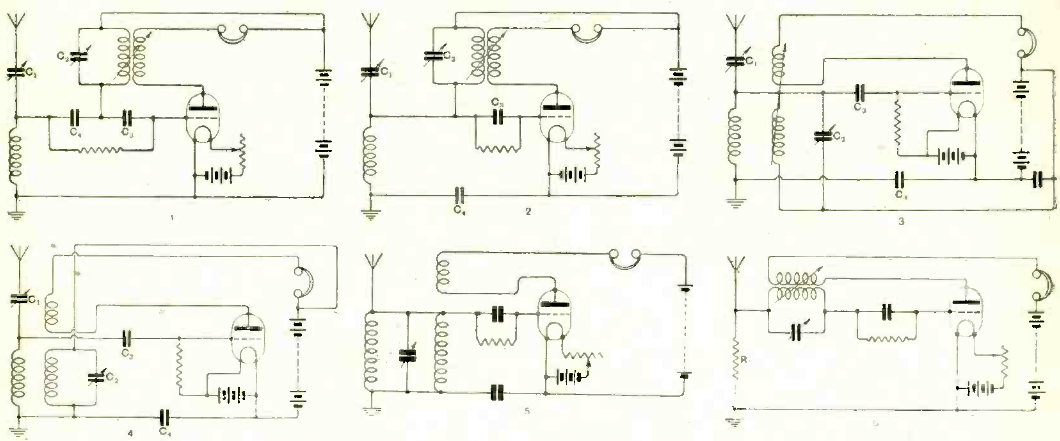
ALTHOUGH this circuit does not pretend to be ultra-sensitive, it appears to be efficient, and has brought forth favourable comment. Some readers claim to have used the circuit for some time. How many have improved it?

About twenty variations are possible, and a few of the best are given herewith. Figs. 1 and 2 are obvious arrangements. It is better, however, to connect the grid leak to the filament positive instead of placing it across the grid condenser.

Circuits shown in Figs. 3 and 4 work well. The value of the condenser C_4 is not critical, and good results may be obtained with 0·003 μF to 0·005 μF. C_2 should have a maximum value of 0·0001 μF if the greates efficiency is desired. Other condenser value are normal.

Figs. 5 and 6 are suggestions worth trying and are merely modifications of circuits th writer has seen elsewhere. Fig. 6 is a interesting method of tuning to short wave lengths, as the capacity and inductance o the aerial are negligible. R_1 need no exceed 1,000 ω, and the circuit will work without it, but it is desirable to include it. In the case of Fig. 5 the inductance L_2 is usually about twice the value of L_1. The most suitable values for individual sets, however, must be determined by experiment.

E. J. H.



Suggested modifications to the circuit recommended by E. J. H.

SHEET METAL WORKING.

SIMPLE PROCESSES USEFUL IN WIRELESS INSTRUMENT MAKING.

By Richard Twelvetrees, A.M.I.Mech.E.

IT is said with a great deal of truth that some wireless instruments can be put together with the aid of very primitive tools, but amateurs who confine themselves to the work of assembling ready-made components, miss a great deal of real scientific knowledge, and certainly deprive themselves of the pleasure and satisfaction to be gained from constructing their own apparatus throughout.

Now in selecting the best kind of equipment for the kind of work bench or the workshop described in previous issues of this journal, a very large number of important considerations arise. The amateur may provide himself with one of the numerous catalogues of tool merchants, which in themselves are extremely valuable, spend hours in making up his mind what to buy, and then go and purchase an expensive set of tools which do not actually fulfil the conditions prevailing in his own particular work. In looking through any illustrated catalogue one will find details of many similar tools for performing the identical operations, and in some cases the differences relate to price only. Price alone is not the sole factor to be taken into account in selecting tools; for whilst in some instances an inexpensive tool will serve just as well as one costing double the price, the reverse is equally true in other cases. Sometimes the tool that costs most to buy is the cheapest in the long run, and a moment's reflection will convince the amateur constructor that the selection and purchase of tools for his work cannot be done properly without a very considerable amount of forethought.

Classification of Tools.

In thinking out a plan for purchasing a set of tools for constructional operations, it is rather difficult to know where to begin, unless we direct our thoughts in well-defined channels. Standing in the middle of a fairly well-equipped shop and glancing round, one can see this and that tool without which many jobs would be impossible. To turn out a well-stocked tool drawer or cabinet and then commence to describe the contents, would result in a series of notes containing much information, but as untidy and jumbled up as a tool drawer hurriedly crammed with tools in a frantic endeavour to make the shop *look* tidy. Of course, the writer fully realises that a mere cataloguing of tools from a supplier's list would not be very valuable, and therefore in classifying the tools, an endeavour will be made to treat them in relation to their uses and offer such practical hints in their manipulation as may be useful to the general reader.

Cutting up Raw Materials.

Leaving, for the time being, the consideration of wood working tools, the problem of cutting our various kinds of raw material into shape presents itself. We have a bench, a kit of tools for marking out, some sheet metal, and now desire to cut the metal into shape with a minimum amount of waste. If the metal happens to be of a convenient size, some amateurs will proceed to divide it into the required shapes with an ordinary hack saw, and with luck they may succeed under favourable conditions before all the teeth of the blade disappear. The hack saw is an extremely useful implement for a number of purposes, but cutting sheet metal is not included amongst them. If persisted in, the use of the hack saw in this way will increase the shop overhead charges to an enormous extent by the continual purchase of blades. By the way, do amateur constructors often think how the selection and use of tools influence overhead charges? Perhaps not, but the point is worth bearing in mind, for money spent in purchasing unsuitable tools, or replacing those damaged by improper use, is money lost.

Shears for Sheet Metals.

The soft sheet metals, brass, aluminium, tin, etc., up to 1/16 in. thick, used in wireless construction, can be cut to any required shape by the use of hand shears. If properly used, shears will cut the metal clean and evenly, either in curved or straight lines as required, leaving the edges so regular that a few strokes with a file alone are necessary to finish the work off.

Fig. 1 illustrates two useful forms of shears, known as tinman's snips, the straight bladed pair being shown in the vice, whilst the other pair for cutting curves has suitably shaped blades. As it will not be necessary to deal with sheet metal in very large sizes, neither pair of shears need exceed 8 in. or 9 in. in length, and care should be taken to see that they are made from best Sheffield steel. Cheap foreign tools simply flood the market, and although to all appearances they are of good quality, those with edges usually fail miserably to maintain the necessary keenness as soon as they have to be sharpened.

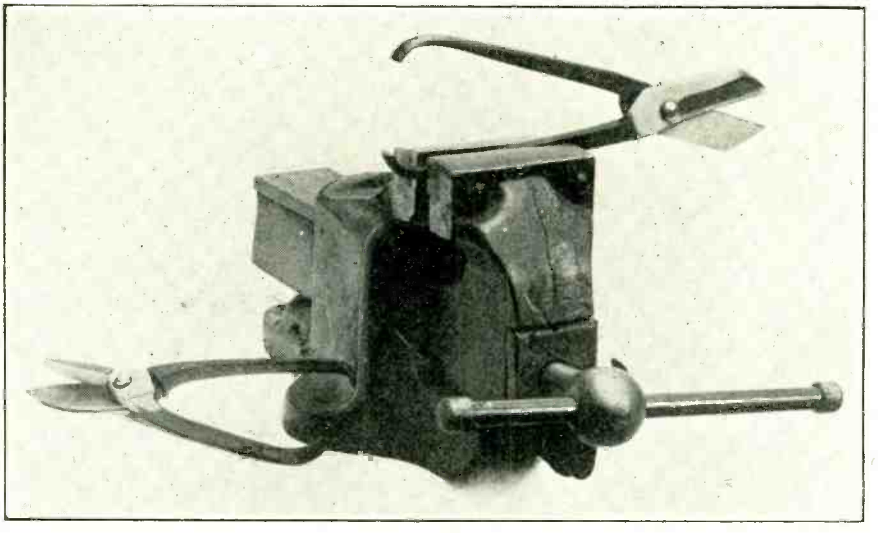


Fig. 1. Tinman's snips mounted in the vice for accurately cutting sheet metal.

A certain amount of practice has to be acquired before one can cut sheet metal with shears, accurately to marked lines; but if the tool is so held that the edge can be lined up with the mark representing the cut, very little difficulty will be experienced. When the metal has been cut to a length corresponding with that of the blade, and the cut has to be continued still further, the end of the tool must not be moved sideways, or the line of the cut in the metal will be deflected. If difficulty is experienced in kee[ping] the cuts straight when the shears a[re] held in the hand, it may be found easier t[o] grip one end of the tool in the jaws of a vi[ce] as shown in Fig. 1, hold the sheet met[al] between the blades with one hand, an[d] operate the tool with the other. This wi[ll] enable beginners to guide the metal so tha[t] the cuts agree with the lines marked on i[t] and incidentally to use the shears in th[e] easiest manner.

Unless a very keen edge is maintained o[n] all forms of shears, they will tend either t[o] twist when being used or else to make th[e] edges being cut very ragged; which can, o[f] course, be prevented by rubbing the blades as required with a fine piece of oil stone.

A Word about Vices.

As might have been expected, the vice has introduced itself at a very early stage of our discussion, and as it is undoubtedly the hardest worked tool in the whole equipment, some detailed reference to it becomes desirable.

Vices can be purchased at prices ranging from two shillings to five pounds each, so that it will be seen that the amateur cannot complain about any lack of variety. Personally, the writer prefers a fixed bench vice with 4 in. jaws, the surfaces of which are renewable, and what is very important—

instantaneous grip action. The latter nsists of an internal rack and cam move-ent, so that by releasing a trigger at the de of the handle, the jaws can be opened closed as required. This arrangement ves much waste of time and labour in xing wide and narrow parts of a piece of ork alternately between the jaws. Swivel-ase vices appear very attractive, as the ws can be turned round to the most con-enient position for working. There may e some swivel vices that remain tight when wivelled to any required position, but the vriter has not yet been able to find one. As rule the swivel mechanism seems to over-vhelm the stability of the vice and the whole iffair develops a very ricketty condition.

The best results will be obtained by using a good solid bench vice, fixed firmly in a permanent position, at a convenient height for the user. The amateur is not advised to purchase examples which combine an anvil or other accessories; let the vice do one job, and if it does that properly it will be worth the money. The addition of anvils with vices tends to induce the amateur to use other parts for the same purpose, and will probably result in damage to the jaws and general ill-treatment of the whole vice.

Shaping Thick Sheet Metal.

When sheet metal is too thick to be cut into the required shape with shears, one of two methods may be used. The first is that of using a cold chisel and the second consists of drilling adjacent holes all round the lines showing where the cut has to be made.

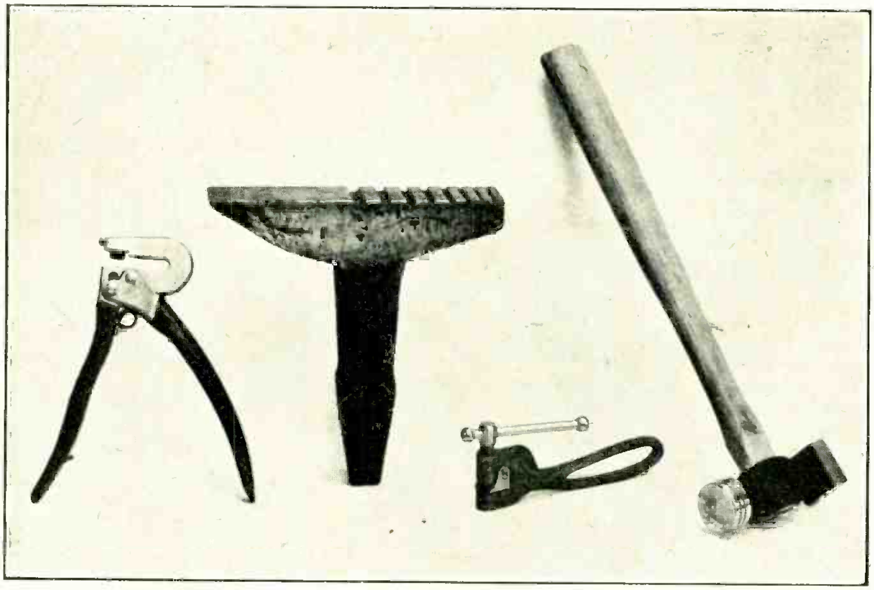
Now although the chisel is probably the oldest tool known to the human race, few amateur mechanics are really adept in using it. Let us imagine we have to cut a narrow strip from a piece of sheet brass about $\frac{1}{8}$ in. thick and propose to use a hammer and chisel for the job. A line indicating the cut is first marked on the brass and the sheet is held in the vice so that the jaws are level with the line. If the chisel is held at a proper angle, the action of the blows combining with the shearing effect of the edge and the jaws of the vice, will cause the strip to separate from the remainder of the metal very easily, and without burrs or other irregularities on the edge. In all kinds of chisel work it is essential to keep one's eyes fixed on the edge of the tool, not on the top. A third-rate mechanic can always be picked out, because in using his hammer he will look at the top of a chisel to be struck, rather than at the cutting edge, where the actual business is going on. In addition to the flat chisel for cutting out work, one or two cross-cut chisels will be found very useful for forming large holes or openings in sheet metal. Narrow cross-cut chisels are used for cutting away circular portions by following circular lines previously marked out with dividers.

The amateur constructor who desires to produce quick and accurate work should spend some time in becoming proficient in using various forms of chisels, not only for cutting out sheet metal but for chipping and removing odd bits of metal, which are treated by filing in the ordinary way. Ten strokes of a chisel will perform more work than several hundred strokes of a file, and at less expenditure of labour and wear and tear on tools.

When work to be cut by chiselling is not held in the vice, it must rest upon a solid metal block—other than the marking-out slab, if you *please*—and the hammer used for the job must be nicely balanced. It is curious to notice the different "feel" of hammers of equal weight, some of them appearing to be much heavier than others. One secret of good chisel work is a well balanced hammer, and if a newly purchased one seems heavy to handle, the balance can be corrected by rasping away the reduced portion of the shaft until the desired result is obtained. In the days when really first-class hand work was done in workshops, little details of this kind received close attention, and the amateur will appreciate that such minor refinements in tools make all the difference between good and indifferent workmanship.

Bending Sheet Metals.

Having discussed the more important points connected with shaping sheet metal, we now have to consider how metal may be bent into a few simple forms. Attempts to bend sheet or strip metal at right angles in the jaws of a vice usually leads to disappointing results, for not only do the edges of the hard jaws disfigure the metal, but the latter is very apt to split whilst being hammered over. Without entering into complicated details of the art of metal bending, we may pass on by recommending the use of the bick iron illustrated in Fig. 2, together with a special square-faced hammer which should be kept for this class of work alone. The main thing to bear in mind when bending metal sheet is that the fibres of the metal will not stand sudden extension, so that the bends must be worked up gradually if chances of fracture are to be avoided. Graduated hammer blows are also necessary in bending sheet metal into curved forms, the rounded portion of the bick iron finding useful employment in this direction. Bick irons, like butter, are sold by weight and for wireless amateurs the smallest size, about 10 lbs. in weight, will be plenty big enough.



(1) (2) (3) (4)

Fig. 2. Tools used in sheet metal working.
(1) *Punch.* (2) *Bick iron.* (3) *Screw punch.* (4) *Square-faced hammer.*

Punching Holes in Sheet Metal.

A tremendous amount of time can be saved by using punches to make small holes in sheet metal, instead of by drilling. The usual form of hollow or wad punch is not recommended for the purpose as these are only suitable for use on soft materials. Punches for this kind of work must be made specially and can be formed from chisel steel turned down at one end to the size of the hole required. For a distance of about $\frac{1}{8}$ in. behind the flat end of the punch the tool must have a clearance made by gradually reducing the diameter. This, as shown in Fig. 3, prevents the tool from jambing in the metal when being driven through wit a hammer, and also permits of its eas withdrawal after the hole has been mad Metal to be punched out in this way must b laid flat on a lead slab, and the range o punches may include sizes from 1/16 in. up to 3/16 in., above which latter size there is the risk of buckling the metal. A special form of punch shown in Fig. 2 is very useful

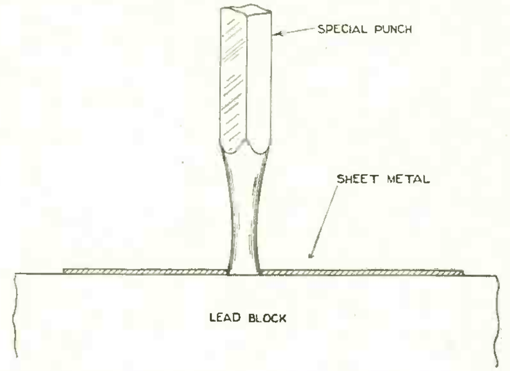


Fig. 3. Method of punching holes in thin sheet metal.

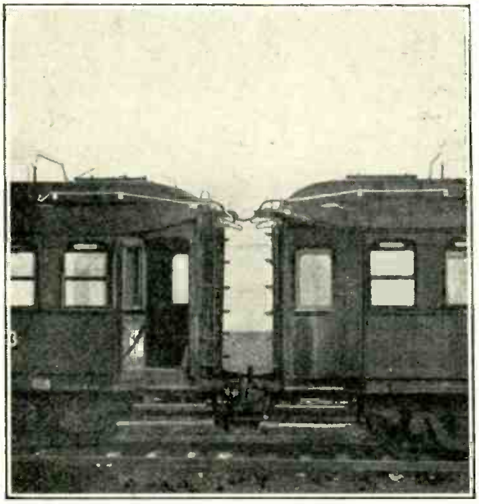
for making small holes near the edges of sheet metal, but for most purposes the plain punch used with a hammer and lead block will be found more generally useful.

DUPLEX RADIOTELEPHONY ON CONTINENTAL RAILWAYS.

By NICHOLAS LANGER.

SOME interesting work has recently been done on the Continent in developing a system of duplex radio telephony on trains, and the experiments carried out have been extremely successful. This new method differs from older attempts in that instead of the transmission being conducted entirely by wireless, there is a combination of both wired and wireless telephony. A fixed transmitting station, instead of propagating electric waves in all directions, energises the wires such as are used for telegraph or telephone purposes.

The receiving aerial is arranged along the top of the railway carriages as shown in the accompanying photograph. There is no connection between this aerial and the telegraph and telephone wires which run along the side of the railway, so that between these two points the transmission is actually wireless. The earth connection of the apparatus installed on the train itself is the rails of the track on which the train travels. Since the telegraph lines running along the side of the railway determine the direction of propagation of the electro-magnetic waves a very considerable saving in transmission energy is thereby obtained, whilst no interference occurs with the ordinary use of these wires for telegraphic or telephonic purposes. The principle is nearly the same as with the well-known wired wireless system which is used almost all over the world. Fig. 1 illustrates how the various connections are made in order that conversations may be carried on between a passenger travelling in the train and the fixed wireless transmitting and receiving set at the railway station, and it also indicates how connections are made with the ordinary telephone line so that a subscriber in a town can communicate with a friend travelling by train at any distance. If the traveller wishes to communicate by telephone with a friend in a distant town he makes use of the system of wireless on the train to ring up the ordinary telephone exchange. He is then connected directly with the telephone of the subscriber in the town and a con-



The brackets on the extreme left and right support the aerial wires. The lead between the compartments is the connecting cable.

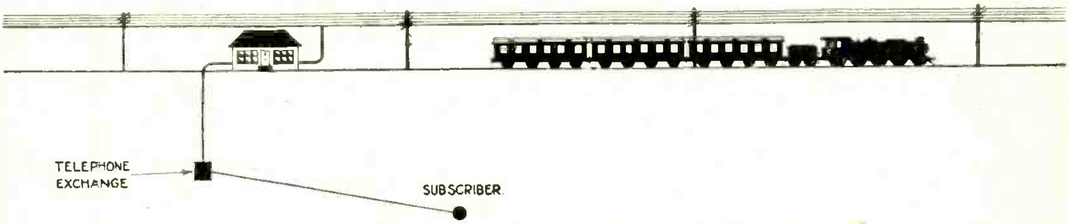


Fig. 1. Schematic diagram showing how communication is established between a subscriber on the public telephone system and the moving train.

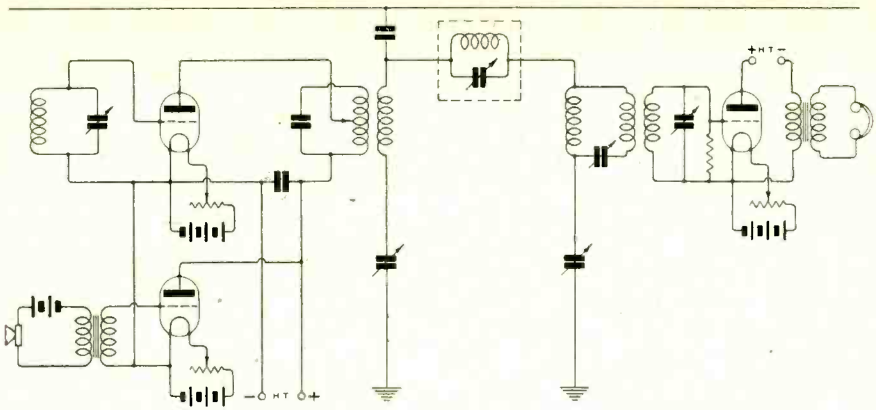


Fig. 2. Circuit arrangement at the fixed station.

versation can be carried on without any interference.

One of the principal difficulties which have held up the development of ordinary wireless transmission to and from trains has been the fact that it has not been possible to install anything in the way of an efficient aerial on the moving train itself. The height of the aerial is decided by the fact that the train has to pass under bridges, and since the distance which can be communicated over is largely dependent upon the height of the aerial, this has been a serious drawback. With the present system, however, the actual wireless transmission has only to cover a distance of two or three yards to the adjoining telephone wires, and consequently an enormous saving of energy is the result, and a very inefficient aerial system will suffice.

Fig. 2 shows the circuit arrangements at the fixed station. Valves are used to generate the high frequency oscillations, the apparatus corresponding largely to an ordinary wireless telephone transmitter. In place of the ordinary aerial and earth connections we have connections to the telegraph or telephone wires and to earth. The simple receiving circuit is shown on the right-hand side of Fig. 2.

On the train itself a similar valve transmitter is employed, and here again instead of aerial and earth the connections are made to wires stretched along the top of the coaches and to the wheels running on the rails. The circuit arrangement of

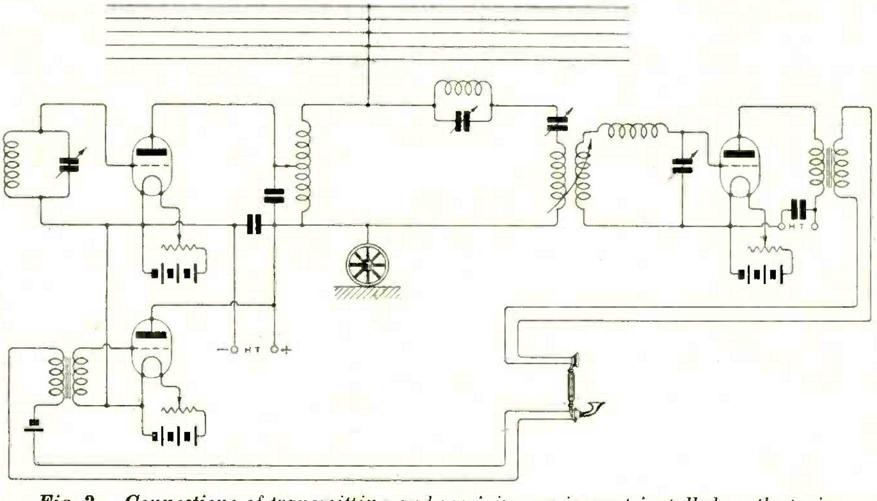


Fig. 3. Connections of transmitting and receiving equipment installed on the train.

1e apparatus on the train is shown in 'ig. 3. At the present time on the trains tted with wireless there is an official vho arranges to put passengers in touch vho desire to carry on a conversation. t is not, however, essential that this official should be in attendance, as new apparatus is devised whereby by simply lifting the receiver the circuits may be put into operation, and these being tuned to definite wavelengths there is no manipulation necessary.

The system has been developed by the Huth Company in Berlin, and particularly by two engineers of that Company, Nauwerk and Walter.

A Common Fallacy.

By W. J. Joughin.

MANY sayings oft repeated by radio enthusiasts do not bear careful criticism. One frequently hears, for instance, the remark, "phones burnt out." This immediately brings to one's mind the idea of stupendous signal strength of such magnitude as to fuse the wire carrying the speech currents.

Careful measurements on average loud speaker signal currents show that the alternating component rises on a peak to about two or four milliamperes above the steady plate current. Much greater modulation currents may be obtained, it is true, but the average value is of this order. Loud speakers or telephone earpieces when wound for high resistance usually have wire of No. 47 S.W.G. This wire has a diameter of 0·002 in. and the current required to fuse a fair length of this wire is 0·917 amperes. Allowing that this wire would fuse much quicker when wound into a coil, as the heat would not so easily become dissipated, it is safe to assume that a coil of No. 47 S.W.G. would require a current of a quarter of an ampere to become unduly hot. Who, then, has such an efficient amplifier as to obtain plate current variations of the order of one quarter of an ampere?

Obviously telephones do not burn out as is popularly supposed, through excessively loud signals or powerful atmospherics, and one must look elsewhere for the trouble. When using powerful amplifiers with unsuitable intervalve transformers, it is possible to hear the signals through the rattling of the transformer stampings. This is no exaggeration, and a good telephone with the diaphragm removed will similarly reproduce signals due to movement of the windings. Here we have the root of the trouble. Physical movement of the wires, either individually or collectively, may easily account for the fracture of the wire at some weak point. This suggestion is borne out in practice, as several years of observation on the behaviour of telephone headgear has brought the following phenomena to notice.

Low resistance telephones are by no means immune from this trouble, but in any given batch it is usually found that approximately two-thirds are high resistance and the rest low resistance. There is also one remarkable fact which may easily be verified. In the case of Brown adjustable telephone headgear, the fault when it develops can easily be traced. If the earpiece is held with the terminals towards one, it is usually the coil to the left which has the fault in it, and very often the fault there is near, if not actually at the join of the leading-in wire. This leads one to expect that the movement is greatest where the magnetic force is greatest. Another check which gives much information is the examination of the broken ends. These have seldom shown signs of having been fused, and in those few cases where fusing has occurred it is safe to assume that secondary effects disguise the real root of the trouble. In the majority of cases, however, it is a plain fracture showing signs of brittleness, a condition probably attained by slight ageing. Frequently it is found that the dye in the green silk-covered leading-in wire has set up local action on the copper extending to several layers.

There is sufficient proof to veto the idea that telephones or loud speakers can burn out through ordinary use, and it is to be hoped that a non-committal phrase such as "petered out" might be substituted for one so obviously incorrect.

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. 16.

To arrange simple apparatus to demonstrate highly selective reception.

The apparatus required is as follows:—

- 3-contact tuner.
- "R" valve.
- Filament Resistance.
- 6-volt battery.
- Variable H.T. battery.
- 0·0001 mfd. variable condenser.
- 0·0003 mfd. fixed condenser.
- 0·001 mfd. fixed condenser.
- Telephone transformer.
- Set Igranic or Burndept coils for wavelengths from 200 to 1,500 metres.
- Coil holder.

The apparatus should be joined up as in Fig. 25. This diagram has been purposely shown in a somewhat unorthodox manner, the principal variation being in the arrangement of the grid circuit and reaction coils, which must not be, under any circumstances, in inductive relation with the aerial tuning coil.

It will be seen that there is no grid leak provided. In its place we have a circuit

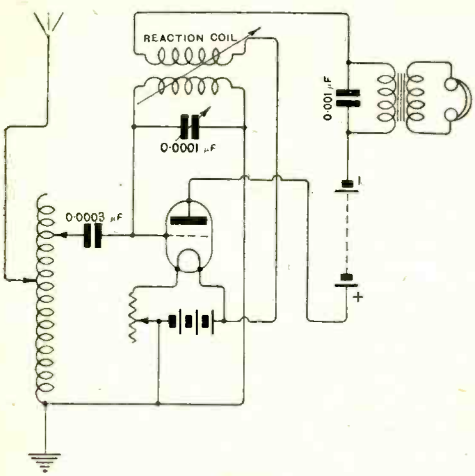


Fig. 25.

which can be tuned with the 0·0001 microfarad condenser, and on the accuracy with which this circuit is tuned will depend the success of the experiment. The connections from the valve to the grid circuit coil and reaction coil should be kept as short as possible and well away from the other parts of the apparatus, especially the tuner.

Having selected the wavelength it is desired to receive, the aerial circuit must be adjusted by means of the buzzer in the usual way. For this purpose it may be found convenient to temporarily disconnect the grid circuit, variable condenser and inductance, and substitute the usual form of grid leak.

On signals being obtained the grid leak should be cut out and the grid circuit carefully tuned until signals are heard. In all probability they will be weak, and can be strengthened up by carefully adjusting the reaction coil. Further improvement in signal strength may be gained by varying the voltage to the H.T. battery, but as the object of the experiment is to demonstrate the possibilities of selective reception, great strength of signal must not be looked for. It should be possible, however, to completely eliminate signals of any wavelength within 1 or 2 per cent. of that desired, provided their strength is not too great.

With regard to the size of coils to be used for the grid circuit, these will depend, of course, on the wavelength to be received. In general, however, it will be found that the greatest success is obtained when the coil in the grid circuit has a minimum wavelength slightly under that which is to be received. The reaction coil should be one size smaller for wavelengths up to 800 metres, after which the size need not be increased. With the values given, it will not be found practicable to use this arrangement for long wavelengths much above 2,000 metres, but if it is desired to do so, the usual arrangement of an additional condenser across the aerial inductance coil, together with a condenser of 0·0005 mfd. in place of the 0·0001 mfd. will enable longer wavelengths to be received by this method.

EXPERIMENT No. 17.

To demonstrate the reception of long-wave high power stations.

The apparatus required is :—

- 2 "R" valves.
- 1 6-volt accumulator battery.
- 2 Filament resistances.
- 1 2-megohm grid leak resistance.
- 1 80,000-ohm resistance.
- 1 H.T. battery, 30 volts.
- 1 Telephone transformer.
- 1 Pair 120-ohm telephones.
- 1 0·0005 microfarad condenser.
- 1 0·001 fixed condenser.
- 1 0·001 variable condenser.
- 1 Set "plug-in" inductances from 200 turns upwards, with holder stand for same.
- 1 Heterodyne wavemeter.

The apparatus must be joined up as in Fig. 26. The aerial inductance "A" should be suited as regards size to the wavelength it is desired to receive. The reaction coil B can be of half the turns on A. Various values of these inductances of the "Igranic" and "Burndept" type are appended for the guidance of the experimenter.

The values given on these tables assume a condenser of 0·001 microfarads across the inductance, and the wave range is that obtainable with this condenser. The experimenter must bear in mind, however, that the extra capacity of the aerial system across the inductance will increase the wave-range by quite an appreciable amount, especially on the shorter wavelengths. As a general guide it will be found that coils one size smaller can be used for any given wavelength when connected in the aerial circuit.

The voltage of the H.T. battery should be from 60 to 80 volts, and may be higher with advantage with certain valves.

In this matter the experimenter is advised to try out things for himself. For wavelengths varying from 15,000 metres upwards, the fixed condenser of 0·0005 microfarads may be increased to 0·00075 with advantage.

As most stations on these long wavelengths are employing continuous waves, it is necessary that some part of the circuit shall be set in oscillation, such as the aerial circuit, and in the diagram the reaction coil is shown coupled directly to this circuit. The experimenter need not trouble himself with regard to the production of waves from his aerial, as they will be very, very weak, owing to the large inductance inserted in this circuit; such radiation would only be detected at a distance of a few hundred yards, except with very elaborate or powerful long wave amplifying apparatus.

It is unlikely, in practice, that any other experimenter or station in the near vicinity will be receiving on such very long wavelengths, and if so, will not probably be adjusted to the particular wavelength that may be selected for reception.

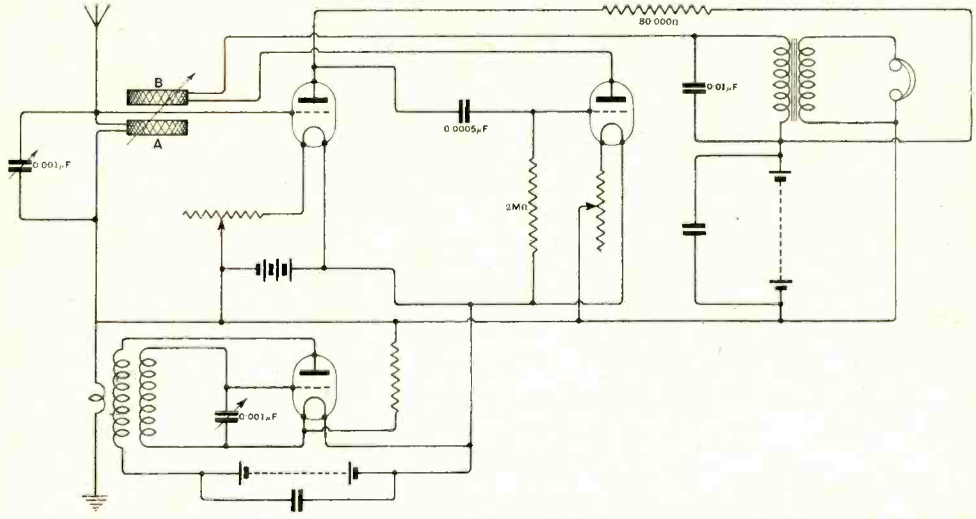


Fig. 26. Long-wave receiving circuit with separate heterodyne wavemeter.

With this circuit, the experimenter will find that the difficulty will not be to receive signals, but to select out any one particular set of signals from all the others. For this purpose it is necessary that a separate oscillating circuit be provided, such as a heterodyne wavemeter,* which is shown in the diagram.

The instrument should be set up close to the aerial tuning inductance, the reaction coil should be adjusted so that no oscillations are self-generated, and the wavemeter condenser swung round to a position where signals are heard.

Having adjusted the note of the signals in the telephones to the required pitch, the reactance coil should be brought up until the aerial circuit is almost on the point of self-oscillation. By carefully re-tuning the 0·001 mfd. variable condenser, it will be found that the signals required will stand out clearly above any others of a slightly different wavelength. With a little practice, this circuit can be made to receive signals from many of the American and Continental high-power transmitting stations, and will be found to be quite easily handled.

The writer nearly always employs this circuit when wishing to demonstrate the reception of long wave signals.

Further note or low-frequency amplification can be employed if desired, but is not recommended on wavelengths above 8,000 metres unless special transformers and circuit precautions are employed.

A useful extension of this experiment without involving the use of any more apparatus is the approximate calibration of the aerial circuit in order that any particular station can be easily located by reference to the wavelength being received.

At first sight this might be thought to be unnecessary, since the wavemeter itself might be employed for this purpose.

It is easily demonstrable, however, that in the case of weak signals, they cannot be heard unless the *note* as fixed by the local oscillator or wavemeter is fairly high, and thus it becomes troublesome to every time find the "dead point" on the wavemeter condenser scale, from which the wavelength received can be read. This is particularly the case with very long wa stations.

The procedure to be adopted for t calibration of the aerial circuit may best explained by taking an example.

Assume the station required is Eilve **(OUI)**. The published list of stations giv the wavelength as 14,400 metres.

Reference to the table or graph of indu tance values shows that a coil of 1,000 tur can be used, and the condenser value wi probably be about 40 degrees.

Having therefore approximately adjuste the aerial circuit, the wavemeter or loca oscillator can be adjusted until the signal are clear.

It may be necessary to listen for som time to hear the code call of the statio given, as, unfortunately, this is not alway a frequent occurrence.

Having definitely established the fac that the signals heard are those required the reaction coil is brought up until self-oscillation is almost occurring, and the aerial condenser slightly readjusted until the signals stand well out from others.

It will be found that the resonance point is very sharp. The wavemeter has now to be adjusted until a silent or dead point is found, either side of which the signals begin to "bubble" in.

At the silent point read the wavelength, and plot this off with the aerial condenser reading on to a tuning curve.

Repeat the same procedure with two or three other stations whose wavelengths come within the range of the particular coil used, and a useful curve may then be drawn.†

* For construction of heterodyne wavemeters, see *The Wireless World and Radio Review, Sept. 30th*, 1922.

† See Fig. 9, Experiment 5, *The Wireless World and Radio Review*, p. 172, *May 12th*, 1923.

In next issue:—

Complete Constructional Details of

A PORTABLE FOUR-VALVE RECEIVER

By F. H. Haynes.

WORKSHOP PRACTICE

By Capt. Richard Twelvetrees, A.M.I.Mech.E.

LOW VOLTAGE CATHODE-RAY OSCILLOGRAPH

By N. V. Kipping.

A FIVE-VALVE RECEIVER

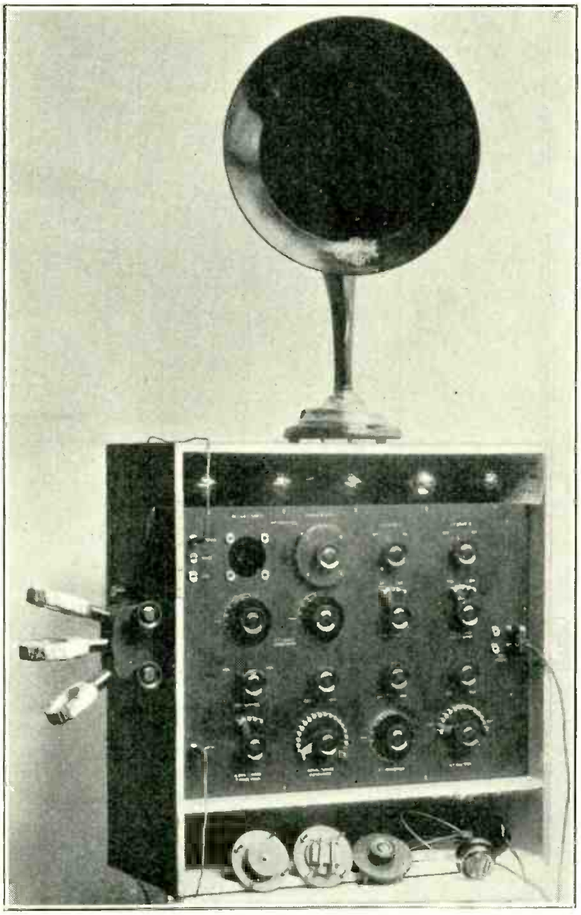
THE EXPERIENCE OF AN EXPERIMENTER IN BUILDING A MULTI-VALVE SET.

MULTI-VALVE Receivers, constructed on orthodox lines, have reached such a state of perfection that one is rather at a loss to introduce anything new or striking into the design of an instrument.

Nevertheless, the advent of broadcasting in this country has brought the amateur face to face with many new problems in the pursuit of his hobby, and not the least of these problems is the practical application of two or three stages of high frequency amplification to the short wavelengths on which broadcasting is carried out.

The question of reaction has to be considered and the most suitable method of coupling the reaction coil into a particular circuit to prevent re-radiation from the aerial in accordance with the Postmaster-General's regulations.

In the following description of a five-valve receiver, the writer proposes to explain how these difficulties were overcome in his own case and an instrument produced which is capable of receiving on any wavelength employed at present, and which combines selectivity with stability and maximum amplification on all wavelengths. Various other points were taken into consideration and these will be referred to in due course.



The complete five-valve receiver.

The receiver consists of two high frequency, detector and two low frequency stages and this, in the writer's opinion, is the best combination of valves for the reception of weak or long distance signals and also to provide sufficient power to operate a loud speaker satisfactorily.

To obtain selectivity and stability of the high frequency circuits it was decided to adopt high frequency transformers in place of the well-known tuned anode method of coupling and for maximum amplification, particularly on the shorter wavelengths, the interchangeable type of high frequency transformer was considered most efficient. Reference to the photograph, which shows a front view of the receiver, will enable the reader to locate the various controls as their respective positions and uses are described.

In the first place, it will be observed that the five valves, or rather, their holders, are mounted on an ebonite panel which is sunk below the level of the main panel to a depth of some 4½ inches. Thus the valves are well protected against mishaps and need never be removed unless for the purpose of changing.

The two interchangeable H.F. transformers are situated at the top left-hand side of the main panel, the first one being removed to show the four brass sockets into which four brass plugs on the transformer fit, when in position.

A number of these transformers have be wound in pairs, to cover wavelengths u to 3,000 metres. The reaction coil, used conjunction with a potentiometer not pr viously referred to, produces the necessar regenerative effect for the reception of wea telephony and other signals, over the who range of transformers used.

Above 3,000 metres, two resistance-capa city units have proved extremely efficien and so no transformers have been wound fo longer wavelengths than this.

Immediately under the two H.F. trans formers can be seen their tuning condensers

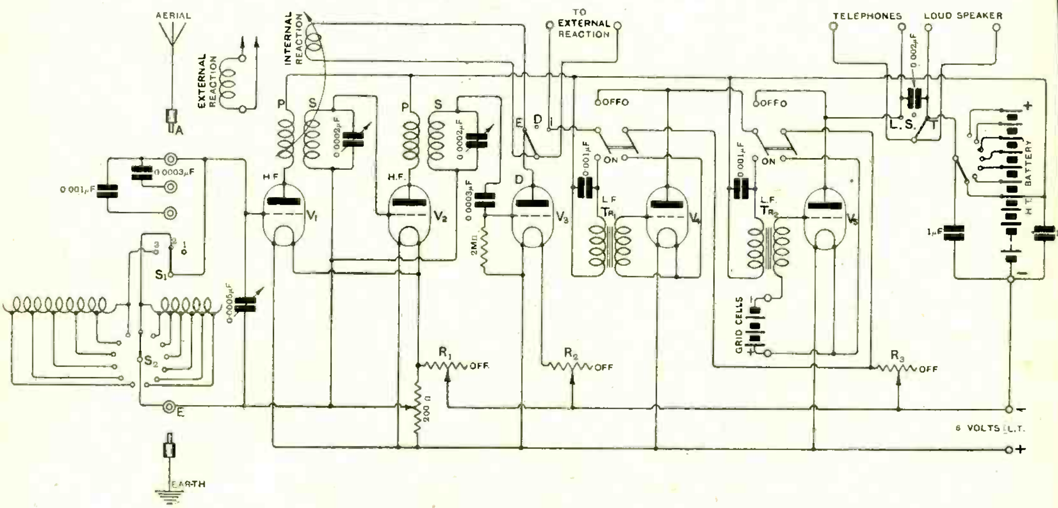


Diagram of the connections showing the arrangement of the switches.

The large hole cut in the panel allows that part of the transformer ebonite former which carries the actual windings, to pass through to the interior of the instrument, so that a movable reaction coil behind the panel is enabled to couple magnetically into the secondary winding of the transformer. This reaction coil is controlled by means of the ebonite knob at the top left-hand side of the instrument, suitable reduction gear being fitted to give a slow movement to the coil. The primary and secondary windings of the transformers are wound side by side in two narrow grooves turned out on the periphery of the ebonite former and separated by $\frac{1}{16}''$, the inner groove containing the secondary winding.

each of 0·0002 mfds. capacity. These condensers are usually set to zero when the resistance-capacity units are in use.

Normally the two H.F. and detector valves are in operation and anti-capacity switches are provided for bringing in the two low frequency valves as required. The two switch knobs are those to the right on the top row. Thus, three, four, or five valves are available, and in practice this provides sufficient flexibility for all requirements.

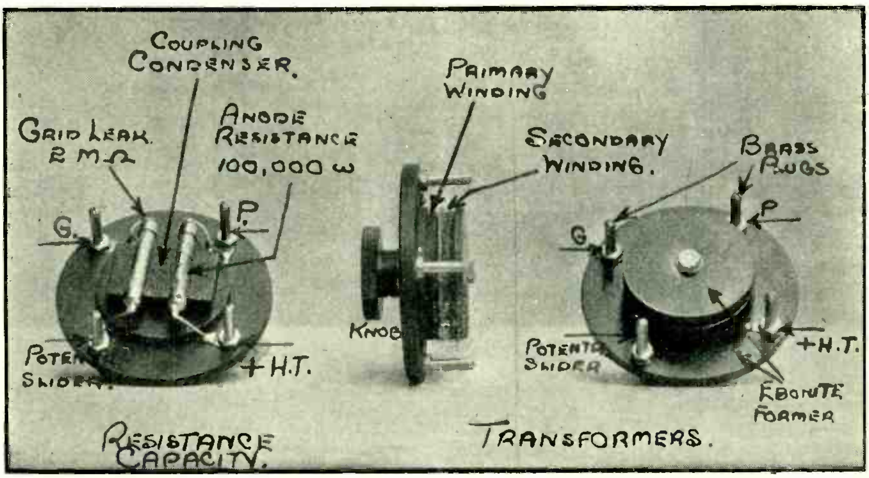
The adoption of a large number of switches for cutting out valves, is not greatly favoured by the writer as it usually introduces undesirable capacity effects.

The short wave coil covers a range of 200 to 1,000 metres and the long wave coil a ınge of 1,000 to 3,000 metres. The variable ndenser to the right of the eighteen-point ritch, provides the fine tuning required.

It will be observed that plugs and sockets e utilised to make connection from the :rial and earth to the set, the aerial plug eing provided with three sockets. When ıis plug is inserted into the middle socket, fixed value 0·0003 mfds. condenser is ıcluded in the aerial tuning circuit, while similar condenser of 0·001 mfds. capacity introduced when the plug is moved to the ottom socket. This little arrangement has roved invaluable for short wave working.

The potentiometer of 200 ohms resistance ınd the three filament rheostats occupy the third row; the first rheostat serving to control the two H.F. valve filaments, the second the detector valve filament, and the third the two L.F. valve filaments. The potentiometer is not used to any great extent, as the two high frequency stages are quite stable in action even with a full negative potential on the grids of the H.F. valves. It has not been necessary to provide a switch for disconnecting the potentiometer winding from the accumulator when the set is out of action, as the first rheostat automatically performs this function when it is turned to the " off " position. The theoretical circuit diagram will make this point clear and it is thought that it will appeal to many readers, because a potentiometer control switch is more often than not left in the " on " position after the set has been in use, with the result that the accumulator is being slowly discharged.

One other control remains to be explained, namely, that to the right of the bottom row which is a selector switch arranged to make contact with any one of a number of studs connected up to the high tension battery contained within the set. This selector switch is included in the plate circuit of the last valve, which may be an ordinary hard valve of the well-known " R " type or an " L.S.2 " so that a higher voltage can be applied when it is desired to produce a great volume of sound from the loud speaker. It will be understood that no attempt has been made to convert the last valve into a power magnifier in the true sense, as the voltage used never exceeds 90 volts, and for normal working the usual voltage of sixty, as applied to the first few valves, has been found quite sufficient for the last valve also.



Constructional details of the plug-in units for intervalve coupling in the high frequency circuits.

Nevertheless, provision is made at the back of the panel for connecting up a battery of dry cells in the grid circuit of the last valve to give the grid of this valve an additional negative potential.

The internal wiring is carried out with No. 16 S.W.G. tinned copper wire and all connections are soldered. W. R. C.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—XXII.

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.

Recent sections deal with series and parallel circuits, damping, choke coils, and transformers.

By W. JAMES.

44.—Mutual Induction.

SUPPOSE we have a circuit such as Fig. 107A, the inductance of coil A being $1{,}000\,\mu H$, and that of coil B, $400\,\mu H$. We may find the mutual inductance of the coils by measuring the inductance of the coils when they are connected in series as in Fig. 107C, and measuring

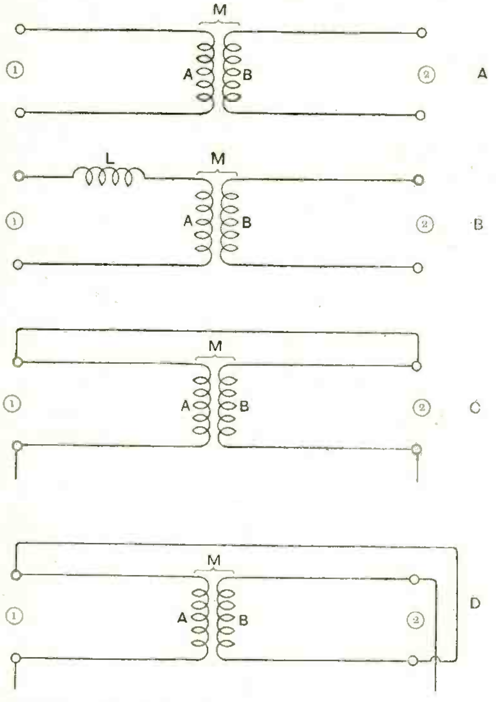


Fig. 107. To obtain the mutual inductance, measure the inductance with the coils in series as at (C), and then with the connections as at D. If the inductances are L_1 and L_2, $M = \frac{L_1 - L_2}{4}$.

the inductance again with the connections to one of the coils reversed as in Fig. 107D. If the inductances measured are L_1 and $L_2\,\mu H$, the mutual inductance $M = \frac{L_1 - L_2}{4}\,\mu H$. If in the case considered $M = 250\,\mu H$, we may find the coefficient of coupling as follows:—

$$k = \frac{M}{\sqrt{A \times B}}$$

$$k = \frac{250}{\sqrt{1{,}000 \times 400}} = 0{\cdot}4$$

Any addition to the total inductance of either circuit changes the value of k. Thus if a coil of inductance $500\,\mu H$ is added to circuit 1, as in Fig. 107B, this coil not being inductively coupled with any of the others,

$$k = \frac{250}{\sqrt{(1{,}000 + 500) \times 400}} = 0{\cdot}32$$

The coupling is reduced.

45. — Effects Produced in Coupled Circuits.

Wireless circuits are commonly coupled one with the other. Thus the aerial circuit may be coupled with a second circuit. It is interesting to notice the effects produced by coupling circuits. It will be remembered when dealing with iron cored transformers the effect of resistance, capacity or inductance connected in the secondary circuit is equivalent to introducing those

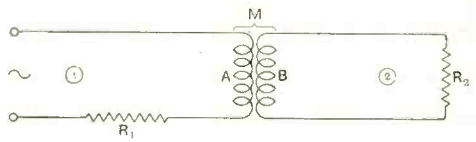


Fig. 108. Coupled circuits with resistances R_1 and R_2 in each circuit. The effect of the resistance of circuit (2) is to increase the apparent resistance of circuit (1) and vice versa.

quantities into the primary circuit (section 17). The co-efficient of coupling of the coils of iron-cored transformer is high—generally the neighbourhood of 0·95. If k were ity, $M = \sqrt{L_1 L_2}$.

In the case of a circuit such as Fig. 108, ich consists of circuit 1, possessing sistance R_1 and an inductance A equal to coupled to circuit 2, which also consists an inductance B and resistance R_2, e effective resistance of circuit 1 is in-eased by the quantity

$$\left(\frac{\omega M}{Z_2}\right)^2 R_2\,;\ \text{where } \omega = 2\pi f \ (f = \text{the}$$

equency of the current),

M = the mutual inductance,

Z_2 = impedance of circuit 2,

R_2 = resistance of circuit 2.

The total effective primary resistance is hen $R\,eff = R_1 + \left(\frac{\omega M}{Z_2}\right)^2 R_2$ ohms.

It should not be difficult to see that the rimary effective resistance is increased if t is remembered that the secondary losses nust be made good by a transfer of energy rom the primary.

At the same time, the effective inductance of circuit 1 is modified, and is given by

$$L_1 eff = L_1 - \left(\frac{\omega M}{Z_2}\right)^2 L_2 \mu H.$$

While the effective primary resistance is increased the effective primary inductance is reduced. The extent to which the effective values of the primary circuit are changed may be varied by altering the coupling between the coils. There will be one value of coupling which produces the maximum current in the secondary circuit (2). The value is most easily obtained by experiment.

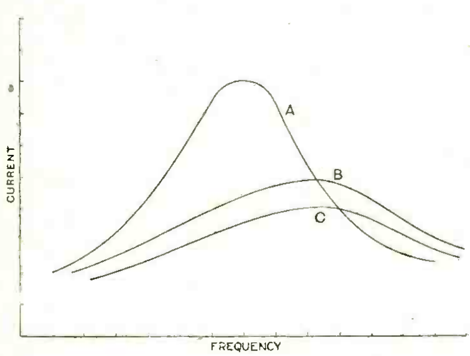


Fig. 109. Curve A represents the resonance curve for circuit (1) above. When circuit (2) is coupled, the resonance curve is as shown by curve B. If the resistance of circuit (2) is increased, or if the coupling is increased, the curve will be as represented by C.

When the primary circuit has a condenser in addition to inductance and resistance, this circuit may be adjusted so that it is in resonance with the applied voltage, but the effect of coupling a second circuit is still to reduce the effective primary inductance and increase its resistance. The value of the primary condenser will have to be altered to compensate for the reduced inductance when it is necessary that the resonant frequency of the primary circuit should be the same as that of the applied voltage. Referring to Fig. 109, curve A is the resonance curve of the primary circuit alone. When the secondary circuit is coupled, the resonant frequency of the primary is increased through the effective inductance of the primary being reduced, ($f = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}} = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$ when R is negligible.)

and at the same time the current at the

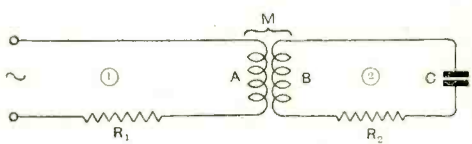


Fig. 110. Coupled circuit with condenser C in the secondary circuit (2).

resonant frequency is reduced through the increase of the effective resistance, as represented by curve B. If the resistance of the secondary circuit is increased, the curve is flattened as represented by curve C.

If the secondary circuit is tuned to the frequency of the voltage with the primary removed, and then the voltage is induced into the secondary circuit from the primary, Fig. 110, the effective resistance of the primary is increased while the effective inductance may be increased or decreased, according to the frequency of the applied voltage. If the frequency of the applied voltage should give resonance in the secondary circuit, the effective resistance of the primary may be very greatly increased.

In the case where the primary and secondary circuits are both separately tuned to the frequency of the voltage, the maximum secondary current is obtained when $\omega^2 M^2 = R_1 R_2$. The correct value of mutual inductance is best found by trial. A curve plotted to show the relationship between the secondary current and the mutual inductance is given in Fig. 111. Increasing the secondary resistance reduces the

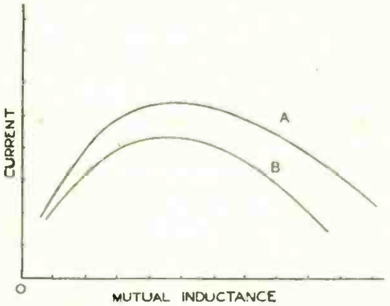


Fig. 111. *The secondary current varies with the mutal inductance in the manner shown. There is one best value of coupling which gives the maximum secondary current. If the secondary resistance is increased, the relationship between secondary current and the coupling is as shown by curve B.*

secondary current as shown by curve B. the voltage applied to the primary is E, t primary and secondary resistances R_1 and R

$I_2 = \frac{E}{2\sqrt{R_1 R_2}}$ when adjustments are mad so that the secondary current is a maximum with the circuits both separately tuned t the frequency of E. The secondary curren will be higher the lower the secondar and primary resistances.

The voltage ratio of coupled circuit depends upon the values of the capacit and resistance. When they are very tightl coupled as in the case of some types o high frequency transformers, the voltag ratio may be almost the turn ratio. To obtain maximum secondary voltage, the secondary capacity and resistance should be made as small as possible, when the

voltage ratio is almost $\sqrt{\frac{C_1}{C_2}}$

Wireless Club Reports.

Ilford and District Radio Society.*

On Thursday, August 9th, an open-air demonstration was given in St. Valentine's Park, Ilford. Splendid results were obtained, speech and music being audible as far distant as a quarter of a mile. The proceedings, were unfortunately brought to a premature close owing to heavy rain.

The thanks of the Society are due to Messrs. The Western Electric Co., who, through their agents, Messrs. Negretti and Zambra, loaned a set of their loud speaking equipment. Thanks are also due to Messrs. The Fullers United Electric Works, who lent five of their accumulator H.T. units.

Hon. Sec., L. Vizard, 12, Seymour Gardens, Ilford.

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

The last lecture of the summer session was delivered on Thursday evening, July 12th, by Mr. R. W. Steel, who took as his subject "The Measurement of Electrical Quantities."

Mr. Steel dealt particularly with the measurements of those quantities encountered in wireless work, describing the measurement of resistance, inductance, capacity, potential current, etc., and by means of many diagrams he showed the apparatus required and the methods of connecting up.

The Society has now closed down until after the holidays, and the next meeting will be held at the Y.M.C.A., Hanley, on Thursday evening, September 6th.

Hon. Sec., F. J. Goodson, B.Sc., Tontine Square, Hanley.

Tottenham Wireless Society.*

"Mast Construction" was the subject dealt with in a lecture delivered by Mr. A. G. W. Cole, on Wednesday, August 15th.

The lecturer explained the many details of a mast he had constructed from a 20-ft. length of 3 ins. by 2 ins. joined by an 18 ins. bolted tongue joint to a 20 ft. length of 2 ins. by 2 ins. The whole was tarred and sunk in a "tabernacle" buried in concrete. The mast stays in two sets were of ex-Government cable and secured ten feet distant from the mast base.

The total cost was 9s. 6d., and the mast was strong enough to support a man climbing it.

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

Walthamstow Amateur Radio Society.*

On Thursday, August 9th, Mr. E. G. Whiter, the Chairman, gave a very interesting and instructive lecture on the manufacture and working of ebonite.

Commencing from where the rubber latex is first collected in the East, the lecturer described in detail all the various stages through which rubber has to pass before it can be put on the market in the form of ebonite.

The lecturer's remarks helped members to realise why good ebonite is so dear.

Hon. Sec., H. J. Sarson, Y.M.C.A., Church Hill, Walthamstow, E.17.

Honor Oak Park Radio Society.

A brief description was given on August 8th of a very interesting visit to Marconi House by a party of ten members on July 28th. Mr. R. C. Lane gave an interesting talk on "Cause and Effect of Reaction."

Hon. Sec., Mr. G. J. Price, 22, Honor Oak Park, S.E.

NOVEL IDEAS AND INVENTIONS.

Abstracted by

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

nproving the Loud-Speaker Horn.

The exact shape to be given to the horns loud-speaking telephones, or similar apparatus, in which the horn is intended to mplify a sound, has long been a cause of nuch argument. It is usually stated that ood reproduction is only possible if the orn is so designed as to give a uniform r smooth expansion with a complete absence of sharp reflecting edges, etc. It has recently been claimed however* that improved esults are possible if a definite reflecting surface is provided by constructing the horn in two portions, which make an acute angle with each other, somewhat as sketched

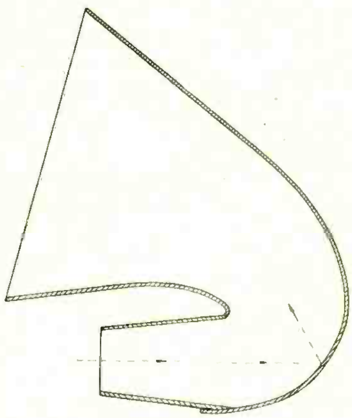


Fig. 1.

in Fig. 1, which gives a section through a horn of this type. Sound waves entering from the smaller end of the horn are reflected by the curved portion of the horn somewhat as indicated by the dotted line.

Loop Aerials for the Home.

For the reception of radio broadcast transmissions loop or frame aerials are often used, but their bulky nature when used indoors is often a disadvantage. To facilitate storage of such loop aerials, they have been constructed on the lines of an ordinary roller blind, the wires forming the loop being attached to the flexible sheet which constitutes the blind, and which is attached to a spring or other blind roller in the usual manner.* Thus when the aerial is not required it can be rolled up so as to occupy only a very little space. The general arrangement is sketched in Fig. 2, WW being the loop aerial wires and R the blind roller.

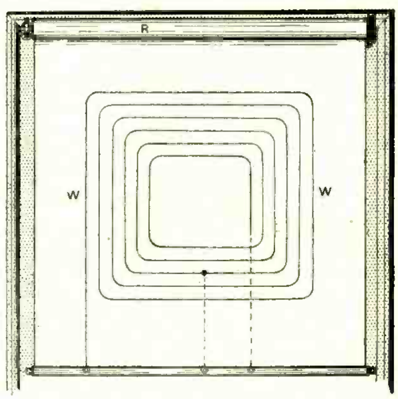


Fig. 2.

The complete roller can be turned into different directions in order to utilise the directive action of the frame aerial.

A Three-Coil Holder for Plug-in Coils.

Plug-in inductances are now very largely used in radio receiving apparatus. As a variation on the conventional coil mounting in which the two or three coils are plugged into hinged holders, the relative movements of the coils may be made in their own plane instead of moving them nearer together or further apart.† Thus the centre one of three coils may be fixed, while a coil on either side of it may be held close up against it in a holder, which can be rotated so as to slide either of these coils over the fixed one, and so alter the coupling between them.

*British Patent No. 197437, by A. Pedley.

*British Patent No. 195051, by Marconi's Wireless Telegraph Co., Ltd. Assignees of L. L. Manley.

British Patent No. 198589, by A. W. Knight.

Notes and News

The wireless station at Peking, erected by the Japanese Missui Company, is completed, and is in touch with Bordeaux.

* * * *

The Mexican Government's radio stations are to install C.W. equipment in place of the present spark system.

* * * *

RRR is the call sign of the Oxford University's Expedition ship "Terningen," which will shortly be transmitting messages in the Arctic regions between 9 and 10 p.m. (B.S.T.) on a wavelength of 440 metres.

* * * *

The Firth of Clyde turbine steamer "Queen Alexandra," which plies to and from Inverary, has been equipped with a wireless set and three loud speakers.

* * * *

Australian Amateur Relay Project.

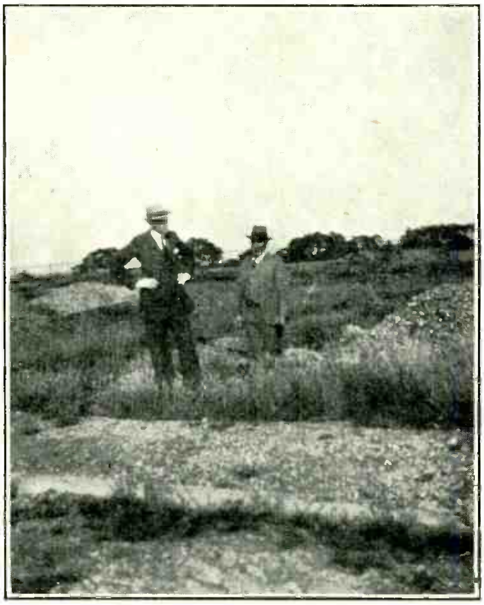
So successful have been the experiments in long distance communication recently conducted between Australia and America that Melbourne amateurs are forming a relay league. It is hoped by this means to link up every part of Australia and New Zealand.

The communication tests between Australia and America commenced on May 1st last, and the first signals were received from an American amateur station two days later. On May 13th, a Melbourne experimenter copied the call letters sent out by 22 American stations. One of these was situated in the State of New York, nearly 11,000 miles from Melbourne and the reception of this station is the more remarkable inasmuch as the input power was only a quarter of that used by coastal stations for working over distances of less than 500 miles.

Koenigswusterhausen's Transmissions.

As will be seen in our list of regular broadcast programmes, the Sunday transmissions from the above station are from 11 a.m. to 12 noon (B.S.T.) on 4,000 metres, and from 12 noon to 1 p.m. on 2,700 metres. In recent issues the wavelengths for these two periods have been erroneou reversed.

BROADCASTING AT BOURNEMOUTH.



Mr. J. C. W. Reith, the general manager of the B.B.C. is seen in the illustration inspecting the site of the Bournemouth station of the Company.

An Unidentified Transmission.

"On Sunday, August 12th, at 11.45 (B.S.T on approximately 450 metres," writes a Finchl correspondent, "I received an announceme either in Danish or Dutch for about eight minute followed by a string orchestral selection. 'Horvath Humoreske' was the played, and was followe by a Fox Trot."

We should be glad t know whether any othe readers received th transmission, and whethe it has been identified.

Reception with Match box Set.

With a shilling crysta set, contained in a matchbox, Sir Hanbury Brown (**2 SA**), of Crawley Down, Sussex, report that on August 14th, a 2 p.m., he heard **2 AD** testing. Although London is 30 miles to the north of Crawley Down, **2 LO** telephony is heard, though imperfectly, on the matchbox set, while Croydon speech is received excellently.

Amateurs who have heard **2 AD** would be glad of information as to his identity.

American Broadcasting on Two Valves.

While listening-in from 1 a.m. to 4 a.m. on Sunday August 12th, Mr. W. R. Stainton, of Leigh, Lancashire, picked up **WNAF** (Enid, Okla., U.S.A.).

An ordinary two-valve circuit was employed (D. and L.F.), and the strength was R.3.

Subterranean Wireless Experiments.

Successful tests in underground wireless have been conducted by two Lancashire experimenters. The tests were carried out at Woodpark Colliery, Bardsley, on August 12th, when communication was obtained from the surface to a distance of 1,560 feet underground. The transmitter (**6 ZY** ortable) was operated by Mr. L. Gordon, while ıe receiver was under the supervision of Mr. J. ropper (6 NG). Reception was quite good on ne valve, and with the addition of a single-valve ote magnifier, music and speech were heard at oud speaker strength. Further experiments are o be made by 6 ZY.

ɪn Ingenious Fog Signalling Arrangement.

An interesting and valuable aid to navigation ıas been installed in the Maas lightvessel off the oast of Holland. It consists of a submarine ound transmitter worked in conjunction with ι series of signals by wireless telegraphy, in the ollowing manner :—

The submarine sound transmitter is made on the electro-magnetic principle and sends out the letter "M" in Morse code every 20 seconds, the duration of the dashes being 3 seconds. The wireless transmitter also sends out the letter "M," synchronised to the submarine sound transmitter, on a wavelength of 450 metres.

Both signals are picked up by the ship. The W/T direction finder then gives the bearing of the ship from the lightvessel. The distance is found by observing the time that elapses between the reception of the W/T signal and the submarine sound signal, allowing 1,625 yards for each second.

The signals will probably be received up to 15 miles from the lightvessel and should be of great assistance to the mariner in fog as he will be able to fix his position with accuracy.

Wireless Telephony Demonstration on Aircraft.

A demonstration of the use of wireless telephony on aircraft was given to Sir Samuel Hoare, Secretary of State for Air, and Lady Hoare, when they recently flew to Gothenburg, Sweden, for the International Air Exhibition. The Daimler Airway Napier D.H.4 aeroplane in which they travelled, was fitted with the Marconi A.D.2 Wireless Telephone Set, the apparatus with which all British commercial machines are equipped, and extra 'phones were provided to enable Sir Samuel and Lady Hoare to listen to the conversations with the wireless stations during the voyage.

FORTHCOMING EVENTS.

FRIDAY, AUGUST 31st.

Wireless Society of Hull and District. At 7.30 p.m. At the Co-operative Social Institute, Jarratt Street. Lecture: "Ebonite." By Mr. C. B. Snowden (Pres.).

SATURDAY, SEPTEMBER 1st.

Ipswich and District Radio Society. Visit to Parkeston Land Station and Oversea Boats Wireless Station.

WEDNESDAY, SEPTEMBER 5th.

Hall Green Radio Society. Re-opening Meeting. Lecture: "Obtaining the Best from Loud Speakers." By Mr. Colin H. Gardner.

North Lincs. Wireless Society. At 8 p.m. General Meeting.

THURSDAY, SEPTEMBER 6th.

Dewsbury and District Wireless Society. Opening Meeting of Session.

Stoke-on-Trent Wireless Experimental Society. At the Y.M.C.A., Hanley. Ordinary Meeting.

Newcastle and District Amateur Wireless Association. At 7.30 p.m. Annual General Meeting.

A Removal.

We have been informed by Messrs. Hambling, Clapp & Co., the well-known wireless specialists, that they have now moved from their premises at 110, Strand, W.C.2., and that their new address is 11, Agar Street, London, W.C.2.

An Error.

We have been asked to draw attention to an omission in the advertisement of Messrs. Falk, Stadelmann & Co's. appearing in our issue of August 15th. "Write for Illustrated Catalogue of this and less models" should read "Write for Illustrated Catalogue of this and less expensive models."

AN APPEAL FOR LECTURERS.

In a recent issue of this Journal an appeal was made by the Radio Society of Great Britain for volunteers who would be prepared to assist the affiliated societies during the coming winter session by giving lectures on any subject allied to radio science.

Although this appeal has been responded to it is still felt that there are many other lecturers who would readily give their services if they were aware of the need. In this connection we have received the following letter :—

To the Editor,

The Wireless World and Radio Review.

Sir,—It has been the custom of this Society during the past two or three years to arrange for lecturers who are willing to go within a certain radius of their homes to give lectures before affiliated societies. This list of lecturers is now being compiled, and will shortly be circulated to all the affiliated societies in the country.

I am appealing now, however, to the large number of people who regularly give lectures and demonstrations before their own Radio Society, and who would no doubt be prepared to give similar lectures before their neighbouring Radio Societies.

I shall be glad to hear from any such gentlemen, and at the same time I would like particulars of the radius they would cover from their own town together with the titles of any lectures or demonstrations they would be prepared to give. No fee is paid, but it is usual for the out-of-pocket expenses of the lecturer to be paid by the Society before which the lecture is given.

Yours faithfully,

H. L. McMICHAEL,

Hon. Secretary.

Radio Society of Great Britain.

London, N.W.6.

August 22nd, 1923.

Radio in Russia.

According to *The Russian Information and Review* of July 21st, there are at present 290 receiving and transmitting stations in Russia. Moscow is the centre of the organisation, and possesses three powerful transmitting stations. These are (1) the Shabalovsk station (RAJ), called the "Mossoviet," of 150 kilowatts, used for internal communications ; (2) the Central radio telephone station, called the "Comintern" (RDW) ; (3) the "October," formerly the Khodinsk (RAI), for internal communications. In addition there is the Lynberetsk receiving station.

D

Most of these stations were hastily and crudely erected for military use during the civil war. In consequence they are now being reconstructed and the Commissariat for Posts and Telegraphs is engaged on a scheme of reorganisation for the whole network of wireless communications. The "October" station is being fitted with a C.W. transmitter using fifty kilowatts.

In regard to radiotelephony, it is proposed to open eleven radio receiving stations in the industrial districts of Moscow and to equip them with loud speakers for the purpose of broadcasting speeches and lectures for propaganda and educational purposes.

The Scottish National Radio Exhibition.

The Secretary of the Glasgow and District Radio Club, Mr. A. L. Todd, "Thorncliffe," 12, Albert Road, North Pollokshields, would be glad if secretaries of Scottish Wireless Societies would immediately communicate with him so that he may forward them particulars and tickets in connection with the Scottish National Radio Exhibition. The Exhibition is to be held from September 3rd to 8th, in St. Andrew's Hall, Glasgow.

Books and Catalogues Received.

"Radio" (Volume I, No. 1). A monthly Journal devoted to Wireless Telegraphy and Telephony. Published at "Villa Amélie," Uytkerke, Blankenberghe, Belgium.

Sterling Telephone and Electric Co., Ltd. (210-212, Tottenham Court Road, London, W.1). Publication No. 363, illustrating and describing the "Magnavox" Gramophone and Voice Amplifying Outfits, combined with "Sterling" Power Amplifiers.

The Peto-Scott Co., Ltd. (64, High Holborn, W.C.1). An attractive 40-page Catalogue of Wireless Components.

A. Hinderlich (1, Lechmere Road, Willesden Green, N.W.2). Price List of Wireless Supplies.

Broadcasting

The Postmaster-General's Committee.

As we go to press certain rumours are current concerning the outcome of the Broadcasting Committee's deliberations. In unofficial quarters it is stated that the Committee will probably recommend the abolition of the B.B.C.'s royalty, and the substitution of a single licence with a fee of 10/- per annum. A proportion of the licence fee will be allocated to the B.B.C.

Forthcoming Items at 2 LO.

Saturday, September 1st.—7.15. Mr. Colin J. Campbell on "The Dragon Fly"; 9.0. Mr. J. W. Robertson Scott on "Country Life."

Monday, September 3rd.—7.15. Mr. John Strachey, "Literary Criticism"; 9.0. Mr. A. E. Bawtree on "Bank Notes."

Tuesday, September 4th.—7.15. Rev. W. Hodson Smith on "The National Children's Home and Orphanage"; 9.0. Lt.-Col. W. W. Clemesha on "The Decline of Malaria in England." 10.0. Captain Richard Twelvetrees on "Motoring."

Wednesday, September 5th.—7.15. Mr. Archibald Haddon: "Dramatic Criticism"; 9.0. Sir J. Broodbank on "The Port of London"; 10.0. Mr. F. E. Illingworth on "Woollen Industries."

Thursday, September 6th.—7.15. Mr. Percy Scholes: "Musical Criticism"; 9.0. Mr. C. S. Walker on "St. Paul's Cathedral"; 10.0. Mr. E. Farmer, M.A., on "Saving Effort at Work."

Friday, September 7th.—6.45. Mr. Ernest Esdaile on "Elocution"; 7.15. Mr. G. E. Atkinson: "Cinema Criticism"; 9.0. Mr. Godfrey Cheesman, "The National Union of Manufacturers."

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; 7.20 p.m., 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 and Sundays, 10 to 10.45 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.

DENMARK.

LYNGBY OXE, 2,400 metres. 10.30, 4.40 p.m., and 9.45 p.m. Meteorological Report in Danish. 8.30 p.m. to 9.45 p.m., Concert (Sundays excepted).

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, 1 p.m., Meteorological Bulletin. Daily, 5.50 p.m., Meteorological Bulletin; Tuesday and Thursday, 10 p.m., Concert. Sunday, 7 p.m., Concert.

GERMANY.

BERLIN (Koenigswusterhausen), LP, Sunday, 4,000 metres, 11 a.m. to 12 noon, music and speech; 2,700 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.

KBEL (near Prague), 1,000 metres. Daily, 7.20 p.m. Concert Meteorological Report and News.

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.

CORRESPONDENCE.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In a paragraph on page 519 of *The Wireless World and Radio Review* for July 21st it was stated that a method had recently been patented for the production of radio-frequency oscillations by the inter-action of light waves of slightly different frequencies.

The idea of generating oscillations in this way also occurred to me some months ago, and together with a friend I went into the matter. The conclusion we came to was that it would be quite impossible to carry out the scheme in practice, owing to the difficulty of isolating a sufficiently narrow wave band. This will be realised when it is considered that the difference in frequency between the two sodium lines in the spectrum is of the order of 2,000,000,000,000 cycles per second! Yet a moderately good spectroscope is required even to make these two lines distinguishable from one another.

Thus, even if it were possible to isolate the required waves and maintain them sufficiently constant, the energy contained by them would be such a minute fraction of that emitted from the original source of light that the arrangement would be no more than a costly and difficult laboratory experiment.

N. L. YATES-FISH **(5 CA)**.

Reading, *July 23rd*, 1923.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I note on going through *The Wireless World and Radio Review* this week that Mr. Louis J. Wood, Hon. Secretary of the Halifax Wireless Club, states that he has been receiving transmissions from **5 OW** and **2 UF** and wishes to know *where they are.*

2 UF is my station, situated at 51, Manchester Road, Denton, near Manchester, and on the night he mentions my input was 4 watts, using 350 volts and radiation 1·4 of an ampere.

Mr. Wood informs us that with his Flewelling circuit he heard me at loud speaker strength, which is most surprising on the low power I was using.

A most remarkable coincidence is that it was from Mr. L. J. Wood's station that I first heard wireless telephony; this would be about four years ago, when our old friend Mr. Dennison (**2 KD**), of Halifax, arranged to transmit to us. I intend, however, to get in touch with Mr. Wood some evening, and work with him officially.

Yours, etc.,

H. BAILEY.

Denton, Nr. Manchester, *July 13th*, 1923.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Before the advent of broadcasting, in my lecture to the Wireless Society of London on June 29th, 1920 (see report in *The Wireless World*, Vol. VIII, No. 9, July 24th, 1920), I made predictions and suggestions for the application of Ruhman's photographophonic film records for the reproduction of the voice and music from wireless telephone transmitting stations, also re the employment of photographophonic film records in synchronisation with the cinematograph. It may interest your readers to see that both these predictions have been fulfilled even to the employment of the "case" photoelectric cell in place of selenium.

In May, this year, Mr. C. A. Hoxie gave a paper before the American Institute of Electrical Engineers (see "Proceedings of American I.E.E.," Vol. XLII, page 520-524), in which he described a greatly improved photographophone called the "Pallophotophone," which has fulfilled in almost every detail my predictions of 1920.

On Christmas Eve and New Year's night speech and songs were re-transmitted from photophonographic film records from the broadcasting station of the General Electric Company (**WGY**) at Schenectady with great clearness of articulation.

My last prediction of the possibilities in front of film producers in the possible synchronisation of the photophonic film records with the cinematographic film has also been fulfilled in Dr. De Forest's recent development, "The Phonofilm." The photophonic records are made on the edge of the ordinary cinematograph film as demonstrated recently in London, at the Finsbury Park Rink Cinema.

G. G. BLAKE.

Richmond, Surrey, *July 17th*, 1923.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The letter of Mr. T. Burt Trott, in your issue of July 14th, and the remarks of Sir Hanbury Brown in that of July 21st, respecting the synchronisation of time signals from **NSS** and **YN**, are of great interest to me as I count **NSS** as one of my oldest and most obliging wireless "friends."

But much as I would like to believe that Mr. Trott has been enabled repeatedly to detect the minute difference of one-seventieth (·014) of a second by his phones, due to the time lag arising from the difference in distances between his station and Annapolis and Lyons, a difficulty arises in my mind in that this assumes that the transmission of the particular dots or dashes which establish coincidence in time have taken place at the identical time at each station.

As a matter of scientific fact, I believe that never, except in rare instances, is any time transmission absolutely exact, and the error, *which may be plus or minus*, may amount to several hundredths of a second.

Taking London as the base, **NSS** is approximately 3,200 miles distant and **YN** 450 miles. This gives a transmission difference of 2,750 miles which accounts for a time lag of ·015 seconds.

It would appear from these figures that if **NSS** has an error of, say, only plus ·015 seconds and **YN** an error of only minus ·015 seconds, you will get a condition in which **NSS**, the distant station, will be actually heard ·015 seconds before **YN**, the near station, and, on the law of averages, this is not at all an improbable condition.

In pursuance of such an investigation, it occurs to me that it would be extremely interesting to compare the midnight transmissions (G.M.T.) of **POZ** and **NPO**.

With London as a base, there would be a time lag of something like ·04 seconds to account for, and supposing that **POZ** maintained its usual degree of accuracy and **NPO** did not exceed, say, an error of ·015 seconds, it would be really possible to appreciate, whether the ear can differentiate between sounds which are separated by a minute interval of time in the manner so thoughtfully suggested by Mr. Trott.

Vernon I. N. Williams.

Bramhall, Cheshire. (5 TA)

To the Editor of The Wireless World and Radio Review.

Sir,—With reference to the correspondence in recent issues on the subject of the Annapolis time signal at 0900 G.M.T., it may interest your readers to know that this special signal is transmitted for the purpose of survey operations in Alaska. No further details are available respecting the power used.

Your correspondent, Mr. A. C. H. Bassano, is right in suggesting that the difference in the times of receipt of the Annapolis and Lyons signals at 0900 is due to errors in transmission. It should be remembered that for the purpose of sending out time signals the different transmitting stations are telegraphically connected with an astronomical observatory, and the actual time signal is given from the observatory clock and thence relayed over land-line to the W/T transmitter. In the case of Annapolis, the "lag" due to relaying from the U.S. Naval Observatory at Washington is about 0·08 sec. If we take the distance of **NSS** from London as 3,600 miles, travel time accounts for another 0·02 sec. On the other hand the travel time of the Lyons signal may be neglected as the distance of this station is only about 500 miles. Superimposed on these "lag" errors, there are smaller ones amounting to perhaps a few hundredths of a second in the actual time determinations at the controlling observatory.

At Greenwich Observatory the times of receipt of the Annapolis signals are automatically registered by a syphon recorder against the Greenwich clock. After all known errors have been allowed for, the "monthly means" of comparisons show Annapolis to be sometimes as much as 0·07 sec. behind G.M.T. These differences are not peculiar to American signals. The same automatic registration shows differences of 0·16 sec. in the 10hr. Paris Rhythmics, and 0·20 sec. in the Bordeaux Rhythmics. Nauen midday signals differ from 0·05 sec. slow to 0·08 sec. fast on G.M.T. As I have pointed out in an article "Some Practical Applications of Time Signals," these differences are not yet fully understood.

It is to be regretted that in your issue of July 28th, there appeared a note over my initials on "Errors in Wireless Time Signals," in which it was stated that in the case of Annapolis signals the discordance of 0·03 sec. could be accounted for by the time of transmission. The Astronomer-Royal has ve[ry] kindly pointed out to me that the travel tim[e] had already been allowed for in the figures [ ] given, and also that as the Paris and Bordeau[x] values relate to Rhythmics, which are in sidere[al] units, the explanation suggested in the paragrap[h] is not applicable.

Your readers may also be interested to kno[w] that since April 28th last, Bordeaux Rhythmi[c] signals at 2000 G.M.T. (approx.) have been trans[-]mitted on a wave of 18,940 metres C.W. instea[d] of the former 23,400 metres.

W. G. W. Mitchell.

Newbury, Berks.

Calls Heard.

Sidcup, Kent.

2 KF, 2 KS, 2 NP, 2 OD, 2 OL, 2 OM, 2 PD, 2 PX, 2 PZ, 2 QS, 2 VJ, 2 XP, 2 XR, 2 XY, 5 AC, 5 AI, 5 AQ, 5 CQ, 5 DT, 5 FQ, 5 FU, 5 HI, 5 HR, 5 IP, 5 IR, 5 JT, 5 LP, 5 OX, 5 OY, 5 PR, 5 PX, 5 PY, 5 PZ, 5 QI, 5 QJ, 5 QO, 5 TP, 5 UL, 5 VD, 5 WM, 5 WR, 5 XE, 5 XN, 5 XZ. (V. S. W. Smyth).

Peterborough.

2 AO, 2 DF, 2 DU, 2 DX, 2 FC, 2 FH, 2 FN, 2 FQ, 2 FR, 2 GG, 2 HF, 2 JX, 2 KF, 2 KM, 2 KT, 2 LG, 2 LW, 2 LZ, 2 OD, 2 OM, 2 ON, 2 PB, 2 PL, 2 OH, 2 PW, 2 PY, 2 SZ, 2 TN, 2 TO, 2 TV, 2 UX, 2 VC, 2 VJ, 2 VQ, 2 WA, 2 WD, 2 WP, 2 WZ, 2 YQ, 2 ZZ, 5 CC, 5 CP, 5 DK, 5 HY, 5 MA, 5 MS, 5 PU, 5 SU, 5 VP 5 VR, 6 HD, 8 AB. (J. Sargent).

Buxton.

2 AL, 2 AM, 2 AO, 2 AR, 2 AW, 2 BC, 2 DF, 2 DU, 2 FC, 2 FE*, 2 FL, 2 FN, 2 FQ, 2 FZ, 2 GJ, 2 GL, 2 GN*, 2 GU, 2 HF, 2 IJ, 2 IN, 2 IQ, 2 IX, 2 JF, 2 JH, 2 JK, 2 JO, 2 JP, 2 JU, 2 JZ, 2 KF, 2 KL, 2 KO, 2 KQ, 2 KX, 2 LQ, 2 LZ, 2 MF, 2 MI, 2 MM, 2 MY, 2 NA, 2 NB, 2 ND, 2 NF*, 2 NK, 2 NM, 2 NV, 2 OD, 2 OF, 2 OJ, 2 OM, 2 ON, 2 OY, 2 PC, 2 PP*, 2 PS, 2 PX, 2 QH, 2 RB, 2 RG, 2 RM, 2 SH, 2 SP, 2 SZ, 2 TA, 2 TB, 2 TO, 2 TP, 2 TR, 2 TV, 2 TW, 2 UA, 2 UF*, 2 UG, 2 UM, 2 UX, 2 VG, 2 VO, 2 VQ, 2 VT, 2 VW, 2 WJ, 2 WK, 2 WM, 2 WN, 2 XC, 2 XR, 2 XW, 2 YR, 2 YT*, 2 ZO, 2 ZK, 2 ZS, 5 AH,* 5 AJ, 5 AT, 5 AW, 5 AZ, 5 BC,* 5 BK, 5 BL, 5 BS*, 5 BV, 5 CI*, 5 CK, 5 CU, 5 CX, 5 DC, 5 DJ,* 5 DM, 5 DT, 5 FD*, 5 FH, 5 FS, 5 FU*, 5 FV*, 5 FW*, 5 GL, 5 GS*, 5 GT, 5 HA, 5 HG*, 5 HL, 5 HM*, 5 HT*, 5 IC, 5 ID, 5 IK, 5 JP*, 5 KC*, 5 KM*, 5 KO, 5 KS*, 5 KZ,* 5 LC,* 5 LT,* 5 LZ, 5 ML*, 5 MS, 5 MT, 5 NB*, 5 NH, 5 NM, 5 NP, 5 OL, 5 OW,* 5 QZ*, 5 RP, 5 RT*, 5 SI, 5 XJ*, 5 XQ*, 5 ZK,* 5 ZV*, 6 AJ, 6 CF, 6 FV, 6 HG*, 6 IJ*, 6 JQ*, 6 ND, 6 NI, 8 AB, 8 AG, 8 AQ, 8 BC, 8 BM, 8 BV, 8 BX, 8 CS, 8 CZ, 8 XY, 8 ZZ, 0 DV, 0 FN, 0 MX, 0 NY, 0 YS. (F. Wiseman Jr.).

* Location unknown.

QUESTIONS AND ANSWERS

C.H.S. (Derby) *submits a diagram of a four-ılve receiver, and asks* (1) *Is the diagram correct.* 2) *Is a single wire aerial better than a twin wire erial.* (3) *Would it be advisable for him to alter ıe height of his aerial, the present position of which s described.*

(1) The diagram is not correct. In Fig. 1 we ;ive the correct diagram for this receiver.

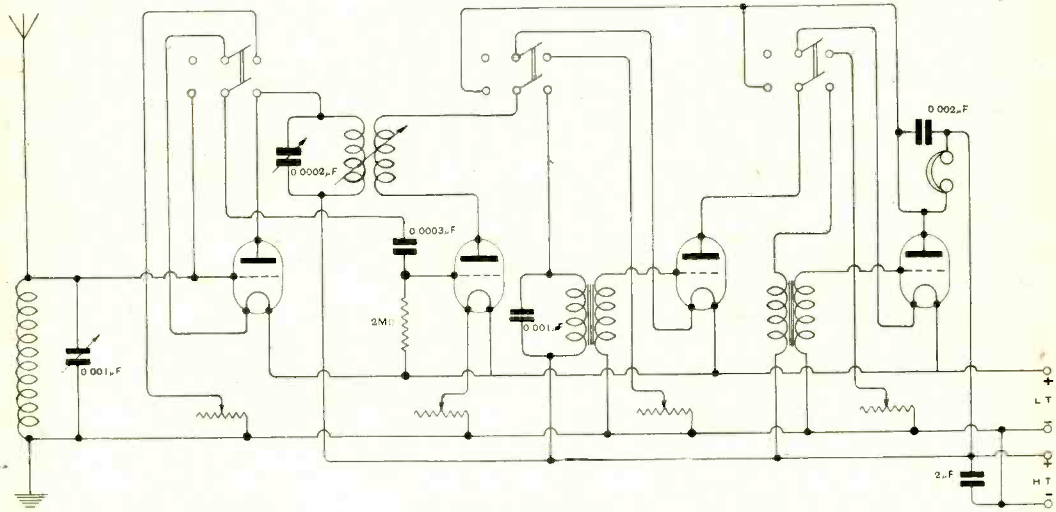


Fig. 1. **"C.H.S." (Derby).** *Diagram of 4-valve receiver with one H.F., tuned anode coupled, rectifier and two note magnifiers* (1—V—2). *Switches are provided so that any valve except the rectifier may be cut out of circuit.*

(2) Provided that the full permissible length of wire can be incorporated in a single wire aerial this type gives equally satisfactory results with the twin wire type. (3) Under the circumstances reception might be improved by raising the aerial.

A.G.B. (Camberley) *asks for a diagram of a simple receiver to operate a loud speaker from the London broadcast transmissions at a distance of five miles, using a frame aerial.*

The diagram is given in Fig. 2.

"J.M." (London, N.8) *gives details of a proposed method of winding coils, and asks* (1) *Will the self-capacity of coils wound by this method be as low as that of basket coils.* (2) *What will be a suitable insulation covering for wires when winding the type of coil mentioned.* (3) *What are suitable dimensions for primary, secondary, anode, and reaction coils to tune from* 300 *to* 500 *metres,* 900 *to* 1,000 *metres, and* 2,000 *to* 3,000 *metres.* (4) *Is it possible to use a reaction coil in the anode circuit of a L.F. valve when a crystal is employed as rectifier.*

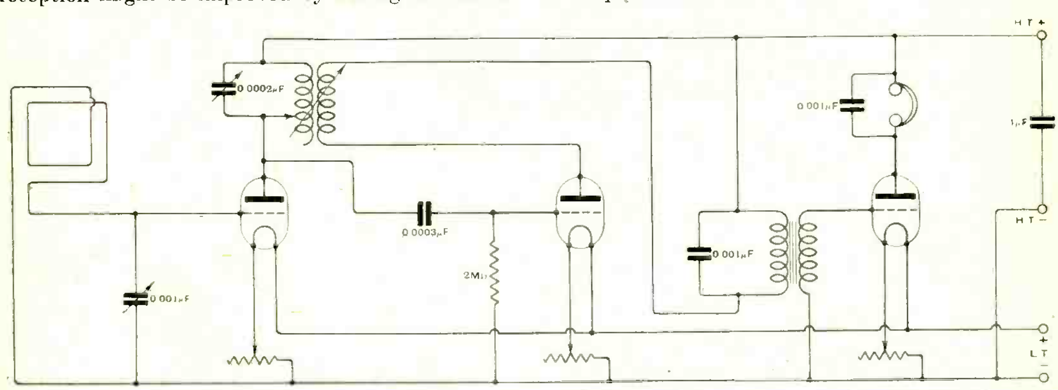


Fig. 2. **"A.G.B." (Camberley)** *Receiver with H.F., rectifier and note magnifier* (1—V—1), *connected to a frame aerial.*

(1) The self-capacity of the coils will probably be a little greater than that of basket coils. The method of winding will make this a very small value. (2) Either D.C.C. or S.S.C. wire will be found suitable. (3) Using No. 26 D.C.C. wire, the following coils may be wound for the wave-

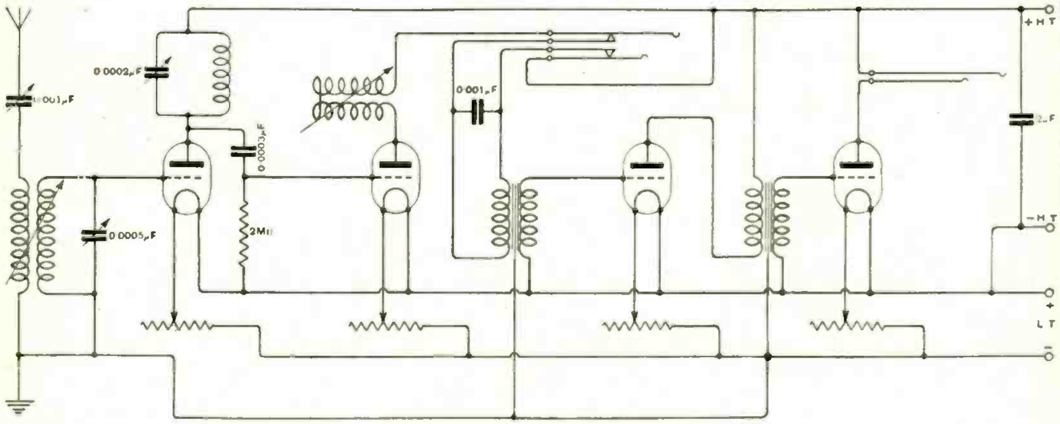


Fig. 3. " **YANK** " **(Doncaster).** *Receiver with H.F., rectifier and optional note magnifiers* (1—V—2). *The telephones are connected to a plug. The purpose of the variometer in the anode circuit of the rectifier is to provide reaction effects.*

lengths given, when a 0·001 μF variable condenser is used in series or parallel with the A.T.I., a 0·0005 μF variable condenser in parallel with the secondary coil, and a 0·0002 μF variable condenser in parallel with the anode coil. A.T.I., 300 to 500 metres, 50 turns ; 900 to 1,000 metres, 150 turns ; 2,000 to 3,000 metres, 300 turns. Secondary coil, 300 to 500 metres, 70 turns ; 900 to 1,000 metres, 200 turns ; 2,000 to 3,000 metres, 450 turns. Anode coil, 300 to 500 metres, 90 turns ; 900 to 1,000 metres, 300 turns ; 2,000 to 3,000 metres, 600 turns. Reaction coil, 300 to 500 metres, 100 turns ; 900 to 1,000 metres, 250 turns ; 2,000 to 3,000 metres, 400 turns.

" **YANK** " **(Doncaster)** *submits a diagram of a three-valve receiver comprising detector and two L.F. valves, and asks* (1) *For a repetition of the*

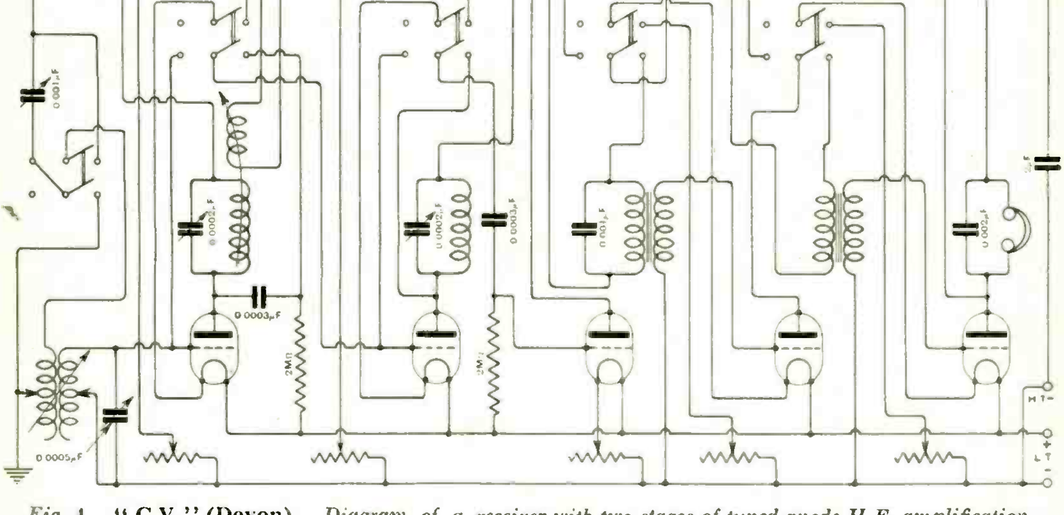


Fig. 4. " **C.V.** " **(Devon).** *Diagram of a receiver with two stages of tuned anode H.F. amplification, rectifier and two note magnifiers* (2—V—2). *The reaction coil is coupled with the first anode coil.*

gram with the addition of one H.F. valve. (2) *ιat are suitable windings for a reaction variometer h given sizes of stator and rotor.*

.1) The diagram is given in Fig. 3. (2) Each mer may be wound with 40 turns of No. 26 C.C. wire.

"C.V." (Devon) *asks* (1) *For a diagram of five-valve receiver comprising two H.F. valves, th switches for cutting out all valves except the tector.* (2) *What will be the approximate range this receiver.*

(1) The diagram is given in Fig. 4. (2) The nge for telephony will be approximately 600 iles, and for telegraphy a considerably greater stance.

"F.B." (Yorks) *asks for particulars of e resistance, weight and cost of certain sizes of sistance wire.*

We should advise you to communicate with ıe manufacturers of "Eureka" resistance wire, ıe London Electric Wire Co. and Smith's, Ltd., olden Lane, E.C.

ıerial circuit. (2) *Should the primary and secondary windings be wound in the same direction.*

(1) No magnetic coupling should exist between these two components. (2) The primary and secondary windings should be wound in the same direction.

"K.M.L." (Petersfield) *asks* (1) *Is it possible to screen an outdoor aerial, in order to eliminate certain morse signals.* (2) *With reference to a sketch of a three-valve receiver submitted, would it be possible to add another H.F. stage to this receiver without altering the internal connections.*

(1) The method would not effect much improvement. (2) Without a diagram of connections, it is not possible for us to say whether the addition could be made.

"D.G.K." (Herts) *submits a list of components, and asks for a diagram of an amplifier made with these components.*

It will not be possible for you to construct an amplifier of the type mentioned with the components listed.

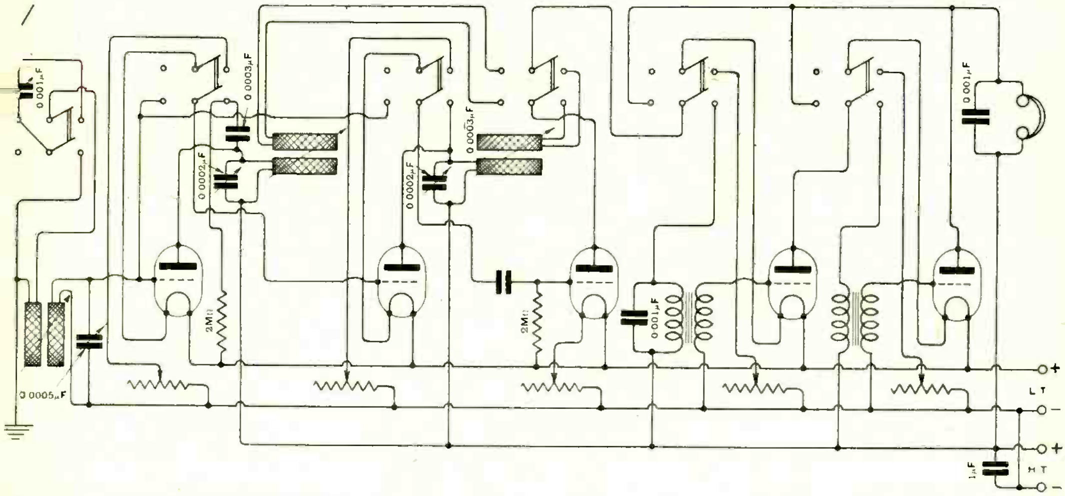


Fig. 5. **"G.C.B." (London).** *Receiver with two H.F., rectifier and two note magnifiers, switches being connected to each valve. The reaction coil may be coupled with either the first or second anode circuits.*

"G.C.B." (London) *asks for a diagram of a five-valve receiver employing two H.F., detector, and two L.F. valves, the H.F. valves to be tuned anode coupled, with reaction to either the first or second anode inductance. Switches are required for cutting out all valves except the detectors.*

The diagram is given in Fig. 5.

"G.W.R." (Southwark, S.E.1) *asks for suitable dimensions for a telephone transformer.*

The primary winding may consist of 3 ozs. of No. 44 S.S.C. wire on an iron wire core 4″ long and ½″ in diameter. The secondary winding may be 4 ozs. of No. 34 S.S.C. wire.

"J.M.J." (Chesham Bois) *asks* (1) *With reference to the description of "The Neutrodyne" in the issue of April 21st, should any magnetic coupling exist between the reactance variometer and*

"T.H.F." (Liverpool) *gives a description of a fixed condenser which he has bought, and asks* (1) *Is the advertised capacity of the condenser likely to be correct.* (2) *Is there any simple method of measuring the capacity of this condenser.* (3) *What is the internal construction of the type of condenser referred to.*

(1) Condensers of this make usually have the capacity marked on the case. (2) Several methods for measurement of capacities of this order have been given in recent issues of this journal. See the issues of May and June, 1923. (3) These condensers are constructed of tinfoil and paraffin waxed paper.

"ARFRYN" (Wales) *asks what is the origin of certain noises heard in the telephones when a telephone transformer is connected directly in the aerial circuit.*

The noises are due probably to a power station, or generator in the vicinity.

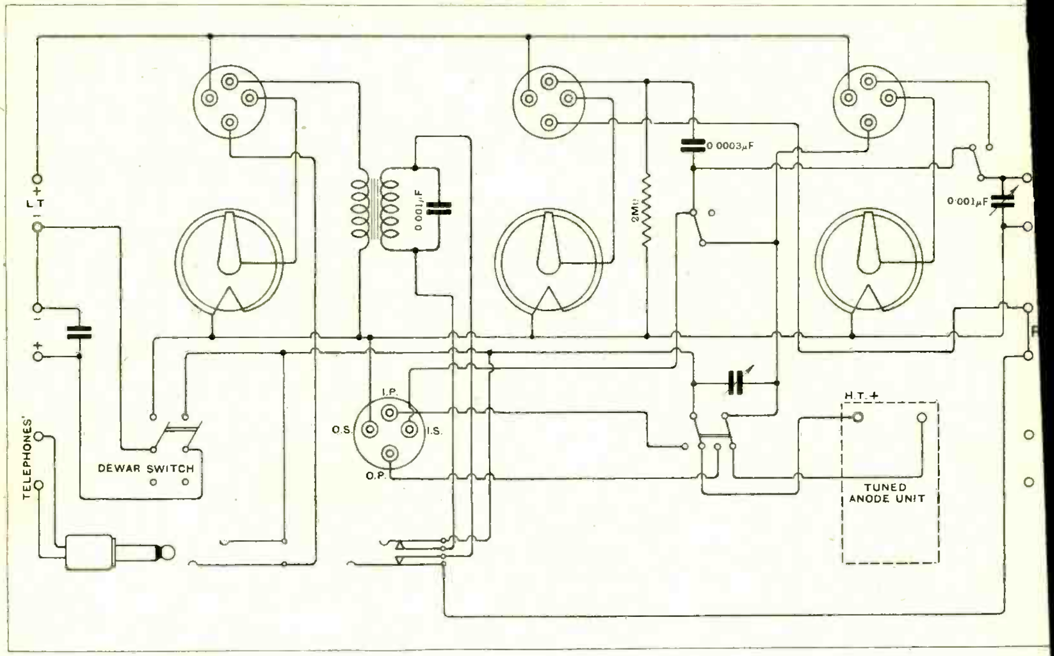


Fig. 6. **"P.R.K." (Philadelphia).** *Wiring diagram of three-valve receiver* (1—V—1).)

"P.R.K." (Philadelphia) *submits a diagram of a three-valve receiver with which he has trouble, and asks* (1) *Is the diagram correct.* (2) *If the wiring is not correct, will we give the proper diagram for this receiver.*

(1) The diagram is not correct. (2) The correct wiring is given in Fig. 6.

"W.H.R." (Sussex) *submits details of a crystal receiver, and asks* (1) *Why are no signals obtained.* (2) *Will telephone wires, crossing the aerial just above it, affect the reception.* (3) *What is a suitable contact for silicon.* (4) *Would it be possible to receive from* **2 LO** *with a single-valve receiver.*

(1) From the details given. it is not possible for us to say if there is any fault in the receiver itself. We advise you to increase the length of the aerial if possible. (2) Unless the telephone wires run nearly parallel with your aerial, no noticeable decrease in signal strength will occur. (3) A steel needle is a very suitable contact for silicon. (4) Under favourable circumstances. reception from **2 LO** with a single-valve receiver may be possible.

"H.K." (King's Norton) *asks* (1) *For particulars of the windings of a L.F. transformer with a ratio of* 5 *to* 1. (2) *For details of the wire required for a potentiometer, to have a resistance of* 500 *ohms.*

(1) The primary winding may consist of 10,000 turns of No. 40 S.S.C. wire, on an iron wire core 4″ long and ¼″ in diameter, and the secondary winding may consist of 50,000 turns of No. 44 S.S.C. wire. (2) On a former 1″ in diameter and 4″ long, wind one layer of No. 36 Eureka resistance wire.

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.*