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Broadcasting.

The Committee to enquire into Broadcasting has now been established by the Postmaster-General. The names of those appointed to serve are as follows:—

- Major-General Sir FREDERICK SYKES, M.P. (Chairman).
- Major the Hon. J. J. ASTOR, M.P.
- Mr. F. J. BROWN, Assistant Secretary, General Post Office.
- Sir HENRY BUNBURY, Comptroller and Accountant-General, General Post Office.
- Viscount BURNHAM, Chairman, Newspaper Proprietors' Association.
- Dr. W. H. ECCLES, F.R.S., President, Radio Society of Great Britain.
- The Right Hon. Sir HENRY NORMAN, Bt., M.P.
- Mr. J. C. W. REITH, General Manager, British Broadcasting Company.
- Field-Marshal Sir WILLIAM ROBERTSON, Bt.
- Mr. CHARLES TREVELYAN, M.P.

The work which this committee has to undertake includes the following subjects:—

(*a*) **Broadcasting in all its aspects.**

(*b*) **The contracts and licenses which have been or may be granted.**

(*c*) **The action which should be taken upon the determination of the existing license of the Broadcasting Company.**

(*d*) **Uses to which broadcasting may be put.**

(*e*) **The restrictions which may need to be placed upon its use or development.**

The scope of this Committee is considerably broader than was anticipated from the first announcement of the Postmaster-General that such a Committee would be formed. It is to concern itself not only with the organisation of broadcasting, but also, as we see, with the action which shall be taken at the conclusion of the period of the existing agreement with the Broadcasting Company. The exact uses to which Broadcasting shall be put is to be considered, and this will no doubt have a considerable bearing on the type of programmes for the future, and will probably include questions of copyright of broadcast information, and musical items.

The Committee has before it a most difficult task, and will undoubtedly have the good wishes of everyone interested in wireless in this country. The amateur and the experimenter may count on their interests being adequately safeguarded by the presence on the Committee of Dr. W. H. Eccles, F.R.S., President of the Radio Society of Great Britain, who has at heart the interests of those who take more than a passing interest in the subject and who desire to investigate and educate themselves in the science of Wireless Telegraphy.

We wish the Committee every success in the very difficult task which they have undertaken, and hope that the result of their deliberations will be a reasonable scheme which will satisfy all parties concerned.

A great deal of adverse criticism has appeared in the Press regarding the British Broadcasting Company, but no one can fail to appreciate the difficult task which has been entrusted to the officials of that Company, and there is no doubt that they have done their utmost to give satisfaction both to their shareholders and the public, and any criticism launched at this organisation should be directed, if at all, at those who introduced the scheme rather than at those who are now entrusted with seeing it through.

Experimental Transmitting Stations Directory.

In our last issue, dated April 28th, we published the first instalment of additions to the list of Experimental Transmitting Stations, additional to the list contained in the Amateur edition of the *Year Book of Wireless Telegraphy and Telephony*, 1923, and again in this issue we publish a further list.

For those who are seriously interested in obtaining a complete list of Experimental Transmitting Stations, it was recommended in our last issue that a card index should be started, and a specimen card was illustrated to serve as a general guide.

We shall continue to publish, from time to time, information relating to new stations or corrections to existing information, and it is hoped that readers will do everything possible to supply us with information which will assist in making this list as complete as possible. Naturally the Post Office will not supply for publication the complete list of which they are in possession, as this is regarded as confidential, therefore we are dependent upon the kindness of holders of transmitting licenses to obtain this information and the authority to publish in *The Wireless World and Radio Review*. Under no circumstances do we publish particulars of stations without first obtaining the permission of the owner.

Experiments in Wireless Telegraphy.

In this issue we are commencing a series of articles by Mr. Maurice Child, who is well known in wireless circles and has been, for many years, Director of Technical Instruction at the London Telegraphic Training College, and a Vice-Chairman of the Radio Society of Great Britain. Mr. Maurice Child has chosen as his subject a graduated course in Experimental Wireless. These articles will commence with elementary experiments, and will lead up gradually to more complicated and advanced work. The purpose of each experiment will be to show the actual function of the component apparatus in wireless circuits, and we believe that this is the first time for a series of experiments, with this object in view, to be described. A special point which the author will bear in mind will be the gradual acquirement of the necessary apparatus without any heavy initial outlay, and every piece of apparatus purchased will be available for later experiments.

Without any hint of belittling the achievements of those British engineers and inventors who have contributed largely to the development of wireless telegraphy and telephony, there is yet, we feel, an excuse for asking why this country is so far behind in inventive genius in this branch of science. Dr. Eccles, in his presidential address before the Radio Society of Great Britain early in the year, laid stress on the extent to which we are indebted to foreign achievement for a large proportion of the equipment of British wireless installations. Cannot something be done to stimulate the activities of wireless students and engineers in this country? It is difficult to see why we should not be foremost amongst all other nations, especially with the enormous increase which has lately occurred in the interest shown in the subject as a result of the introduction of broadcasting.

At the present time there is a vast field open to the experimenter if he will only devote time and interest to the subject, and, in addition, the financial possibilities are probably greater than in any other branch of science at the present time. It is, of course, realised that for those who investigate wireless only as a hobby, and are not professionally engaged, a limited amount of time is usually all that is available for experimenting. On this account the greatest possibilities for the experimenter no doubt lie in the direction of specialising in one particular direction, and devoting all his energies to one specialised branch of the science, rather than dividing his energies over too wide a field.

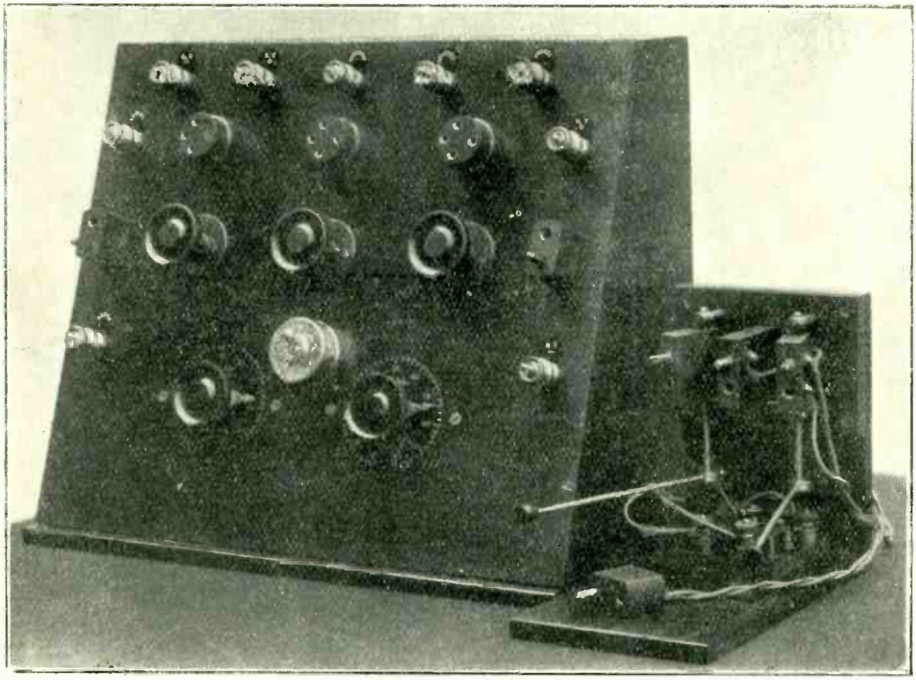
Building a

THREE VALVE RECEIVER

from Component Parts.

This article gives the experience of an amateur in making up an efficient three-valve receiver. His description should prove most helpful to other amateurs who are contemplating the construction of a receiving outfit. The details given with regard to cost are especially useful and the design adopted can be relied upon to embody the best practice.

By M. G. FERGUSON.

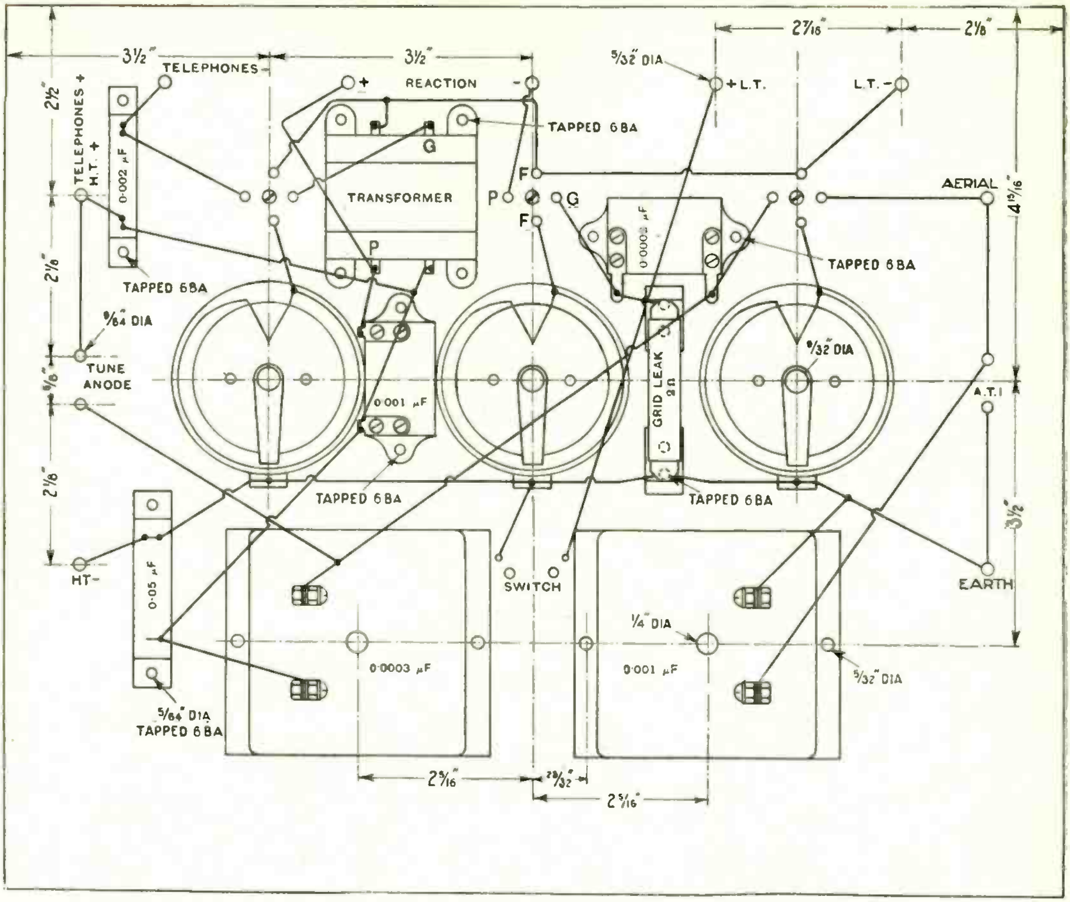


The complete receiver with coil holder stand.

MY original aim in building the three-valve receiver about to be described was simply extra efficiency, and it was only after the completion of the instrument that I realised that I had also achieved cheapness.

With regard to the performance of the set, with an aerial-earth system none too efficient (my den is at the top of a house in Hampstead, 40 feet from the ground, and my earth lead is 35 feet long to a cistern also at the top of the house) on the first evening of its trial, Paris, Radiola, Birmingham, and Manchester concerts all came in with sufficient strength to give loud music on three loud speakers connected in parallel, and working in three different rooms in the house. I may say that these results considerably exceeded my expectations, and that I very nearly decided to scrap my five-valve set then and there. Annapolis, U.S.A. time signals, were also loud enough to operate the loud speaker.

Now as to constructional details, which I give in full in order to encourage any amateurs who may feel that construction of wireless apparatus is a bit beyond their capabilities. The only tools I used in construction were a hand drill with $\frac{5}{64}$ in., $\frac{9}{64}$ in., $\frac{3}{16}$ in., $\frac{1}{4}$ in., $\frac{9}{32}$ in. twist drills, a 6 BA. tap (don't fear this—tapping ebonite is the easiest thing in the



The lay-out of the components, showing the principal dimensions and practical wiring.

world), a screwdriver, wire-cutting pliers, a small centre-punch, a rose bit (for countersinking), a "Britinol" soldering outfit, a small bench vice, a rough file, emery cloth, emery powder, and a little oil.

Also there will be required a small quantity of No. 18 S.W.G. tinned copper wire, six round head 6 BA. by $\frac{1}{4}$ in. brass screws, 12 round head 6 BA. by $\frac{3}{8}$ in. brass screws (and, if not supplied with the valve holders, three countersunk head 5 BA. by $\frac{1}{2}$ in. brass screws), and 4 small brass wood screws.

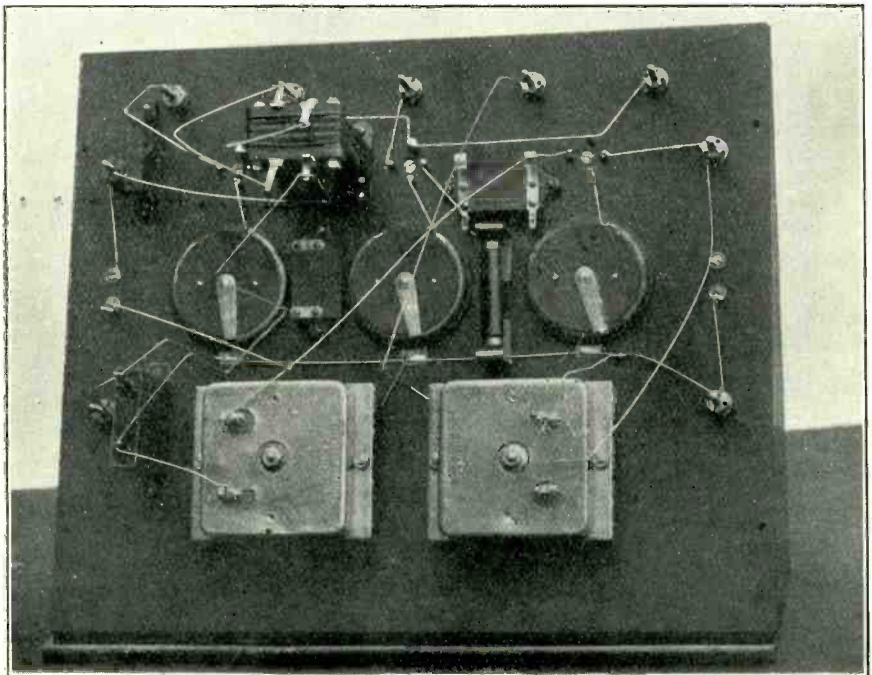
For the instrument itself the following components will be required (I give the actual parts I used with their prices; some of these can of course be varied) :—

	£	s.	d.
2 "Polar" variable condensers, 0·001 mfd. and 0·0003 mfd. ..	£1	8	0
1 Mansbridge condenser, 0·05 mfd.		3	0
2 Dubilier condensers, 0·001 mfd. and 0·002 mfd.		6	0
1 Dubilier condenser, 0·0002 mfd.		2	6
1 Intervalve transformer ..	1	5	0
3 Filament rheostats		15	0
3 Valve holders		3	0
3 Coil plugs		7	6
1 2-megohm grid leak with clips		4	6
9 large 4 B.A. terminals		2	3
9 name tabs ("Aerial," "Earth," "H.T.+," "H.T.−," "L.T.+," "L.T.−," "Phones," "Reactance," "Reactance") ..		3	0
1 miniature tumbler switch ..		3	0
1 three-coil holder		15	0
1 stand for same		5	0
1 small D.P.D.T. switch ..		4	0
Total ..	£6	6	9

Do not expect to get as good results if you try to save expense on such things as the transformer, condensers, and rheostats; the transformer especially should be from a firm of high repute.

This list does not include panel and cabinet. As will be seen from the photographs both of them are larger than absolutely necessary, but they happen to be uniform with my other sets.

On the diagram of connections only the necessary measurements are given. The best position of fixed condensers, etc., should be found by trial. Personally, I always do all my marking and arranging of components on a thick sheet of white cardboard cut to the size of the panel. When these are arranged to my satisfaction, I transfer the cardboard to the panel and very carefully prick through the positions of three or four of the terminals. A few gentle taps of the punch in these pin-holes on the panel will serve as sufficient guide for drilling the holes through. I then clamp the cardboard and panel together by means of these terminals, and the rest of the holes can be rapidly transferred from the cardboard to the panel. When all the holes have been drilled a very fine surface can be given to the front of the panel by means of a rag dipped in oil and emery powder, the final polishing being done with a dry cloth. The holes can be cleared of oil and powder by means of pipe cleaners and paint brushes.



The underside of the panel, showing the arrangement of the components and the wiring.

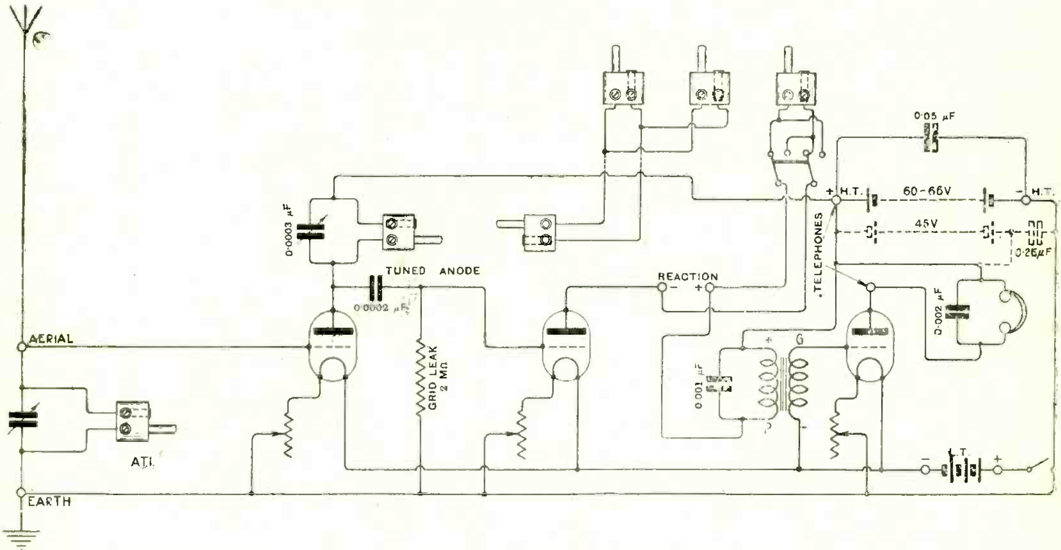
The cabinet need not be very deep in view of the type of variable condensers adopted. It can be so shaped that the panel slopes back about 15° from the vertical. The panel itself measures 14 in. × 11¾ in. × ¼ in.

In addition to the foregoing, to complete the instrument there will, of course, be needed valves, batteries (H.T. and L.T.), and a set of coils for tuning. Very much louder signals will be obtained if a second H.T. battery is used, the positive lead of the phones connected to its positive terminal, and its negative terminal connected together with the positive lead of your original H.T. battery to the H.T. plus terminal of the set. The terminal on the set marked "Phones" should always be connected to the negative lead of your phones, or to the O.P. of the telephone transformer.

There may be a novelty in the constructional side, namely, in the use of the three-coil plugs. Two of these are mounted on the panel, the left-hand one in the photograph being for the

A.T.I. coil, and the right hand one for the tuned anode coil. The third coil plug is wired to the middle coil plug (and to one of the outside arms if necessary) of the three-coil holder. By this means, on broadcasting wavelengths, reaction can be used in the tuned anode circuit, while for other wavelengths reaction can be used either in the aerial circuit or in the tuned end flat in the bench vice, so as to fit it square on to the panel.

Another novelty may be in the arrangement of the wiring and terminals. These are designed so as to give a minimum of wiring, well spaced, and the shortest possible paths, especially in the grid circuits. It is this, probably, that makes the set so efficient. This



The circuit provides for the transferring of reaction coupling from the tuned anode to the aerial circuit by means of the plug-in connectors.

anode circuit. I will give two examples to make the working quite clear. 2 LO, etc., come in very loud with a Burndept "S 2" coil in the left-hand coil plug on the panel, the wired coil plug from the coil stand plugged into the right-hand coil plug on the panel, an "S 4" coil in the centre coil plug of the stand, and a 75 coil in the left-hand or reaction coil plug of the stand. Paris comes in with 150 coil in the left-hand panel plug, 300 coil in the centre stand plug, 200 in the reaction plug; it also comes in with 300 coil in the right-hand panel plug, wired plug plugged into the left-hand panel plug, 150 coil in the centre plug of the stand, 200 in the reaction plug, as before. The second method gives the reaction on the aerial coil. Whenever possible, the first method of using reaction should be adopted for telephony, as the chance of interfering with other receiving stations is thereby reduced to a minimum.

The coil plugs, when purchased, will probably be curved at one end. It is only a matter of a few minutes, however, to file this

incidentally explains the absence of nearly all switching arrangements.

Finally, a tip as to wiring. Twist the free end of your coil of tinned copper wire round the key or handle of your door, uncoil about 10 feet or so of the wire, and then pull hard—hard enough, in fact, not only to straighten out all kinks in the wire, but to stretch it by several inches. The wire will now lie absolutely straight, and with a pair of pliers you will get very neat right-angle bends.

The cabinet in the photograph was made of $\frac{3}{8}$ in. walnut, and the panel of $\frac{1}{4}$ in. ebonite.

Wire the coil stand with sufficient length of flex to keep it well away from the panel. If twisted flex is used, as shown in the photograph, the capacity of your condensers will be quite appreciably added to. This may or may not be an advantage, and it is worth while experimenting with different types of wiring so as to get the best all-round effects.

The double-pole two-way switch on the coil stand is a very necessary piece of apparatus.

VALVES WITH DULL-EMITTING FILAMENTS.

The type of valve here described is one which is likely to rapidly replace the usual " R " type valve now so generally adopted. It has a longer life than the " R " type, and in view of the very low power employed to heat the filament, it is possible to replace the accumulator with its charging and maintenance difficulties by dry or wet cells of the Leclanche type. Experimenters and designers of wireless receiving apparatus are strongly advised to give the dull-emitter valve their early attention.

By M. Thompson, B.A., A.I.C.

(1) The Different Kinds of Filaments.

Although this article deals principally with one type only of valve filament, it will possibly interest the reader to learn that there are at present being produced on a commercial scale in various parts of the world at least three different types of valves classified according to the kind of filament employed.

The one in most general use is probably the tungsten filament, similar to that which one sees in the ordinary electric lamp. When employed in the valve this type of filament generally " burns " rather more brightly than in the vacuum lamp, but much less brightly than in the " gas-filled " or so-called " half-watt " lamp. The filaments of nearly all transmitting valves, such, for example, as the valves in use at the London Broadcasting station, consist of tungsten, while a large proportion of the smaller valves employed in receiving sets have the same kind of filament.

Very extensive use is made in American telephone circuits, of valves which have a filament of strip platinum alloy coated with a mixture of the oxides of calcium, barium and strontium. With this kind of filament, the electrons which are necessary for the operation of the valve are given off by the filament when it is at only a dull red heat.

The third kind of filament, and the one with which we propose to deal in this short article, also runs at quite a low temperature in operation, and is also " coated," but in a very peculiar manner, as described below.

By Courtesy of the Gen. Electric Co., Ltd.
The Dull-Emitter Valve having a thorium treated filament. Silent working and longer life than the ordinary " R " type are claimed, whilst the power consumption for filament heating is only 0·72 watts as compared with about 2·8 watts with the ordinary types.

(2) History of the Dull-Emitter.

In the early days of manufacture of tungsten filaments for electric lamps it was discovered that a stronger filament was obtained if the tungsten metal contained mixed with it a very small proportion—something like 1 per cent.—of other substances. Several substances would increase the strength of the filament in this way, but the one which proved the most useful was thoria, this being the oxide of the rare metal, thorium. So that, in course of time, large numbers of electric lamps were made in which a filament of tungsten, containing thoria, or, more briefly, thoriated tungsten, was employed. At this point it is interesting to observe that the dull-emitting filaments of the valves are made from thoriated tungsten, and it is possible, even probable, that if thoriated tungsten had not proved useful in electric lamp manufacture, there would not exist to-day the " dull-emitter " valve.

Now it is well known to everybody interested in " wireless " that the working of a thermionic valve depends upon the filament (or cathode) being at a sufficiently high temperature for it to emit, or give off, electrons, the flow of these to the positively charged anode or plate being controlled by the electric potential of the grid. All substances, when heated to a sufficiently high temperature, will emit electrons, but the temperature required for the emission of the same number of electrons is different for different substances. On account of its strength and long life when burning at a temperature at which it gives off large numbers of electrons, the tungsten filament has proved very useful in valves.

When the thoriated-tungsten filaments, so common in lamp manufacture, were employed in valves, it was noticed, as long ago as 1914, that the electron emission from the filament, particularly when the vacuum in the valve was more than ordinarily good, would sometimes be very much larger than usual. Dr. Langmuir, in America, investigated this behaviour of thoriated-tungsten, and as a result of his work found that in order to develop the maximum electron emission from the filament it was necessary to raise its temperature to about 2,600° C. for a few minutes, after which, on lowering the temperature to about 2,000° C. the electron emission rapidly increased until it reached a magnitude about 100,000 times greater than that from tungsten at the same temperature. Furthermore, for the same electron emission, the thoriated filament, when actuated in the same manner, was cooler than a tungsten filament by about 600° C.* What actually happens in the thoriated filament when subjected in succession to the temperatures of 2,600° C. and 2,000° C, is a chemical reaction between the thoria and the tungsten, as a result of which a small amount of thorium is produced, and this thorium at the lower temperature diffuses outwards from the interior of the filament and forms a film or coating on the surface. When this surface layer of thorium has formed, the electron emission from the filament is that which is characteristic of thorium, and it so happens that electrons can escape more easily from a thorium surface than from tungsten. They do so because thorium is much more electro-positive than tungsten, and the unfortunate thing is, that by virtue of this electro-positive character thorium has a very strong tendency to become oxidised back again to thoria by any suitable gas which may be present. The term "unfortunate" is used because, as stated by Dr. Langmuir, in order to produce the low temperature emission, very special precautions have to be taken to produce a valve having an exceptionally good vacuum, so that the thorium surface shall not be contaminated during the long life of the filament. However, the thorium present in the interior of the filament very slowly diffuses to the surface even at the low temperature at which the filament burns during the working of the valve, and by doing so helps to keep a complete layer of thorium on the surface. Extraordinarily long lives have been obtained from valves containing these filaments, in some cases in excess of 5,000 hours.

*An account of Dr. Langmuir's earlier work can be found in U.S. Patent No. 1,244,216.

(3) ADVANTAGES OF THE DULL-EMITTER.

There are several advantages which the dull-emitter receiving valve has when compared with the ordinary tungsten filament valve, and only one disadvantage—that of price. The dull-emitter will probably always be dearer than the ordinary valve, owing to its more difficult manufacture, and it is for the user to decide whether the several advantages outweigh the one disadvantage. The advantages are as follows :—

(*a*) *Smaller Power Consumption for Filament Heating*.—The ordinary tungsten filament requires about 0·7 amp. at 4 volts, *i.e.*, 2·8 watts, while the corresponding dull-emitter takes about 0·4 amp. at 1·8 volts, *i.e.*, 0·72 watts. Also, when one remembers that the ordinary tungsten filament practically always requires a six-volt battery, and that the dull-emitter is well within the capacity of a two-volt battery, the difference becomes even more marked.

(*b*) *Longer Life*.—Reports from valve users and tests carried out on a large scale, have proved that the life of a dull-emitter is certainly more than twice as great as that of an ordinary valve.

(*c*) *Silent Working*.—This advantage becomes of importance only when more than two valves are used for note-magnification. Partly owing to its lower filament temperature, the dull-emitter is free from "crackle."

The "Gravity Float" Accumulator

Many readers will have experienced exasperation through the running out of the accumulator at an inconvenient juncture. To avoid this unpleasantness, Messrs. Peto and Radford (Proprietors, Pritchett & Gold and E.P.S. Co., Ltd.), 50, Grosvenor Gardens, Victoria, S.W.1, have produced a new "Gravity Float" type of battery. Each cell is assembled with three "gravity floats" of distinctive colours—white, blue and red—which are calibrated to sink as the density of the acid in the cell falls. A faithful indication is thus afforded of the approximate energy remaining in the battery.

THE AMATEUR'S EXPERIMENTAL LABORATORY

III. Application of the "Double-Click" Method to Capacity Measurement.

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

IN the last article it was described how resonance between two circuits could very readily be indicated by using the "double-click" method. This is quite a simple method to employ for the comparison of condensers. It will first be desirable to make a calibration curve for the variable tuning condenser (C_3) used in the second oscillation circuit described in connection with Fig. 4 of the last article. For this purpose we must procure a fixed condenser of known capacity value. The values marked on the usual patterns of small fixed condensers purchasable through most dealers in radio apparatus are approximate only, but most manufacturers of such condensers will supply the *exact* capacity value of any one of these condensers if it is asked for when ordering the condenser. If the tuning condenser used in the second oscillation circuit has a maximum value of about 0·001 microfarad, a convenient size of fixed condenser for use in its calibration would be one of about 0·0001 microfarad, and it will therefore be assumed in what follows that a condenser of about this value has been obtained, and that its exact capacity reading has been obtained from the manufacturers.

The first procedure is to determine one point on the calibration curve of the variable condenser. This can be accomplished by connecting up the second oscillation circuit, to which reference has been made, with the fixed condenser and a coil of suitable size that will tune to some wavelength within the range generated by the valve oscillator. For this purpose the circuit should be arranged as in Fig. 1, which shows a double pole throw-over switch connected between the coil and the condenser. The purpose of this switch is to enable the fixed condenser to be interchanged with the variable that is to be calibrated. In Fig. 1, Sw represents this switch, which can be thrown over into either position (1) or position (2). When in position (1) the fixed condenser of known capacity value C_3 is connected in parallel with the coil L_3, while when it is in position (2), the variable condenser C_4 is similarly connected.

The most important point to consider when arranging this test circuit is to keep the wires from the two sets of switch contacts as short as possible, and also of the same length, and as nearly as possible at the same distance apart and at the same height above the table. These precautions may seem to be a refinement that is scarcely necessary, but a few moments' consideration should emphasise the necessity of adhering to it.

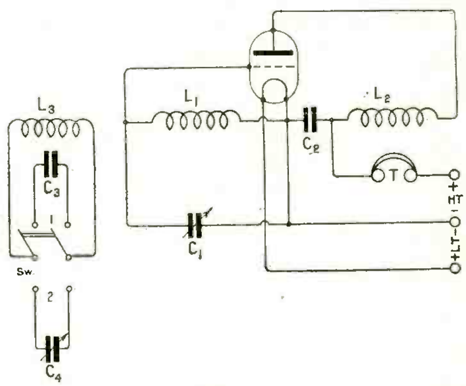


Fig. 1.

The wires connecting the two sides of the switch Sw to the condensers C_3 and C_4 respectively have some capacity between them, and this capacity will, of course, add to that of the condenser to which they are connected. That is, the capacity of the wires between condenser C_3 and contacts (1) of the switch will add to the capacity of condenser C_3 while the wires from contacts (2) will add to the capacity of condenser C_4. It is for this reason that the arrangement of the two sets of wires must be kept as nearly alike as possible so that the two additive capacities may also be the same.

Any difference between them may be allowed for by interchanging the positions of condensers C_3 and C_4 without, of course, altering the positions of the wires, and noting whether there is any apparent difference in the capacity of the condenser C_3.

This method of checking will be discussed more fully later.

Having arranged the circuit in this manner, the procedure becomes as follows :—

Put the switch Sw into position (1), so that the fixed condenser C_3 of known capacity value is in circuit. This will give the circuit composed of the coil L_3 and the condenser C_3 a certain natural oscillation frequency. The oscillator valve should next be switched on so as to produce radio frequency oscillations in the circuit $L_1 C_1$ forming part of the oscillator. By adjusting the variable condenser C_1 the frequency of these oscillations can be made the same as the natural frequency of the test circuit $L_3 C_3$, provided that a suitable sized coil is used for L_1. By listening in the telephone receivers attached to the oscillator valve clicks will be heard as the oscillator circuit passes through the resonance point as has already been indicated. When once the approximate tuning position has been ascertained, a careful adjustment should be made so as to determine exactly the mean setting for the two click positions.

The tuning condenser of the oscillator should then be left at this mean setting, so that the frequency of the oscillations generated by the valve is the same as the natural oscillation frequency of the test circuit $C_3 L_3$. The switch Sw should next be moved over to the second position so as to put the variable condenser C_4. into the test circuit in place of the fixed condenser C_3, and the setting of this condenser should be altered until the clicks are again heard in the telephones attached to the oscillator valve, taking care that the setting of the condenser of the oscillator (C_1) is not moved at all while this is being done.

The setting of C_4 which is the mean of the positions where clicks are heard in the telephones should be noted very carefully, as this is the first fixed point on the calibration curve which we wish to determine.

As has already been pointed out, any inequality in the capacities of the wires connecting the two condensers with the two sides of the switch will affect the accuracy of this determination, so that for checking purposes it is desirable to interchange the two condensers C_3 and C_4 and to repeat the determination exactly in the manner just described, taking care that the relative positions and arrangement of the two sets of wires are not changed when making this alteration.

The setting of the test condenser at which its capacity is exactly equal to that of the known fixed condenser as determined by either of these experiments should be identical. If by any chance the two experiments do not give exactly the same result, the mean of the two readings can be taken as a first approximation to the true setting, but a more reliable procedure would be to effect such modifications in the disposition of the wires as will make the two sets of readings identical.

A note should be made of this setting, preferably by filling in the figures in a table drawn out in the manner indicated in Table I below, so that other readings can be added to it from subsequent determinations.

The setting of the condenser C_4 found by these experiments should be entered in the left-hand column, while the exact capacity of the companion condenser C_3 should be filled in opposite to it in the right-hand column. The results of other similar determinations can be added later.

TABLE I.

Calibration Curve of Variable Condenser.

Scale Reading of Condenser.	Capacity in Microfarads.

If now other fixed condensers of known capacity value are available or can be obtained easily, it is possible to repeat the above described process for each of them, and so to determine several points upon the calibration curve of the condenser. For instance, if as has already been assumed, the condenser under test has a maximum capacity value of about 0·001 microfarad, and the first determination has been made with a comparison condenser of about 0·0001 microfarad capacity, it would be convenient to make other comparisons by the same method against known condensers of about 0·0002, 0·0004, 0·0007, 0·00095 microfarad, as these will give points well distributed along the calibration curve of the condenser.

The readings of the scale of the test condenser corresponding to the mean of the two "click" positions obtained when each of these condensers is used in turn as the comparison standard, should be noted in the table already commenced, so that the calibration curve can subsequently be plotted easily. The exact capacity value of each comparison condenser should of course be entered up in the table, not merely its nominal value.

If the above, or some similar series of comparison condensers is used, we shall thus obtain five points on our calibration curve, from which a preliminary curve may be prepared. To plot out this curve, a sheet of squared paper should be obtained—the most commonly used varieties being those ruled in inches and tenths, or in centimetres and millimetres.

Two lines should be ruled on this paper, one horizontally near the bottom, and the other vertically near the left, to form the two "axes" of the curve (Fig. 2). The horizontal line should be marked "SCALE READING," and should be numbered off from 0 (at the left) to 180 (at the right), taking one large division (inch or centimetre, according to the paper in use) for each 10 or 20, depending upon the size of paper available. It is assumed, of course, that the condenser scale is marked out in degrees from 0 to 180 in the usual manner, but if it has any other marking it should of course be set out along the "scale reading" line of our graph in lieu of the figures marked in Fig. 2.

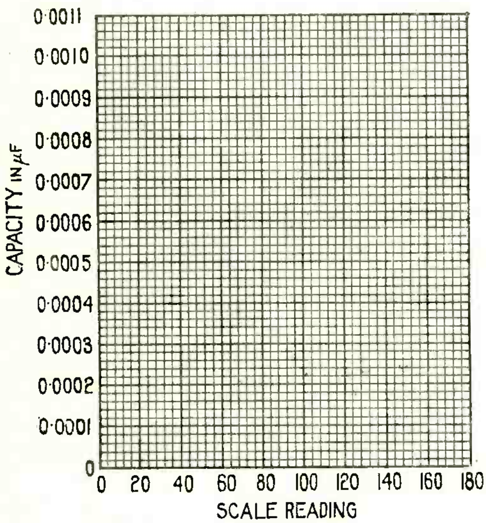


Fig. 2.

The vertical line on the left-hand side of the paper should be marked "CAPACITY IN MICROFARADS,"* and may conveniently be marked off from 0 to 0·0011 microfarad as indicated in Fig. 2, using one large division of the paper for each 0·0001. This marking is, of course, suitable for a condenser having a nominal maximum value of 0·001 such as has already been assumed will be used, but if the actual condenser under test has any other maximum value differing much from this figure the scale figures can obviously be modified accordingly.

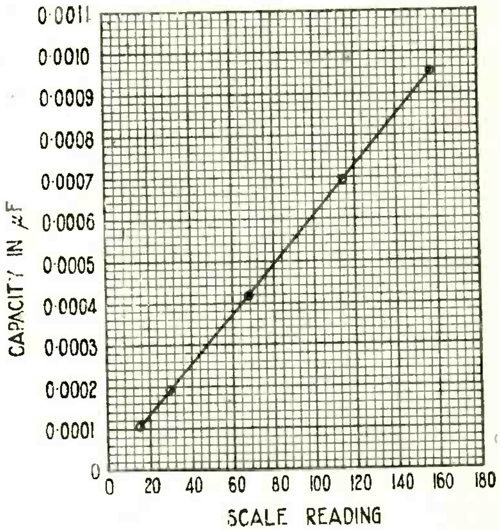


Fig. 3.

The figures which have already been filled into the table drawn up on the lines of Table I can now be plotted, by putting a small cross or dot at the point of intersection of the horizontal and vertical lines through the reading in question. Thus, suppose that the first line of the table gives 16° corresponding to a fixed condenser of 0·000105 microfarad, we should follow up the vertical line through the point on the horizontal scale corresponding to 16° on the scale, until it intersects a horizontal line through the point on the vertical scale corresponding to 0·000105, and put a dot on the paper at the point of intersection.

*Or "CAPACITY IN μF," if preferred, since μF is the official abbreviation for microfarad.

Thus suppose, merely for the sake of example, our experiments have given us the series of figures such as are set out in Table II, these would be plotted out on the curve in the positions shown in Fig. 3.

TABLE II.

Calibration Curve of Variable Condenser.

Scale Reading of Condenser.	Capacity in Microfarads.
16	0·000105
31	0·000190
68	0·000420
115	0·000698
158	0·000950

If the variable condenser is a good one, and the experiments have been performed carefully, it will be found that the points so obtained lie almost, if not quite, along a straight line, as has been indicated in Fig. 3, by the straight line ruled through them.

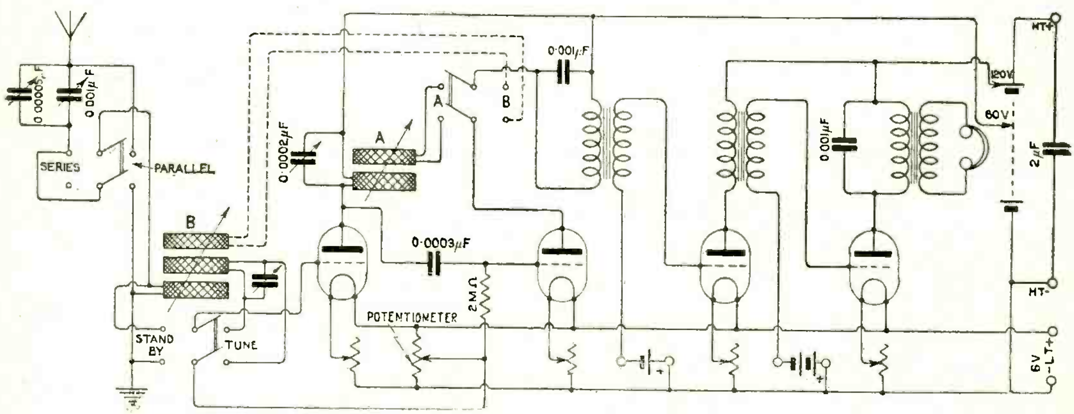
The straight line should not be extended beyond the extreme points obtained by these experiments, as the linear relation usually does not hold good at the ends of the condenser scale, but the calibration line becomes slightly curved. A method of determining this curvature will be described in the next article, which will also deal with the manner in which the calibration curve can be delineated if only *one* known fixed condenser is available, instead of five, as has been assumed in the preceding description.

A NOTE ON REACTION.

IT is the object of the present note to bring out one or two points in connection with reaction. In recent issues of this journal various writers have urged that reaction should not be used in receivers while receiving broadcast transmissions, or indeed any transmission of speech or music.

The evil effects of reaction are well known. In the first place, the signal *suffers considerable distortion* unless the person using the reaction has a good deal of experience. In the second place, most receivers, except, of course, those which bear the B.B.C. stamp, will set up oscillating energy in the aerial circuit.

The purpose of reaction is to neutralise, in part, the resistance of a circuit. Thus in the figure, the purpose of the reaction coil when connected at A, is to neutralise part of the resistance of the tuned anode circuit. When the reaction coil is connected in position B, part of the resistance of the closed and aerial circuits is neutralised. In the latter case, if the resistance is completely neutralised, or if the reaction coil is coupled so tightly that the closed and aerial circuits have negative resistance, the signal is cut up altogether, and, in addition, energy is being radiated from the aerial, to the annoyance of other listeners-in.



The diagram gives the connections of a four-valve receiver. The reaction coil may be connected at A or B by the switch.

In the former case, when the reaction coil is tightly coupled, oscillating energy is present in the tuned anode and detector circuit. The signal is of course cut up, but there is another effect which should receive serious attention. It is well known there is capacity between the valve electrodes and between the receiver wiring; in addition, circuits may be coupled with the aid of small capacities. Therefore when oscillations are generated in the anode and detector circuits, energy will be transferred back to the closed and aerial circuits through the stray capacities. If the coils connected in the anode and grid circuits were coupled magnetically, there would be a further transference of energy.

It must therefore be apparent that so long as there is coupling, either magnetic or capacitive, between anode and grid circuits, we have *not* a receiver which will not cause oscillating energy to flow in the aerial circuit. It is generally supposed that, provided the reaction coil is coupled with the anode coil, only a small amount of energy can be transferred, which is so limited in value that interference will not be caused. This, as has been shown, is not the case.

It is therefore the view of the writer that those who build their own receivers should not use reaction when receiving telephony. One finds that, not content with the use of a single reaction coil, some writers are recommending the use of a number of reaction coils, each coil being coupled with a different part of the receiver. This practice is to be condemned.

A satisfactory solution of the problem—that of obtaining the full amplification of a valve with its associated circuits without distortion—is not to be found in the use of a multiplicity of reaction coils, but rather one should avoid reaction and design circuits which have low losses, and which cannot transfer energy back to the aerial circuit. The description of the "Neutrodyne" receiver in a recent issue should be of great assistance to those who build their own receivers. With a receiver of this type, built according to the description,* enormous amplification is obtained. Signals are not distorted, the receiver is very selective, and, the most important point of all, oscillating energy cannot be transferred back to the aerial circuit, even though, through the use of a variometer in the detector valve anode circuit, local oscillations are generated for the reception of C.W. signals. W. J.

***Wireless World and Radio Review*, p. 67, April 21st, 1923.

STATION WHAZ, TROY, N.Y.

General view of the operating room of the American Station **WHAZ** *at the Rensselaer Polytechnic Institute, Troy, N.Y. The equipment was installed for the purpose of collecting data on fading, interference, etc., in long distance short wave communication, and tests have been made for the U.S. Department of Commerce. Musical selections and addresses by prominent men are broadcast every Monday evening at* 8.15 *Eastern Standard Time (U.S.).*

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—IV.

(*Continued from page* 103 *of the previous issue.*)

It is the purpose of the writer to deal with the principles underlying the action of wireless receivers and transmitters. Those who know *why*, obtain much pleasure which is not experienced by those who have no idea of the action of their wireless set.

The series has been specially designed 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.

By reason of his work in supervising the replies to the queries and difficulties of readers, the writer has an experience which is not possessed by other engineers. Readers will appreciate that this experience will be reflected in both the selection and the method of presenting the subject.

By W. James.

16.—Inductance.

If now the wire is wound round a cylinder to form a spiral, and a battery is connected to its ends, the magnetic field created will be more intense along its diameter as shown in Fig. 26.

Let us now see what happens when the switch is closed. A current tends to flow due to the battery, and lines of force are generated. The lines of force are now, however, much more effective in producing a back pressure. The lines of force will cut each of the turns of wire, and as each turn of wire is producing a field we have a two-fold increase.

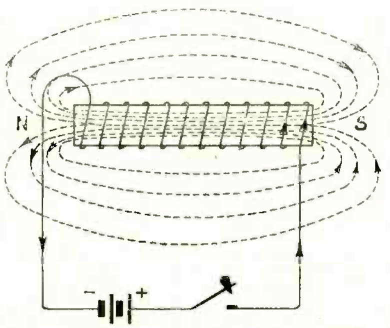


Fig. 26. When a wire is wound in the form of a coil and a battery is connected, a magnetic field is created as shown by the dotted lines. The field has its greatest density along the centre of the coil.

When the lines of force have reached their final value a steady current flows as in the previous case and there is no back pressure being generated. The number of linkages N_L, by which is meant the number of lines of force which link with the conductor, is equal to $N \times F$, where N is the number of turns and F is the flux, or the number of magnetic lines. The magnitude of the back voltage E_B may be represented by $\frac{N_L}{t}$ where t is the time in seconds. In other words the back voltage produced is proportional to the number of linkages per second.

The inductance L of the circuit is given by $N_L = LI$ where I is the current in amperes. Since N_L is the number of l nkages, and is equal to the number of turns, times the flux, and the flux is proportional to the current, it is plain the inductance depends principally upon N, the number of turns of wire in the circuit. The unit of self inductance L is expressed in henries. A circuit possesses an inductance of one henry when a current changing at the rate of one ampere per second produces a back pressure of 1 volt. The henry is too large for wireless purposes so a smaller unit termed the microhenry, abbreviated μh, which is one-millionth part of a henry, is used. Sometimes a still smaller unit called the centimetre, abbreviated cm., is used. One centimetre is equal to one-thousandth part of a microhenry.

As in the case of condensers, it is possible to intensify the field produced by the current flowing through the winding. If a piece of iron is inserted in the coil, forming a core, the number of lines of force produced by a given current is greatly increased. The increase is due to the magnetic properties of the iron. It is a good conductor of magnetic lines. The flux produced in a coil is increased by a value μ. The term μ represents the *permeability* of the iron, that is, its readiness to conduct magnetic lines. The value of μ is not a constant, but depends upon the quality of the iron, and upon the density or the number of lines of force per square inch which pass through it. The permeability is defined as the ratio of the number of lines of force present when the iron core is used, B, to the number present when the iron is absent, or in the form of an equation $\mu = \frac{B}{H}$.

The term H is known as the magnetising force, and is equal to $\frac{1{\cdot}257 \times N \times I}{l}$.

The total flux produced is given by

$$\frac{\frac{1{\cdot}257 \times N \times I}{l}}{\frac{l}{a \times \mu}}.$$

The term $\frac{l}{a \times \mu}$ is termed the *reluctance* of the magnetic circuit.

The above equation represents the "Ohm's law" of the magnetic circuit. The resemblance is easily noticed. We have the magnetising force, which is comparable with voltage; and the reluctance which is similar to resistance. The equation could be written thus:

$$\text{Flux} = \frac{\text{magnetising force}}{\text{reluctance}}$$ which is similar to current $= \frac{\text{voltage}}{\text{resistance}}$.

Writing the above equations in a different way, the flux produced

$$F = \frac{1.257 \times N \times I \times a \times \mu}{l}.$$

Where N = The total number of turns of wire.
I = The current in amperes.
a = The area of the core in square inches.
μ = The permeability of the iron.
l = The length of the magnetic path in inches.

When it is desired to produce a choke coil it is obvious from the above that the number of turns N should be as large as possible, the area of the iron core should be large, and the permeability of the iron core high. Soft iron has a high permeability. On the other hand, the length of the magnetic circuit should be kept as small as convenient.

Further informa ion concerning inductance coils for use in wireless circuits will be given later.

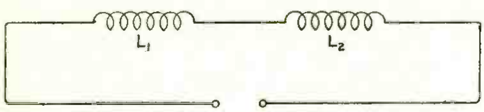


Fig. 27. When inductances are connected in series, the total inductance is equal to the sum of the individual inductances, provided the magnetic fields of the coils do not interlink. In the above case the total inductance is given by $L_1 + L_2$.

17.—Inductances in Series and Parallel.

The total inductance of two inductance coils connected in series, Fig. 27, is given by the sum of the separate inductances provided the lines of force due to one coil does not interlink with the other coil. Thus—

$$L = L_1 + L_2.$$

The effect of connecting inductance coils in series is analogous to connecting ordinary resistance in series.

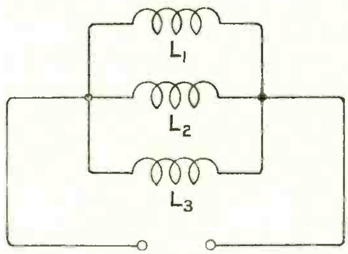


Fig. 28. When inductances are joined in parallel, the total inductance is less than that of the smallest, in the same way that the nett resistance of resistances in parallel is less than that of the smallest resistance.

When coils are joined in parallel (Fig. 28) the total inductance is reduced in the same way that the nett resistance of a number of resistances in series is less than that of any individual resistance. The resultant inductance L is given by

$$\frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}, \text{ etc.}}$$

The Energy stored in a Magnetic Field.

In the case of a condenser, as previously explained, the energy which may be stored in its dielectric is equal to (*a*) $\frac{1}{2}QE$ joules, or in another form (*b*) $\frac{1}{2}CE^2$ joules, where Q is the quantity of electricity in coulombs, E is the potential difference in volts, and C is the capacity in farads.

Now, in the case of an inductance coil, the energy is stored in the form of magnetic lines of force in the space around the coil and its magnitude is given by $\frac{1}{2}LI_2$ joules. The similarity between the latter equation and equation (*b*) above for the case of the condenser is evident. In each case the factor $\frac{1}{2}$ appears and in addition in one case we have the capacity *C* of the condenser, which is a physical property, while in the other we have the inductance *L*, which also is a physical property. The last factor in equation (*b*), the pressure squared differs from the factor current squared in the inductance formula, but it will be noticed that the charge given to a condenser is due to the *pressure applied*, while the flux generated in the inductance coil is simply due to the *current* which flows through the turns of wire. When the coil has an iron core the quality and area of the iron has to be reckoned with as previously explained.

It is instructive to notice the greater the current in the coil the larger the amount of energy which may be stored up as magnetic lines of force, and, in addition, the greater the inductance of the coil the greater the energy stored.

18.—Alternating Currents.

It will help us considerably in the understanding of the principles and action of condensers and coils, as well as tuned circuits and

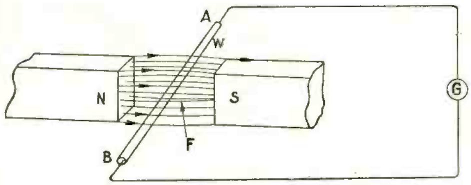


Fig. 29. When a wire moves across a magnetic field a pressure is induced in the wire, and when the external circuit is complete, a current will flow.

transformers, if a little consideration is given to alternating current work. Previously we have dealt with direct currents which are obtained when cells are connected with a circuit; transient currents which flow when a source of direct current is applied to a condenser, and displacement currents which are produced in the dielectric of a condenser.

When studying the property of inductance it was explained that a difference in pressure is produced across the ends of a wire which "cuts" a magnetic field. If the circuit is completed, a current will flow. The arrangement is given in Fig. 29. Here W is the wire, N and S the poles of magnets, and F is the magnetic field or flux.

Suppose now the wire is moved downwards. A difference of potential (abbreviated to P.D) will be set up across the ends of the wire and a current flows in the circuit. It is important to know which end will be made positive and which negative. We know from Lenz's law that a force has to be applied to the conductor to force it through the field, because the magnetic lines of force which will be generated around the wire due to its motion act as a drag and impede its

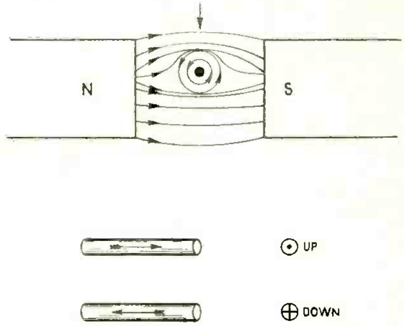


Fig. 30. With the magnetic field and the motion of the conductor as shown, the current in the wire will flow in a direction up out of the paper. When the current is flowing in the direction of the arrow, and the observer is looking at the point of the arrow, a dot is shown in the centre of the wire. When one is looking at the end of the arrow, a cross is shown on the end of the conductor.

motion due to their direction. Actually they link with the main field as shown in Fig. 30. The main field is distorted by the field due to the current flowing in the wire, as shown, the

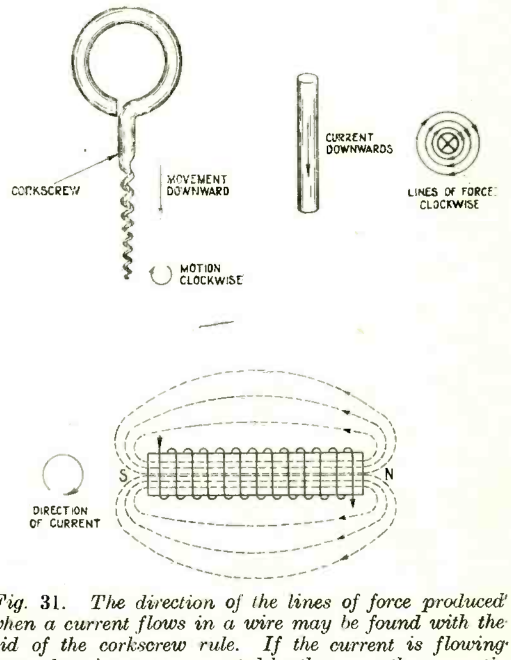


Fig. 31. The direction of the lines of force produced when a current flows in a wire may be found with the aid of the corkscrew rule. If the current is flowing down the wire, as represented by the cross, the magnetic field is as shown.

lines tending to crowd below the conductor and so impede its motion.

This will perhaps be more readily seen if the lines of force are looked upon as elastic bands. The tendency is for the bands to lie straight between N and S, whereas due to the pressure of the wire which is being moved downwards they stretch, and the tension in the bands opposes the movement of the wire. The direction of the magnetic lines of force around a conductor is easily remembered from the *corkscrew* rule. If we have a right-handed corkscrew, we screw it into a cork with a right-handed movement. If we have a wire carrying current in the direction of movement of the corkscrew, the direction of the lines of

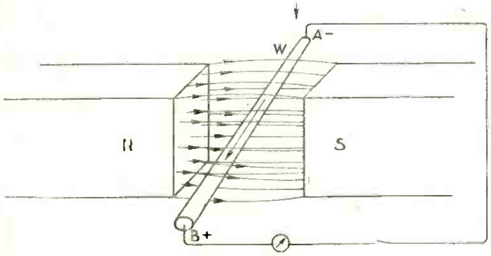


Fig. 32. This figure shows the direction of a current flowing along a wire which is moving through the magnetic field in the direction shown.

force is the same as the direction of turning the corkscrew. This is shown in Fig. 31.

The direction of the current is therefore up out of the paper as in Fig. 32; the end A is negative and end B positive.

If now the wire is moved *up* through the field it is obvious the direction of the current has reversed, because the direction of movement has been reversed.

The direction of the induced pressure may be obtained in another manner with the aid of Fleming's right-hand rule which is as follows :—

The right-hand is held out, the thumb is pointed to the left, the first finger forward and the second finger downward; the thumb represents the direction of motion of the wire, the first finger the direction of the lines of force, which is from north to south, and the direction of current in the wire is represented

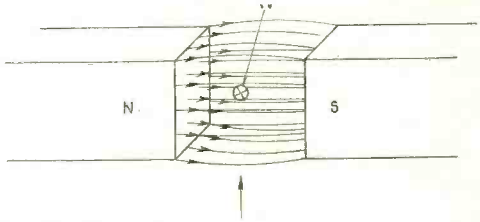


Fig. 33. When the wire moves across the magnetic field in the direction of the arrow, the current flows down the wire away from the observer—represented by the cross on the wire.

by the direction of the second finger. Thus in Fig. 30 the current is flowing upwards, and is represented by a symbol consisting of a circle with a dot in its centre. When the direction of motion is reversed, as in Fig. 33, the current is going down into the wire and is represented by a circle with a cross. If now the wire is bent in the form of a loop, which may be rotated, it is apparent that the P.D. set up in each portion of the wire will *assist* as shown in Fig. 34. Thus the loop is rotating in a clockwise direction and at the moment shown in the figure the portion of the loop A is moving upwards, while portion B is moving downwards. From figures 30 and 33 we

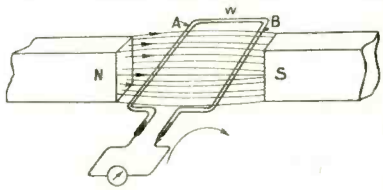
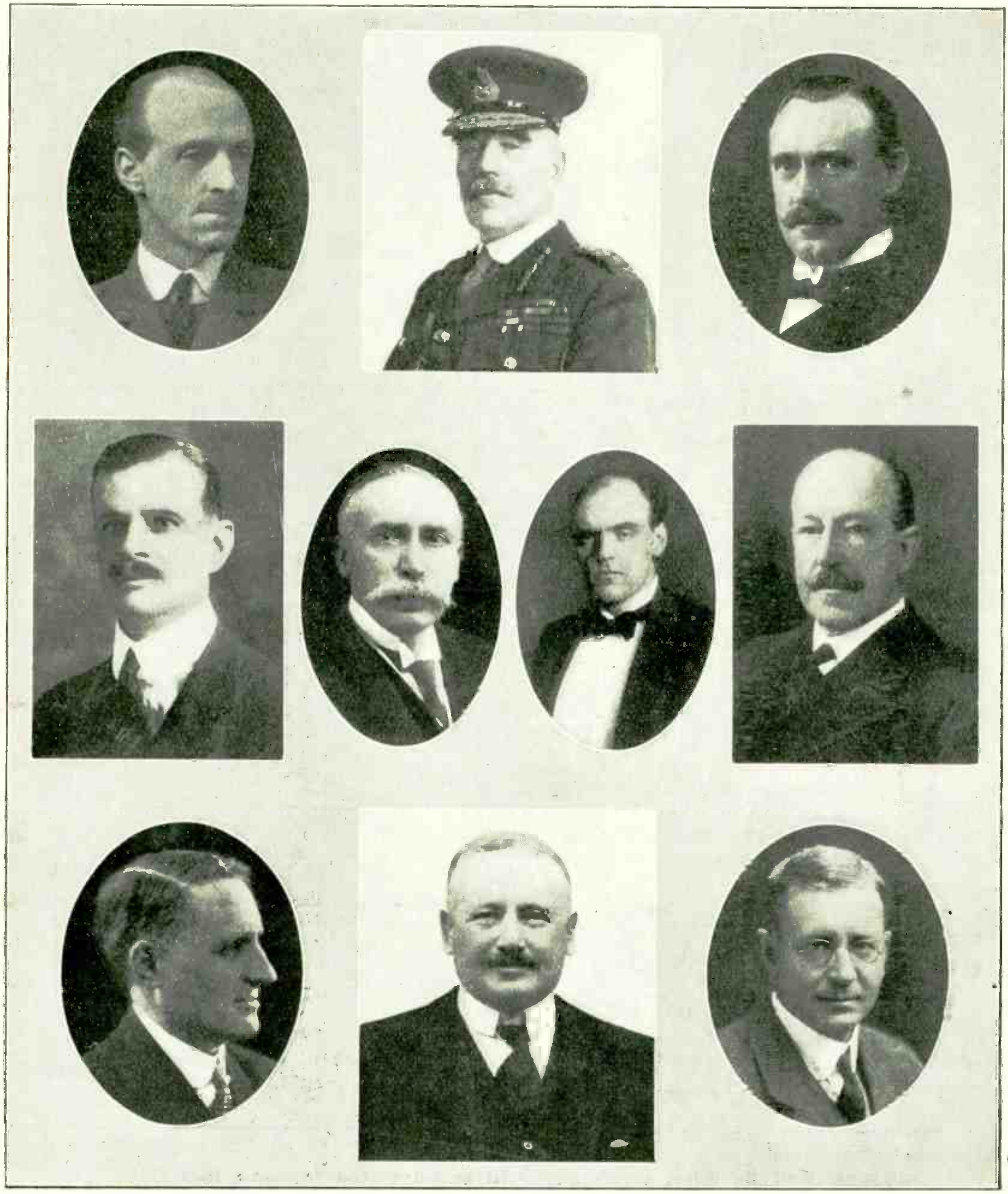


Fig. 34. When a loop is rotated in a magnetic field, the voltages induced in each half of the loop have such a direction that they add together.

see the current in parts A and B is as shown by the arrows. The total pressure generated is twice that generated by a single wire provided the rate of cutting the lines of force remains unaltered.

Readers of "The Wireless World" will be interested to know that Dr. J. A. Fleming, F.R.S., will broadcast from 2LO on Friday, May 4th, at 9 p.m. His subject will be "An Appreciation of the Scientific Work of the late Sir James Dewar."

THE BROADCAST ENQUIRY COMMITTEE.



Photos : Vandyk, Elliott & Fry, Bassano, and the Press Portrait Bureau.

The Committee who have been appointed to enquire into the Broadcasting problem.

(*Top—Left to right.*) Major-General Sir Frederick Sykes, M.P. (*Chairman*) ; Field-Marshal Sir William Robertson, Bt. ; Dr. W. H. Eccles, F.R.S. (*Centre*) Major The Hon. J. J. Astor, M.P. ; Mr. F. J. Brown ; Mr. J. C. W. Reith ; The Right Hon. Sir Henry Norman, Bt., M.P. (*Bottom*) Mr. Charles Trevelyan, M.P. ; Viscount Burnham and Sir Henry Bunbury.

Wireless Club Reports.

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Streatham Radio Society.*

A most interesting paper and demonstration upon "High Speed Reception," was given by Mr. E. R. Batten on April 11th, when the lecturer traced the history of automatic recorders for radio reception, concluding with a detailed description of his own apparatus. Ongar was perfectly reproduced, but later in the evening the records were badly interfered with by the static due to the approaching thunderstorm. During a lull in the Ongar reception, the static alone was recorded, showing the frequency and character of the interference.

Hon. Sec., S. C. Newton, A.M.I.E.E., "Compton," Pendennis Road, S.W.16.

Stratford-on-Avon and District Radio Society.*

On Monday, April 16th, the Secretary read a paper on "How Wireless Waves are Sent and Received," dealing with the subject in non-technical language. During the evening two members of the Halifax Radio Society paid a visit and gave interesting information regarding their amateur transmitting stations, call signs, wavelengths and hours of transmission.

It is pleasing to note that the membership of this very useful Society is still growing, and great keenness is evinced by the members.

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

The North London Wireless Association.*

On April 16th, a discussion on future events was held, and an interesting series of lectures has been arranged for the coming weeks.

Particulars of membership can be obtained from the Hon. Sec., J. C. Lane, Northern Polytechnic Institute, Holloway Road, N.

Swansea Radio Society.*

On April 18th, a lecture was given by Mr. J. C. Kirkman, B.Sc., A.Inst.P., Fellow of Phy. Soc. Lond., entitled "Carrier Waves and Rectification."

The lecturer had spent the afternoon erecting expensive apparatus to demonstrate his lecture, which was of vital interest to the wireless enthusiasts. He cleared up many debatable points, and advanced a theory on the peculiar phenomenon of wireless telephony, viz., "Fading."

Next autumn the Society hopes to arrange with the Education Authorities for a course of lectures for its members at the Technical College. A series of these lectures have been given by Mr. Kirkman at the College every Thursday night, and much to the general regret these lectures are about to terminate.

Hon. Sec., Herbert Morgan, 218, Oxford Street, Swansea.

Ilkley and District Wireless Society.*

The first annual general meeting of the Society was held on March 28th under the chairmanship of Dr. J. B. Whitfield. The Hon. Treasurer's report for the session showed a satisfactory balance in hand after the rather heavy initial expenses of the first year's working, which included the purchase of the Society's receiving apparatus.

The Hon. Sec. mentioned in his report that the membership, which now stands at 32, had shown a steady increase throughout the session, while the Society's activities included ten lectures and demonstrations, together with morse practice classes, etc. A library was available for the use of members, together with an aerial and receiving apparatus.

Dr. J. B. Whitfield was unanimously re-elected President, with Mr. C. L. Wilson as Vice-President, Mr. E. Dobson again being elected to the Hon. Treasurership. Mr. L. E. Overington was elected Hon. Secretary, with Mr. Green as Assistant Hon. Secretary.

The programme for the ensuing year includes a series of fifteen lectures and demonstrations, together with outdoor excursions during the summer months. There are still a few vacant dates for lectures, and the Hon. Sec. will be pleased to hear from anyone willing to contribute to the programme. Applications for membership should be made to the Hon. Sec., L. E. Overington, 11, Wilmot Road, Ilkley.

High Wycombe and District Radio Society.*

This recently formed Society has just concluded its short winter session by a well-attended meeting at headquarters—Technical Institute—when Mr. W. S. Pyrah, representing the Igranic Electric Company, discoursed upon the use of honeycomb coils, with lantern illustrations and loud speaker demonstration. Mr. Shirley, of the Oxford Wireless Telephone Company, demonstrated a B.B.C. set, using these coils. The President (Mr. T. J. Northy) occupied the chair. The present membership is 51.

Hon. Sec., A. C. Yates, 30, High Street, High Wycombe.

Newcastle and District Amateur Wireless Association.*

An extraordinary general meeting was held on Monday, April 16th, when the following alterations were made :—

(1) The title of the Society is changed to "The Newcastle-on-Tyne Radio Society."

(2) During the summer months the Society will meet on the first Thursday in the month only (May, June, July and August).

The Committee are pleased to be able to report that the following gentlemen are showing their interest in the work of the Society by becoming Hon. Vice-Presidents :—

The Lord Mayor of Newcastle.

Sir David Drummond (of the Armstrong College).

Sir Thomas Oliver.

Professor Todd (of the Armstrong College).

The Town Clerk of Newcastle.

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

Hackney and District Radio Society.*

On Thursday, April 12th, at the Y.M.C.A., Mare Street, Hackney, E.8., the Chairman, Mr. H. A. Epton, F.B.E.A., gave an interesting description of his four-valve set, and related his early experiences as a wireless amateur. He then demonstrated the set he had constructed, using an Amplion loud speaker. Later a Brown loud speaker was connected in series, with improved results. **2 LO** was received loudly and clearly, using H.F., detector and one L.F. Loud signals were received on the new frame aerial presented to the Society by Mr. Bell.

Hon. Sec., C. C. Phillips, 247, Evering Road, E.5. (Letters only.)

The West London Wireless and Experimental Association.*

On April 17th, Mr. T. W. Hyne Jones gave a very interesting paper entitled "Primary and Secondary Batteries, Their Construction and Action," dealing among other points with the following four methods of procuring an E.M.F., viz., 1st Chemical, 2nd Mechanical, 3rd Thermal and 4th Fractional.

It is hoped to have more papers contributed by members in the future.

Club Rooms, The Acton and Chiswick Polytechnic, Bath Road, Chiswick, W.4.

Full particulars of membership can be obtained from the Hon. Sec., Horace W. Cotton, 19, Bushey Road, Harlington, Hayes, Middlesex.

Sheffield and District Wireless Society.*

On Friday, April 20th, the last paper of the session was read by Mr. Harry Lloyd, on the subject of "Sound Transmission by Wireless," and it proved to be of absorbing interest to the large audience.

Mr. Lloyd described various types of microphone at present in use, and by means of a gramophone in an adjoining room and a four-valve amplifier on the lecture table, demonstrated the different types, also giving some very useful and interesting hints on the improvement of quality of tone by additions to the low frequency amplifier.

Hon. Sec., L. H. Crowther, A.M.I.E.E., 18, Linden Avenue, Woodseats, Sheffield.

The Ilford and District Radio Society.*

On April 19th, Mr. A. G. S. Gwinn lectured on "Short Wave Reception," stating that by "short" waves he meant those shorter than 300 metres. He recommended a single wire aerial for this work. Mr. Gwinn said that, with regard to tuning gear, he thought perhaps the well-known "plug-in" coils were the best, but he had had great success by using the aerial coil out of an Army "short wave tuner"

Hon. Sec., 77, Khedive Road, Forest Gate, E.7.

The Manchester Radio Scientific Society.*

On Wednesday, April 11th, the Society discussed the phenomenon of the fading of **2 LO**, certain members having been carrying out experiments. The results were compared and analysed and investigations are proceeding. The co-operation of other Societies is invited.

On Tuesday, April 17th, at 7.30 p.m., about twelve members of the Society paid a visit to the Manchester Broadcasting Station in Trafford Park, where they were very cordially received by Mr. Bell and conducted over the station.

Next evening, at the regular weekly meeting, Mr. Lomas gave his impressions of the previous evening's visit to **2 ZY**. The discussion which followed led up to the question of dealing with the interference caused through oscillating receiving sets, which at times is very troublesome in this area.

Hon. Sec., H. D. Whitehouse, 16, Todd Street, Manchester.

Change of Name.

The Trafalgar Wireless Society, reports of which have frequently appeared in our columns, has changed its name to "The Lewisham and Catford Radio Society." The Society, which is affiliated to the Radio Society of Great Britain, has its headquarters at the Y.M.C.A., High Street, Lewisham, S.E.13.

Hon. Sec., F. A. L. Roberts, 43, Adelaide Road, S.E.24.

The Pudsey and District Radio Society.

At a well-attended meeting of the Society held at the Mechanics' Institute on April 16th, Mr. F. Wild lectured very ably on "The Fundamental Principles of Radio Work." The Hon. Sec., Mr. W. G. A. Daniels, contending that the human ear was a very essential asset to radio reception, expressed a desire to learn more of this organ, and one of the Society's distinguished members, Dr. Byrd, kindly consented to give a discourse on the human ear at a future meeting.

Hon. Sec., W. G. A. Daniels, 21, The Wharrels, Lowtown, Pudsey.

The Warrington Radio Association.

"Frame Aerials and Their Uses," was the title of a recent lecture given by the Vice-Chairman, Mr. W. H. Taylor, member of the Radio Society of Great Britain.

A three-valve set (one H.F., one detector and one L.F. tuned anode, plug-in coil, loose coupled tuner, employing reaction on the secondary circuit) and a frame aerial (4 ft. square, five turns spirally wound insulated bell wire spaced ½ in.) were used and explained.

At the close of a very interesting lecture, Mr. Taylor gave a demonstration with exceptionally good results, the transmission from **2 ZY**, Manchester, being heard quite clearly with the earpieces of three pairs of phones on the table.

Meetings are held on the second and fourth Thursday in each month at 7.30 p.m. Club-room, The Y.M.C.A., Market Gate, Warrington.

Hon. Sec., W. Whittaker, Brickmakers' Arms, School Brow, Warrington.

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.

INTRODUCTION.

It is intended to outline in the following articles a number of experiments which the average amateur, taking up the study of radio science, could with interest and profit undertake.

It will be assumed that, in the first instance, the experimenter has little or no apparatus, and therefore is prepared to spend a pound or two from time to time in necessary and useful instruments. The writer will bear in mind that initial experimental work is usually the most difficult and laborious, and frequently results in great disappointments after considerable outlays of time and money. Realising this, and that there is an enormous amount of expensive rubbish on the market (called apparatus) to ensnare the "new blood" (as the trade terms them) whenever any apparatus is required, the essential points to be looked for by the purchaser, as regards electrical and mechanical design, will be mentioned.

The proper functioning of every part, and the points to be carefully noted in each experiment, will be emphasised.

It is hoped, therefore, that by following closely these articles, not only will much time and money be saved, but that in a comparatively short while the experimentalist will have a thorough ground knowledge—practical rather than theoretical—which will enable him or her to study more advanced problems with the greater certainty of adding to our knowledge, and a corresponding pecuniary benefit to themselves.

The first six experiments to be outlined can be made without any licence from the Post Office.

Anyone who carries these experiments through, and has calibrated his own wavemeter, is in a position to apply for an *experimental* licence to use apparatus for the reception of radio signals, with the reasonable certainty of it being granted.

A secretary of a local radio society would, in the writer's opinion, be justified in recommending the granting of the above type of licence to anyone who had qualified himself (or herself) to the extent indicated.

Experiment No. 1.

To show the nature of the effect required to give a sound in a telephone head-gear receiver.

The apparatus required is as follows :—

1 dry cell.
1 head-gear telephone apparatus (resistance, say, 120 ohms.)
1 6-8 ohm resistance (for example, a filament resistance).
1 buzzer.

The procedure is as follows :—

The dry cell is connected to the head-gear telephone cords and intermittent contact is made between one of the telephone connections and the brass terminal (+) of the dry cell. (Fig. 1). It will be noticed that a click results in the telephones every time the circuit is

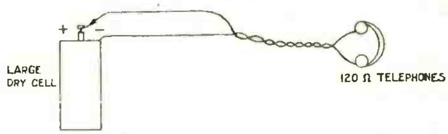


Fig. 1. To show how a sound is produced in the telephones.

made and broken. This experiment can be further extended with advantage with the addition of a buzzer of from 5 to 10 ohms resistance. In this case the buzzer should be connected as in Fig. 2, in series with the dry cell and filament resistance. On the buzzer being set in operation, the note produced by it will be heard if the telephone connections are placed across the ends of the filament resistance.

The results which should be noted from the above experiment are as follows :—

No sound in the telephones is heard when the current is passing continuously through them such as when they are permanently connected to the dry cell. A sound is only produced at the time when the current is varied or interrupted.

The dry cell should be a large one, as it will be required for future experiments, and may measure about 6 in. in height. The telephones should be of first-class manufacture as they will be subsequently used for sensitive radio experiments. Before purchase they should be examined carefully inside by removing the ear-piece.

(NOTE.—With a certain well-known make this is not practicable, and in this case unnecessary.)

The points to be looked for in good instruments are :—

(*a*) Thick ring magnet, preferably laminated, *i.e.*, two or three rings clamped together.

(*b*) Strong poles. A good sized bunch of keys should be easily supported if one of them is placed across the poles.

The diaphragm should preferably be of "stalloy" steel. This has a very faint mottled or pitted appearance on its surface as distinct from the highly polished surface of ferrotype which is used in cheap telephones.

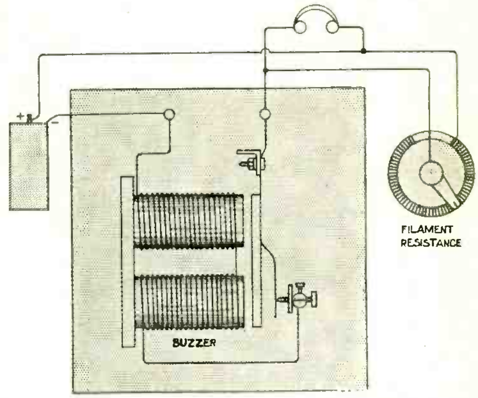


Fig. 2.—Producing a buzzer note in the telephones.

The cords should preferably be attached to outside nuts, as they are easily renewed if and when the inevitable "fault" occurs in them.

The filament resistance should preferably be of a large size with a reliable phosphor-bronze contact sliding on the wire. The cheap variety with a single thin spring moving on the wire should be avoided. They will soon give trouble owing to the oxidisation of the resistance wire.

EXPERIMENT NO. 2.

To show how a transformer works.

The apparatus required is as follows :—
- 1 dry cell.
- Head-gear telephones.
- A cotton-reel.
- 10 yards of No. 28 or No. 30 cotton-covered copper wire.
- 1 large iron nail capable of being pressed into the centre of the cotton-reel.

About half the wire should be wound closely on the reel and the two ends brought out for further connection. The remaining half of the wire is wound over the first coil, and the ends connected to the telephones. The inner winding is called the primary and the outer the secondary. The connections should be made as in the diagram Fig. 3. It will be noted that every time the primary circuit is completed to the dry cell, a click will be heard in the telephone, and likewise when the circuit is broken. It will be also observed that, on

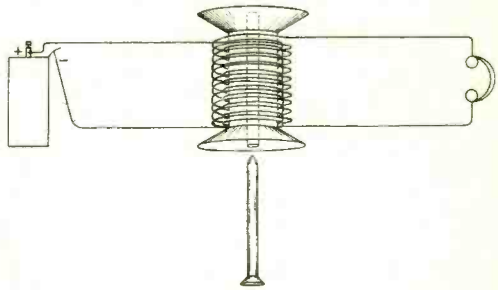


Fig. 3. Increase in signal strength with insertion of iron core.

placing the iron nail in the centre of the reel, very much louder clicks will result.

As in Experiment 1, the buzzer can be connected in series between the dry cell and the primary of the transformer, and a buzzing in the telephone will result on the buzzer circuit being completed.

Avoid *small* buzzers which sometimes give high notes with considerable sparking at their contacts, and much consumption of battery power. The best procedure is to purchase a good second-hand electric bell. (Old Post Office bells can very often be picked up in second-hand shops). There should be plenty of solid iron to be seen, and the magnet coils should not be of thick wire. (No. 30 S.W.G. is about right.) The gong and hammer can be removed and small silver contacts fitted in place of those on the contact spring and screw. The note of the buzzer can be improved by packing a tuft of cotton-wool between the contact spring and the armature.

Reliability of operation is most essential for serious work. An efficient buzzer is unfortunately rarely to be found in the amateur's equipment, but the serious experimenter will be well advised to pay attention to this device and become experienced in its adjustment, and to value its utility.

Experiment No. 3.

To show how a Crystal Detector operates.

The apparatus required is :—

1 dry cell.
Head-gear telephones, 160 ohms.
Various crystals (suitably mounted).
1 6-8 ohm resistance.

The procedure is as follows :—

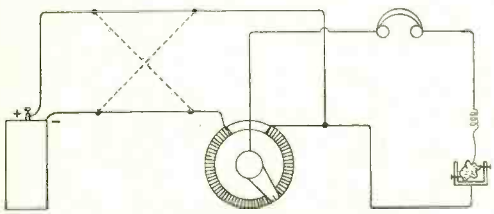


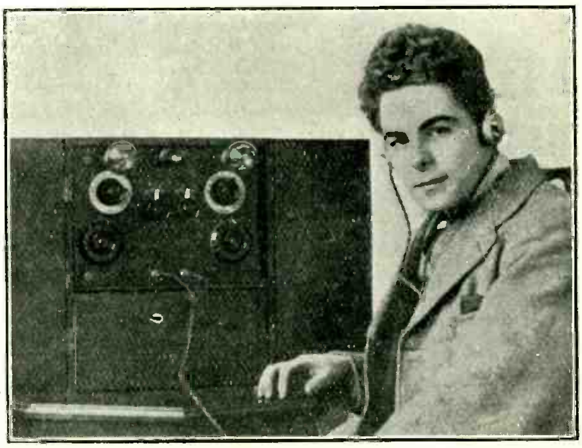
Fig. 4. Illustrating the operation of a crystal detector.

The dry cell should be joined to the resistance, but final connection should not be made until it is intended to make the actual test. The crystal should be connected in series with the telephones, and both of these should be joined to the resistance, or across part of same as the case may be, as shown in Fig. 4.

On connecting up the dry cell and listening carefully, a certain strength of click will be heard. The wire to the dry cell should be tapped on and off a few times to enable the experimenter to determine the strength of the clicks which he hears. The connections to the dry cell should now be reversed, and the difference in the strength of the clicks should be noted. Usually it will be found that, with most crystals, providing a certain amount of care is taken to obtain a good adjustment between the fine wire making the contact with the specimen, that a considerable difference in the strength of clicks in the telephones results with the reversal of the battery, thus indicating that the crystal detector conducts the current very much more readily in one direction than the other. The particular direction in which the crystal conducts most readily should be noted.

SUCCESSFUL IN THE TRANSATLANTIC TESTS.

That much can be done to compensate for a poor aerial is proved by the experience of Mr. Anthony Richardson, of 29, Josephine Avenue, Brixton Hill, S.W.2, who was successful in receiving U.S. stations in the Transatlantic Tests. Mr. Richardson, who appears in our illustration with his set, was restricted to a double inverted L type aerial with 5 ft. spreaders slung between the walls of two houses, the amount of wire in the flat top part being only 25 ft. and the height 18 to 20 ft. The directional properties were not good, as the aerial pointed north-west with the free end S.E. The set consisted of two H.F. valves and detector. With only one H.F. valve signals were readable from **8 QT**, **2 ZK** and **1 CMK**.



Mr. Richardson with his three-valve receiver.

Forthcoming Events

FRIDAY, MAY 4th.

Leeds and District Amateur Wireless Society. Discussion: "Unorthodox Circuits for Short Wave Reception," by Mr. J. Croysdale.

Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove. Lecture: "Elementary Theory, Part IV," by Mr. H. Andrewes.

The Fulham and Putney Radio Society. Lecture: "Formation of Wireless Waves." By W. B. Gardnier.

MONDAY, MAY 7th.

Ipswich and District Wireless Society. At 8 p.m. At 55, Fonnereau Road. Lecture by Mr. H. G. Garrett.

North London Wireless Association. In the Physics Theatre, Northern Polytechnic Institute. Lecture: "Experiences in Radio Reception," by Mr. A. G. Hill.

Ashton-under-Lyne and District Radio Society. Lecture: "Electricity, Past and Future, as Applied to Wireless," by Mr. A. C. Stephens, A.M.I.E.E.

TUESDAY, MAY 8th.

Plymouth Wireless and Scientific Society. At 7.30 p.m. At Plymouth Chambers, Old Town Street. Buzzer Practice. At 8 p.m. Construction of Society's Three-Valve Set and Demonstration.

THURSDAY, MAY 10th.

Hackney and District Radio Society. Lecture: "Electrical Currents Minute and Large," by Mr. L. L. Robinson, M.Inst.C.E., M.I.E.E., M.I.Mech.E., Hackney Borough Electrical Engineer. Chair to be taken by the Mayor of Hackney. Visitors welcome.

Stoke-on-Trent Wireless and Experimental Society. At 7.30 p.m. Discussion on "Reaction: Its Use and Abuse," opened by Messrs. F. T. Jones and F. J. Goodson, B.Sc.

The Magnetic Drum Relay

With reference to the abstract of the lecture before the Institution of Electrical Engineers given in April 28th issue of this journal, we are asked by Dr. McLachlan to state that as the result of further experimental work the following modifications should be made:—Fig. 8, page 107, instead of 300 volts, 200 volts will give satisfactory results. Fig. 10 page 108, instead of 90 mA, 40 mA will give a working pull of 20 lbs. Dr. McLachlan has now a recorder with a larger shoe than that fitted to the instrument exhibited at the Institution of Electrical Engineers, which will record up to speeds of 150 words per minute, using a current of only 25 microamperes on double current working, and 50 microamperes on single current working. This is 1/400th part of the current used by other types of recording apparatus.

The Radio Society of Great Britain.

The Fifty-fourth General Meeting of the Radio Society of Great Britain, held at the Institution of Electrical Engineers on Wednesday, 28th February, 1923.

Opening the meeting, the Chairman, **Mr. F. Hope-Jones,** said:—

The Society offered a prize for the best Super-regenerative Circuit, which should be made by members of the Society, and submitted for testing and examination. The number of responses was small. The prizes were valuable, so that it has been a little of a disappointment, I think, to the Committee, that there has been this poor response as regards numbers. They are especially sorry because the funds from which the prizes are drawn is one which was subscribed by two companies, and by *The Wireless World and Radio Review*, our official organ. Mr. Burnham subscribed £10, Mr. McMichael £5, and the *Wireless World and Radio Review* £10, so that the funds of the Society itself were not drawn upon. We ought later, I think, to thank the gentlemen representing those firms, and *The Wireless World and Radio Review*, for their generosity in this matter; but the first thing is to hear the prize winners describe their apparatus, and if possible, show it to us working here. It does not matter which we take first, so I will ask Mr. Mair to give his description, and then ask Mr. Cowper to follow.

(*For descriptions of these sets see pp.* 111-115 *of April 28th, issue, and a report of the discussion will appear in our next issue*).

At the conclusion of the discussion the Chairman said:—

I feel sure you would not wish to close this meeting without expressing thanks to those enterprising and generous gentlemen who have provided the prizes, and incidentally a most excellent evening's entertainment to ourselves. I refer, of course, to Mr. Burnham, Mr. McMichael, and our excellent organ the *Wireless World and Radio Review* and its editor, Mr. Pocock. This proposal was made as long as five or six months ago, but we have had plenty to talk about since, and have been waiting for a fitting opportunity. It is all part of the policy of the Radio Society of Great Britain to encourage invention and exploration in every branch of radio science. It is in conformity with this policy that we are to give annually a medal—the Radio Society's Medal—which I think will in time become one of the best known and honoured prizes in the world of radio science.

The President, in proposing a vote of thanks to the judges in the competition, said:—

I wish in the name of the Society to thank the judges for the labour they undertook and for the excellent judicial manner in which they have executed their very difficult task. I am glad that Mr. Child described the manner in which the entries were judged. Everyone will feel that they could not improve upon that process.

It was then announced that Members and Associate Members up for ballot had been duly elected and 13 Radio Societies admitted to affiliation.

(For list see pp. 27, of April 7th issue.)

Notes

Sheffield's Broadcasting Difficulties.

Captain Eckersley, Chief Engineer of the British Broadcasting Company, recently paid a visit to the Sheffield and District Wireless Society, when he spoke on the problems of broadcasting. While in the district, Captain Eckersley made a point of listening in to the various broadcasting stations, so as to see for himself what grounds there were for complaints of difficult reception. It is reported that in the near future, arrangements may be made to relay the London broadcasting from a transmitting station in Sheffield.

The Wireless Club, Ltd.

Suitable premises are in course of being acquired by the above newly-formed organisation, for the purpose of providing a centre for all wireless students, particularly amateurs. The temporary offices of the Club are at 56, Long Lane (near Aldersgate Street station), London, E.C.1, lent by Mr. S. C. Samuel, who was an operator during the war. Other directors are Mr. L. A. Gordon, B.Sc., M.C., and Mr. Wm. Glass, A.M.I. Auto. E., A.M.I. Aero. E., and Mr. James Cawson and Miss Euphemia Smith. The Secretary is Mr. J. H. Worrall, A.C.I.S.

Wireless Communication between France and Algeria.

A wireless service between France and Algeria is shortly to come into operation. Transmissions will be made from the station at La Doua, Lyons, the times each day being 8.30 to 9.30 a.m. and 1 to 2 p.m.

An Error.

We very much regret a mistake which crept into our issue of April 21st. Figure 11 on page 84 illustrates the Chloride Electrical Storage Company's Standard AYG 1 High Tension Accumulator. The illustration should therefore have been acknowledged to this Company.

Which Station was it ?

While listening in for American stations on the morning of March 25th, Mr. R. W. Galpin (**5 NF**), of the Bank House, Herne Bay, picked up a station transmitting telephony on about 380 metres from 0340 to 0355. Speech came through clearly, but seemed to be absolute nonsense, a reference to the whiskers of some old gentleman being followed by a discourse on walking-sticks. Once the transmitter asked if he was modulating too strongly. The transmission concluded with a selection of classical music played by what seemed to be a very fine orchestra. Mr. Galpin would be pleased to hear from any reader who was listening-in at the time.

An Error.

In the diagram appearing on page 112 of our issue of April 28th, a condenser is shown bridging a choke coil and telephones. The value of this condenser should be 0.005 mfds. and not 0.0005 mfds., as marked. The correct value is of importance in obtaining good results from the outfit described by Mr. Cowper.

A Valuable Wireless Map.

A useful aid to the listener-in is Philip's Wireless Map of Great Britain, just published. All classes of transmitting stations are marked, and distinctive marks differentiate between Broadcasting, Commercial, Aviation and Experimental transmitters. A complete index to Amateur and Experimental stations appears on the map and diagrams with compass bearings show the direction of important overseas stations in relation to different portions of the map. An inset map of London and district is included. The map is obtainable at three prices (according to mounting) viz., 2s. 6d., 5s. 6d., and 7s. 6d. net. It is produced by Messrs. George Philip & Son, Ltd., 32, Fleet Street, London, E.C.4, and is compiled from information supplied by the Wireless Press, Ltd.

Who is 5 HL ?

Many amateurs in the London area are reporting strong reception, on about 400 metres, from a station using the above call sign. In view of the widespread reception of this station, it would be interesting to know its location..

Lord Curzon Broadcasts.

Photo, British Illustrations.

Lord Curzon, the Foreign Secretary, broadcasting a speech on April 23rd, from his house in Carlton House Terrace, on behalf of the Queen Victoria Jubilee Institute for Nurses.

Amateur Reception in Italy.

Signor Giulio Salom, an Italian amateur in Venice, states that he has heard excellent music and speech from **2 LO** and **5 WA** with a loud speaker. His set comprised a detector and two L.F. valves. Our correspondent also reports that these stations have been picked up by another Italian amateur, Signor Eugenio Gnesutta, of Milan, using a single valve home-built regenerative set.

Broadcasting in Norway and Sweden.

Scandinavia is being confronted with broadcasting problems similar to those which are occupying the authorities in this country. In Norway a certain section of the Public is in favour of a State monopoly, but no definite steps have been taken. In Sweden a broadcasting company has been licensed by the Post Office, and the regulations are very similar to those obtaining in Great Britain.

For Trade Readers.

Readers who are solely identified with the wireless trade should not miss seeing "The Wireless and Allied Trades' Review" (published weekly, Wireless Press, Ltd., 17s. 6d. yearly or 9s. half-yearly). It includes in its news and comments a valuable summary of current topics and events; its leading trade articles treat helpfully in regard to matters likely to be informative and useful to the retailer; and its current wireless apparatus pages record the latest and best that manufacturers can offer. There are general items of trade interest in a couple of pages entitled "Around the Trade," whilst the most up-to-date patent records and commercial news concludes each number.

No retailer, or in fact wireless trader generally, who wishes to be informed as to the progressive conduct of the trade should miss the "W.A.T.R." It is edited with the aid of some two decades of successful experience in trade journalism, allied with the unfailing ability of putting wireless trade interests and news forward advantageously.

Teutonic Courage ?

Undismayed, apparently, by the broadcasting *impasse* in Great Britain, Germany has formed a broadcasting company on the same lines as the B.B.C., according to information we have received from a Berlin correspondent. The principal radio firms have joined the company, the name of which is "Rundfunk G.m.b.H.

A "Radio Club" has been formed in Berlin, and it is hoped that amateur broadcasting will be permitted in the near future.

The Paris Fair.

The 15th National Sample Fair is being held in Paris from May 10th to 25th inclusive, and a large section is being specially devoted to wireless apparatus. All information will be gladly furnished to possible English visitors by the French Commercial Office, 153, Queen Victoria Street, London, E.C.4.

Perplexing Signals.

BBBDD FwwTT obWVH ALaNH C₁ddVV—What does this mean ? What is the Lindenburg code ? How does the Eiffel Tower send out weather reports ? How does one translate these code messages into everyday language ? When and how are meteorological reports sent out ?

A complete explanation and a detailed tabular list of every meteorological transmission, with the necessary translation of the code, is contained in the Meteorological Section of the *Year-Book of Wireless Telegraphy and Telephony*, 1923 edition, in addition to which, detailed information on Time Signals and various "special message" services are to be found in the section.

London's "All-Star" Wireless Concert.

Yet another possibility in wireless broadcasting was successfully exploited on April 26th, the day of the Royal Wedding, when **2 LO** broadcast an "all-star" programme specially arranged by Messrs. Harrods, Ltd. Unique facilities for listening in were provided at Messrs. Harrods, and over 4,000 people were there enabled to enjoy the concert. In the Georgian Restaurant alone, in which were installed ten loud speakers, over 2,000 guests assembled. Three loud speakers were also placed in the Lecture Hall and two in the Music Salons. No hitch whatever occurred during the concert, which was received with remarkable clarity, but disappointment was general at the announcement that Mr. George Robey and Mr. Billie Merson, both on the programme, had been forbidden by their Agencies to take part. In the course of a few well-chosen words delivered from **2 LO**, Sir Woodman Burbidge, Bart., Chairman of the firm, spoke on the wonderful possibilities of the new science.

The receiving arrangements at Messrs. Harrods were carried out by Mr. T. M. Rogers, Chief of the Electrical Department, and Mr. C. J. Close, Manager of the Wireless Section.

BROADCASTING.

GREAT BRITAIN.

Regular evening programmes, details of which appear in the daily Press, are now conducted from the following stations of the British Broadcasting Company :—

London	**2 LO**	369	metres.
Birmingham	**5 IT**	420	,,
Manchester	**2 ZY**	385	,,
Newcastle	**5 NO**	400	,,
Cardiff	**5 WA**	353	,,
Glasgow	**5 SC**	415	,,

FRANCE.

Eiffel Tower. 2,600 metres. 12.15 a.m. weather reports (duration 10 mins.) 7.20 p.m., weather reports and concert (duration about 30 mins.) 11.10 p.m., weather reports (duration 10 mins.).

Radiola Concerts. 1,780 metres, 6.5 p.m. news ; 6.15 p.m. concert till 7 p.m. ; 9.45 p.m. news ; 10 p.m., concert till 11 p.m.

L'Ecole Supérieure des Postes, Télégraphes et Téléphones de Paris. 450 metres. Tuesdays and Thursdays, 8.45 p.m. to 11 p.m. Saturdays, 5.30 p.m. to 8.30 p.m.

Lyons (YN). 3,100 metres, 1·5 kW. 11.45 a.m. to 12.15 p.m. daily (Sundays excepted). Gramophone records.

BELGIUM.

Brussels (BAV). 1,300 metres, 1 kW. Sunday, Tuesday and Thursday, 6 p.m.

HOLLAND.

PCGG. The Hague, 1,050 metres, Sunday : 4 to 6.40 p.m., Concert. Monday and Thursday : 9.40 to 10.40 p.m., Concert. (Monday concerts are sometimes given on 1,300 metres, notice of this being given on the previous Sunday.)

EXPERIMENTAL TRANSMITTING STATIONS

ALTERATIONS AND ADDITIONS.

(*Continued from page 116, April 28th issue.*)

The particulars given below include amendments and additions to the list of Experimental Transmitting Stations given in "The Year-Book of Wireless Telegraphy and Telephony, 1923," published by THE WIRELESS PRESS, LTD., which comprises 470 stations.

2 NV	10 watts, C.W., T. & T.T.	H. Littley, Lodge Road, West Bromwich.
2 NW	10 watts, C.W. & T. Portable	H. Littley, Lodge Road, West Bromwich.
2 OI	Artificial Aerial, C.W., T & T.T.	Colin Bain, 51, Grainger St., Newcastle-on-Tyne.
2 OL	—	H. D. Butler, "Trebarwith," South Nutfield, Surrey.
2 OM	50 watts, C.W. & T.	H. S. Walker, Park Lodge, Brentford, Middlesex.
2 OT	10 watts, Sp., C.W. & T.	Ilford & District Radio Society, Sec., L. Vizard, 12, Seymour Gardens, The Drive, Ilford.
2 OU	10 watts, Sp., C.W. & T. Portable.	Ilford & District Radio Society, Sec., L. Vizard, 12, Seymour Gardens, The Drive, Ilford.
2 OX	C.W. & T. ..	Dr. Ratcliffe, 22, Wake Green Road, Moseley, Birmingham.
2 PC	10 watts, C.W. & T.	A. G. Davies, "Redcot," Park Road, Timperley, Cheshire.
2 PT	10 watts, C.W. & T.	J. Jardine, Hall Road West, Blundellsands, Liverpool.
2 PV	10 watts, C.W. & T.	G. Smith Clarke, "Glenroy," Waverley Road, Kenilworth.
2 PX	10 watts, C.W. & T.	H. H. Lassman, 429, Barking Road, E. Ham, E.6.
2 QA	10 watts, C.W. & T.	Dr. H. W. Estgarth-Taylor, 320, Humberstone Road, Leicester.
2 QI	—	Hurst & Lucas, 3, Mayford Road, Balham, S.W.12.
2 QL	C.W. & T. ..	R. J. Hibberd, Grayswood Mount, Haslemere, Surrey.
2 QU	—	Lucas & Hurst, 19b, Lansdown Road, Blackheath, S.E.13.
2 QV	—	Altrincham W'less Society, "Breeze Crest," Plane Tree Rd., Hale, Cheshire.
2 RD	10 watts, C.W. & T.	H. W. Fairall, 27, Newbridge St., W'hampton.
2 RR	—	W. V. Waddoup, 56, Wellington Rd., Handsworth Wood, Birmingham.
2 RT	—	North Eastern Instrument Co., Durham Rd., Low Fell, Gateshead.
2 SK	T., C.W., & Sp.	K. Graham Styles, 43, New Oxford St. (2nd floor), W.C.1.
2 SL	T., C.W. & Sp.	K. Graham Styles, "Kitscot," 52, Bower Mount Road, Maidstone.
2 SQ	C.W. & T. ..	A. J. Spears, 25, Rawlings Road, Bearwood, Smethwick, Birmingham.
2 SZ	10 watts, Sp., C.W. & T.	The Wireless Society, Mill Hill School, N.W.7.
2 TA	10 watts, C.W., T.T. & 'Phone.	H. Andrews, 8, North Grove, Highgate, N.6.
2 TB	10 watts, C.W. & T.	H. W. Sellers, Edgerton Grove Road, Huddersf'd.
2 TC	10 watts, C.W. & T. Portable	H. W. Sellers, Edgerton Grove Road, Huddersf'd.
2 TF	C.W. & T. ..	Edinburgh & District Radio Society, 9, Ettrick Road, Edinburgh.
2 TY	10 watts, Sp., C.W. & T.	S. Scott, Field Villa, Norton, Malton.
2 TZ	C.W. & T. Receiving and Transmitting.	Ernest Jones, "Newholme," Hempshaw Lane, Offerton, Stockport.
2 VS	—	W. K. Hill, 79, Beulah Hill, S.E.19.
2 WJ	C.W. & T. ..	R. L. Royle, "Southwold," Alderman's Hill, Palmers Green, N.13.
2 WM	10 watts, C.W. & T.	Jos. W. Pallett, 24, Glenfield Road, Leicester.
2 WN	10 watts, C.W., T., Sp. & T.T.	A. H. Wilson, 67, Broad St., Hanley, Stoke-on-Trent.
2 WQ	10 watts, C.W., T. & T.T.	Colin H. Gardner, Amblecote House, Brierly Hill, Staffs.
2 WZ	C.W. & T. .. Portable.	Captain S. A. Wood, 32, Wilbury Road, Hove, Sussex.
2 XF	10 watts, Sp., C.W. & T.	E. T. Chapman, "Hillmorton," Ringwood Rd., Newtown, Dorset.
2 YX	20 watts, C.W. & T.	F. E. B. Jones, "Hill Crest," Jockey Hill, Birmingham Road, Wylde Green, Birmingham.
2 ZB	10 watts, Sp., C.W., Morse & T.	C. R. Small, "Broadhurst," Skelmersdale Road, Clacton-on-Sea
2 ZC	C.W., I.C.W., & T.	General Radio Co. (Transmitting Station), Twyford Abbey Works, Acton Lane, Harlesden, N.W.10

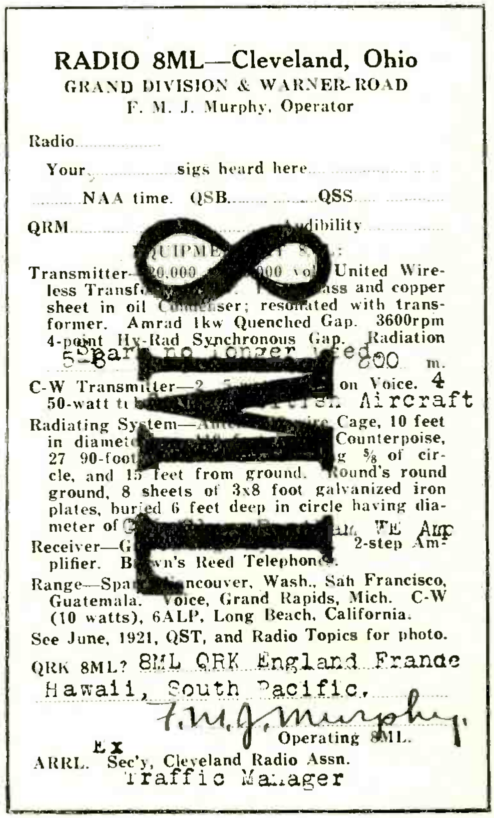
2 ZQ	10 watts, C.W. & T.	H. W. Nunn, 49, Leigh Rd., Highbury Park, N.5.
2 ZS	C.W. & I.C.W.	F. J. Dinsdale, 14, Highfield View, Stonycroft, Liverpool.
2 ZT	10 watts, C.W. & T.	—Benham, Woodbury Rd., New Malden, Surrey.
2 ZU	Sp., C.W., T.T. & T.	T. Eccles, 30, Thackeray Street, Liverpool.
2 ZZ	C.W. & T. ..	Fellows, Ltd., Cumberland Avenue, Park Royal, N.W.10.
2 ZY	—	Metropolitan-Vickers Co., Ltd., Trafford Park, Manchester.
5 AN	C.W., T.T., T.	W. J. Joughin, 158, Sumner Road, Peckham, S.E.15.
5 AQ	10 watts ..	D. Douet, 10, Ruvigny Gardens, Putney, S.W.15.
5 AU	Artificial Aerial	W. H. Goodman, 94, Addison Road, Holland Park, W.14.
5 BA	—	Captain Stevens, Chase Motors, Ltd., Newcastle.
5 BB	20 watts ..	Metropolitan Vickers, Ltd., Vickers House, 4, Central Buildings, S.W.1.
5 BW	C.W. & T. ..	A. de Villiers, 161, Westminster Bdge Rd., S.E.1.
5 CD	C.W. & T. ..	G. Ward Booth, "Eastlands," Queen's Road, Wisbech
5 CK	10 watts, C.W. & T.	L. H. Pearson, c/o Pearson Bros., 54-56, Long Row, Nottingham.
5 DG	10 watts, C.W. & T.	C. H. Stephenson, Penn Manor, Wolverhampton.
5 DP	10 watts, Sp., C.W. & T. Portable	Sea Scouts' Headquarters, Clacton Troop, Clacton-on-Sea.
5 FS	T., C.W. & T.T.	W. A. Andrews, 1, Balmoral Mansions, St. Andrews Park, Bristol.
5 GJ	—	James Bevis, 4, Somerset Road, Linford Estate, Mucking Ford, nr. Stanford-le-Hope, Essex.
GQ	—	F. W. Nightingale, Pikford Schools, Northampton.
5 HC	C.W. & T., Artificial aerial	J. A. Beveridge, "Dunelm," 8, Cluny Drive, Edinburgh.
5 HD	10 watts ..	N. St. John Ward, N.E. Coast W. Co., Ltd., Blenheim Chamber, 1, Crowtree Road, Sunderland.
5 HI	C.W., T.T., T. & Duplex C.W. & T	L. W. Birch, 30, Limesford Road, Waverley Park, S.E.15.

(*A further list will appear in our next issue.*)

Holders of transmitting licences are requested to keep this Journal advised as to particulars of their stations, while experimenters hearing calls not to be found in the *Wireless World* Lists, should write to the Editor, giving details of the transmissions intercepted, in hope that some information concerning the transmitter may be available.

The card index system is recommended for the purpose of forming a ready reference, whilst cards of new calls can be dropped in pending the publications of details of ownership and location. A specimen of such a record card was published on page 117 of our previous issue.

Reports of reception are usually welcomed by operators of experimental stations and listeners-in might do good service by passing reports of reception to the transmitters concerned, pending the organisation of range tests by the British Wireless Relay League.


RADIO 8ML—Cleveland, Ohio
GRAND DIVISION & WARNER ROAD
F. M. J. Murphy, Operator

Radio..........

Your.......... sigs heard here..........

..........NAA time. QSB.......... QSS..........

QRM.......... Audibility..........

EQUIPMENT 8ML:

Transmitter—20,000 ... 000 volt United Wireless Transf... ...ass and copper sheet in oil Condenser; resonated with transformer. Amrad 1kw Quenched Gap. 3600rpm 4-point Hy-Rad Synchronous Gap. Radiation 5-8 Spark no longer used 800 m.

C-W Transmitter—2 ... on Voice. 4 50-watt tu... Aircraft

Radiating System—... Cage, 10 feet in diamete... Counterpoise, 27 90-foot ... g ⅝ of circle, and 15 feet from ground. Round's round ground, 8 sheets of 3x8 foot galvanized iron plates, buried 6 feet deep in circle having diameter of ... WE Amp

Receiver—G... 2-step Amplifier. Brown's Reed Telephones.

Range—Spar... Vancouver, Wash., San Francisco, Guatemala. Voice, Grand Rapids, Mich. C-W (10 watts), 6ALP, Long Beach, California.

See June, 1921, QST, and Radio Topics for photo.

QRK 8ML? 8ML QRK England France Hawaii, South Pacific.

F. M. J. Murphy
Operating 8ML.

ARRL. Ex Sec'y, Cleveland Radio Assn.
Traffic Manager

Specially printed postcards are circulated in America by members of the Radio Relay League for reporting the reception of experimental transmissions. Such reports are very valuable to the transmitters concerned. Transmitting Licence holders, by keeping this Journal, which is now the official organ of the British Wireless Relay League, advised as to the location of their stations, may receive advice from the innumerable listeners-in as to the ranges achieved and other details relating to the transmissions. Owners of receiving stations can, on the other hand, greatly help the transmitting experimenters by passing reports by postcard. In so doing they would induce new transmitting licence holders to promptly come forward with details of their stations for inclusion in "The Wireless World" lists.

Questions and Answers

"G.J." (South Shields) *asks* (1) *Whether it is advisable to apply for an experimental licence before one commences to construct a wireless receiver.* (2) *What are the qualifications required to become a member of the Radio Society of Great Britain.* (3) *What is the address of the Radio Society of Great Britain.*

(1) We certainly think it is advisable that you should apply for an experimenter's licence before you commence to build a wireless receiver. (2) Anyone who is interested in wireless and has a reasonable amount of wireless knowledge is eligible for membership, and we suggest that you communicate with the Secretary of the nearest Wireless Society which is affiliated to the Radio Society of Great Britain. (3) The address of the Secretary of the Radio Society of Great Britain is 32, Quex Road, West Hampstead, N.W.6.

"L.G.C." (Bucks) *submits a diagram of his receiver and asks* (1) *What broadcast stations should he hear.* (2) *For a diagram of a receiver employing crystal detector and one valve note magnifier.*

(1) The diagram of connections submitted is correct, although we do not recommend coupling the tuned anode coil with the aerial coil in the manner shown, especially when it is desired to receive the broadcast transmissions. (2) A suitable diagram is given in Fig. 1. It is better to

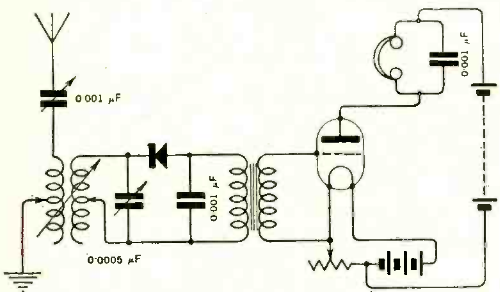


Fig. 1. **"L.G.C." (Bucks).** *Loose coupled tuner with crystal detector and note magnifier.*

connect a transformer to couple the crystal rectifier with the input circuit of the low frequency connected valve. We would also refer you to Fig. 3, page 783, March 10th issue of this journal.

"SCOT" (Hunts) *asks* (1) *What is the minimum height and length of an indoor aerial which would be suitable for use in connection with the reception of broadcast transmissions.* (2) *What is the smallest number of valves which would amplify the signals sufficiently to give a good volume of sound.*

(1) We suggest you use from 70′ to 80′ of insulated wire. The wire should be held a few feet away from the surrounding walls and ceilings. The height of the wire does not very greatly matter. (2) It would be necessary to use two high frequency, one detector, and one low frequency connected valves.

"R.T." (Norway) *asks* (1) *For the dimensions of a tuner which, in conjunction with his tuning condensers, will enable him to tune from 300 to 1,100 metres.* (2) *If a loading coil were connected in series with the aerial coil would it be necessary to change the reaction coil.* (3) *Is an anode potential of 50 volts suitable.* (4) *Which of two types of valves is best suited for service as a rectifier.*

(1) The aerial coil may be 4″ in diameter and 5″ long, wound with No. 20 D.C.C.; 15 tappings should be taken. The closed circuit coil may be 3″ in diameter and 5″ long, wound with No. 26 D.C.C.; five tappings should be taken. The reaction coil may be 2″ in diameter and 6″ long, wound with No. 30 D.C.C.; six tappings should be taken. (2) The loading coil may be connected in the manner suggested in the sketch submitted, and, provided the reaction coil is made variable as suggested in (1) we do not think it will be necessary to connect additional loading coils in the reaction circuit. (3) Fifty volts anode potential is quite suitable. (4) We suggest the use of the Dutch type of valve as rectifier.

"C.E.C." (Leytonstone) *asks* (1) *What wavelengths would various basket coils tune to.* (2) *Is the diagram submitted correct.*

(1) The four basket coils connected in series and mounted side by side, with a small spacing washer separating the coils, will tune from 150 to 2,000 metres. (2) The diagram submitted is correct, although it is very often better when receiving short wavelength signals, to connect the aerial tuning condenser in series with the aerial tuning inductance. We do not think the addition of variable grid leaks and condensers will be of great assistance, but we suggest the use of a potentiometer, connected as shown in a large number of diagrams in this section of the journal.

"AERIAL" (Newcastle) *submits two sketches of two proposed aerials and asks which is considered the best.*

We suggest you use the aerial represented in your sketch B.

"C.F.G." (Leicester) *asks* (1) *To what wavelength will a coil 4½″ in diameter and 9″ long, wound with No. 28 enamelled wire, tune.* (2) *To what size should basket coils be wound to give a range of wavelengths from 180 to 4,000 metres.* (3) *Is there any simple formula for calculating the inductance of coils.* (4) *Is it possible to receive C.W. transmissions with a crystal receiver.*

(1) The coil will tune from 200 to 9,000 metres provided an 0·001 mfd. tuning condenser is used. (2) We suggest you use a former 1⅛″ in diameter with 13 spokes, the spokes being ⅛″ thick. The coil should be wound with No. 26 D.C.C., with the following numbers of turns: 25, 40, 70, 100, 120. Coils having 150 and 200 turns may be wound with No. 30 D.S.C. The coils should be connected in series and tappings taken from the connections. When mounting the coils they should be separated by about ⅛″, with spacing washers to prevent an increase in the self-capacity

of the whole winding. (3) The formula for calculating the inductance of coils is :—

$$\pi^2 n^2 d^2 lk$$

where $\pi = 3.14$; N = the number of turns of the winding per centimetre length ; d = the diameter of the winding ; l = the total length of the winding ; and k is a factor which depends upon the ratio of the length and the diameter of the winding, and is taken from tables. We would refer you to a book entitled "The Calculation and Measurement of Inductance and Capacity," by Nottage. (4) You cannot normally receive continuous wave signals with a crystal receiver.

"SCAMP" (Finchley) *asks* (1) *For a diagram showing how valves are connected by the resistance capacity method ; the reaction effects obtained through the use of a variable condenser.* (2) *What would be the suitable dimensions of a loose coupler to tune from 200 to 3,500 metres.* (3) *and* (4) *Is it thought that the use of an aerial built upon the cage principle will result in greatly increased signal strength.*

(1) The diagram is given in Fig. 2. Three high frequency connected valves are used, and the fourth valve is a detector valve. The resistance in the anode circuits should be of the order of 70,000 ohms. The reaction condenser should have a value of 0·00005 mfds. (2) The primary of the loose coupler may be 4″ in diameter and 7″ long, wound full of No. 22 D.C.C. ; 20 tappings should be taken. As the aerial tuning and condenser will be connected in series at times and at other times in parallel the tappings may be about equally spaced. The secondary winding may be 3″ in diameter and 7″ long, wound full of No. 28 D.C.C. ; 10 tappings should be taken. (3) and (4) We suggest you use the aerial sketched in Fig. A submitted. We do not think any great gain will be obtained through the use of a cage type aerial when you only wish to conduct receiving experiments.

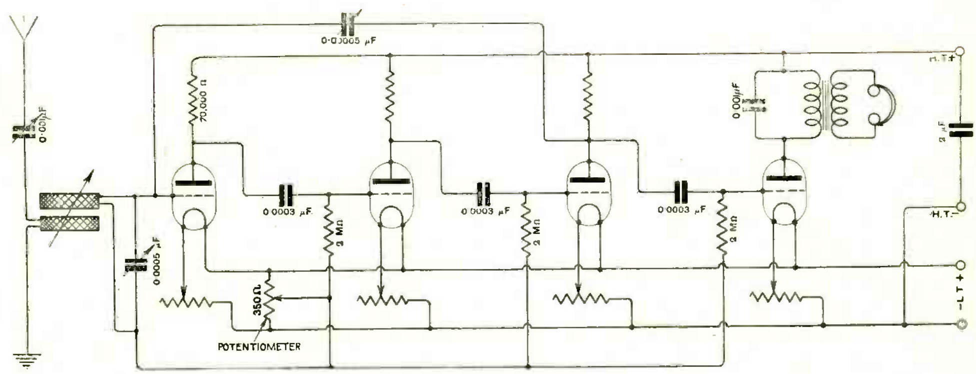


Fig. 2. **"SCAMP" (Finchley).** *Method of joining up an amplifier on the resistance capacity principle.*

"L.J.S." (Manchester) *asks* (1) *What would be suitable dimensions for a frame aerial to be used in conjunction with a receiver for receiving Eiffel Tower signals.* (2) *What would be the suitable dimensions for a frame to be used in conjunction with the frame mentioned in question* (1) *as a reaction coil.* (3) *Is there any book which deals fully with the design of frame aerials.* (4) *Are high frequency transformers wound to cover a definite wavelength when used in conjunction with a given transformer, or is it not necessary to use a transformer.*

(1) A suitable frame would be 4′ square. The winding may be ordinary electric lighting flex ; 16 turns should be wound, and each turn should be spaced ½″. (2) The reaction coil, when used with the frame aerial, should be mounted so that its position relative to the frame may be varied. The reaction frame may be 4′ square, and should be wound with eight turns of electric lighting flex, the wires being spaced ½″ apart. Four tappings should be taken. (3) We do not know of any book which deals thoroughly with the design of frame aerials, but we would refer you to the article entitled "Frame Aerials in Radio Reception" in the issue of Jan. 27th, page 255. (4) High frequency transformers should be wound for use with a definite capacity. It does not matter which portion of the receiver the high frequency transformer is connected to. There is always capacity present. The value of this capacity will vary very greatly with the method of wiring the receiver.

"R.W.S." (Ilford) *asks* (1) *With reference to the wavelength formula, how is the formula applied when we have two condensers in series connected across the coil.* (2) *Using R type valves in a transmitter with 240 volts high tension D.C., what emission current would flow. Should it be expected that the aerial current would be greater if proper transmitting valves were used.* (3) *Could a tuned circuit be calibrated with the aid of the harmonics of a large power transmitting station.*

(1) The formula wavelength $\lambda = 1885\sqrt{C \times L}$ can be applied to any oscillatory circuit. L represents the inductance of the coil in microhenries, and C is the resultant capacity of the circuit. In the case mentioned in the query the condenser is in series with the capacity of the aerial. The resultant capacity of two condensers

in series may be obtained from the following formula :—

$$\frac{I}{C} = \frac{I}{C_1} \times \frac{I}{C_2}$$

Where C represents the resultant capacity and C_1 and C_2 the capacities of the condensers connected in series. The value of C is then put in the wavelength formula and the wavelength calculated. Because the capacity of the aerial is distributed, and not located at one point, this formula is not strictly accurate, but nevertheless is sufficiently accurate for most purposes. You should find the series of articles entitled " Wireless Theory for the Listener-in and Experimenter " extremely useful. (2) The normal anode current will probably be of the order of 6 to 8 milliamperes. It should be expected that more power will be obtained in the aerial circuit when transmitting valves are used. (3) The circuit comprising a tuning condenser and coil may be calibrated from the harmonics of high power transmitting stations. It is generally found the harmonics have odd numbers, *i.e.*, the wavelength will be the fundamental one-third ; one-fifth, and so on.

" L.G.L." (Surrey) *asks* (1) *For a diagram of a three-valve receiver with one high frequency, one detector, and one low frequency connected valves. It is preferred to use the tuned anode method of high frequency amplification.* (2) *What is a suitable size of a loose coupler to tune from 300/1,500 metres.* (3) *What is a heterodyne and how does it work.*

(1) A suitable diagram is given in Fig. 2, page 782, March 10th issue. Suitable values are given in the diagram. (2) The primary of the loose coupler may be 4″ in diameter and 5″ long wound with No. 20 D.C.C. Fifteen tappings should be taken. The secondary coil of the loose coupler may be 3″ in diameter and 3″ long wound with No. 26 D.C.C. Ten tappings should be taken. (3) A heterodyne comprises the valve with suitable coils and condensers connected to anode and grid circuits so that it may be made to readily oscillate to any desired wavelength simply by altering the constance of the circuits. Heterodyne wavemeters have been fully described in past issues of this journal.

" S.R." (Perth) *asks with reference to the valve and crystal receiver described in the March 3rd issue of this journal.* (1) *What is the range of the receiver.* (2) *What kind of condensers are used.*

(1) With a receiver of this description, the broadcast transmissions should be heard when a pair of sensitive head telephones are used over a radius of 50 to 60 miles. (2) The only condensers used in this receiver are fixed condensers, and they have the values given in Fig. 5 of the article. The fixed condenser in the aerial circuit has a capacity of 0·0002 mfds., and the condenser connected across the telephones 0·002 mfds.

" C.V.C.H." (Norfolk).—The grid to filament capacity of an " R " type valve is of the order 0·000015 mfds. ; that of a Mullard " Ora " type valve is approximately the same. As you probably know, the effect of the self capacity of a valve depends very largely upon the type of circuit with which it is used, and we have no accurate data concerning the capacity of these valves when they are not connected in a receiver. We think for all practical purposes they may be taken as the same.

" NOVICE " (Birmingham).—We are afraid we do not know of a wireless receiver which, when installed within four or five miles of one broadcast station, will, when tuned, amplify the signals of another broadcast station so that the concerts of the distant broadcast station are properly received. We think you would find that, even with careful tuning, the transmissions of the Manchester station would be heard, even if you were tuned to the wavelength of the London station. If manufacturers state they are able to provide a set which will enable you to make very selective tuning, and so tune-in the particular broadcast station you wish, we suggest you ask for a demonstration.

" R.W." (Nottingham) *asks* (1) *For a diagram of a three-valve receiver with one high frequency, one detector, and one low frequency valve, with a switch so that the high frequency transformer or a tuned anode coil may be used.* (2) *If the reaction coil is coupled with the high frequency anode winding, is it possible to cause interference.* (3) *If a basket coil type of reaction coil is coupled with the high frequency transformer, is this likely to cause interference.* (4) *With a single valve receiver with the reaction coil coupled to the aerial coil, if the receiver were to generate oscillations in the aerial circuit, would the oscillations so generated interfere with the*

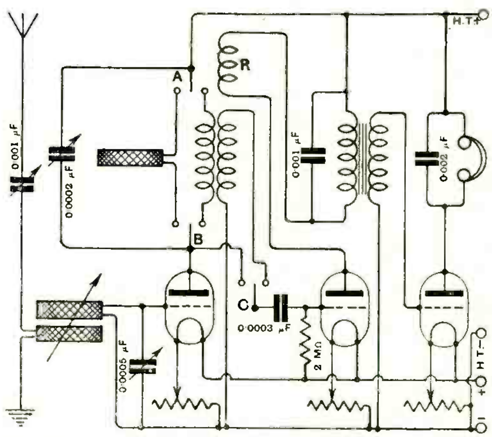


Fig. 3. **" R.W." (Nottingham).** *Method of interchanging transformer and tuned anode by means of switches.*

reception of broadcast transmissions, although the single valve receiver is tuned to a very different wavelength.

(1) The diagram is given in Fig. 3. (2) and (3) When the reaction coil is coupled with the high frequency transformer for the tuned anode winding, oscillating energy is not generated in the aerial circuit, although, due to the coupling between the anode and grid condenser of the first valve, there may be a tendency for oscillating energy to be generated in the aerial circuit, and one should

therefore guard against this by using a potentiometer. (4) An oscillating receiver with a wavelength of, say, 1,000 metres, will not cause interference with the broadcast wavelength. At the same time, if other experimenters are receiving 1,000 metre signals, the oscillations produced by your receiver will seriously interfere with them and hinder their work. It is very bad practice to use a receiver with the reaction coil coupled to the aerial coil when it is desired to receive continuous wave signals. It is much better to use a separate oscillator, the oscillator being coupled with the high frequency transformer.

"A.H." (Bolton) *asks* (1) *For a diagram of a three-valve receiver using one detector, and two L.F. valves, the tuner to provide for selective tuning.* (2) *Why is it that with only the reaction coil connected faint signals are heard.*

(1) A suitable diagram was given in Fig. 1, page 676 of Feb. 17th issue. A three-coil tuner was used, and this should provide you with the means for selective tuning. (2) The reason why faint signals are received when the reaction coil only is in circuit is because the reaction coil is acting as a small frame aerial, and is picking up a small amount of energy which is being passed on through the transformer to the low frequency connected valves.

"TREBLA" (E.18) *asks* (1) *For criticism of his receiver, diagram of which is submitted.* (2) *Should the receiver operate a loud speaker satisfactorily.* (3) *Should it be expected that an improvement would be made if smaller tuning coils were used.* (4) *Should it be expected that there is a large loss in signal strength through the aerial and earth wires running close together.*

(1) The diagram of connections submitted is correct. The anode tuning condenser which is marked as 0·0005 mfds. is far too large. We suggest you use a 0·0002 mfd. condenser. A 0·001 mfd. fixed condenser should be connected across the primary of the transformer in the second valve circuit. (2) With a receiver of this description we think you should satisfactorily operate a small loud speaker. (3) The coils are rather large, and for short wavelength work we suggest you use a set of smaller coils. The aerial coil should be 4″ in diameter and 4″ long, of No. 20 D.C.C. wire, with 12 tappings. The anode coil could be 3″ in diameter and 4″ long, of No. 28 D.S.C. wire, with 8 tappings. (4) No doubt there is a reduction in signal strength, due to the closeness of the aerial and earth wires, and we suggest you separate them as widely as possible.

"A.H.O." (Harrow) *refers to the receiver described on page 685, February 24th issue of this journal, and asks* (1) *Why, when one inductance coil lies directly over the second, the slightest movement of the moving coil tunes out the broadcast station transmissions.* (2) *Should he try another size of fixed condenser in his aerial circuit.*

(1) and (2) We suggest you try reversing the connections of one of the tuning coils, and if the adjustment is still very critical, connect a larger condenser in the aerial circuit. One having a maximum value of 0·0005 mfds. will be suitable. Alternatively, you could rewind one of the inductances, using another ten turns of wire.

"NEW READER" (Bearwood) *asks* (1) *For a diagram of a receiver comprising one high frequency connected valve, crystal detector, and one note magnifier with a potentiometer connected in the grid circuit and another connected in the anode circuit. A variometer has to be used for tuning.*

The diagram is given in Fig. 4.

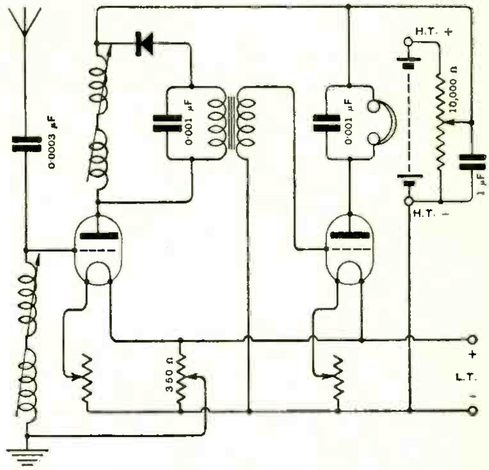


Fig. 4. **"NEW READER" (Bearwood).** *H.F. amplifier, with crystal detector and note magnifier. The value of the H.T. is continuously variable. Care must be taken to break the battery circuit when not in use.*

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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"Blind Spots" and "Fading."

Probably no one who has interested himself, even to a slight extent, in wireless telegraphy and telephony, has failed to appreciate the interesting yet extremely troublesome problem of the fading and weakness of signals in certain localities. Elsewhere in this issue we are authorised by the Radio Society of Great Britain, and the Radio Research Board, to publish details of the organisation recently started by the Radio Research Board to collect data and information on this subject with a view to elucidating some of the causes.

The Radio Research Board has realised the possibilities of valuable assistance in this direction through the organisation of the Radio Society of Great Britain and affiliated societies, and has therefore approached the Society with a view to obtaining the co-operation of all those members and experimenters in the country who are in a position to assist in this important work.

A good number of independent efforts have been made to collect data on this phenomenon, and it is gratifying to see that the Radio Research Board is now taking up the question, so that all reports can be concentrated through an organisation which, more than any other, is in a position to make full use of the information obtained.

It is hoped that all those who are in a position to do so will make every effort to assist in supplying useful data.

Wireless as an Aid to the Observation of Earthquakes.

Those who listen-in to the broadcast transmissions from Birmingham (**5 IT**) will have had their interest aroused in the subject of the recording of earthquakes, as a result of lectures delivered from that station by Mr. J. J. Shaw, who is so well known an authority on this subject, and director of the West Bromwich Seismological Station. Mr. Shaw is again talking on this topic from the Birmingham Broadcasting Station on May 11th, and it is therefore opportune that in the present issue we publish an article dealing in some detail with this subject, by our well-known contributor on meteorological and kindred subjects, Mr. W. G. W. Mitchell, B.Sc., F.R.A.S., F.R.Met.S.

Through the kind co-operation of Mr. Shaw, we are also able to publish with this article illustrations of his apparatus and interesting details regarding its operation.

Here we see wireless applied to facilitate research in yet another branch of science.

AN ARTICLE OF SPECIAL INTEREST TO THE EXPERIMENTER.

DOUBLE MAGNIFICATION CIRCUITS

The author discusses amplification, early methods of securing double magnification, and brings new circuits to the attention of the experimenter which have been tried out.

By W. JAMES.

1.—GENERAL.

IT is perfectly evident that ordinary methods of amplification are very wasteful in two ways—excessive battery power is used, and more valves than are necessary are employed for a given result. Thus, if one examines an ordinary receiver with, say, two stages of high frequency amplification, a rectifier and two note magnifiers, it will be noticed that in all probability the same type of valve is used throughout. The point to be emphasised is that the second valve is dealing with much more energy than the first, and so on right through the amplifier to the last note magnifier, which is dealing with hundreds of thousands times the *signal energy* which is applied to the input circuit of the first radio frequency valve.

Now the first valve is probably taking nearly the same battery power as the last; therefore if the last valve is working at its full capacity, the remainder, while amplifying the signal as we desire, are at the same time taking an unjust share of battery power and are thus wasteful. Reference should be made to Fig. 1, which shows schematically a valve amplifier, the input side of the first valve being joined with the tuner, while the output side of the last is connected with the sound producing device. It will be noticed a crystal rectifier may be used in place of the valve rectifier at will.

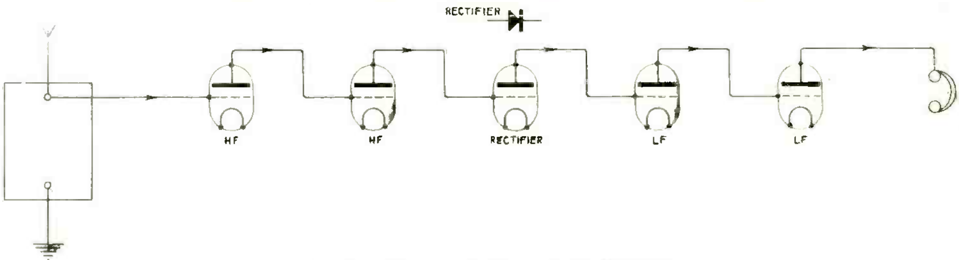


Fig. 1. Schematic Layout of Receiver.

The receiver is shown schematically. The radio-frequency energy which is collected by the aerial circuit is applied to the input circuit (grid-filament) of the first valve, the output from the first valve is passed on to the input of the second, and so on to the rectifier, where the energy is rectified either by valve or crystal. The audio-frequency energy is then dealt with by each stage of magnification, and finally operates the receiver.

2.—EARLY INVESTIGATIONS.

It is not surprising that early workers attempted to prevent waste, and early in 1915 we find valves were used for both radio and audio frequency amplification at the same time. In Fig. 2 we have H. J. Round's circuit, together with its schematic diagram. The arrangement is really a tuned anode circuit, part of the anode coil being coupled with the aerial coil. In some arrangements, part of the aerial coil is coupled with the anode coil, but the effect is the same. The aerial circuit consists of the tuned circuit LC, which is connected with the grid and filament of the valve V. In the anode circuit we have a coil L_1, tuned with the condenser C_1. Across the tuned circuit is the crystal rectifier R and transformer Tr, which is shunted with condenser C_2. A potentiometer P is connected, to provide an adjustment to secure stability consistent with the highest amplification.

This circuit is commonly used at the present time, and it is interesting to note with whom the tuned anode method of amplification is associated, and that its merits were so well realised by those who were the first to employ valves as amplifiers. Instead of connecting telephones to the secondary winding of the transformer, it is easy to see that the secondary winding may be connected in the grid circuit of the valve, so that the audio-frequency energy is amplified by the valve. This is

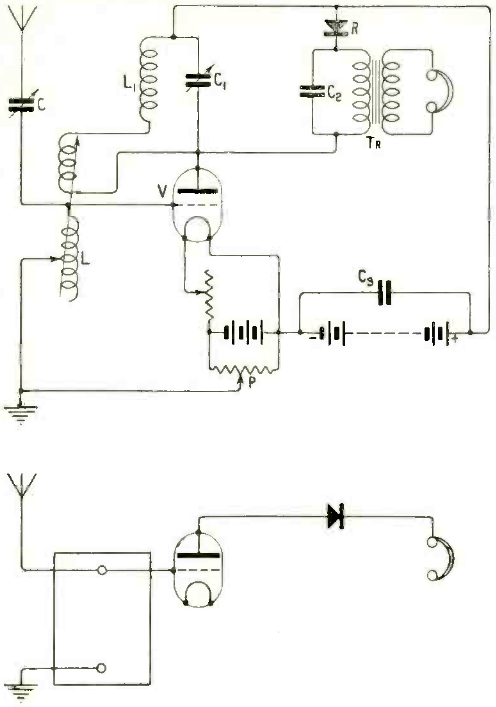


Fig. 2. H. J. Round's Circuit.

Here the energy collected is applied to the first valve which together with its associated tuned anode circuit amplifies it. The crystal rectifier and transformer being connected across the tuned circuit, rectified signal energy is passed through the telephones. The lower diagram illustrates the receiver schematically.

For short wavelength work—

- C = 0·001 *mfds.*
- L = 4 *in. tube with* 80 *turns of No.* 20 *D.C.C. tapped every* 10 *turns.*
- L_1 = 4 *in. tube with* 160 *turns of No.* 26 *D.C.C. tapped every* 15 *turns.*
- C_1 = 0·0002 *mfds.*
- C_2 = 0·002 *mfds.*
- C_3 = 2 *mfds.*
- P = 250 *ohms.*

illustrated in Fig. 3. The telephones, or the telephone-transformer combination, may be joined in the anode circuit, when they will respond to the magnified audio-frequency signal.

To digress for a moment; it is probably well known by the reader that the *reactance* (which is only another name for *resistance*) of a condenser depends upon the frequency. Thus if a condenser has a reactance of 10 ohms at 1,000,000 cycles (corresponding to a wavelength of 300 metres), its reactance at 1,000 cycles (which is an average music frequency) is 1,000 times larger; that is 10,000 ohms. In a similar manner the reactance of an inductance varies directly with the frequency, that is, for example, if the reactance of a coil at 1,000 cycles is 10 ohms, at 1,000,000 cycles it is 1,000 times larger, or 10,000 ohms.

When the secondary of the transformer is joined in the grid circuit it is therefore necessary to shunt it with a condenser C_4, which offers small resistance to the radio-frequency signal, but offers a high resistance to the audio-frequency. In the same manner, the primary winding of the telephone transformer Tr_1 is shunted to by-pass the radio-frequency energy. This circuit gives excellent results, and was used in 1915, although this is not very well known.

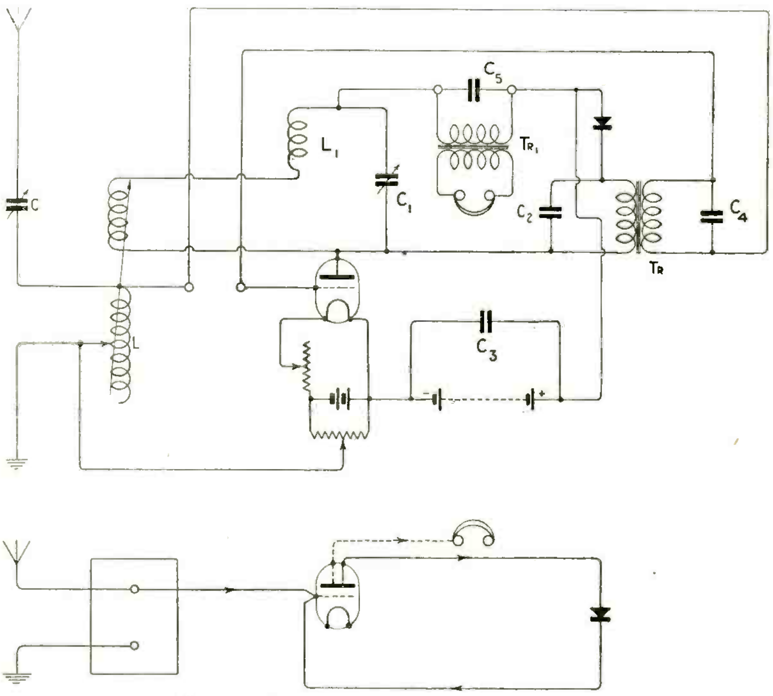


Fig. 3. Single-Valve Double Magnification.

This circuit should be compared with Fig. 2. Instead of the secondary winding of transformer Tr being connected to the telephones, it is connected with the grid circuit and shunted with C_4 — 0·002 mfds. The telephone transformer is connected in the anode circuit. C_5 = 0·002 mfds. Other values as in Fig. 2.

It is described in the "Text Book on Wireless Telegraphy," part 2, by Rupert Stanley, 1919 edition.* The arrangement is a double magnification circuit, and is identical in principle to that illustrated in Fig. 9 (Receiving Telephony without Reaction, by P.G.A.H. Voigt), page 41, April 14th issue of this journal.

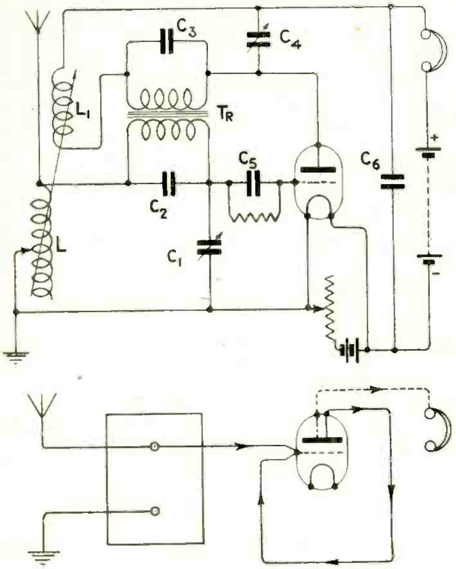


Fig. 4. Single Valve Double Magnification. *This arrangement is attributed to Armstrong. The valve operates as a rectifier, and reaction effects are obtained by coupling coils L_1 and L. Condenser C_4 tunes the reaction coil. The rectified energy is fed back to the grid circuit through Tr and operates the telephones. The components have usual values.*

* Both parts 1 and 2 of this book are valuable, and should be studied by every experimenter.

3.—ARMSTRONG CIRCUIT.

Another method of double magnification due to Armstrong is illustrated in Fig. 4. Here the aerial circuit contains the coil L, which is connected to the rectifying valve V. The grid leak and condenser is represented by C_5. The high frequency energy, which is always present in the anode circuit of a rectifying valve, passes through the tuned circuit L_1 C_4, and reaction effects are obtained by coupling L_1 with L. The audio frequency energy in the anode circuit passes through the transformer Tr, which has its secondary winding joined in the grid circuit. The valve then amplifies the audio frequency signal and the telephones are operated.

A slightly different circuit, in which a radio-frequency transformer and a crystal rectifier is used, is given in Fig. 5. Here the aerial circuit is tuned with condenser C, and inductance L. The closed circuit C_1 L_1 is connected to the grid and filament of valve V. In the anode circuit we have the radio frequency transformer Tr, across the secondary of which is the crystal rectifier R and the primary winding of the audio-frequency transformer Tr_1.

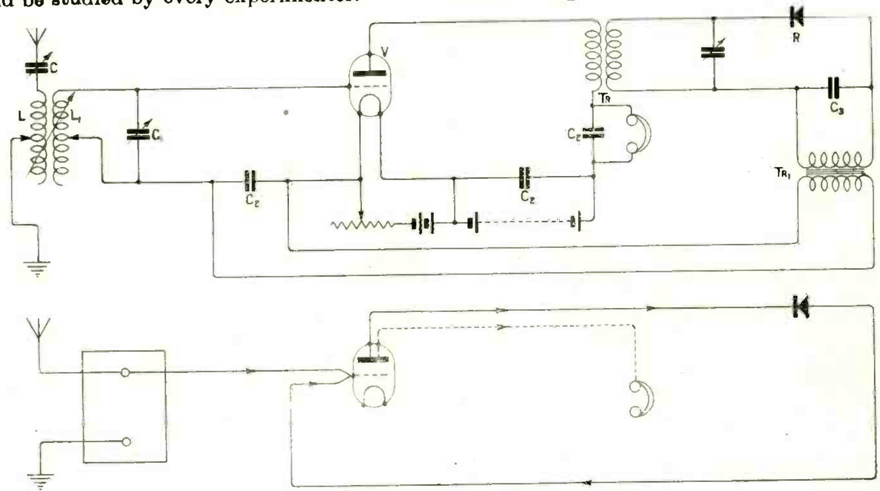


Fig. 5. Single Valve Double Magnification.
The radio-frequency energy is amplified by valve V and transformer Tr, and is rectified by the crystal R. The audio-frequency energy is fed back through Tr_1 to the grid circuit, is magnified by the valve and operates the telephones. The valves are as in Fig. 2. Coil L_1 may be 3 ins. in diamater with 80 turns of No. 22 D.C.C. Condenser $C_1 = 0{\cdot}0005$ mfds. Tr may consist of a tube $1\frac{1}{8}$ in. in diameter with a primary and secondary winding of 450 turns of No. 34 S.S.C.

The secondary winding of Tr_1 is connected back to the grid circuit, so in this circuit we amplify radio-frequency energy, which is rectified with the crystal, and then the audio frequency energy is magnified and operates the telephones. The circuit works very well, although it may be necessary to connect a potentiometer across the filament battery, and to connect the lead which at present joins the TR_1, TR_2, TR_3, and valves V_1, V_2, and V_3. Valve V_4 is arranged for rectification, and in its anode circuit is included the primary winding of the audio-frequency transformer LF_1. The secondary winding is included in the grid circuit of valve V_2, and the signal is magnified and passes through transformer LF_2, and is magnified again in valve V_3. The telephones are connected in the anode circuit

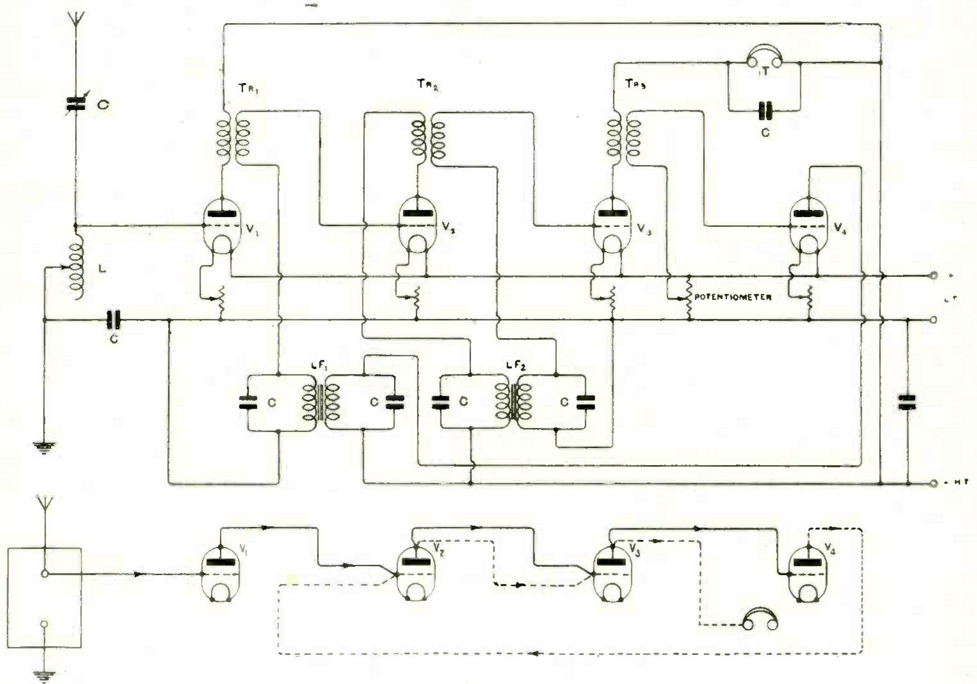


Fig. 6. Four Valves, Double Magnification.
The radio-frequency energy is amplified by V_1, V_2 and V_3, and rectified by V_4. The energy is fed back to the grid circuit of V^2 and is amplified and passed to V_3 in whose anode circuit is connected the telephones. Valve V_4 rectifies through the adjustment of the normal grid potential being suitable for rectification.

negative end of the filament, to the sliding contact.

4.—French Circuit.

A further development was made by the French during the war, who designed a receiver having the circuit given in Fig. 6. The aerial circuit C L is joined to the first valve, V_1 and the high-frequency energy is amplified through the high-frequency transformers of this valve. The low-frequency windings are all shunted with condensers marked C, to pass the radio-frequency energy readily. Referring to the schematic diagram it will be clearly seen that the first valve carries only weak radio frequency energy, the second carries stronger radio and weak audio-frequency energy, and the third valve carries strong radio and strong audio-frequency energy.

(To be concluded in our next issue.)

EXPERIMENTAL FOUR-VALVE RECEIVER.

HIGH FREQUENCY AMPLIFIER UNIT

The design of this high-frequency amplifier is such that it can very quickly be made up from components, and the instrument has a very good appearance when completed. It is simple and convenient to operate. The system of damping adopted is of special interest, and renders the complete four-valve receiver particularly useful for reception on broadcast wavelengths, as it complies with the requirements of the Postmaster-General.

RESEMBLING in general dimensions the tuning and detector valve unit already described,* this instrument is arranged for connection to the terminals marked 1 to 7, and is brought into operation by the high frequency amplifier switch.

For the construction of this unit the following components are required :—

Anode circuit tuning condenser, 0·0003 mfds., air dielectric. It is a great advantage if this condenser is of precisely similar construction to that used for tuning the closed circuit, so that by using identical coils in the closed and tuned anode circuits, tuning will be made much easier as the two condensers will be operated together and be of almost identical setting.

Three-coil holder, similar in pattern to that used in making the tuning unit.

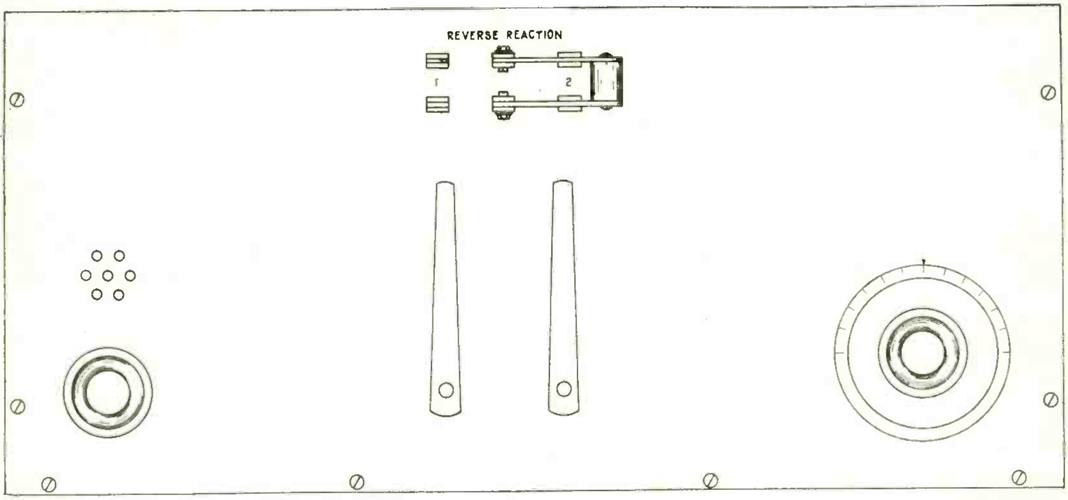
Valve holder.

Circular pattern filament resistance.

The arms and contacts of a double pole, two-position switch as used previously.

7 terminals.

A piece of best quality polished ebonite, $\frac{5}{16}$ in. in thickness and of a size suitable for constructing a panel 18 ins. by 8 ins., and a strip 18 ins. by 1 in. The strip may be shorter, of course, but it is convenient to make it the full width of the panel so that additional terminals can be arranged to suit any special requirements of the user.



Front view of panel. The precise spacing of the components depends upon the patterns adopted.

Hard wood base-board, 18 ins. by 6 ins. by $\frac{5}{8}$ in. Also another piece $7\frac{1}{2}$ ins. by 6 ins. by $\frac{1}{2}$ in., which will form the end supports for the panel when sawn across diagonally.

12 brass wood screws 1 in. by No. 6.

A piece of hard sheet brass 3 ins. by 3 ins. No 18 S.W.G.

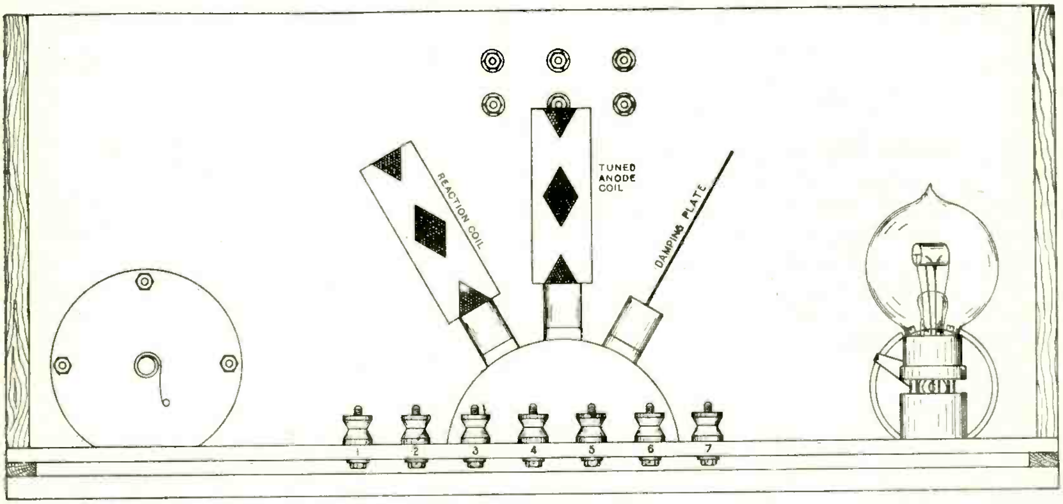
Coil plug, such as is used for mounting home-made honeycomb coils.

$\frac{1}{2}$ lb. No. 20 tinned copper wire and a quantity of insulating sleeving of various colours. (Make sure that the sleeving slips easily over the wire when purchasing.) The instructions for making up and

* *Wireless World and Radio Review*, page 98. April 28th, 1923.

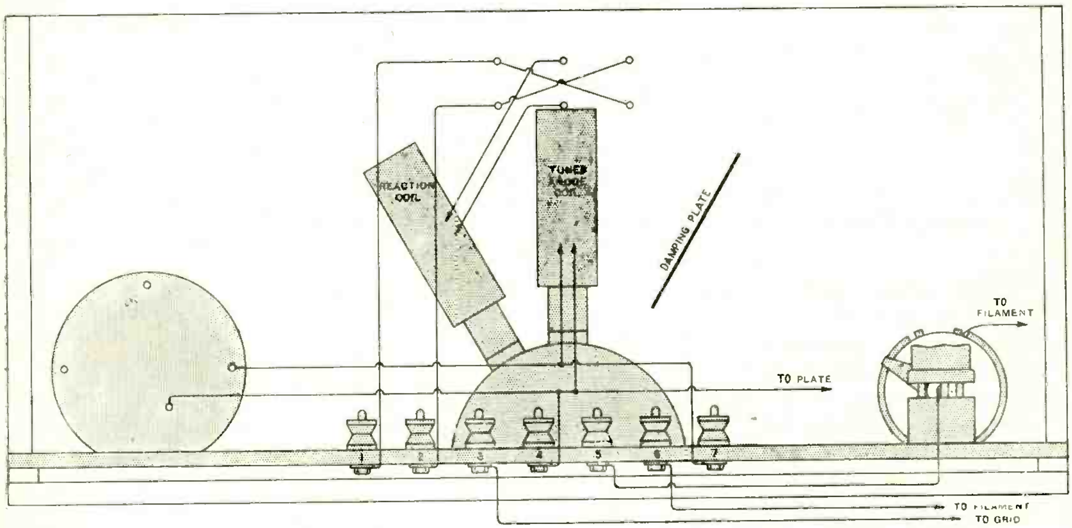
assembling given in connection with the unit already made apply here, and need not be repeated.

The connections to the centre bracket of



Back view of panel.

the coil-holder are in the plate circuit of the high frequency amplifying valve. On one side of this bracket is the holder which supports



The practical wiring. The leads must be rigid and well spaced.

the reaction coil, whilst the other has one of its sockets connected to terminal No. 5, *i.e.*, the L.T. negative and earth, when the H.F. switch is in the "on" position. By making a saw-cut into a coil plug, it is possible to secure to it a plate of brass or copper of about $\frac{1}{16}$ in. (or No. 16 S.W.G.) in thickness. A lead is run from this plate so as to pick up contact with the earth lead in the socket. This plate serves a double purpose. In the first place, when at a distance of about 1 in. from the anode coil it can be used for fine tuning when receiving on wavelengths below 400 metres. When, however, it is close up to the anode coil it will be noticed that the tendency to self oscillate, when the closed and anode circuits are in tune, is reduced. This is a very important refinement as, in practice, it will be found that slightly tighter reaction coupling may be used without critical oscillating effects and that the tuning of the anode circuit is less sharp, which is a very desirable feature when receiving broadcast telephony. Reacting on to the tuned anode winding, of course, limits the extent of radiation, but in spite of this, interference may still occur. The use of the variable damping plate allows for just such a degree of reduction of self-oscillation, as will prevent radiation even when the reaction coupling to the anode inductance is at zero and sufficiently flattens the tuning to eliminate, to a large extent, distortion in the reception of well modulated telephony. It must be remembered that telephony such as is transmitted by the British broadcasting stations is modulated in such a manner as to produce a number of side bands, and it is due to these oscillations of slightly different wavelength, and of lesser amplitude than those on the wavelength to which the tuning circuits are adjusted, that the pure transmission of telephony depends. The effect of the plate for the purpose of damping only occurs when it is hard up against the coil.

Apart from the introduction of this device into the high frequency amplifier being described, it is a new feature worthy of attention by all those making use of the tuned anode method of high frequency amplification for, as already explained, it broadens the tuning which is normally so critical, and also further reduces the extent of radiation such as may be caused by a reacting or self oscillating high frequency amplifier.

From the circuit diagram it will be seen that a switch is provided for reversing the connections to the reaction coil. The advantage of this is that if coupled in one direction the coil may stimulate the production of oscillations, whilst in the other it has the effect of damping them out when suitably coupled. Thus, for receiving high power telephony at short range "reversed reaction" should be used, and for long distance reception the reaction coil may be coupled in a manner to produce a suitable degree of regeneration.

Provision is made for reacting on to either the anode inductance or the aerial circuit (according to whether, or not, reception is being carried out on the broadcasting wavelengths) by simply transferring the reaction coil from one socket to another, for it will be seen that the reaction sockets in the detector unit and the H.F. amplifier are paralleled across through terminals 1 and 2.

It may be suggested that the dimensions of the panel for this H.F. unit are excessive,

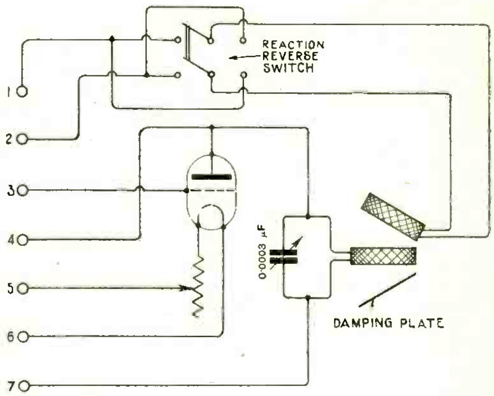


Diagram showing the action of the amplifier.

and involve unnecessary expense. True, the components might be differently arranged and perhaps more cramped, but what must be remembered is the need for arranging the inductances associated with the H.F. valve amply spaced from those in the aerial and closed circuits. For economy the front panel, if desired, may be made of wood, as there are not many components that are actually in circuit attached to it. The changeover switch must, in this case, be mounted on an insulating base, and the spindle of the condenser (which, by the way, must be joined to H.T. positive and not the valve plate) should not make contact with the wood.

The following coils of the honeycomb type will be required for tuning to broadcasting wavelengths. One "25," three "50's," three "75's," and one "100." This number of coils allows of the use of a "25," "50," "75" or "100" in the aerial circuit according to the dimensions of the aerial used. For the closed and anode circuits "50's" or "75's" are required, and the reaction inductance is a "75" or "100," according to which of these is not required for the aerial inductance.

A QUALIFYING COURSE FOR AN EXPERIMENTAL LICENCE

EXPERIMENTS FOR THE RADIO AMATEUR

In the previous issue the author described some simple experiments to illustrate the action of the buzzer, the transformer, and the crystal detector. The present instalment deals with the operation and construction of a simple, yet very useful wavemeter, and demonstrates the principles of tuning. As already explained, a wireless receiving licence is not required for the construction of the apparatus described, yet a study of the principles as can be gained by carrying out these simple experiments should qualify the reader for an experimenter's licence, and the apparatus made use of in the experiments will be required for building the receiving station when the permit is obtained

By Maurice Child.
Vice-Chairman of The Radio Society of Great Britain.

Experiment No. 4.

To cause a buzzer to emit feeble electric waves, and further, to use it for obtaining a sensitive adjustment on the crystal.

The apparatus required is :—
1 dry cell,
A buzzer,
A crystal detector, and
Telephones.

The method is as follows :—

Join the dry cell to the buzzer, and attach 2 feet of wire to either the iron framework or the contact pillar. The end of this wire is free and can lie on the table. As to which

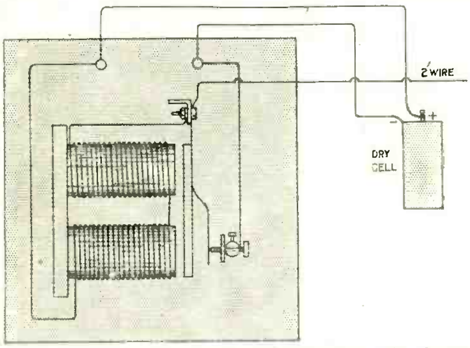


Fig. 5. Method of attaching the wire to the buzzer for the production of feeble electric waves.

of these points this wire must be attached, depends upon the particular wiring arrangement adopted. See Figs. 5 and 6.

Connect the crystal detector directly with the telephones and place it about a foot or two from the buzzer (Fig. 7). It should be possible when a suitable contact has been found on the crystal to hear the note of the buzzer in the telephones. The experimenter is strongly

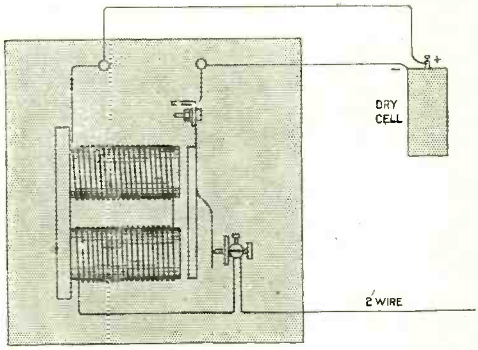


Fig. 6. Should the wiring up of the buzzer be as shown in this figure then the wire must be attached to the contact screw instead of the bracket which supports the armature

advised to make this simple experiment, and to obtain some dexterity in adjusting the various crystals and comparing the strength of sound produced by them when placed at a uniform distance from the buzzer.

Fig. 7. The crystal detector with telephones connected to it for the purpose of detecting the feeble electric waves emitted by the buzzer.

EXPERIMENT No. 5.

To set up a buzzer wavemeter circuit and to calibrate same.

Apparatus required :—
- 1 dry cell.
- A set of inductance coils.
- A variable condenser 0·001 mfds.
- 4 yds of No. 40 S.W.G. single silk-covered " Eureka " wire.
- A small single-pole switch.
- A crystal detector, and
- Telephones.

The method is as follows :—

Take the length of resistance wire and double it back on itself. Commence winding both wires together from the loop over a short length of wood (a match will do).

When the whole of the wire has been wound up, leave about three inches of each end over, and place the whole winding in a small quantity of melted paraffin wax such as can be obtained from an ordinary candle. Connect the two ends of this " shunt " across the magnet coils of the buzzer. Join the dry cell through one of the inductance coils to the buzzer, and complete the circuit from the remaining buzzer terminal, through a switch, to the dry cell.

Connect across the inductance coil the variable condenser. See Fig. 8.

On setting the buzzer working it should be noted whether there is any appreciable sparking

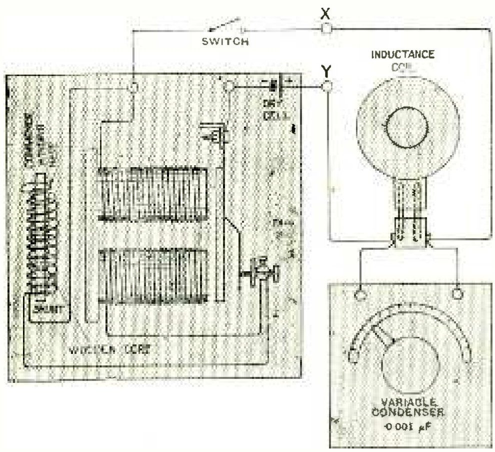


Fig. 8. The shunted buzzer, inductance coil, and variable condenser, connected together to form a buzzer wavemeter.

at the contacts ; if so, a little less resistance wire on the " shunt " should be used, but in general it will be found that the sparking at these contacts will be exceedingly small. With large inductance coils the sparking will increase, and for this reason the circuit will not operate well on wavelengths over 3,000 metres.

The circuit comprising the inductance and the variable condenser will have weak high

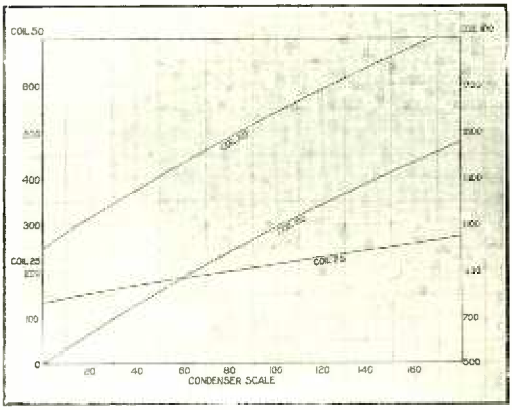


Fig. 9. Curves such as may be obtained for showing the wavelengths produced by various condenser settings with " 25," " 50 " and " 100 " inductance coils.

frequency alternating currents (oscillations) generated in it, and the frequency of these oscillations will be determined by the value of the capacity of the condenser and the value of the inductance used.

It is recommended that the inductances of some well-known type, such as those made by the Igranic Company or the Burndept Company, are employed, but the experimenter can wind them up on a suitable machine himself if he prefers.

The chart (Fig. 9), gives the approximate length of waves which would be emitted from such a circuit when using the various sized inductances of the Igranic Company. With Burndept coils the values are slightly higher. The wavemeter as set up can be accurately calibrated if a standard wavemeter is available, as is usually the case if the reader is a member of one of the many wireless societies. The method of calibration is as follows :—

Join the crystal detector with the telephones across the variable condenser and inductance coil of the standard wavemeter. Set the standard close to the inductance coil of the circuit to be tested, and note the position of the variable condenser which gives maximum signals in the telephones. By making several such tests with different settings of the standard wavemeter it will be possible to plot out curves somewhat similar to those shown in Fig. 9. A preferable method which conduces to greater accuracy is to place the standard wavemeter as far away from the circuit to be calibrated as can be done in order to produce very weak sounds in the telephones when the circuit is "tuned." Carefully note the position of the condenser pointer on the scale *each side* of the " maximum " where the sound becomes just inaudible. Halve the number of degrees between these two points on the scale, and the resultant is the maximum position for the particular wavelength tested. If difficulty is experienced with this experiment the local radio society should be sought out, when help will be undoubtedly obtained.

As an extra check on the above method of calibration, the arrangement of the apparatus can be reversed. Referring to Fig. 8, the crystal and telephones can be placed across the points marked X and Y, and the dry cell and buzzer disconnected. The buzzer on the standard wavemeter is then set in operation, and the whole instrument brought fairly close to the inductance coil in such a way as to produce weak signals in the telephones when the circuit to be calibrated is brought into tune by means of the variable condenser.

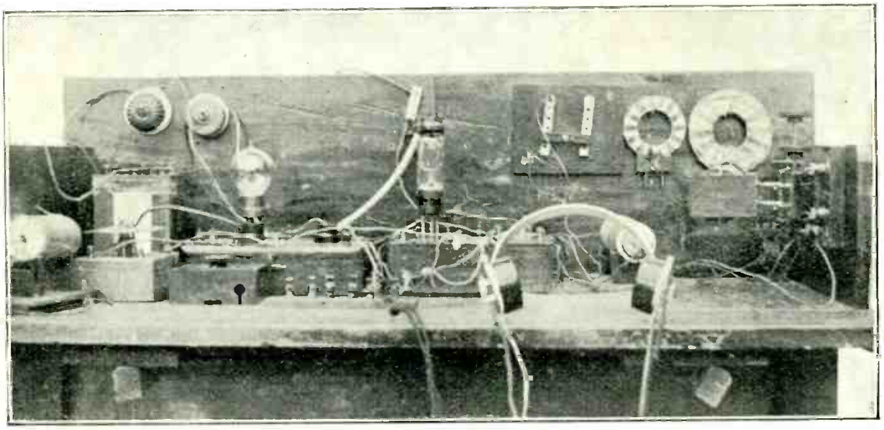
The readings of the variable condenser should now coincide with the original ones for any particular wavelength selected on the standard instrument.

With regard to the choice of a variable condenser, the experimenter will be, to a very large extent, governed by the price he can afford to pay. Inasmuch, however, as a good variable condenser may be considered an absolute necessity for serious experimental work, every effort should be made to procure a thoroughly sound and workmanlike piece of apparatus. In choosing such an instrument the experimenter should mainly look to the following points :—

The rigidity of construction, *i.e.*, substantial top and bottom plates, which should be of good quality ebonite or composition. Alternatively, in the better instruments, a metal case, together with top and bottom plates, are usually provided. The latter should be to the order of $\frac{1}{4}$ in. in thickness.

The vanes in good instruments have a very small clearance and are of considerable thickness. Note should be made that there is no slackness in the spindle either in a vertical or horizontal direction. In cheap instruments the tendency for slackness in a vertical direction is usually compensated for by a spring washer. This is no disadvantage, and is frequently provided in good instruments, but this washer does not prevent slackness to the spindle in a horizontal direction. At the same time the movement should be fairly free, and there should be no tendency for binding at any particular point of its movement

(Further Experiments will appear in alternate issues.)



One of the successful attempts in the Transatlantic Tests was that of Mr. F. Walker, of Feltham, Middlesex. Our illustration shows the set used, which comprises a detector valve with high frequency amplifier. The home-made coil holder appears on the extreme right and the H.F. transformer and condenser on the left. The tuning condenser will be seen behind the telephones, to the right of the detector panel.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—VI.

(Continued from page 147 of the previous issue.)

It is the purpose of the writer to deal with the principles underlying the action of wireless receivers and transmitters. Those who know *why*, obtain much pleasure which is not experienced by those who have no idea of the action of their wireless set.

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.

By reason of his work in supervising the replies to the queries and difficulties of readers, the writer has an experience which is not possessed by other engineers. Readers will appreciate that this experience will be reflected in both the selection and the method of presenting the subject.

By W. JAMES.

18—Alternating Currents (*cont.*).

It has been shown that the P.D. produced depends upon the *rate* at which lines of force are cut. Therefore in the present case the P.D. produced will depend upon the speed with which the wire is rotated, and the number of lines cut. The speed of rotation may be assumed constant, and we have therefore only to consider the magnitude of the field at each part of the revolution of the wire. Starting with the loop in a vertical plane, for the instant considered no lines are being cut. A little further round a few more lines are being cut, the number not being very great because the wire is passing through the field in a sloping direction. This is shown in Fig. 35.

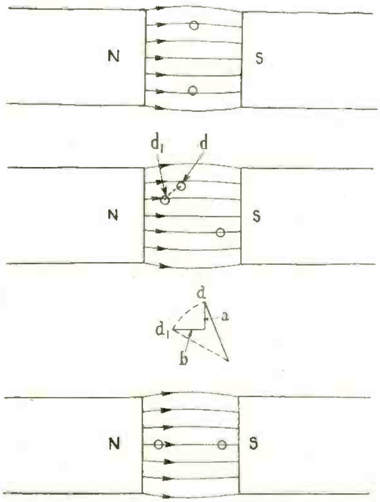


Fig. 35. When the loop is vertical, the pressure induced is zero, as represented at point 0, Fig. 36. As the loop rotates a few lines are cut at first, until when the loop reaches the horizontal position a maximum number of lines are cut, and the voltage induced at this instant is a maximum as shown at 90°, Fig. 36.

If we examine what happens while the wire is moving for a very short distance, from d to d_1, it will be seen the movement may be divided up into two portions, a and b. The lines are cut due to the vertical component of the motion, a, while no lines are cut due to the horizontal component of the motion b. When the loop has reached the horizontal position, a maximum number of lines are being cut.

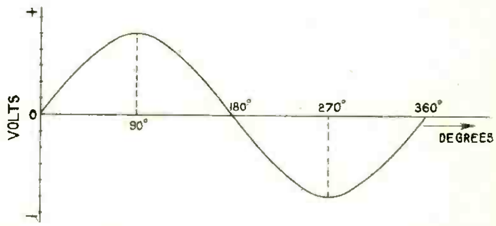


Fig. 36. The pressure induced in the loop varies as shown in the above curve, which is a sine curve, when the loop rotates in a uniform magnetic field.

As the loop rotates further, the number of lines cut is gradually reduced until when the loop is again vertical, once more no lines are being cut. As the loop moves a little further, the lines are cut in an opposite direction, but the same cycle is passed through. As the only variation in the factors which govern the magnitude of the P.D. produced is the number of lines cut, it follows the P.D. was zero at first, then built up to a maximum when the loop had rotated 90°, and then gradually reduced again until zero volts is produced when the loop has reached the vertical position, after turning through 180°. As the loop rotates further, the voltage gradually rises and falls again, but this time in an opposite direction.

If, as in Fig. 36, we let the horizontal line represent the degrees of movement of the loop, the pressure will rise slowly at first as shown, reach a maximum, fall off slowly to zero, and then gradually increase again in a reverse direction to a maximum and fall off to zero again.

The portion of the voltage curve above the line is reckoned as positive, while that below is negative. The pressure produced is an alternating pressure, and the current which flows when the circuit is completed is an alternating current. The frequency of the current is the number of complete cycles passed through in one second. Thus if the wire loop rotates 50 times per second, the frequency of the current is 50 cycles per second when the wire rotates in a magnetic field produced by a pair of poles, that is one north and one south.

positive or negative, depends upon the direction of motion of the wires of the loop, or whether the wire is cutting *up* through the lines of force, or whether it is moving *down* through them.

If the field distribution is uniform between the poles, so that the wire loop rotates in a field of uniform strength, it is found the curve of the voltage generated follows a definite law, and furthermore the curve may be drawn with the aid of a rule and compasses. Referring to Fig. 37, let us suppose a wire is rotating in a uniform field and the path traced out by the wire is the circle. The horizontal line is marked off in equal divisions to represent degrees. Thus, between position 1 of the wire and position 2 represents 90°, between 2 and 3 another 90°, and so on. If now we

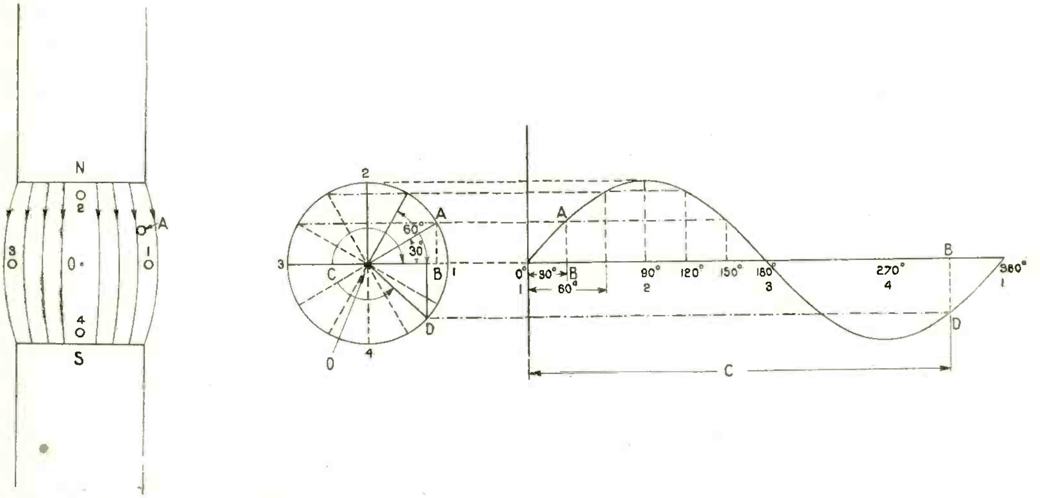


Fig. 37. The sine curve. The construction illustrated in the figure will enable one to construct a sine curve.

There are two important facts which should be remembered—(1) the voltage generated across the ends of the wire loop is proportional to the number of lines of force cut per second, and as the speed of the loop is constant, the variation in voltage is brought about through the *direction* with which the loop is cutting the lines of force. Thus, when the loop is vertical, for an instant the loop is moving along the lines of force and no pressure is set up; when the loop is horizontal, for an instant the wire is moving at right angles to the lines of force, and the maximum potential is generated. At all intermediate points the loop is cutting a fraction of the lines of force, depending upon the position of the loop at the instant considered. (2) The *direction* of the voltage generated, that is, which end of the loop is

divide the circle 1, 2, 3, 4 into a number of equal parts, we can plot the voltage curve. At point 1 the voltage is zero, at point A the voltage is represented by the length A B, and if this height is marked off above the horizontal line we have one point of the curve. The point A is simply drawn to the right, and the angle between 1—0 and A—0 is marked along the horizontal line. Other points may be marked in the same way. The curve produced is known as a *sine curve*, because the height of the ordinate at any given point is proportional to the sine of the angle through which the wire has rotated. The sine of an angle is the ratio of the vertical height to the hypotenuse, in this case the radius of the circle.

If, therefore, the value of the induced voltage is at any instant represented by e, the maximum voltage generated is represented by E_{max}, we have the relationship $e = E_{max} \sin \theta$, where θ is the angle through which the wire has passed from the starting point 1 in the diagram. The value E_{max}, of course is the crest voltage.

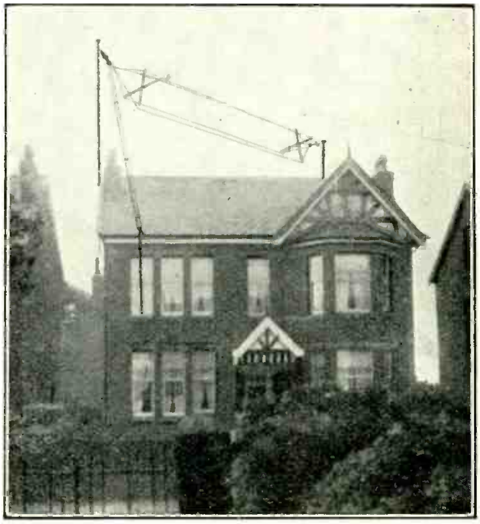
In the case of direct currents and pressures, where the current is flowing continuously, the heat generated is proportional to I^2r, where I is the current in amperes, and r is the resistance in ohms. This is the power lost in the circuit through resistance. In the case of alternating currents we obviously cannot take the maximum or crest value of the current corresponding to the crest voltage when we wish to find the power in the circuit, because the value is varying from instant to instant. Now the *rate* at which heat is produced from the above equation is proportional to I^2; the heat produced over a given time, say the time of one complete cycle, must be proportional to the mean value of the current squared. The effective value of the alternating current is therefore equal to the *square root of the mean value of the current squared*. This value is called the root mean square, abbreviated R.M.S. value of the alternating current. If the maximum value of the current is denoted by I_{max}, the R.M.S. value denoted by i is equal to $\cdot 707\ I_{max}$ or $i = \cdot 707\ I_{max}$. In the case of the pressure, $e = \cdot 707\ E_{max}$.

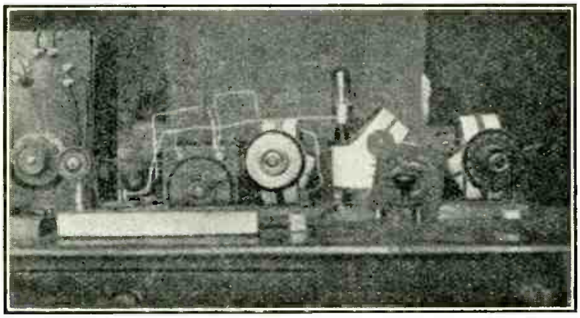
Instruments which are used to measure alternating currents or pressures read the R.M.S. values. It should be remembered, therefore, that when one refers to an alternating pressure of V volts as measured by a voltmeter (which is an instrument used to indicate the volts across a circuit), the maximum pressure in the circuit will be $\frac{1}{\cdot 707}$, or $1\cdot 414$ times the voltmeter reading, twice per cycle.

Commercial machines which generate alternating currents for heating and lighting purposes consist of an iron drum with slots arranged around the circumference in which the loops of wire are placed, the ends of the loops being brought out to rings so that contact may be made with stationary brushes which bear on the rings, and a field magnet system for generating the magnetic lines of force through which the wires pass. The greater the number of loops of wire joined in series, the faster the speed of the drum carrying the wire, and the more intense the magnetic field, the greater is the voltage generated. The curve of pressure generated is not generally a pure sine curve because for one reason the field is not uniform. The current which flows in the wires placed in the slots of the iron core magnetise the core, and as we have seen, the direction of the magnetic lines produced is such that they interact with the field of the field magnets and distort it.

(*To be continued.*)

Successful Transatlantic Reception.





The illustrations on this page show the apparatus and antenna system employed by Mr. A. H. Fielding, of 32, Stanley Avenue, Birkdale, Lancs., who was among the successful amateurs in the recent Transatlantic tests. In describing his set, a single-valve receiver, Mr. Fielding apologises for the appearance of his variometers and coupler, which were hurriedly put together the night before the tests were made. The aerial used was a four-wire cage on 6-ft spreaders, 60 ft. high at each end.

RESISTANCE COUPLED AMPLIFIER
FOR SPEECH FREQUENCIES.

A constructional article dealing with the application of resistance-capacity intervalve coupling to low frequency amplification is here given for the first time. This principle of amplification has much to recommend it to the experimenter, in particular the elimination of distortion and low cost of components. The author has introduced several novel features into the circuit arrangement, which will appeal to the experimenter, whilst no unnecessarily elaborate details are to be found in the design.

By Paul D. Tyers.

To experimenters whose means are limited, the problem of providing an amplifier suitable for operating a loud speaker or recording device presents many difficulties, chiefly on account of the comparatively high cost of the necessary transformers. To retain the original quality of the speech or music, calls for expert design of the instrument as a whole and in particular the intervalve transformers. From the point of view of amateur construction the building of a resistance coupled amplifier is a very simple matter, and the initial outlay is confined chiefly to the cost of the valves, which, of course, may be used for other experimental work. Excluding the cost of the valves, a three-valve resistance amplifier may be made for the moderate sum of about fifteen or twenty shillings.

There are certain advantages to be gained by the use of a resistance coupled amplifier, while, on the other hand, there are certain inherent drawbacks. The insertion of a resistance in the anode circuit of the valves naturally reduces the steady potentials on the anodes which are supplied by the anode battery, and thereby necessitates the use of a battery of about double the normal voltage. Further, the use of a resistance as the coupling device does not permit of any step-up effect, the resultant amplification being wholly dependent, therefore, upon the voltage amplification factor of the valves. This means that where two valves would be employed in the normal way an extra valve must be added to obtain about the same amount of amplification.

On the other hand, the use of a resistance coupled amplifier very frequently makes for better quality of reproduced speech and music, since the many disturbing factors which are always present with transformer coupling do not exist.

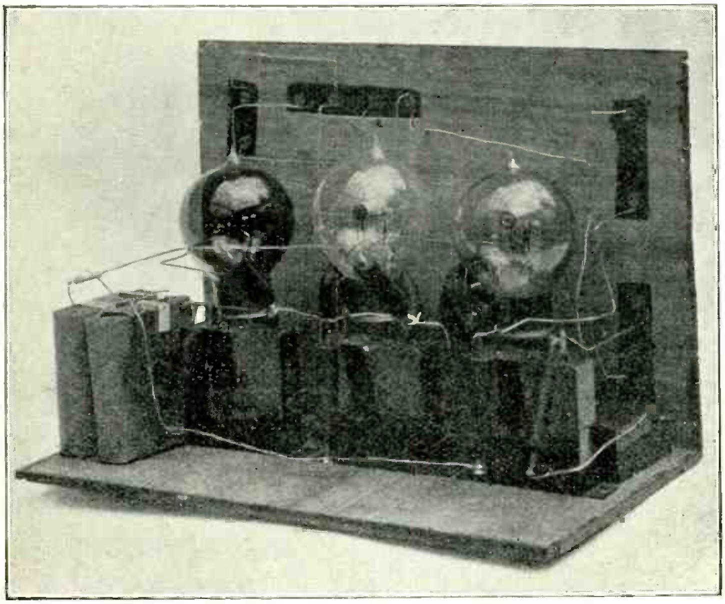


Fig. 1. View showing arrangement of components.

The Conditions for Good Amplification.

The amplification of Morse signals is a far simpler problem than that of the amplification of speech frequencies, since it is not necessary to preserve the original wave form and harmonics of the rectified oscillations. Speech consists of a very wide band of frequencies, and hence it is obvious that the amplifier should give constant amplification over a very wide band, a condition which is not easily satisfied in practice. The conditions necessary for good amplification are briefly as follows :—

The instrument must give constant amplification at all frequencies at which it is to be used, and the available power in successive stages must increase. The valves must be employed in such a manner that linear amplification occurs. The last two conditions are easily fulfilled, as will be shown later.

THE FUNDAMENTAL CIRCUIT.

The amplifier described in this article has been specially designed for the amateur with limited means, and although the various components are made from "scrap" to reduce the expense, and the values adjusted by the method of trial and error, it is both necessary and instructive to consider very briefly how they should be determined accurately. In any case, it is necessary to form some rough idea of the correct values of the condensers and resistances even if they are finally adjusted by trial.

The fundamental circuit which is adopted in most resistance amplifiers is shown in Fig. 2, and the manner in which it operates has been explained many times, There are four quantities which have to be determined, viz., the values of R_1, C_1, R_2 and B_3. There must obviously be an optimum value for each, and these may be

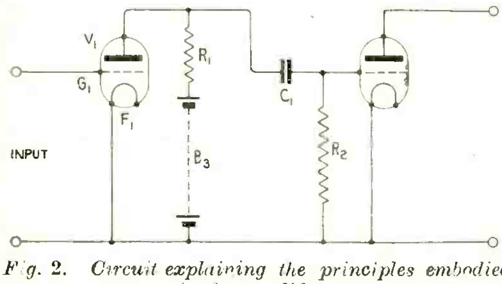


Fig. 2. Circuit explaining the principles embodied in the amplifier.

found by considering the effect of applying an alternating voltage at speech frequency to the input of the valve V_1. The first consideration is the value of the anode resistance R_1. The anode circuit of the valve V_1 contains the resistance R_1 and the battery B_3 shunted by C_1, R_2 and the capacity between the grid and filament of the valve V_2. The latter capacity is very small, and hence the impedance across R_1 and B_3 may be considered as infinite at speech frequencies. The anode circuit of the

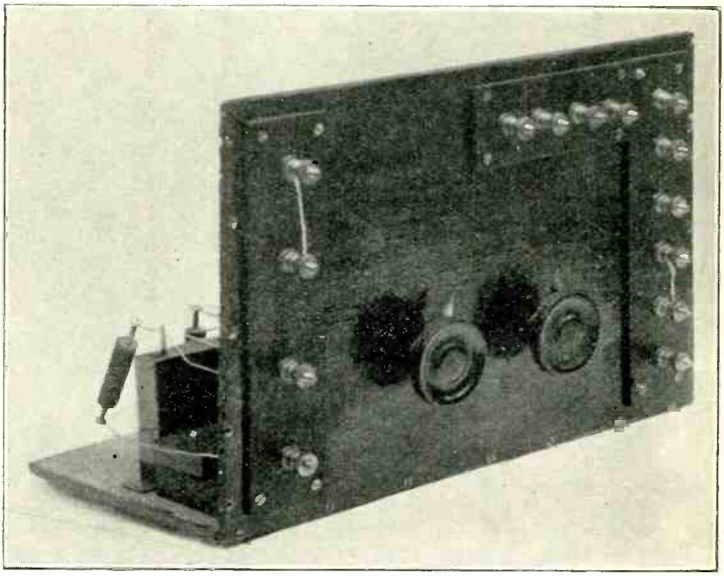


Fig. 3. Front view of panel.

valve V_1 may be considered as containing nothing but the resistance R_1 and the battery B_3. The resistance of the battery is only of the order of a few ohms in comparison with that of the resistance R_1, and hence it may be neglected. To obtain the greatest possible amplification the largest possible potentials must be passed on to the grid of the second valve. Now the value of the potentials will be dependent upon the value of the coupling resistance R_1, and hence it is necessary to make it of such a value that the maximum possible potential will be produced across it for a given input potential.

Thus, if an alternating voltage of E_g be applied to the grid of the first valve a voltage of vE_g will be produced in the anode circuit, where v is the voltage amplification factor of the valve. If the alternating current produced in the anode circuit be represented by I_a, and if the anode-filament resistance of the valve be represented by R_a, then, by Ohm's law

$$I_a = \frac{vE_g}{R_1 + R_a}$$

Then, assuming that there is no potential drop across the coupling condenser, the voltage applied to the grid of the second valve, G_2, will be

$$E_{g2} = I_a R_1$$
$$= \frac{vE_g R_1}{R_a + R_1}$$

from which $\frac{E_{g2}}{E_g} = \frac{vR_1}{R_a + R_1}$

This shows that the ratio of the grid voltages increases as R_1 increases, and becomes a maximum when R_a, the anode-filament resistance, may be neglected in comparison with R_1. This means that for maximum amplification the value of R_1 should be almost infinite, and

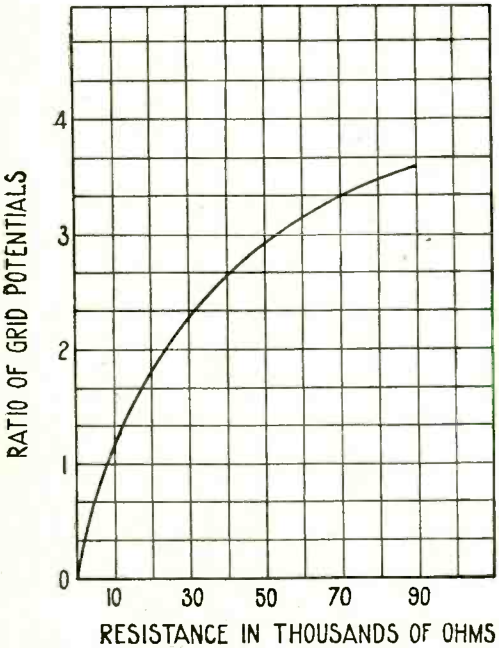


Fig. 4. The curve shows how the ratio of grid potentials between two successive resistance coupled valves, varies with increase in the value of the valve coupling resistance.

hence the voltage of the anode battery would have to be of the same order—an impossible condition. The inevitable result is naturally a compromise, and the best value may be found by plotting a curve representing the last equation. It takes the form shown in Fig. 4, and it will be seen that there is little to be gained by using a coupling resistance of a greater value than about 70,000 ohms, while in actual practice it is preferable to employ one of the order of about 50,000 ohms, as a very much lower voltage battery is then required. The values and the curve refer to an ordinary French " R " type valve.

THE COUPLING CONDENSER.

The value of the coupling condenser must next be determined. The reactance of the condenser must be very small in comparison with the grid-filament capacity of the valve and also the impedance must be comparatively negligible at all speech frequencies. The impedance of the grid-filament circuit, which consists of the inter-capacity between the electrodes shunted by the grid leak is in most cases of the order of about 500,000 ohms, and therefore at the lowest speech frequency the coupling condenser may have a reactance of about 60,000 ohms without substantially reducing the potentials applied to the grid. This value on calculation comes to about 0·2 mfd. However, there is another factor which must not be forgotten.

The larger the capacity of the coupling condensers the longer is the time required for them to discharge. If the capacity is made too large the amplifier is apt to become paralysed and in addition a rectifying action is liable to occur with the higher speech harmonics. It is also found that if the capacities are not identical or if one discharges before the others, surges are set up which produce a variety of effects. This defect can be easily obviated by making the condensers of equal capacity and altering the time constant of the circuits by varying the grid leaks as described later.

THE GRID LEAKS.

The value of the grid leaks are fairly critical as they have a double action. They serve to by-pass an accumulation of electrons on the grids, and at the same time they are made to control the steady potential on the grids. They should not be of too low value, as this reduces the impedance between the grid and filament, thus decreasing the effective values of the applied potentials. Speaking generally, they should be sufficiently low to prevent the grids from becoming temporarily charged.

THE ANODE BATTERY.

The voltage of the anode battery is determined by two factors—the correct working value for the particular valves in use and also upon the coupling resistances. Thus, if the anode potential were 60 volts, the potential of the anode battery would have to be increased by an amount equal to the potential drop across the coupling resistance. An amplifier which employs ordinary "R" type valves for the first one or two stages would need a battery of about 150 volts, which should be regulated to a suitable value by tappings. The particular amplifier under consideration is provided with an alternative supply for the anode circuit of the last valve in order to increase the available power.

The other components of the amplifier need no special mention, since they are quite normal, and they will be referred to in our next issue when the construction of the instrument will be dealt with.

(*To be concluded.*)

THE STORY OF WIRELESS

By J. J. HONAN, A.M.I.E.E.

This brief article relating to the development of Wireless Telegraphy lays stress on the process by which theory may clear the road for practical invention. It is not always the theorist who can grasp the importance of the phenomenom he is investigating for the purpose of applying it to advancement and progress.

THERE is no more interesting chapter in the long history of scientific achievement than that which records the discovery of ether waves and the manner in which they were finally brought to serve as a means for human intercourse across the barriers of space.

The mysterious nature of the medium involved, and the unusual methods and apparatus employed in the art of wireless, combine to clothe the subject with a fascination that is peculiarly its own. Throughout the story "speculation" is followed by "application," until one of the most elusive of Nature's resources has been brought under control. At the end, the reward of the theorist is but a place in the textbooks, whilst the "practical" inventor reaps both fame and wealth.

For many centuries before the birth of wireless, philosophers had taught the futility of belief in "action at a distance." They insisted that wherever an "effect" of any kind is separated by space from its "cause" the logical mind must seek for some connecting link between the two events.

Upon this basis of reason was built up the hypothesis of a luminiferous ether, an intangible all-pervading "fluid" which penetrates alike the outermost confines of stellar space and the minute interstices of all material objects. Heat and light from the sun and distant stars, travel through this medium in the form of alternate stresses and strains which may be likened to the ripples set up by a stone thrown into smooth water.

The early Greeks were well acquainted with the attractive forces exerted by static or "amber" electricity, and knew something also of the magnetic powers of the lodestone. At the beginning of last century Michael Faraday pointed out the existence of similar phenomena in the case of current or "moving" electricity. He discovered that when the electric fluid passed along a metal wire, the whole of the action was not confined to the metallic path. Some considerable part of the energy concerned spread outwards from the wire through adjacent "space," and, like the electrified amber and the magnet, making its presence felt at a distance.

All these manifestations involve "action at a distance," and therefore require the presence of a connecting link or medium by means of which the observed effects can be produced.

In 1865, Clerk Maxwell, by a brilliant mathematical generalisation, built up a theory which (*a*) identified the older luminiferous ether with the medium required to explain the static, magnetic, and Faraday effects; (*b*) established the fact that light and heat are simply forms of electro-magnetic energy, and (*c*) foreshadowed the existence of ether vibrations similar to those giving rise to optical and radiant heat sensations but of immensely greater wavelength. Clerk Maxwell's prophecy found its fulfilment at the hands of other men, but the first conception of wireless science is undoubtedly due to him.

Twenty-three years were to elapse before the German professor Heinrich Hertz succeeded in putting this theory to the proof. By discharging a Leyden jar through a spark-gap he produced oscillatory currents of such enormous frequency that they set up vibrations in the ether of the kind anticipated by Clerk Maxwell.

These electric disturbances travelled outwards from the "oscillator" in all directions through space. Hertz demonstrated this to be so by using a detector formed of a metal loop which he called a "ring resonator." The ether waves falling upon the distant resonator set up or "induced" electric currents which, in turn, caused minute electric sparks to pass across a small gap formed in the ring.

Here in actual fact was the first wireless transmitter and receiver. Unfortunately the range was limited to a few yards at most, so that the system was useless as a practical means of signalling.

Matters were left at this stage during a further period of eight years. In 1896 Marconi left his Italian home for England, bringing with him the grain of genius which was to fertilise so much dead weight of theory into practical activity. By the simple addition of an upright wire or "aerial" to the Hertz oscillator, and the provision of a similar device at the receiving end, he achieved success, and wireless communication was put upon a commercial footing.

Within three years of his invention of the elevated aerial, Marconi had increased the range of wireless signalling to a hundred miles. Two years later, at the end of 1901, the Atlantic had been bridged and telegraphic communication set up between Newfoundland and the village of Poldhu in Cornwall.

The young Italian's extraordinary faculty for extracting the essential marrow from theory and applying it to practical use is further exemplified in the means he utilised for detecting his wireless messages over these relatively enormous distances.

Some years before, in the year 1890, Professor Branley of Paris had discovered that sparks from a Hertz "oscillator" had the peculiar property of breaking down the air spaces between a mass of metal filings contained in a glass tube. Normally such an arrangement, if placed across the poles of a battery, would stop the passage of any current. In the presence of a Hertz "oscillator," however, the insulation was destroyed and a current passed, which could, of course, be used to operate a suitable indicator. Unfortunately, once the insulation had been so destroyed, the device was insensitive to further reception until the metal filings had been shaken up and re-arranged.

Marconi took the Branley "coherer," as this device was called, and amongst other improvements devised a "tapping" arrangement which automatically shook up the metal filings after the receipt of each signal, so that the coherer was kept in a constant condition of sensitivity.

From this stage the number of inventions relating to wireless is legion, but they belong rather to the technique than to the simple story of development.

One subsequent event which, more than any other, has served to bring wireless telephony to its present state of efficiency, was the discovery and development of the thermionic valve. The history of this device presents many points in parallel with that of wireless itself.

The fundamental principle upon which the action of the valve is based was investigated by Edison so long ago as 1883. It depends upon the fact that a glowing filament shoots off particles of electricity or "electrons," which can be collected so as to form an electric current. This current will flow through the vacuous space inside the valve in one direction only. It cannot be reversed.

Many years afterwards, in 1904, Professor Fleming seized upon this effect as a means of detecting or "rectifying" the signals conveyed by wireless waves. De Forest, four years later, introduced another element into the bulb and caused it not only to detect but also to amplify or strengthen the signals received.

Finally, the outstanding discovery of the principle of reaction or self-oscillation, which clothed the valve with supreme importance both as a generator of wireless waves and as a supersensitive receiver, did not occur until 1913, some thirty years after the date when Edison's original investigations first became known.

RADIO SOCIETY OF GT. BRITAIN.

The next of the series of lectures especially arranged for Associates will be given on Monday, May 14th, at 6.30 p.m., at the Institution of Electrical Engineers, when Mr. Percy W. Harris will talk on "Pitfalls for Beginners."

Wireless Club Reports.

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

The Radio Society of Highgate.*

"A single valve set without reaction is very little better than a crystal, and in many cases such a set is sheer waste of good juice." This was the spoken opinion of Mr. H. Andrewes, B.Sc., A.C.G.I., when he gave the fifth of a special series of lectures on wireless theory on Friday, April 27th.

Full particulars of the Society and a programme of forthcoming lectures may be obtained from the Hon. Sec., J. F. Stanley, B.Sc., A.C.G.I., F.R.A., 49, Cholmeley Park, Highgate, N.6.

Wireless and Experimental Association.*

A most successful demonstration was given at the Central Hall, Peckham, on Thursday, April 26th.

The exhibition of members' home-constructed apparatus fully proved the contention that this is an Experimental Association, and that the experimental licence is the only one which can suit the Society.

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

The Fulham and Putney Radio Society.*

At a well attended meeting on Friday, April 20th, Mr. Wyatt gave a very instructive lecture on "Inductance and Inductances." He illustrated his points by a considerable number of blackboard diagrams and explained most fully the various formulae used.

At the close of the meeting several of the visitors filled in membership application forms, a good sign of the progress of the Society.

Wimbledon Radio Society.*

At the Red Cross Hall, Church Road, on Thursday, April 26th, a successful demonstration of the reception of the special Broadcasting Concert from **2 LO** was given by Mr. J. A. Partridge, **2 KF.** An efficient aerial and earth system has now been installed and facilities for testing out apparatus of members and friends are now available. Application has been made for full transmitting and receiving permit. The Secretary is pleased to report that the Society is making steady progress, both as regards membership and the character of the meetings held. An attractive programme is in course of preparation, and the Hon. Sec., C. G. Stokes, 6, Worple Avenue, Wimbledon, S.W.19, welcomes applications for membership.

Tottenham Wireless Society.*

On April 25th the President of the Society, Professor A. M. Low, A.C.G.I., D.Sc., M.I.A.E., F.R.G.S., F.C.S., etc., gave a lecture on his recent invention the "Audiometer." This machine photographs sounds and enables measurements to be taken to determine their purity.

A demonstration of the Audiometer followed and many members were shown the wave forms of their own voices on a screen.

Meetings are held every Wednesday at the Institute, 10, Bruce Grove. New members will be welcomed, and should communicate with the Hon. Sec., S. J. Glyde, 137, Winchelsea Road, Tottenham, N.17.

North London Wireless Association.*

On April 23rd, Mr. F. S. Angel gave his seventh paper on "The Elementary Principles of Wireless."

After a brief outline of the valve, past and present, various curves were shown, giving the correct point for maximum results, also the means of retarding saturation point.

In closing his most interesting lecture, Mr. Angel added that he thought it would be a great benefit to users of valves, if the various makes were sold accompanied by their characteristic curve.

Full particulars of membership can be obtained from the Hon. Sec., J. C. Lane, Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.

The Leeds and District Amateur Wireless Society.*

The 33rd general meeting was held on April 20th, when Mr. H. F. Yardley, M.I.R.E., was elected a Vice-President of the Society. The headquarters of the Society have been transferred to the Woodhouse Lane United Methodist Church School, Leeds, where all future meetings will be held. After the business of the evening, Mr. T. Brown Thomson lectured upon "Detectors, Ancient and Modern."

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

Dewsbury and District Wireless Society.*

On Tuesday, April 17th, Mr. Townend (of Messrs. Burndept, Ltd., Leeds) gave a very interesting explanation of the Burndept "Ultra IV"—a "de-luxe" model four-valve receiving set—and the members were allowed to examine and take notes of the internal wiring and arrangements.

On the following Thursday Mr. F. Dransfield gave a lecture on "Tuning," and the "why and wherefore" of this necessary part of radio was explained in a very able manner.

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

Portsmouth and District Wireless Association.*

"The Construction of Cabinets for Wireless Apparatus" was the subject of a lecture on April 11th by Mr. R. J. Turner. He described teak, mahogany, walnut and well-seasoned oak as being the best woods for this purpose, and then explained the methods of joining, such as dovetailing, etc.

Of exceptional interest to beginners was a lecture given by Mr. A. G. Priest, on April 18th.

The lecturer described in detail the making of a crystal set.

Clubrooms: John Pile Memorial Rooms, Fratton Road, Portsmouth.

Hon. Sec., S. G. Hogg, 9, Pelham Road, Southsea.

Kensington Radio Society.*

"The History of Radiotelegraphy" was the title of a most interesting and instructive lecture given by Mr. G. G. Blake, A.M.I.E.E., on Thursday, April 12th. Several good analogies were given explaining the electron theory.

The Hon. Sec., J. Murchie, 2, Sterndale Road, W.14., will be pleased to forward particulars of the Society to anyone desirous of joining.

The Finchley and District Wireless Society.*

The Society gave a grand Dance on Saturday, April 7th, when about 100 people were present. One of the items, a fox trot, was danced to the wireless music received from **2 LO.**

Hon. Sec., A. E. Field, 28, Holmwood Gardens, Finchley, N.3.

Hackney and District Radio Society.*

At the weekly meeting on Thursday, April 19th, it was stated that visits were being arranged to a certain steamship in dock and to the Croydon Aerodrome, by the kind permission of the respective authorities.

Mr. O. S. Puckle then lectured on "Telephone Receivers," dividing his lecture into five sections, (1) Electromagnetic, (2) Electrostatic, (3) Electro-thermionic, (4) Piezzo Electric, (5) Mechanical. *Inter alia,* he referred to the Johnsen-Rahbeck loud speaker and to the invention of Mr Miller, the "Thermophone," of which he spoke in favourable terms.

After the lecture, a two-valve converted Mark III Tuner set was tested on the Society's aerial, and gave fine reception on a loud speaker.

Hon. Sec., C. C. Phillips, 247, Evering Road, Clapton, E.5. (Letters only.)

Ipswich and District Radio Society.*

On Monday, April 23rd, a sale and exchange of members' wireless apparatus was held, Mr. Page acting in the capacity of auctioneer.

A considerable variety of goods was on show, consisting of complete crystal sets, Morse keys, D.P. earthing switches, tuning inductance, microphones, telephone transformers, loading inductance, headphones, coils, resistance capacity units (fixed and variable), and also valves.

Much amusement was caused by several members, who, having bought goods, returned them to the Secretary to be raffled off, the proceeds going to the Club's fund.

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

The Clapham Park Wireless Society.*

This Society, whose members hail from Streatham Hill, Balham, Tooting, and even Kensington, in addition to Clapham, has a rapidly increasing number on its roll.

On April 11th, Mr. H. V. Hodgson continued his address on "Thorium," commenced on March 7th.

Mr. W. P. A. Emms reported that with the aid of the rudimentary crystal detector shown on March 7th, he had tuned in, from Crawley, the broadcasting stations of Glasgow, Manchester and Birmingham, and was now getting Cardiff, without valves.

The Society is seriously considering the present broadcasting position, and it is felt that some move should be made. Mr. J. G. Hurst has been requested to put his suggestions in writing before the Committee.

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

The Redhill and Reigate Radio Society.

On Thursday, April 19th, Mr. H. G. White, A.M.I.E.E., gave an interesting lecture on "An Experimenter's Ideal Unit System" to a large and attentive gathering of members.

Membership of this Society is increasing satisfactorily and all information as to subscriptions, etc., can be obtained from the Hon. Sec., Chas. W. Johnson, 111, Station Road, Redhill.

The Beckenham and District Radio Society.

As a good deal of comment of late has been centred on dual amplification circuits, one of the members, Mr. West, was asked to give a demonstration on April 19th. This he very successfully carried out and, with only one valve and crystal, broadcasting could be heard very clearly. With the addition of one note magnifier the volume of sound produced was equal to that produced by a good many four-valve sets.

The Radio Society of Bradford-on-Avon.

The inhabitants of the village of Broughton Gifford enjoyed a new experience on Friday evening last, when a few members of the above Society went there by request to give a demonstration of radio reception. A four-valve receiver was used (the property of the Society), also a Brown microphone amplifier and a Western Electric loud speaker, kindly loaned for the occasion by Messrs. Smith, of Union Passage, Bath.

The Children's Fund will benefit considerably from the entertainment.

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

Northampton and District Amateur Radio Society.

A general meeting was held on Monday, April 16th in the Exchange Assembly Rooms.

The resignation of the Hon. Treasurer, Mr. H. B. Howe, was accepted with regret, and Mr. H. A. Jeffery, of the Northampton Union Bank, was elected in his place. Two vacancies on the council were also filled by the election of Rev. J. Whittall and Mr. J. F. Cameron.

Suggestions were made and discussed in connection with the summer programme, and it was arranged that there should be one lecture each month except during August, until October 1st, and two outings each month except during August, which would take the form of picnics, etc., at which various experiments in radio work would be attempted.

The membership of the Society numbers 102.

Hon. Sec., S. H. Barber, College Street, Northampton.

Notes

Have You Heard Italian Telephony?

Daily gramophone selections are now being broadcast from the wireless station at Centocelle, near Rome, on a wavelength of 2,900 metres. The time of transmission is 7.10 p.m. to 7.40 p.m.

Rome on Two-Valve Flewelling Circuit.

Dr. Wortley Talbot, of "Elmington," Torquay, informs us that he has just heard Rome on his two-valve Flewelling circuit. A letter describing this gentleman's apparatus has been received, but lack of space has compelled us to hold this over till an early issue.

Duke of York's Wireless Set.

White Lodge, Richmond Park, the new residence of the Duke and Duchess of York, is to be fitted with a special valve receiving set embodying many interesting refinements.

Amateur Working with Amsterdam.

In a recent issue we reported the claim of Mr. Hugh N. Ryan (**5 BV**), of Wimbledon Park, that he had communicated with Amsterdam, using 0·01 amperes radiation, by wireless telephony. This was, of course, a mistake. Mr. Ryan was transmitting C.W. Morse.

Amateur Call Signs Reach the 6's.

If you should hear a station with a call sign beginning with 6, don't imagine you are listening to the Continent or America. **6 AA, 6 AB, 6 AW, 6 BQ** and **6 BX** are the latest call signs to be allotted to British amateurs.

British Amateurs Heard in Holland.

No fewer than thirty-five British amateurs have been heard by Mr. H. J. Jesse, Junr., of Rynsburgerweg 35, Leiden, Holland. His log for this year contains the following:—**2 AV, 2 AW, 2 DF, 2 DX, 2 FP, 2 FG, 2 IN, 2 JF, 2 JO, 2 JP, 2 JX, 2 JZ, 2 KF, 2 LZ, 2 MM, 2 NA, 2 NM, 2 OD, 2 OM, 2 ON, 2 RB, 2 RY, 2 SH, 2 SX, 2 TN, 2 VW, 2 YT, 5 BV, 5 CX, 5 HI, 5 IC, 5 KO, 5 MS, 5 NM** and **5 ZV.**

Good reception was accomplished in most cases with two valves (one L.F.) or three (two L.F.).

The Broadcasting Enquiry Committee.

The Committee appointed to consider the agreement between the Post Office and the B.B.C. has commenced its meetings, which are to be held twice a week at the General Post Office. Major Gen. Sir Frederick Sykes, M.P., is the Chairman of the Committee.

A list of the members of the Committee, with portraits, appeared in our last issue.

The South Coast Broadcasting Station.

Plymouth and Southampton are doomed to disappointment in the matter of broadcasting, for, according to the British Broadcasting Company, the new station for the South of England will be in neither of these towns. A site has been found where there is a minimum of shielding, but at the time of going to press the negotiations are not complete.

High Frequency Oscillations in 1840.

It may not be generally known that high frequency electrical oscillations were the subject of research as early as 1840. The first scientist to produce them was Joseph Henry, by means of the discharge of a condenser. Lord Kelvin called them "Transient Electric Currents," and in a paper on the subject, written in 1853, he deduced mathematically the conditions necessary for electrical oscillations in a circuit.

Wireless history is of absorbing interest, and no experimenter ought to be ignorant of the evolution of his hobby. A thorough survey of the development of radiotelegraphy from the earliest experiments until the present day is a feature of the *Year Book of Wireless Telegraphy and Telephony*, 1923 edition.

The Service Lunch Club.

An institution with the above name is being formed by the Service Company, Ltd. An endeavour is being made to attract persons interested in motoring, photography and sports, with a view to forming a rendezvous for "kindred spirits." It is expected that wireless enthusiasts will be well represented. The Club will be a business and professional man's organisation where members can have meals served quickly, comfortably and economically, and have use of a lounge, committee rooms, etc. Entrance fee, 10s.; annual subscription, 5s. Full particulars can be obtained from the Secretary, Mr. D. C. Lorkin, 273-274, High Holborn, W.C.1.

Sheffield University Assists B.B.C.

Last week we referred to the projected relay station at Sheffield for broadcasting London programmes. The University of Sheffield has undertaken to place its resources at the disposal of the British Broadcasting Company in order to facilitate the experiment, and it is hoped to have the station established in the course of a month or so.

Transmission from London will be by land line to the relay station, where it will be amplified, and broadcast by wireless. Satisfactory results should then be obtainable in the Sheffield area with crystal sets, which are at present of little use.

Awards to Wireless Operators.

The three Marconi operators of the s.s. *City of Valencia* have each been presented by the German Government and the Hamburg America line with a pair of Zeiss prism binoculars, suitably inscribed, as a mark of appreciation of the services rendered by wireless at the foundering of the Hamburg America liner *Hammonia.*

The *Hammonia* was lost off the Spanish coast in September last. In response to her distress call several ships, among which was the *City of Valencia*, hurried to her assistance, and the 800 passengers and crew were rescued.

The B.B.C.'s New Studio.

Said to be one of the best in the world, the new studio of the British Broadcasting Company, at 2, Savoy Hill, London, was opened on May 1st. Speeches were delivered by Lord Birkenhead, Lord Gainford and Sir William Bull, each of whom championed the cause of the B.B.C.

In referring to the situation which has arisen between the theatre managers and the Broadcasting Company, Lord Birkenhead said there were no differences which were not capable of adjustment. Sir William Bull, in a characteristic speech, remarked that the theatres could no more stop broadcasting than Mrs. Partington could sweep back the ocean. Lord Gainford once more stressed the point that the B.B.C. was a public utility service and not a profit-making concern.

The Band of H.M. Grenadier Guards gave a number of selections during the evening.

Five tons of canvas and wood served effectively to silence all echo in the studio, and the new microphones are stated to be extraordinarily sensitive.

Erratum.

We have been asked by Messrs. S. Lipowsky & Co., of 614, Old Ford Road, to draw attention to a mistake in their advertisement appearing in the April 21st issue of this journal. The price of the 4,000 ohm telephones should have been stated as 19s. 6d. per pair, not 17s. 6d.

The Institution of Electrical Engineers.

An ordinary meeting of the Institution will take place on Thursday, May 10th, at Savoy Place, Victoria Embankment, W.C.2, at 6 p.m., when Dr. J. A. Fleming, F.R.S., will deliver the Fourteenth Kelvin Lecture, entitled "Problems in Telephony, Solved and Unsolved." An interesting feature will be the presentation of the Faraday Medal to the Hon. Sir Charles A. Parsons.

Concert Artistes Meet B.B.C.

An important decision was arrived at on Sunday, May 6th, when the Concert Artistes' Association, meeting at St. George's Hall, Langham Place, W.1., discussed the subject of broadcasting in relation to the profession. The chair was taken by Mr. John Humphreys, supported by Sir Wm. Bull, M.P., and others. Several representatives of the B.B.C. were present, including Mr. J. C. W. Reith, General Manager.

The seriousness of the position was emphasised by members of the Association, several of whom spoke bitterly against the B.B.C., while the representatives of the latter urged the benefits conferred by broadcasting.

Finally, unanimous assent was given to a proposal of Mr. Joe Pearson, the song writer, who suggested that new contracts between artistes and the B.B.C. might be submitted to a committee of the Association, giving them an opportunity of considering such essential points as the terms of engagement and the fees to be paid.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—May I beg the hospitality of your columns to correct briefly one or two of the points on which your correspondent Mr. J. G. Lucas seems uninstructed ?

Firstly, your correspondent would appear to have been unfortunate in the types of rectifier he has selected for trial, as a good modern electrolytic rectifier is no more messy and requires no more attention than the accumulator it charges.

Secondly, the cost of replacing a Tungar bulb is, I understand, £4 10s. for the 5 amp. type, and this is, I find, not guaranteed as I had supposed but an *allowance* is made *should it not last* 600 *hours.*

Accepting this figure, the cost is $\frac{1}{8}$d. per hour for the bulb only. As 10 hours will be needed at the 5 amp. rate, I regret I am unable to revise my conservative estimate of 1s. 6d. per charge.

Mr. Lucas states the "chances are" that the life of the bulb is "likely to be much longer." I am dealing with guaranteed facts, not estimated "chances."

Thirdly, I regret my statements re efficiency are not perfectly clear to Mr. Lucas.

One wave (that is one half cycle) in say the negative direction is suppressed or rejected, in other words the apparatus fails to use it, wattless or not.

On Mr. Lucas' reasoning, if neither wave (or the whole cycle) were used the efficiency would be 100 per cent, but the cells would, I am afraid, remain unchanged.

My figures giving the efficiency were taken by me from an article on the Tungar rectifier (*Wireless World and Radio Review*, January 20th, 1923), by Mr. Rushton, under the direction of Professor Mather.

Mr. Lucas states he attains an efficiency of 40 per cent. presumably to be quite fair under the conditions we are discussing, but he will, I am sure, pardon me for preferring to accept the efficiency given by Professor Mather of about 29 per cent. as authoritative.

MORTIMER A. CODD.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I read with interest Mr. J. G. Lucas' letter on charging accumulators from A.C. mains with Tungar rectifier.

Perhaps it might be of interest to give my experience with the Zenith Magnetic Rectifier (vibrating reed) which I have had in constant use for two years.

It charges an 8 volt 22 amp. actual accumulator, taking just under half a unit. It charges a 6 volt 33 amp. actual, taking just a shade over the half unit from the main. This, with our local supply A.C. at 6d. per unit, averages 3d. per charge. The contacts are in perfect condition, and have never received attention.

I put a 2 microfarad Mansbridge condenser across the contacts, and the sparking is practically nil, and it charges very comfortably at 4 amps., whilst as to noise, the hiss of the gas from the accumulator is as loud as the noise of the reed working, which shows its quiet working.

An occasional adjustment of the reed, whilst charging, say about every three hours, is all that is required to stop any sparking, and then only a fraction of a turn of the adjusting screw.

The whole thing is very simple, and requires no skill to operate.

I am not interested in the Zenith rectifier in any way, except that it has given me very satisfactory service, and it may be of interest to your readers.

W. A. PELLY.

Radio Society of Great Britain.

The May lecture, to be delivered before the Society by Prof. E. W. Marchant, D.Sc., will be entitled: "The Methods of Preventing Interference in Wireless Receiving Sets." The date of the lecture will be announced later.

An Ordinary General Meeting of the Society was held on Wednesday, April 25th, at 6 p.m., at the Institute of Electrical Engineers.

As it was anticipated that the paper would be a long one, the **President** postponed the reading of the minutes until the next meeting, and called upon Mr. G. G. Blake to give his lecture entitled "Some Historical Notes on Wireless Telegraphy." A number of most interesting exhibits of historical interest were on view.

At the conclusion of the lecture (for report see future issue of this journal) a vote of thanks was proposed by **Mr. A. A. Campbell Swinton**, who commented on the large amount of work that had been put into the collection of so much material by the author, and referred to Dr. J. A. Fleming's "Fifty Years of Electricity" as being probably the only other account which contained anything like this amount of information.

The vote of thanks was seconded by **Mr. C. F. Phillips**, who also paid a tribute to the amount of work associated with the preparation of the lecture, and only regretted that the lecturer had not continued his observations so as to deal also with the early discoveries connected with the thermionic valve.

It was announced by **the President** that the following members and associate members had been elected:—

Members: Arthur Hoare, Harold F. Cook, Brian G. E. Haywood, C. K. Murrey, Edward Mackie, L. F. Hunter, D. K. Morris, D. G. Scott, John Salter, A. W. Nicklin, Major R. Creyke, F. H. Hobday, J. W. B. Barkwith, J. W. F. Cardell, W. Engelke, C. H. E. Ridpath.

Associate Members: Edward Gillett, W. E. Beard, L. T. Bridgman.

The following Societies were also accepted for affiliation:—

Ingatestone and District Radio Society, Leyton Radio Association, Sydenham and Forest Hill Radio Society, Social and Athletic Club (J. & E. Hill, Ltd.), Dartford, The Grays and District Radio Society, County of London Electric Supply Co., Ltd., Radio Society, Felixstowe and District Radio Society, Berwick-upon-Tweed Wireless Society, The Working Men's College Wireless Society, Burndept Radio Society, Evesham and District Radio Society, Aquarius Radio Society, Vauxhall Metro. Radio Society, Hall Green Radio Society.

The meeting adjourned at 7.30 p.m.

Books, Catalogues, etc., Received.

Comment Recevoir la Téléphonie Sans Fil. By J. Roussel, General Secretary of the Société d'étude de Télégraphie et de Téléphonie sans fil. (Paris: Librairie Vuibert, Boulevard Saint-Germain, 63 pp. 272, with 126 figures. Price 6 francs).

"101 Receiving Circuits." By M. B. Sleeper. (New York City: M. B. Sleeper, Inc., 88, Park Place. Pp. 48. Price Fifty Cents.)

Messrs. Rogers, Foster & Howell, Ltd., have issued a descriptive list of their latest radio instruments, which are conveniently arranged in three classes, according to range and selectivity. Copies can be obtained from the Company at Balsall Heath, Birmingham.

Two leaflets have been issued by Messrs. A. H. Hunt, Ltd., describing the H.A.H. Wander Plug, Valve Protector and Battery Tester, and the H.A.H. Variable Grid Leak. Their address is Tunstall Road, Croydon, Surrey.

Forthcoming Events

FORTHCOMING EVENTS.

FRIDAY, MAY 11th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Dept. of Applied Science, St. George's Square. Practical Demonstration.

Leeds and District Amateur Wireless Society. At 7 p.m. "Aerials: Outdoor, Indoor and Loops," by Mr. A. M. Bage (President).

Bath Radio Club. At 8 p.m. At the Red House, Bath. Smoking Concert (including "Gadgets" Competition and "Radio Auction."

Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove. Lecture: "The Construction of Amplifiers," by Mr. C. A. V. Sowter.

Belvedere and District Radio and Scientific Society. Lecture: "Electric Railways" (Illustrated), by Mr. R. G. Herschell.

MONDAY, MAY 14th.

Ipswich and District Wireless Society. At 8 p.m. At 55, Fonnereau Road. Lecture by Mr. W. Butters.

The North London Wireless Association. At the Northern Polytechnic Institute (Physics Theatre), Holloway Road, N. Lecture: "Elementary Principles, Part VIII," by Mr. F. S. Angel.

TUESDAY, MAY 15th.

Plymouth Wireless and Scientific Society. At 8 p.m. Lecture: "Magnetism," by Mr. Monk.

THURSDAY, MAY 17th.

Ilford and District Radio Society. Lecture: "Ebonite," by Mr. A. P. Welch.

Redhill and Reigate Radio Society. At 8 p.m. Lecture: "Loud Speakers," by Mr. Pope.

Derby Wireless Club. At 7.30 p.m. At the Shaftesbury Restaurant. Lecture: "Radio Gadgets," by Mr. F. J. Cowlishaw.

"Blind Spots" and "Fading of Signals"

INVESTIGATION TO BE UNDERTAKEN BY THE RADIO RESEARCH BOARD WITH THE CO-OPERATION OF AMATEUR STATIONS.

AT their last meeting the Radio Research Board recommended that an investigation should be undertaken into the occurrence of "blind spots" and "fading of signals" observed in connection with broadcasting and other transmitting stations, and it was suggested that observations on these points by amateurs might be invited through the Radio Society of Great Britain.

Accordingly, a letter was sent informing the Society that a conference was held on April 10th, at which were present Admiral of the Fleet Sir Henry Jackson, Dr. Eccles (President of the Radio Society of Great Britain), Professor Howe, Mr. Campbell Swinton (Chairman of the Commission of the U.R.S.I. dealing with amateur co-operation in research), and Dr. Rayner (Chairman of Sub-Committee A of the Radio Research Board). It was agreed that copies of a memorandum setting out the manner in which observations should be made, should be forwarded to the Secretary of the Radio Society of Great Britain, with the request that he would be good enough to circulate copies to members and to the Secretaries of affiliated societies with an invitation to the latter to forward to the Secretary of the Radio Research Board the names of six to ten of their members who would be willing to carry out observations as suggested in the memorandum on behalf of the board. The Conference requested that the Secretaries of Societies should be asked to select as far as possible members widely scattered over the district from which the particular Society drew its members. It also was further agreed that no useful results could be expected from observing stations situated within five miles of a broadcasting station.

The memorandum upon the subject states that the Radio Research Board are of opinion that an enquiry into the cause of reported fading of signals during broadcasting and to irregularity in the strength of signals in different localities, not attributable to the distance of the receiving from the transmitting stations, should be undertaken. In order to carry out this satisfactorily a considerable number of receiving stations in different localities in the country are necessary, and systematic reports from those stations willing to co-operate should be obtained stating accurately the time and local weather conditions, and indicating that the irregularity cannot in any way be attributable to faulty working of the receiver employed.

These reports should be forwarded monthly on the first of each month, addressed to—

The Secretary,
Department of Scientific and Industrial Research,
(For Radio Research Board),
16, Old Queen Street,
London, S.W.1.
(If so addressed, no postage stamp is necessary.)

Reports will be analysed and compared by the appropriate Sub-Committee of the Board, and brief abstracts of the results will be forwarded from time to time to those taking part in the investigation, or the results will be published in the Scientific Press.

The particulars required to be filled up on the form are as follows, and pads of forms will be forwarded to any one ready to take part in the work, who employs a valve receiving set.

The form to be issued by the Radio Research Board calls for the following information :—

Name.
Address.
Any special qualifications of the observer.
Local surroundings of station.
 Town, Country, Hill, Valley, etc.
If situated near any large metallic masses, trees, buildings, etc., the distance from them to be stated.
Receiving apparatus. Brief description.
(The above information need not be repeated after the first report unless any change is made in it.)

TABLE FOR RECORDING OBSERVATIONS.

1	2	3	4	5	6	7
Date.	Standard Time.	Station Transmitting.	Wave-length.	Type of Emission.	Signal Strength at time indicated.	Remarks.

The Time recorded in Column 2 should be standard time at various periods in the year, *i.e.*, G.M.T. in winter and British Summer Time when this is introduced.

Type of emission, Column 5, is C.W., Spark or Speech.

In order to indicate a fading effect three or more observations should be made. The times at which the signals were last heard to be of normal strength should be given in Column 2 and their strength in Column 6. The strength at various intervals during the period in which the fading effects were observed should then be given with their corresponding times, and if possible the time at which the strength became normal again. In the remarks column should be recorded the weather conditions, strength of atmospherics, and whether the bearing of the transmitting station, if observed, varied during the fading period, whether changes in the adjustment of the receiving apparatus were made in the period. If accumulators or batteries were changed this should be recorded, and, in short, any indication that the fading might be traced to the instruments in use, or whether the phenomenon could be accounted for by any local occurrence.

The strength of signals should be recorded according to the following scale :—

0. Inaudible.
1. Just audible.
2. Very faint, unreadable (speech indistinguishable).
3. Just readable (in speech words just distinguishable).
4. Faint.
5. Rather faint.
6. Fair.
7. Good.
8. Strong.
9. Very strong.

Accurate recording of signal strength will, it is hoped, be of considerable assistance in locating districts in which signals are abnormally strong or weak from particular stations.

BROADCASTING.

GREAT BRITAIN.

Regular evening programmes, details of which appear in the daily Press, are now conducted from the following stations of the British Broadcasting Company :—

London	**2 LO**	369 metres.
Birmingham	**5 IT**	420 ,,
Manchester	**2 ZY**	385 ,,
Newcastle	**5 NO**	400 ,,
Cardiff	**5 WA**	353 ,,
Glasgow	**5 SC**	415 ,,

FRANCE.

Eiffel Tower. 2,600 metres. 12.15 a.m. weather reports (duration 10 mins.) 7.20 p.m., weather reports and concert (duration about 30 mins.) 11.10 p.m., weather reports (duration 10 mins.).

Radiola Concerts. 1,780 metres, 6.5 p.m. news ; 6.15 p.m. concert till 7 p.m. ; 9.45 p.m. news ; 10 p.m., concert till 11 p.m.

L'Ecole Supérieure des Postes, Télégraphes et Téléphones de Paris. 450 metres. Tuesdays and Thursdays, 8.45 p.m. to 11 p.m. Saturdays, 5.30 p.m. to 8.30 p.m.

Lyons (YN). 3,100 metres, 1·5 kW. 11.45 a.m. to 12.15 p.m. daily (Sundays excepted). Gramophone records.

BELGIUM.

Brussels (BAV). 1,300 metres, 1 kW. Sunday, Tuesday and Thursday, 6 p.m.

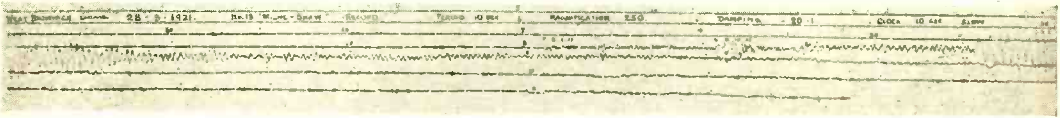
HOLLAND.

PCGG. The Hague, 1,050 metres, Sunday : 4 to 6.40 p.m., Concert. Monday and Thursday : 9.40 to 10.40 p.m., Concert. (Monday concerts are sometimes given on 1,300 metres, notice of this being given on the previous Sunday.)

WIRELESS ASSISTS THE STUDY OF EARTHQUAKES.

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

This article deals with the methods by which earthquakes are recorded and coded for rapid circulation by wireless. A description is given of the equipment used for observing and locating earthquakes and the manner in which the recorded data is embodied in the reports sent out by the Eiffel Tower and other transmitting stations.



A record as made by the Seismograph. The paper is carried on a drum and the lines which terminate on the right-hand side are recommenced on the left. The point marked 8.1.3, *referred to on page* 191 *can be discerned near the centre of the record and represents the time of inception of the first wave.*

THE amateur will have seen from the *Year-Book* that the Eiffel Tower and Bordeaux occasionally transmit news relating to earthquakes and other smaller tremors of the earth known as micro-seismic disturbances. The causes of these disturbances, even if fully known, will not form the chief consideration in the present article. Rather shall we confine ourselves to such explanation of earthquake phenomena as will help to make these coded telegrams more intelligible.

As a matter of fact, we know very little concerning the interior of our earth and its composition and temperature, and our present knowledge of the interior has been largely gathered from the systematic study of earthquakes. Thus we are led to believe that there is an outer shell or rocky crust extending downwards to a depth of about fifty miles. Below this is a metallic core of very different composition. Earthquakes are supposed to originate somewhere between 200 and 300 kilometres below the surface. Starting from the origin or focus, the tremors due to the quake spread out in the form of elastic waves. Some of those travel *through* the earth either as longitudinal compressional waves or as transverse mass vibrations. These are the primary and secondary waves referred to in the radiotelegrams as P and S waves respectively. They are of first importance in enabling us to tell the distance away of the focus. Other waves known as PR (primary reflected) and SR (secondary reflected), PR_1 and SR_1, etc., do not come direct but are the waves reflected from positions midway (or one third, etc.) of the distance on the surface between the epicentre and the observing station.

The quake is most severely felt at the *epicentre* or point on the surface immediately above the focus as in Fig. 1. This is the region of wholesale havoc and destruction to life and property in the case of severe earthquakes. For example, let us take the great Chinese earthquake of December 16th, 1920. The estimated loss of life is given as 40,000 which is a comparatively small figure for a shock of this magnitude. The area disturbed as a result of the quake, covered roughly three million square miles, that is an area almost equal in size to Europe. This does not mean to say that in the outer regions far removed from the epicentre, the feeling of disturbance or movement of the ground was experienced as something sensible to human feelings. The modern seismograph designed to register minute earth tremors is many times more sensitive than the human body.

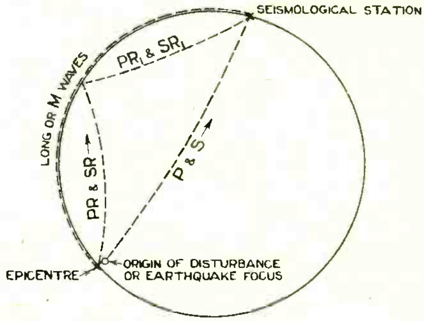
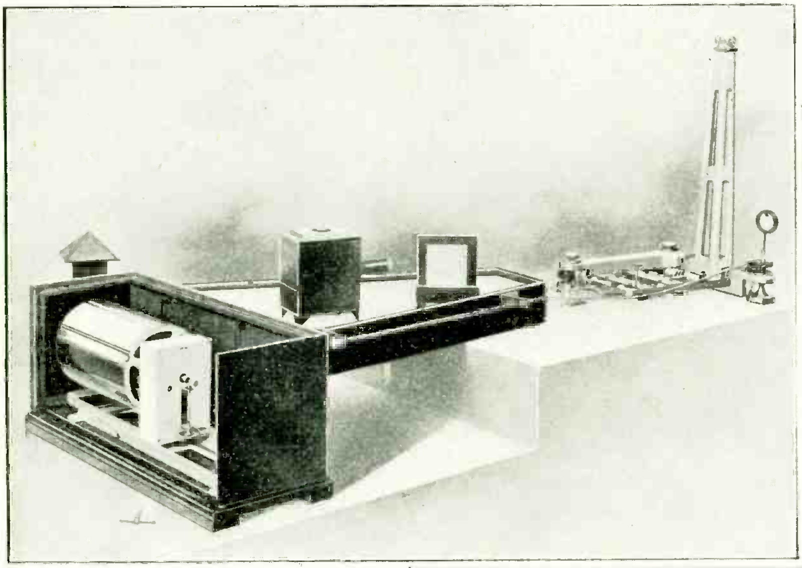
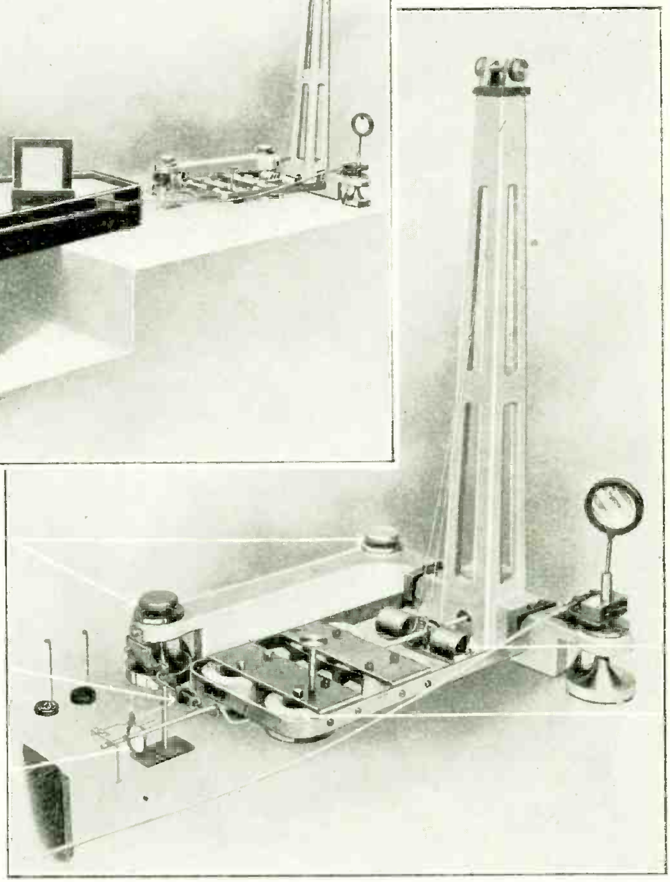


Fig. 1. *Diagram showing wave motion through the earth.*

Recently I had the privilege of visiting Mr. J. J. Shaw's seismological station at West Bromwich, and it is by the courtesy of Mr. Shaw that I am able to reproduce photographs of the actual instruments he is making for detecting minute earth movements. They are sometimes called micro-seisms, although their connection with earthquakes is not yet fully established. The instruments are known as seismographs and the records obtained, seismograms. As to the sensitivity of the Milne-Shaw instrument, it is sufficient to put one's weight against the wall of the cellar where the apparatus is housed to cause a " swaying " of the recording pen and incidentally the ringing of an alarm bell. I would venture to go so far as saying that Mr. Shaw's station is burglar proof! People walking about upstairs cause sufficient " rocking " of the house for the sway to be registered by the seismograph down in the cellar. Normally, of course, the contacts of the alarm are opened out so that every minute disturbance does not start the alarm ringing. But it is surprising how ones ideas of a *solid* earth are changed after a little acquaintance with a seismograph. A fall of rain or a heavy wind, clouds screening the heating rays of the sun, the vibration due to passing football crowds, are all duly registered by the instruments at West Bromwich.



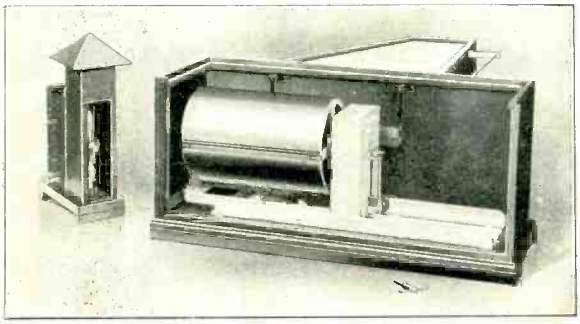
This photograph shows the details of the clock (right of cylinder) and revolving drum. The drum is covered with sensitised photographic paper and the record made by a point of light.



Details of the seismograph, showing method of suspension of the steady point (A), horse-shoe magnet (B), damping device (C), mirror (D) which reflects light beam on to recorder.

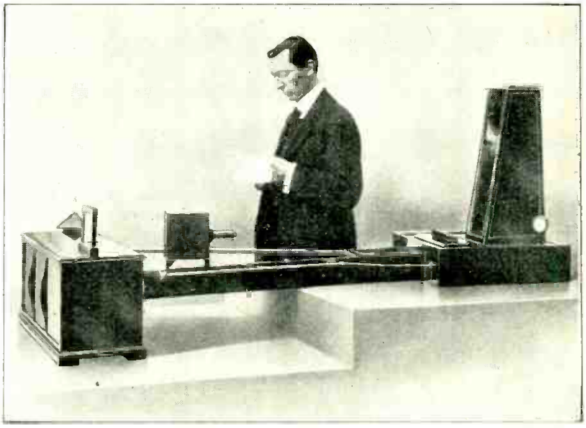
I shall now describe, very briefly, the instrument itself. The essential thing is to get a steady point, that is, something that will remain steady while the earth, in supporting the apparatus, trembles beneath it. Turning to the illustration of the Shaw-Milne Seismograph, the steady point (A) is a mass weighing 1 kilogram, supported by fine wires from the upright pillar which is itself out of the true vertical. The steady point is affixed to the horizontal pendulum, one end of which is free (the nearer end) and the other pointed end rests in an agate cup at the lower end of the pillar. The tilt of the pillar and consequently the period of vibration of the horizontal pendulum can be altered by means of the thumb screws (E). (C) is a small solenoid for adjusting the damping which in the Shaw-Milne instrument is 20:1. The free end of the pendulum, or end furthest from the pillar, is made of very light aluminium rod. A source of light emanating from a small oil lantern strikes the mirror (D) which reflects the beam, through a narrow slit in the recording box, and finally on to the revolving drum. This mirror (D) stands on the same concrete base on which the instrument rests. A typical record is illustrated through the kindness of Mr. Shaw, and it shows how remarkably fine and clear the trace made by the moving spot of light really is.

In localising earthquakes, two phases are utilised, namely (1) P, the very first disturbance of the trace which comes as a direct blow through the earth, and (2) S, which also comes through the earth but is in the nature of a shake and therefore travels less rapidly.



A clearer view of the revolving drum and clock. The lamp can be seen on the left.

It is thus possible for a single station equipped with two seismographs, one with a north-south pendulum and the other seismograph having its pendulum east-west, to record the direction as well as the distance away of a quake.



Mr. J. J. Shaw, Director of the West Bromwich Seismological Station with his latest form of Seismograph. These instruments are now installed in many different parts of the Empire.

The instant taken for the time of arrival of P is the *inception* of the first wave or the point where the trace departs from the normal sine curve. This is marked in the record 8.1.3. Thus in utilising a record, great importance is attached to the beginning of P, as well, of course, as to the timing of the record. For this latter calibration the light spot is interrupted every minute, as will be seen in the record, from a master clock checked by the Paris Time Signals. Between P and S come the reflected waves PR; these are not very clearly marked on the particular record illustrated. The S waves which follow next are easy enough to distinguish from the P waves; the only difficulty is to give precision to the junction of P and S. Following closely after S are the SR waves. These primary waves travel through the earth at a speed roughly equal to twelve kilometres a second, while the secondary come at eight kilometres a second. Further along still come the long waves or L waves. These are propagated as surface waves along the arc joining the origin to the observatory and with a probable velocity of four kilometres a second.

It will thus be seen that from the moment of inception of P until all the waves die out, the spot of light is never still. As I have already pointed out, the difference in time of the arrival of P and S (*i.e.*, S—P) is the all-important element for the seismologist, for this gives the distance away of the shock.

Let us take a further example to make this clear. The primary waves of the great shock of 1920 already mentioned, arrived at the Zi-Ka-Wei Observatory (China) at 12h. 9min. 16sec., and the secondary at 12h. 11min. 45 sec., which gave the distance of the epicentre from Zi-Ka-Wei as about 1,400 kilometres. Two minutes later, one of the recording levers dismounted, and after 3½ minutes more the other passed off the recording paper and was thrown out of action. Hence the desirability of arranging for an audible signal when the recorded waves reach a certain amplitude.

Details of seismological reports transmitted by the Eiffel Tower FL.

(*a*) These reports give information concerning earthquake disturbances registered by the instruments at the Geophysical Observatory at Strasbourg or communicated thereto by co-operating observatories at Algiers, Athens, Barcelona, Brussels, Coimbra, Oxford, Paris, Rome, Zurich and Wei-Hai-Wei.

(*b*) *Times of Transmission.*—The messages are sent *when necessary*, either (1) at the end of the 1920 G.M.T. synoptic weather report on a 7,300 metres continuous wave or (2) at the end of the 1005 G.M.T. International Collective Weather Report on a wavelength of 2,600 metres spark.

(*c*) *Form of Messages.*—The messages may take one of three forms according to whether they refer to (*a*) micro-seismic disturbances (*i.e.*, those small disturbances recorded by the seismographs which may be due to the passage of depressions over the land or to the conflict of waves beating against the cliffs, or possibly a combination of the two causes), or (*b*) earthquakes.

(1) The reports are preceded by the words "Sismo Strasbourg," followed by a message *en clair* (French) giving details of quakes of feeble intensity.

Example.—"Sismo Strasbourg, le 28 mai, longues ondes vers 20h. 12m., maximum N.S., 20h. 26m. Séisme lointain 21h. 05m. 46sec., max. 21h. 44m."

(2) The message frequently contains in addition particulars of micro-seismic disturbances.

Example.—"Sismo Strasbourg du 6 or 7 juin, agitation croît légèrement."

(3) Important earthquake news is sent in the following code :—

ddaap phhmm ssttt D_1D_1DDD

Where—

dd = day of month.

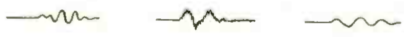
aa = azimuth of epicentre from 10° to 10°, counting from N. through E. (01-36), based on any *clear* indications of the trace.
The addition of 50 (51-86) indicates that the azimuth is uncertain by 180°.
The figures 91-98 indicate that the direction is vague and estimated only to the nearest 45°; 99 indicates that no azimuth determination has yet been made; 00 that it seems impossible.

pp refer to phases P (primary) and S (secondary). The first (1—4) concerns P and the second (5—8) S in accordance with the table below; the figure 9 for either

Phase P.	Code number	1	2	3	4
	Meaning ..	iP	P and $\bar{P}$ clear	P	eP = beginning badly defined on trace.
Phase S.	Code number	5	6	7	8
	Meaning ..	iS	S clear	eS = beginning badly defined on trace.	uncertain

P or S indicates that the minutes signal has interfered with the beginning of the wave (the pen which makes the trace on the recording ribbon is out of contact at this instant).

Fig. 2 will best explain the significance of iP and eP. For disturbances near at hand, when the epicentre is less than 700 km.



(a) (b) (c)

(a) Coded as P. (b) Coded as iP. (c) Coded as eP.

Fig. 2. Typical records showing how they are coded.

distant, waves represented by the symbol $\bar{P}$ are noted.

hh mm ss — are hours, minutes and seconds G.M.T. of the beginning of P (*i.e.*, the inception of P).

ttt — is the difference in seconds of the times of arrival of the S and P waves, i.e., S—P in sec.

D_1D_1 — gives the difference $\bar{P}$—P in seconds for close earthquakes; if this difference is not clear D_1D_1 is replaced by code figures 99.

DDD — is the distance in kilometres for close quakes.

D_1D_1DDD — is the distance in kilometres for distant quakes.

The region of the epicentre is given *en clair* whenever possible, and also an indication of the intensity of the disturbance.

Examples.—20991 50051 33393 04830 Turkestan.

Translation.—Disturbance on the 20th of the month, azimuth of epicentre not yet determined; P waves clear; S waves clear; inception of both P and S waves clear; begining of quake noted as 0h. 51m. 33s.; difference S—P = 393 sec.; distance away 4,830 km.; epicentre Turkestan.

Reports Transmitted by Bordeaux LY.

Important earthquake news, class 3 above, is broadcast by this station at the conclusion of the scientific time signals at 2000 G.M.T. on a wave of 23,450 metres (c.w.). These messages are coded as above.

The rapid means of communication afforded by wireless is therefore seldom seriously needed for locating the epicentre of an earthquake. We have already seen that a *single* well-equipped station is able to do this fairly accurately. It may easily happen, however, that the records of a single station may be indistinct or unreliable. Much depends upon the precision with which the beginning of P and S can be noted. Uncertainty sometimes arises in the case of a single station making a location, by the bearing being in either direction along a straight line, *e.g.*, either N.W. or S.E. A similar difficulty arises in the case of a frame aerial. If on the other hand it is known that P arrives earlier at Strasbourg than at Oxford, this difficulty is overcome.

Public interest is always aroused when a severe earthquake shock is reported, and owing to the breakage of wires and cables news from the devastated area is only slow in coming in. Accurate location is therefore of first-rate importance.

(For further reading on this subject, the reader is referred to "A Manual of Seismology," by Charles Davison, Sc.D. Cambridge University Press. 21s.)

Classified Broadcast Receivers.

Realising the difficulties of choice which beset the prospective purchaser, Messrs. Rogers, Foster & Howell, Ltd., of Balsall Heath, Birmingham, have divided their sets into classes "A," "B" and "C." Class "A" includes sets for use within a few miles of a broadcasting station, Class "B" are more expensive receivers for use at greater distances, and Class "C" embraces a superfine range of instruments. Details of all these sets, from a simple crystal receiver to an elaborate 100 guinea cabinet installation, are admirably presented in the firm's latest catalogue, a copy of which we have received.

Transatlantic Telephony ?

In our issue of April 14th we reported that Messrs. R. W. Galpin (5 NF), of Herne Bay, had heard a very clear transmission of a somewhat frivolous nature on 380 metres during the early morning of March 25th, and was anxious to know whether this was of American origin. On consulting his log, Mr. C. H. Targett, of 21, High Street, Dartford, has found the following entry:—"25th March, 0355-0420 hrs., wavelength about 390 metres—Two very good musical items. Strength (H.F. and D.) R5." Does this agree with Mr. Galpin's experience ?

French Amateur Station 8 AE.

With reference to the note which appeared on page 25 of the issue of April 7th, in the text it should have been stated that numerous tests "are to be made" instead of "are being made," since we are advised that the station has not yet commenced operations.

The station has allotted to it the call sign 8 AE and 8 AÉ (. . - . .), and it is probable that the former call will be used for foreign transmissions, and the latter for transmissions in France.

D

Questions and Answers

"AMATEUR" (Cambridge) *asks for a diagram of a two-valve receiver using one high frequency transformer coupled to a detector valve. (2) What would be suitable condenser values.*

(1) and (2) A suitable diagram is given in Fig. 1, and values are indicated in the figure.

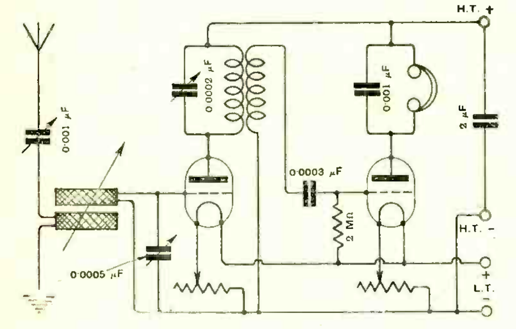


Fig. 1. **"Amateur" (Cambridge).** *Diagram of a two-valve receiver. The first valve is coupled to the rectifier through a high-frequency transformer. The circuit is quite satisfactory for the reception of broadcast transmissions.*

"E.G.H." (Stoke-on-Trent) *refers to the diagram given in reply to* **"E.R.W." (E.9),** *page 607, August 5th issue, and asks (1) Is a loose coupler intended to be used with this receiver. (2) What would be suitable values for the condensers. (3) For a diagram showing how switches may be employed to cut out the low frequency connected valves when required. (4) What would be suitable dimensions for the reaction coil.*

We would refer you to Fig. 6, April 21st issue. Suitable condenser values are indicated. The receiver is coupled with a loose coupler, the one which you have being suitable. (4) The reaction coil may consist of 100 turns of No. 36 S.S.C. wire. If the plug-in type high frequency transformer is used, the reaction coil may conveniently be constructed of a piece of circular ebonite 2″ in diameter and about ¼″ thick, with a groove 1/16″ wide and ⅛″ deep. The reaction coil should be constructed so that it swings over the surface of the high frequency transformers.

"EAST BOLDON" (Newcastle) *asks (1) For a diagram of three-valve receiver which he will be able to construct from a three-valve amplifier purchased. (2) Would a combination of one detector and two L.F. valves be better than one high frequency, one detector, and one L.F. valves. (3) Which is considered better, to use high resistance, or low resistance telephones. (4) Could a crystal receiver be used in conjunction with the three-valve set.*

(1) A suitable diagram is given in Fig. 2. The first valve operates as a high frequency amplifier. Across the anode circuit is a crystal and transformer. The crystal rectifies the signal which is amplified in the second and third valve circuits which operate as low frequency amplifiers. The aerial coil could be a winding 4″ in diameter and 4″ long of No. 20 double cotton-covered wire. The anode coil could be a winding 4″ in diameter and 4″ long of No. 30 double silk-covered wire. Twelve tappings should be taken from each of the windings. Suitable condenser values are given. (2) The combination of one detector and two L.F. valves will give very strong signals when you are receiving from the local broadcast station, but the signals would be very weak when receiving the transmissions of other stations; therefore we have suggested the use of one high frequency connected valve, crystal detector, and two note magnifiers. (3) We suggest the use of low resistance telephones in conjunction with a telephone transformer. When high resistance telephones are connected directly in the anode circuit of the last note magnifying valve, the anode current flows in the telephone winding, and there is always the danger that the insulation of the windings may be destroyed or the windings may burn out, due to the anode current. When a telephone transformer is used,

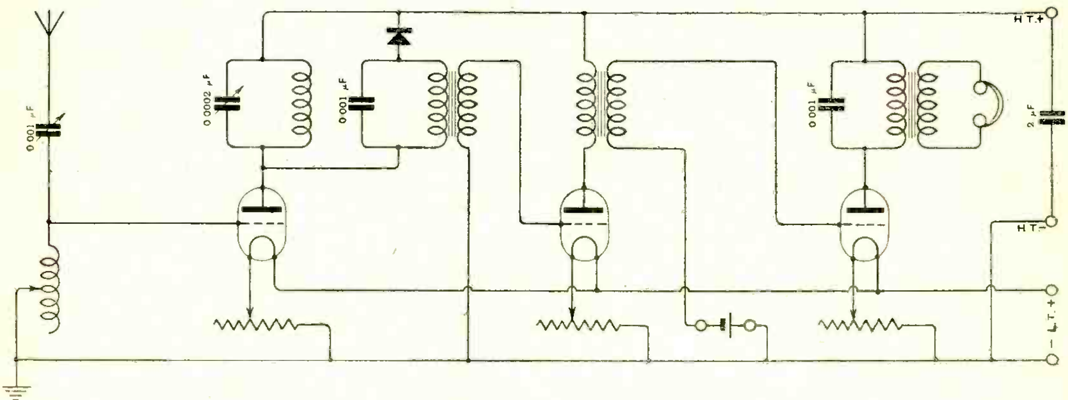


Fig. 2. **"East Boldon" (Newcastle).** *A three-valve receiver. The first valve operates as a high frequency amplifier. The crystal rectifier and transformer are joined across the anode coil. The second and third valves operate as note magnifiers.*

the windings of the primary of the telephone transformer may be carefully insulated to withstand the anode potential, and the wire used may be given such a size that it will safely carry the current. Telephones, of course, having a low resistance winding, are wound with a comparatively heavy gauge of wire, and may therefore be carefully insulated. (4) The crystal receiver may be used as suggested in reply to question (1).

"J.R.T.W." (S.W.11) *asks* (1) *For a diagram of a three-valve receiver which is to be used in conjunction with a frame aerial.* (2) *How many turns of wire should be used on a 4′ frame.*

(1) The diagram is given in Fig. 3, and suitable condenser values are given. (2) The 4′ frame should be wound with 12 turns of No. 18 D.C.C. wire. The turns should be spaced ½″ apart. Tappings should be taken every turn from the sixth.

results as high frequency amplifiers—"V24" or "Q" type valves.

(1) The valve described is a soft valve, and we therefore suggest you use a potentiometer for detection and not a grid leak and condenser. (2) A potentiometer connected to control the potentials of the high frequency connected valves is very useful, and should certainly be employed where two or more stages of high frequency amplification are used. (3) We suggest you use the "V24" type of amplifying valve. As a low frequency amplifier we suggest you use an "R" type valve. The small cylindrical type valves are not very suitable as note magnifiers.

"W.W.B." (Crewe) *asks, with reference to the diagram given on page* 601 *of February 3rd issue* (1) *How are switches connected so that the valves not required may be switched out of circuit.*

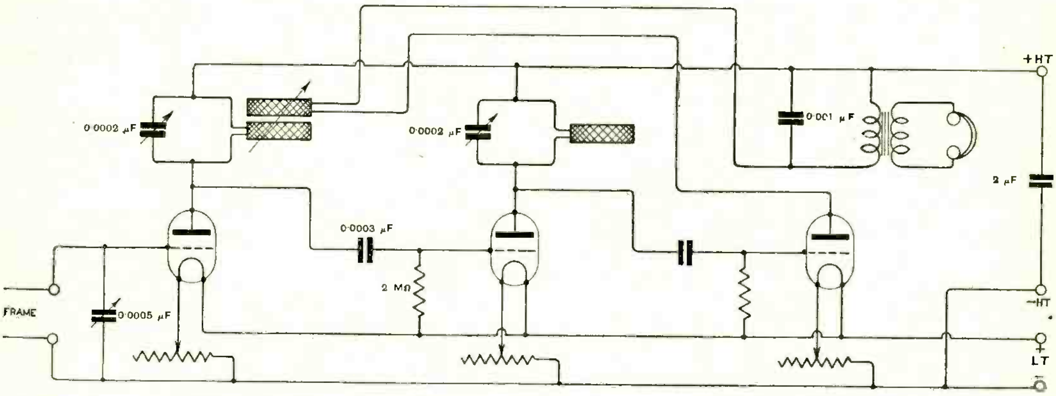


Fig. 3. **"J.R.T.W." (S.W.11).** *The diagram gives the connections of a receiver with two high frequency and rectifier valve. The receiver may be used with a frame for short wave reception.*

"R.O.C." (Leigh-on-Sea) *submits a diagram of his receiver, and asks* (1) *Is wire similar to the samples submitted suitable for winding low frequency transformers, and what number of turns would be required.* (2) *What would be suitable dimensions for high frequency transformers having a wavelength range of from* 180 *to* 2,600 *metres.*

(1) The diagram submitted is correct. (2) We regret the sample of wire has not come to hand. The primary winding of a low frequency transformer may consist of 10,000 turns of No. 42 S.S.C. wire, the secondary having 30,000 turns of No. 44 S.S.C. wire. (3) It is not possible to give you exact information concerning the dimensions of suitable high frequency intervalve transformers. The best values are determined by experiment. We suggest for the shorter wavelengths you use a winding of 80 turns of No. 36 S.S.C. wire. The other transformers may have 120, 200, 300 and 450 turns of wire for each winding. We would refer you to the article dealing with the construction of high frequency transformers in the issues of February 24th and March 3rd.

"ENTYPE" (Doncaster) *asks* (1) *Whether a valve of a type described is suitable as a detector.* (2) *Would a potentiometer connected to the grid circuits of high frequency connected valves improve reception.* (3) *Which valves give best*

(2) *What would be the relative sizes of the aerial, secondary, and reaction coils.* (3) *Is it possible to arrange a potentiometer for controlling the grids of the valves.* (4) *Would a high frequency transformer be necessary if another high frequency amplifier was connected, and is it possible to receive C.W. with this receiver.*

(1) Switches may, of course, be connected to this receiver so that the valves not required may be cut out of circuit. The method is given in most of the issues of this journal, and in particular we would refer you to the diagram given on page 702, in the issue of February 24th. (2) If the aerial coil is a No. 50 coil, the closed circuit coil would be a No. 50 and the reaction coil a No. 35. (3) A potentiometer may be connected if required. The method is given in Fig. 1, page 601, February 3rd issue. (4) Of course, if another high frequency amplifier is required, an additional high frequency transformer will be required. It is possible to receive C.W. with this receiver by coupling the reaction coil closely with the closed circuit coil.

"WORRIED" (N.16) *submits a list of material which he has in his possession and asks* (1) *Why the signals will not operate a loud speaker.* (2) *Would better results be obtained with a high frequency connected amplifier used in conjunction with two low frequency amplifiers.* (3) *Could the filament* *heating battery be used in connection with the potentiometer employed with the crystal detector.*

(1) and (2) Without a diagram of your receiver we cannot help you much, but as the receiver comprises one detector and two L.F. valves, we do not think you should expect to amplify weak signals sufficiently to operate a loud speaker. We suggest you add one high frequency connected valve. A number of diagrams have been given recently in these columns, and we think you will have no difficulty in making a choice yourself. (3) You cannot use the filament heating battery in connection with the potentiometer which is joined across the crystal circuit. Separate dry cells should be used.

"L.P." (N.9) *asks* (1) *For diagram of a our-valve receiver with tuned anode coupling between the first and second valves.* (2) *What is the relationship between the coils used in the circuit: for instance, if a No. 100 coil is used in the earth aerial circuit what coils are used in the remaining circuits.*

(1) A diagram of a four-valve receiver is given in Fig. 5. (2) If a No. 100 turn coil is used in the primary circuit and the aerial condenser is in series, a No. 75 coil should be used in the secondary circuit, and a No. 50 in the reaction.

"D.E.B." (Cambridge) *asks for diagram of a receiver comprising one valve and a crystal detector.*

The diagram is given in Fig. 5.

"J.D." (Wakefield) *refers to a diagram given in the issue of April 8th,* 1922, *and asks* (1) *What is the advantage of using a variable condenser having such a small minimum value of capacity.* (2) *Would it be possible to obtain an actual wiring diagram of the receiver described.*

(1) The advantage of using variable condensers with a small minimum value of capacity is that the tuning range when connected with a given coil is extended. However, the 0·0002 mfd. variable condensers suggested are quite suitable. (2) We regret we cannot give the actual wiring diagram of the receiver.

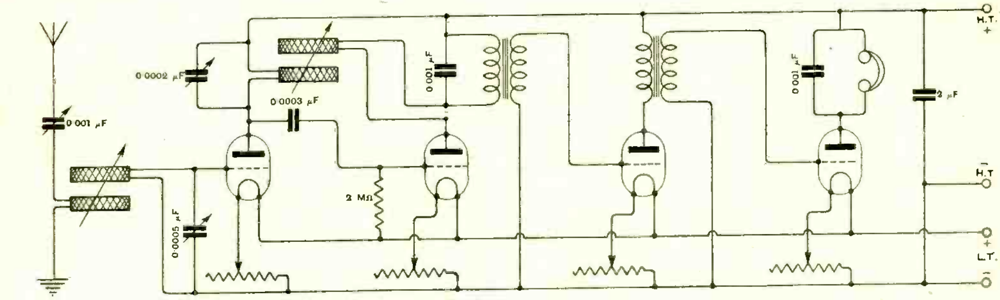


Fig. 4. **"L.P." (N.9).** *Four-valve receiving circuit.*

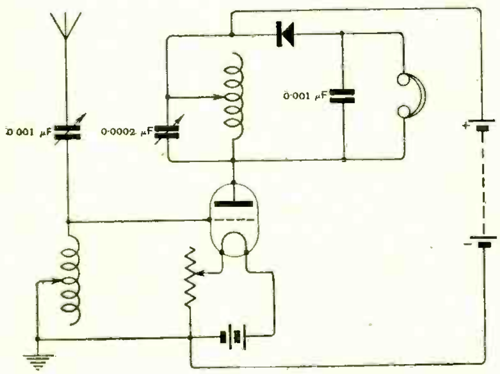


Fig. 5. **"D.E.B." (Cambridge).** *H.F. amplifier with crystal detector.*

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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THE EDITOR will be glad to consider for publication articles 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.

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The Broadcast Position.

No new developments with regard to the broadcasting problem have been recorded, and the whole matter is still awaiting the recommendations to be made by the newly appointed Committee of Enquiry which is now sitting. It is understood that, as is usual in such cases, this Committee is calling witnesses to represent all interested parties, and the action taken at a meeting held on May 9th by the Entertainments Broadcasting Joint Committee, which represents theatres, concerts, copyright interests and actors, is therefore noteworthy. The Committee decided unanimously that no evidence should be tendered to the Broadcasting Committee on behalf of the Entertainments industry "unless and until the industry is represented on the Committee set up by the Postmaster-General."

The National Association of Radio Manufacturers is also taking active steps to present their views before the public. Announcements of the policy of this Association are being published in the advertisement columns of the daily press, and it is believed that this is the first occasion on which a definite policy on the part of the Manufacturers with regard to the broadcasting situation has been made public. This Association endorses in principle the proposal for facilities to be given to those who wish to construct their own sets, provided that parts should be stamped "B.B.C." It will be remembered that in the memorandum of the Radio Society of Great Britain addressed to the P.M.G., the Society expressed the view that it could not endorse a requirement that component parts should be marked "B.B.C." The Society, however, offered no objection to an endorsement limiting the purchase of components to those marked "British manufacture."

The effect of any regulation requiring component parts to be stamped "B.B.C." would be to strengthen the position of the Broadcasting Company very considerably, for every manufacturer would have to become a member of the British Broadcasting Company before he could mark his apparatus. Such an arrangement would, of course, guarantee support for the Broadcasting Company and ensure adequate funds for good programmes.

The question of the methods to be adopted for financing broadcasting is one which will no doubt occupy much of the attention of the newly-formed Committee, whose recommendations will be awaited with the greatest eagerness by every party and interest concerned.

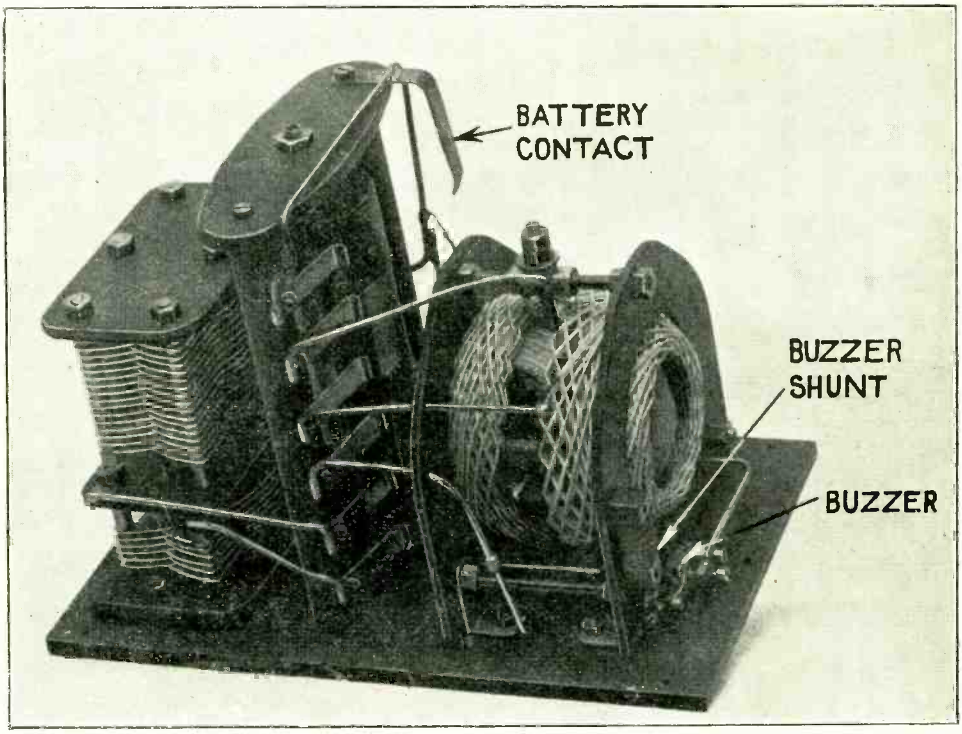
A CONSTRUCTIONAL ARTICLE OF SPECIAL INTEREST.

BUILDING A WAVEMETER

The principle of the Townsend wavemeter is embodied in the design of this instrumnt. The tuning range is covered by a variometer, the coils of which may be connected in series or parallel and shunted with a small or large air dielectric condenser. The method of making up the variometer inductances and the fixed value condensers is unique, and the manner by which the circuit changes are effected by means of a drum switch is of special interest to the experimenter. Such a wavemeter is capable of accurate calibration. The constructional ideas introduced by the author into the design can readily be applied to receiving apparatus in general.

By 5 RL.

THE wavemeter illustrated is similar in general principle to the well-known "Townsend" type, but has several novel points in its construction, and has been found very satisfactory in use. It was made almost entirely from odds and ends in the workshop, and roughly calibrated from signals of approximate known wavelength received on a valve set. More accurate calibration curves have since been made by comparison with a standard wavemeter.



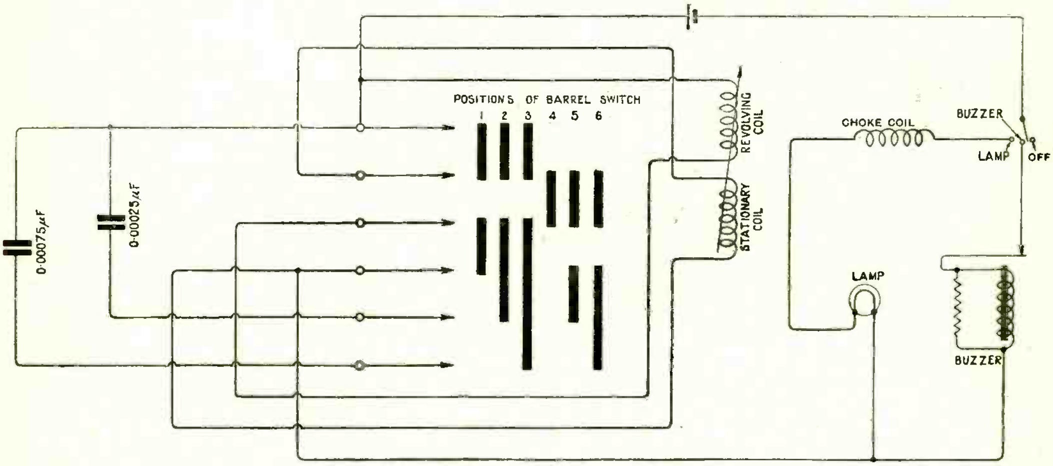
From this photograph it is possible to immediately grasp the unique principles, and very little explanation is needed for building the wavemeter, making use of materials that be to hand.

Like the Townsend, it employs a variable inductance with fixed condensers, in preference to fixed coils and a variable condenser, as it is difficult to maintain constancy of calibration with the latter when subject to the rough-and-tumble of frequent use.

The variometer rotor is an "Elwell," as made for broadcasting reception, but with the winding space reduced $\frac{1}{16}$ in. in diameter in the lathe, thus accommodating a deeper winding between the flanges. This is triple-bank wound with three layers of No. 22 D.C.C., the turns being fixed where necessary during winding by a touch of celluloid cement. The stator is honeycomb wound, with three layers of the same wire, the following method being adopted after several less successful trials.

The wooden knob of a bar-bell was used as a former, as it happened to be the exact diameter required. One hemisphere of this was drilled with three equidistant rows of holes, each row consisting of 21 holes $\frac{3}{32}$ in. in diameter. Wire nails of about the same diameter were placed in these and lightly tapped home with a hammer. This avoids splitting the wood, and ensures greater accuracy than when the nails are driven in without drilling. The nails were numbered from 1 to 21 in each row. Winding was commenced at No. 1 in the "equatorial" row, and taken to No. 6 in the middle row. It was bent slightly round this and taken to the outside of No. 11 in the "polar" row, round which it passed to No. 16 of the middle row and on to No. 21 of the first row. This sequence was repeated (*i.e.*, in steps of five nails at a time) until the winding was completed, forming one-half of the stator. It was then fixed by dabs of celluloid at the exposed crossings, and when dry the nails were pulled out gently and the winding removed from the former and fixed with celluloid varnish. The other half was wound in exactly the same way.

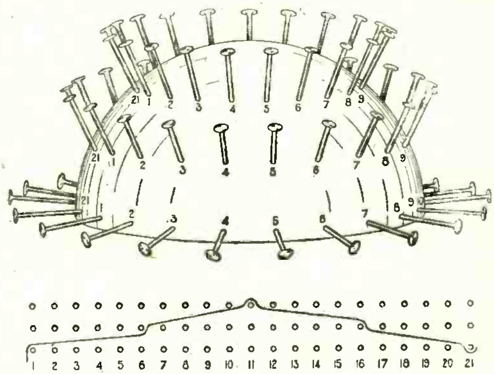
The halves are mounted as shown between two plates of ebonite $\frac{1}{8}$ in. thick, which are drawn together by nuts on 2 BA. brass "studding." The windings are tightened against two small separators of ebonite, thus leaving a space for the rotor spindle to pass through.



The wiring up of the wavemeter to this circuit does not produce an involved arrangement of leads to give the six wavelength ranges. The vertical strips represent the connectors on the drum switch in the six positions.

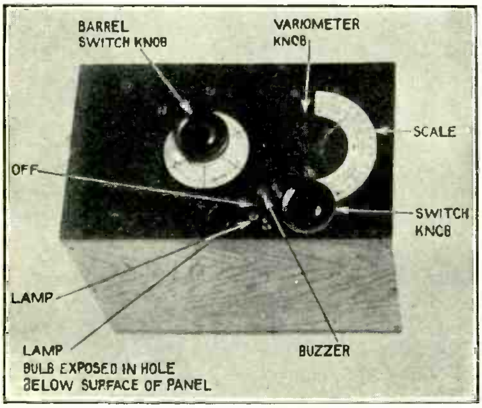
Four small L-shaped brackets made from sheet brass attach the stator to the underside of the ebonite panel.

An air-dielectric condenser is fitted, made up from the semi-circular aluminium fixed plates used for variable condensers. These are alternately reversed and held between spacing washers on six BA. brass rods. The construction is clearly shown in the photograph. The buzzer is mounted on one of the ebonite plates of the stator support in such a position that its adjusting screws can be reached by inserting a small screwdriver through holes in the wooden case. The buzzer windings are shunted by a resistance of about 10 ohms,



Wooden hemisphere with wire nails used for winding the variometer stator. The manner in which the wire passes over the nails is indicated.

non-inductively wound on a small ebonite former. A lamp is also fitted for indicating resonance when metering a transmitting set, and has an air-core choke coil in series between it and the battery. A rotary switch-arm is



The finished wavemeter.

mounted on top of the panel, having contacts for " buzzer," " lamp " and " off."

Between the variometers and the condensers is fixed a barrel switch which can be set to six different positions by means of an external knob. Two steel balls are mounted diametrically opposite in bushed holes in the top of the switch drum, and are pressed by helical springs against a brass disc on the underside of the panel. The disc has six countersunk holes into which the balls can drop successively, thus locating the drum accurately at each of its six positions. An external pointer indicates the respective settings on a fixed engraved scale.

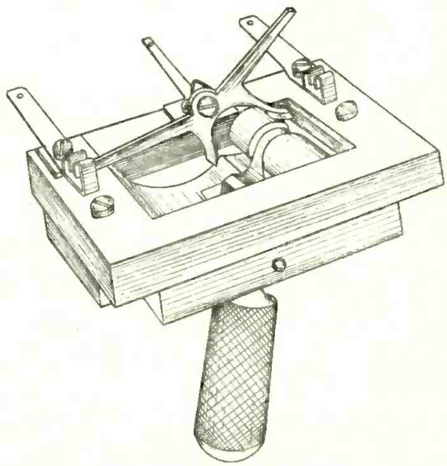
In positions 1, 2 and 3 of this switch the stator and rotor windings of the variometer are in parallel, while in positions 4, 5 and 6 they are in series. In positions 1 and 4 there is only the self-capacity of the windings and connections. The smaller condenser, about 0·00025 mfd. capacity, is shunted across the inductance in positions 2 and 5, while both condensers, totalling 0·001 mfd., are in circuit in positions 3 and 6. Six overlapping ranges are thus obtained.

The interconnections are made with heavy gauge bare copper wire, soldered throughout, in order to minimise accidental displacements. Two phosphor-bronze contact springs are provided on the instrument, one of which can be seen in the photograph of the underside of instrument. When the meter is inserted in its case these bear on fixed contacts in the latter, to which the battery is connected. Dry cells are used, held in spring clips in the bottom of the case, with screw-terminal connections to the fixed contacts.

The total range obtained is from 150 to 5,000 metres.

New Key Switch for H.F. Circuits.

It is customary practice to employ key switches for the purpose of changing connections in low frequency circuits, such as for altering the number of valves in operation or transferring signals from telephones to loud speaker. The advantages of the key type of switch are well-known and include, protection of contacts which are beneath the instrument panel, the changing of a number of contacts by one movement, and simplicity of fixing. Owing to the large capacities introduced between contacts, the usual type of key switch is quite unsuitable for such circuit changes as series or parallel aerial tuning condenser or varying the number of high frequency amplifying valves in operation or tune and stand-by in receiving circuits. The introduction by Mr. E. E. Bramall, who is known to readers as a contributor to this journal, of a new type of switch resembling in external appearance the usual key pattern, will be welcomed by experimenters and manufacturers of wireless apparatus. For simplicity the single pole, two-position model is shown in the accompanying figure, but the multi-contact models can be built up having equal efficiency. This new type of switch is particularly suited for incorporation in apparatus for broadcast reception as it obviates the use of elaborate lever switches with lacquered blades, is dust proof, allows of uniformity of switches for the H.F. and L.F. circuits and permits of the broadcast apparatus more resembling a practical household article than a complicated scientific instrument.



Key switch for H.F. circuits.

THE AMATEUR'S EXPERIMENTAL LABORATORY

IV—THE CALIBRATION OF A VARIABLE CONDENSER.

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

ONE of the simplest ways of effecting an approximate calibration of a variable condenser has already been described in the last article. This involved the use of five other condensers, each of known capacity value. The method gave an indication of the straight part of the characteristic curve, but did not provide a means of delineating the ends, which in many patterns of variable condenser are slightly curved. It will therefore be of value to investigate a means of determining the ends of the calibration curve of our variable condenser before proceeding to discuss other methods of measuring the capacity, and of plotting out the calibration curve.

In the first place it is possible to make some use of the apparatus that has already been fitted up to obtain some additional readings, which should fit in with the portion of the calibration curve that has already been plotted out.

Thus the comparison fixed capacity of the test circuit described in the last article may be made up not of a single condenser, but of two or more of the condensers of known value that have already been employed. For example, the condensers of approximately 0·0001 and 0·0002 could be connected in parallel, so giving a comparison capacity of about 0·0003 microfarad. Also the 0·0001, and the 0·0002 can be added in turn to the 0·0004 condenser, giving comparison values intermediate between the 0·0004 and the 0·0007 condensers. Also these two condensers can in turn and together be added to the 0·0007, giving values of approximately 0·0008, 0·0009, and 0·001 microfarad respectively. For each and all of these capacities the corresponding settings of the variable condenser that is under test can be determined and plotted on the preliminary calibration curve that has already been drawn. In arriving at the capacity values to be plotted on the curve for each of these settings, the exact capacities of the comparison condensers should, of course, be added together, and not merely their nominal values. Thus, suppose for the sake of example, the actual known capacity value of the 0·0001 condenser is 0·000105, and that of the 0·0004 is 0·00036, the capacity of the two used in parallel for an additional comparison is obviously 0·000465 microfarad, and this value should be plotted on the curve, not 0·0005. In such tests care should be taken in the arrangement of the condensers which are connected in parallel, as if they are placed close together, or close to other objects, slight errors may be introduced by reason of the stray capacities between them, or to earth.

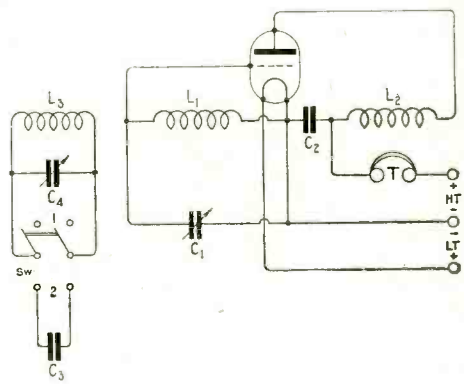


Fig. 1.

These auxiliary readings, while providing a confirmation of the main part of the preliminary calibration curve, do not enable the shape of the ends of the curve to be delineated. For this purpose a slight modification of the arrangement of the circuit is necessary. This modification is indicated in the diagram Fig. 1, in which L_1 L_2, C_1 C_2 and T represent the parts of the oscillator which has already been described and used. This part of the apparatus is identical with that employed before, as also is the coil L_3. The difference is introduced in the arrangement of the switch Sw, which in this case need only be a single-throw switch, so as to enable the fixed condenser C_3 to be placed in parallel with the variable condenser C_4 which is being calibrated. The leads from the switch contacts to the condenser C_3 must be kept as short as possible, as their capacity, as well as the small capacity between the contacts of the switch, will be added to the capacity of the condenser C_3, and will consequently introduce a slight error into the method. By taking due precautions as indicated, this error can be made reasonably small. It will also be reduced by keeping the capacity of the fixed condenser C_3 fairly large—say of the order of 0·0005 microfarad. The value of this condenser must be accurately known as in the case of those used in the earlier measurements.

The method of procedure is as follows: Light up the oscillator valve, and allow it to warm up for a few minutes so as to get into a reasonably steady state, producing oscillations of constant frequency. Close the switch Sw, thus placing the condenser C_3 in parallel with the test condenser C_4, and put the latter at the zero point of its scale. Next adjust the tuning condenser C_1 of the oscillator valve until the oscillator is brought into resonance with the test circuit as indicated by the clicks in the telephones, exactly as has already been described in articles II and III of this series. If found necessary, the relative positions of the oscillator and test circuit should be adjusted until clearly defined clicks are obtained so as to enhance the accuracy of setting the tuning condenser. The coupling between the circuits should, however, be kept as weak as practicable in order to avoid undesirable reactions between the circuits which would affect the accuracy of the setting.

Having found the best relative positions and the correct resonance setting of the tuning condenser of the oscillator, these adjustments should not be touched, but the switch Sw should be opened so as to disconnect the fixed condenser C_3. Then, still not touching the oscillator, the test variable condenser C_4 should be adjusted until the test circuit is again in resonance with the oscillator as indicated by the clicks. The scale reading of the condenser for this adjustment should be noted.

The preliminary calibration curve of the condenser, which has already been plotted out in the manner described in the last article, should now be referred to, and the capacity value of the condenser for the scale reading just obtained should be read off from the curve. From the capacity value of this setting thus obtained subtract the known capacity of the condenser C_3, and the difference will be the capacity of the test condenser at the zero point of its scale.

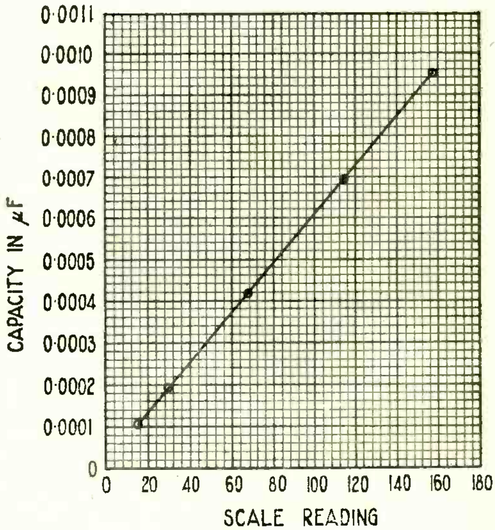


Fig. 2. Preliminary calibration curve of variable condenser, reproduced from Fig. 3 of last article.

Thus, for example, suppose the fixed condenser C_3 used for this measurement is the third comparison condenser (approximately 0·0004 microfarad) used in obtaining the preliminary portion of the calibration curve as described in the last article. The capacity of this condenser (see Table II on page 142) was there taken as 0·000420 microfarad. Suppose also that the scale reading of the test condenser obtained when the test circuit was brought back into resonance with the oscillator after disconnecting the fixed condenser C_3 was 78°. Then by reference to the preliminary calibration plotted in Fig. 3 on page 141 of the last article and reprinted here as Fig. 2 in this article, we find that the condenser capacity corresponding to a scale reading 78° is 0·00048. Subtracting from this the value of C_3, we get :—

0·00048 — 0·00042 = 0·00006 microfarad.

Thus 0·00006 is the capacity of C_4 at the zero point ot its scale, and this figure may be plotted in on the curve as shown in the accompanying chart, Fig. 3.

The switch Sw should now be closed again, putting the two condensers in parallel, and the test condenser (C_4) now placed at 5° instead of at 0. By resetting the oscillator tuning condenser C_1 the oscillator can be brought into resonance with the test circuit exactly as was done before. The switch Sw should be opened and the test circuit restored to resonance by adjusting the test condenser C_4. The scale reading for resonance should be noted, the corresponding capacity noted from the curve, and the value of the fixed condenser C_3 subtracted from this figure to obtain the capacity of the test condenser at 5° in an exactly analogous manner to that followed for obtaining its value at 0.

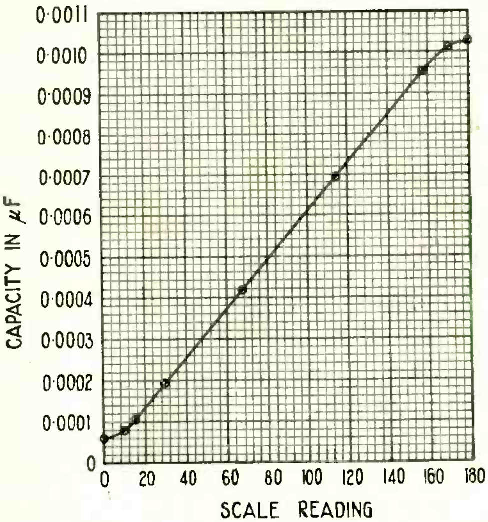


Fig. 3. Completed calibration curve.

The capacity value for the scale reading of 5° should also be plotted on the curve already obtained, to give another point for completing the calibration curve.

The above-described process should again be repeated, commencing at 10° on the scale, and the capacity value for this scale setting thus obtained and plotted on the curve sheet. If necessary, a point should also be obtained for 15°, so as to enable sufficient points to be obtained at the lower end of the curve to enable the line to be put in accurately.

Attention should now be turned to the upper part of the curve, so as to obtain a few extra points by means of which the curve can be completed. For this purpose it is desirable to reverse the actions used for the lower end, in the following manner :—

Commence with the switch Sw open, so that the test circuit includes the test condenser C_4 only, and set this condenser scale to 180°. Now adjust the oscillator to resonance by means of its tuning condenser C_1 making use of the "clicks" to indicate resonance exactly as has been done on the previous occasions. Next, close the switch Sw so as to connect the two condensers in parallel, and adjust the variable condenser C_4 (to a lower scale reading) until resonance is again obtained as indicated by the "clicks" in the telephones. The same condenser C_3 can be used for this measurement as was employed for the lower end of the curve.

Suppose, for example, commencing at a scale reading of 180°, it is found necessary when C_3 is put in parallel to reduce the setting of C_4 to 99°. By reference to the curve that has already been plotted (Fig. 2) we find that the capacity corresponding to a scale setting of 99° is 0·000602 microfarad. To this value we *add* the capacity of the fixed condenser C_3 used in these tests, viz., 0·00042 (as here assumed), giving

0·000602 + 0·00042 = 0·001022 microfarad.

as the capacity of the test condenser at a scale setting of 180°.

In an exactly similar way the capacities corresponding to scale settings of 175°, 170°, 165°, etc., may be obtained by commencing each measurement at the appropriate scale setting of the test condenser.

When all these points have been plotted out on the squared paper chart, it should be found possible to draw a smooth curve through all the points. In some condensers one or even both ends of the curve may turn out to be merely straight line continuations of the main portion of the curve which has already been plotted, but as a general rule it will be found that one at least, and often both of the ends of the curve will be slightly curved. In any case, if care is taken, these ends can be determined with reasonable accuracy by this method.

RESISTANCE-COUPLED L.F. AMPLIFIER
FOR SPEECH FREQUENCIES.

In the previous issue the author dealt with the theory of resistance-capacity coupling as applied to low frequency amplification. This article deals with the construction of an amplifier embodying the principles described. The design has much to recommend it to the experimenter, in particular the elimination of distortion and low cost of components. The author has introduced several novel features into the circuit arrangement, which will appeal to the experimenter, whilst no unnecessarily elaborate details are to be found in the design.

By PAUL D. TYERS.

THE CONSTRUCTION OF THE AMPLIFIER.

As the amplifier has been designed on as inexpensive lines as possible, the familiar ebonite panel has been dispensed with, it having been replaced by a modest wooden board. Insulation, however, has not been sacrificed, since all terminals and "live" parts are mounted on ebonite, slits being cut in the wood to clear the nuts and screws. Figs. 1 and 3 give the general idea of the amplifier and the dimensions of the front are given in Fig. 5. It will be seen that the whole of the apparatus is assembled upon the base and the front panel. This is found to be a most convenient procedure as it makes all parts of the amplifier easily accessible. The arrangement of the amplifier is progressive, and the components are symmetrically disposed along the baseboard, with the exception of the filament rheostats, which are mounted on the front panel. The internal connections are made with stiff tinned copper wire, No. 22 S.W.G. being about the smallest size suitable for the purpose.

The circuit which is employed is shown in Fig. 6 and should need little explanation, except perhaps with regard to the input and output terminals. It will be seen that there are two pairs of input terminals, AB and AD. Normally, C and D are linked together by a brass strap on the front of the instrument and the input is connected across A and B. The input circuit then simply consists of a high resistance R_1 connected to the grid through the capacity C_1 by means of the link across C and D. By opening the link, which is hinged at C, the resistance and the capacity across the input of the first valve are disconnected and by using the terminals A and D it is possible to make connection directly to the grid and the filament. Thus, for example, the valve may be used as a rectifier. Again, this input arrangement would be employed when the incoming currents are being derived

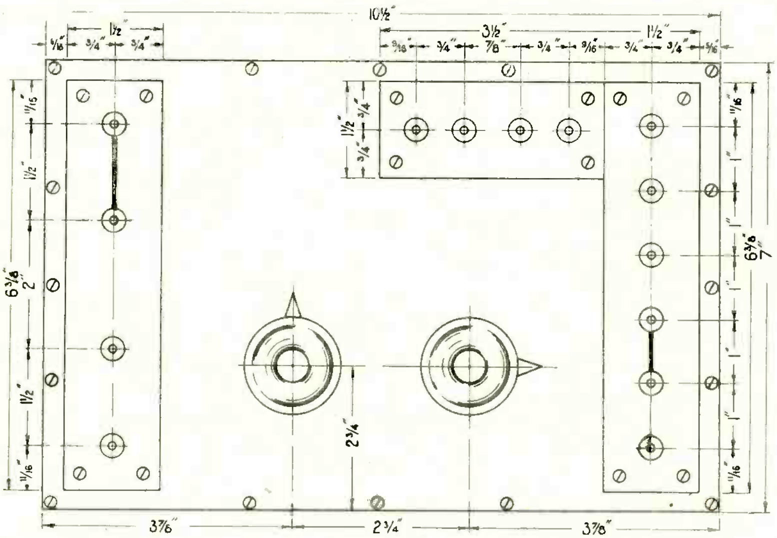


Fig. 5. Dimensional drawing of the front of the amplifier.

from the secondary of a transformer. A link has also been provided between the negative filament and negative high tension to enable the latter to be connected to the slider of a potentiometer which is placed across the filaments when they are heated by alternating current.

The use of the two pairs of output terminals is best understood by referring to the wiring layout of Fig. 7. Many experimenters prefer to use a separate supply of anode current for the last stage of a power amplifier, of the order of two or three hundred volts, which is obtained from the public supply. In this case it is desirable to place the loud speaker at earth potential, and for this purpose the extra output terminals have been provided. When the last valve is being supplied from the ebonite, which should then be secured in position.

The type of filament resistances employed is of little importance so long as the rheostat is capable of carrying the necessary current without overheating. It will be noticed that two are employed, the first controlling the first two valves and the other regulating the last valve. The rheostats may be made or bought, the latter usually proving more convenient on account of the saving of time. These should now be mounted on the front of the panel in the positions indicated. This completes the front panel (with the exception of the wiring) and it may now be screwed to the baseboard.

THE VALVE PANEL.

It will be noticed that valve sockets

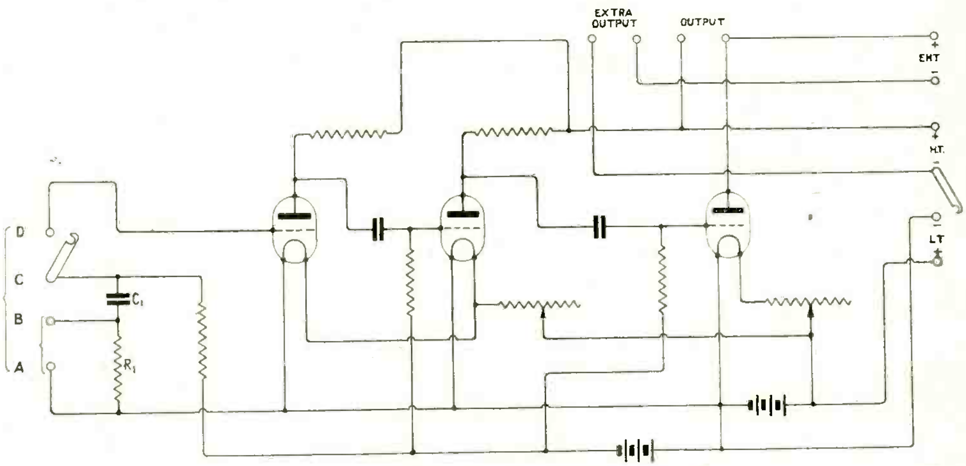


Fig. 6. Schematic diagram of connections.

the ordinary battery the loud speaker is connected to the first pair of output terminals.

THE PANEL AND BASEBOARD.

The front panel and baseboard may be made from any suitable wood, which should not on any account be less than $\frac{1}{4}$ in. thick, as otherwise it will not be strong enough to support the weight of the apparatus. The dimensions are given in Fig. 5. The terminal plates should next be made from ebonite, $\frac{1}{8}$ in. thick, and cut and drilled to the dimensions shown. These should then be laid on the face of the panel and a small mark made on the surface of the wood at the points where the terminal screws will fall, in order that the wood may be cut away. This is best done with a small fret-saw, and as soon as this is accomplished the terminals may be fixed to fixed to a long strip of ebonite have been employed, but any other plan may be adopted. As soon as the valve panel is completed it should be screwed to the baseboard and the wiring of the front panel should then be commenced, in accordance with the diagram (Fig. 7). It is preferable to wire the valve panel before fixing it to the baseboard and a detailed sketch of this is given in Fig. 8. It will be noticed that the panel is wired on the underside, and that the wires are brought through to the top surface by means of small holes drilled in convenient positions. This procedure greatly simplifies the wiring of the amplifier. The wiring should now be continued until all the wires are fixed with exception of those going to the condensers and the resistances and the leaks.

THE CONDENSERS.

The condensers should next be made and fixed in the positions shown. Those seen in the photograph happened to be at hand and consequently they were incorporated in the amplifier. They can, however, be made up as follows. The plates are made from tin foil, 50 pieces $2\frac{1}{2} \times 3\frac{1}{4}$ ins. being used. The dielectric is made from thin notepaper dipped in hot paraffin wax, obtained by melting down some old candles in a shallow tin. The ends of alternate foils are bent back on opposite sides of a piece of cardboard, contact being obtained by means of a small piece of copper foil to which is soldered a wire. The whole condenser is then wrapped in stiff brown paper which is secured with a little glue. The condenser is completed by coating it with hot wax, which serves as an excellent protection against damp. The condensers, of which three will be required, are fixed to the base by means of a wooden clamp or similar arrangement.

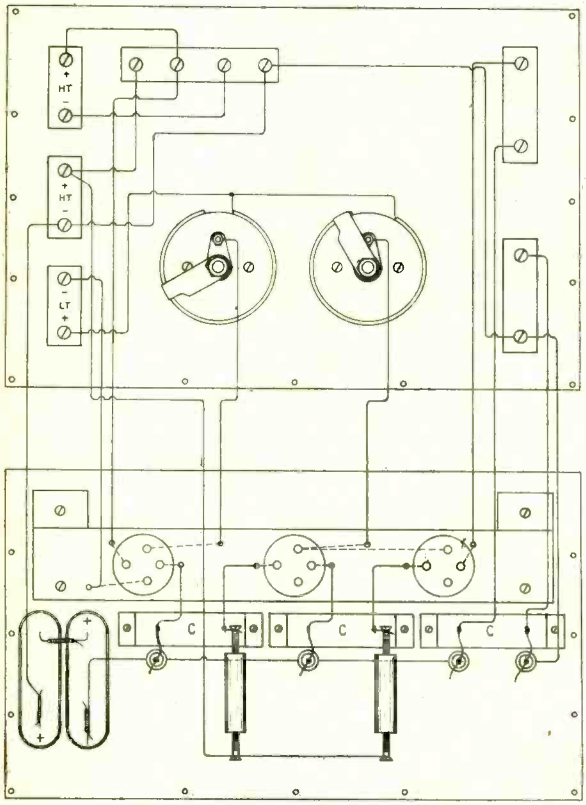


Fig. 7. Practical wiring diagram.

THE ANODE RESISTANCES.

The condensers should now be fixed to the baseboard and the wires from the grid and anode sockets on the valve panel should be soldered to them. The values of the anode resistances are best found by trial in the following manner. It is not advisable to endeavour to regulate many things simultaneously and the first valve should be properly adjusted before proceeding with the others. To do this, therefore, it is only necessary to connect the amplifier, say to a crystal receiver, with only the first valve in its holder and with a pair of telephones in the anode circuit. A temporary anode resistance should now be made as follows. A small strip of graphite from a lead pencil is rubbed on to one end of a slate pencil and a piece of fine wire is twisted round it. The same procedure is repeated at a little distance from the first wire, say 1 in. The two wires are then connected to the correct parts of the amplifier and the receiver is tuned to some station which is working for a fairly long period. The amplifier is now connected and the space between the two graphite bands is gradually filled by drawing pencil lines between the two wires. There will come a point at which maximum signals are obtained, indicating that the correct value of the resistance has been found. The grid leak is adjusted in a similar manner. The temporary grid leak is made by a pencil line between two terminals on a piece of ebonite. It is seen that the grid leak is connected to a six-volt dry cell which is used to give the grids a suitable negative bias.

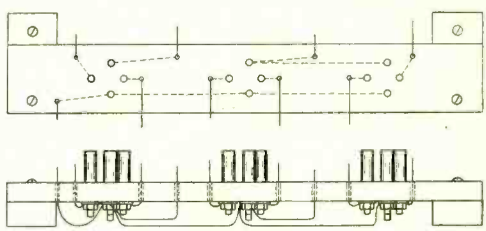


Fig. 8. Valve socket connections.

This battery must not be overlooked in making the preliminary determinations.

Having found the best adjustments for the first valve, the second valve is placed in its holder and the telephones are connected in the anode circuit of the second valve. The anode resistance and grid leak are then adjusted in a similar manner to that previously described. The same process is repeated with the last valve, after which it will be known that the best values for all the components have been found. While making the determinations it must be remembered that the values of the anode voltages and the filament currents are very critical factors, and these must be constantly varied and their effect noted.

THE PERMANENT RESISTANCES.

The resistances just described, when properly mounted, while being satisfactory for a short period, are liable to deteriorate in course of time and it is advisable to use some more reliable type. Perhaps the best form of resistance which it is possible for the amateur to construct easily is one which consists of an

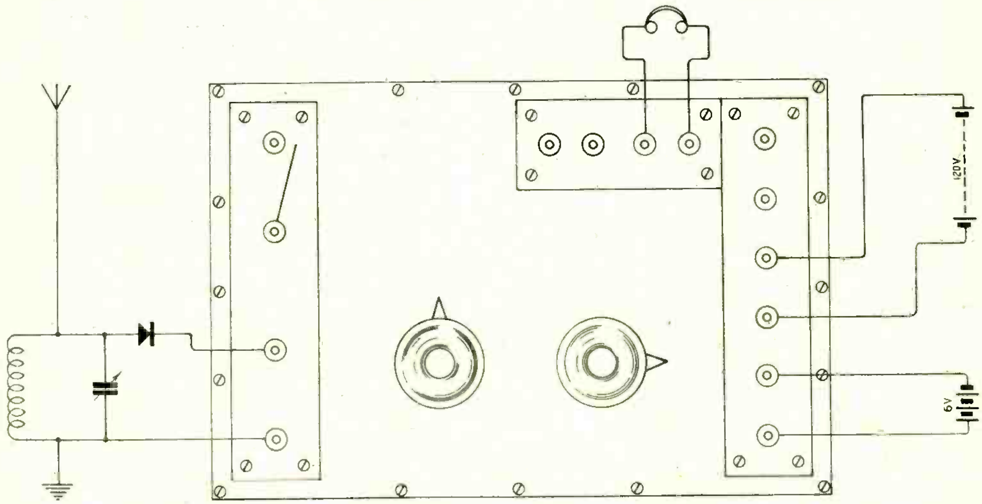


Fig. 9. Method of connecting for amplifying from a crystal detector. The telephones are connected in the plate circuit of the third valve, without the introduction of additional H.T. cells.

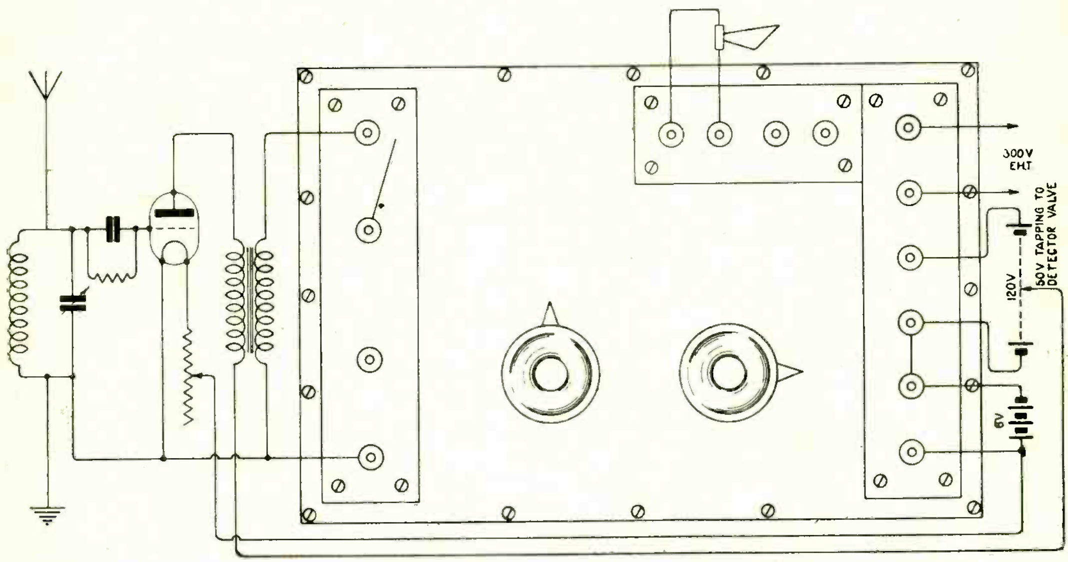


Fig. 10. Amplifying after a detector valve. The amplifier is operating a loud speaker and additional H T. is introduced in the third valve circuit

intimate mixture of a conductor and a non-conductor. The anode resistances are best made from a mixture of powdered slate pencil and powdered graphite, obtained by scraping a piece of "black lead." The mixture is placed in an ebonite tube having a screw at each end for the purpose of making contact with the mixture. The tube should be made from an ebonite rod 1½ ins. long and should have a 3/32 in. hole bored through it axially, which is then tapped to take ⅛ in. screws. Even this type of resistance is found to vary on heavy loads, and it is of course, preferable to employ one consisting of a film of deposited tungsten, or alternatively a length of carbonised cellulose. These articles may be purchased quite cheaply.

The grid leaks are made in a similar manner, the mixture in this case consisting of powdered slate and a smaller proportion of graphite. The quantities depend upon the exact nature of the materials and they can only be found by trial. This is, of course, a very simple matter, since it is only necessary to remove one of the temporary resistances and replace it by the permanent one, which is adjusted until the same signal strength is obtained. As a rough guide the following data may be of use, but it must not be taken as being at all general. The anode resistances required one part of graphite to three of slate and the grid leaks required three parts of slate to one of graphite. It is not, however, a difficult matter to adjust the values, it simply being necessary to add or remove more of the mixture as required.

Having installed the permanent resistances by soldering in position as shown in the photograph, the amplifier may be completed by building a case to fit the front panel and baseboard. It should, of course, have a movable lid as it is necessary to remove the valves from time to time. It is preferable to make some small ventilation holes in the lid, as the heat from the valve filaments is considerable. The amplifier may be suitably used with ordinary "R" valves for the first two stages and a power amplifier or small transmitting valve for the last stage, such as a Marconi-Osram "T15" or a Mullard "P.A." Two useful circuits are shown in Figs. 9 and 10, extra anode supply marked EHT being employed on the last valve in the latter case.

NEW ROTARY RECTIFIER

By M. G. Woods.

This instrument has been produced to permit of accumulator charging at home from alternating current mains. New features have been introduced into the design of the "M.W." Rectifier to overcome the difficulties usually encountered in the operation of rectifiers of this type.

THE rectifier has been developed to meet a demand that has been gradually increasing since the advent of wireless broadcasting.

Its principal object is to enable those who have only an A.C. supply available, to charge their own accumulators with the minimum outlay and running cost, but at the same time a maximum of simplicity.

It was with these points in view that the No. 1 model, with an output of 15 volts at 3 amps. was designed, so that batteries up to 12 volts could be charged on it.

For those who have high tension accumulators a No. 1A has been introduced which has an output of 15-75 volts at 3 amps.; similar models at outputs of 10, 20, and 30 amps. are also available. The unit comprises a synchronous motor driving an interrupting commutator, mounted on an iron box which

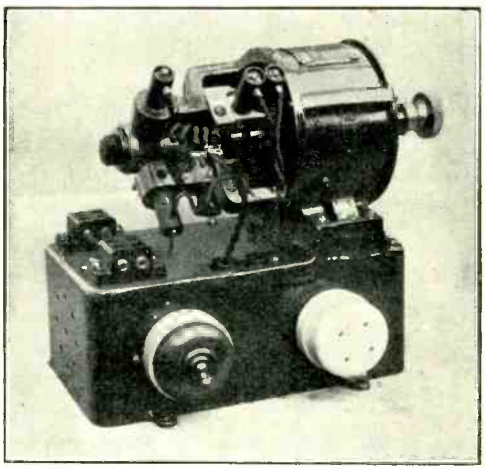


Fig. 1. The Rotary Rectifier. This model has an output of 3 amps. at 15 volts. The iron base box measures 9″ × 5″

contains the auto-transformer and resistance. On the outside of the box is mounted a two-way switch and a cut-out.

The principle of rectification is by no means new, it having been used for many years past. If the ordinary A.C. supply which takes the form of a sine wave, as in curve 1 (Fig. 1),

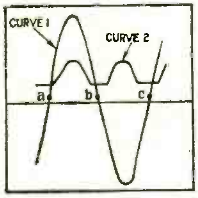


Fig. 1. Curve 1 represents the current amplitude of the A.C. supply and curve 2 the pulsating current delivered by the Rectifier during a corresponding interval of time.

is taken and arrangements made so that the curve is picked up at the point "a" and dropped again at "b" and so on, a series of loops with a gap between where the curve has a negative value will be the result. If then the negative half is similarly treated, and then inverted, a pulsating or unidirectional current as in curve 2 (Fig. 1) will be the result.

Now the means by which it is arranged that the curve is picked up and dropped at the exact moment, is by utilising the fact that a synchronous motor will run absolutely in step with the alternating current waves and its speed depends solely on the frequency.

The synchronism of the motor is maintained by *supplying the rotor winding with the rectified current produced by the machine itself*; this feature is novel.

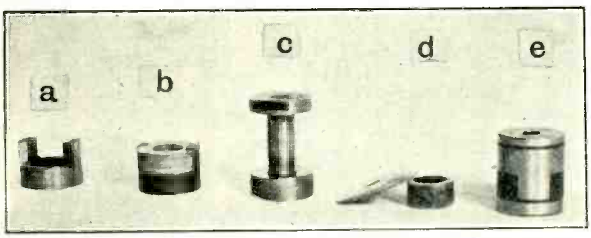


Fig. 2. The components of the interrupting commutators.

Outside the end cover, so as to give easy accessibility, is the interrupting commutator mounted on the same shaft. The commutator, which is of peculiar design, is shown in Fig. 2, and consists of a copper ring with two prongs projecting from it. The space between these two is occupied by compressed mica on edge, and the whole is then insulated from, and mounted on the shaft.

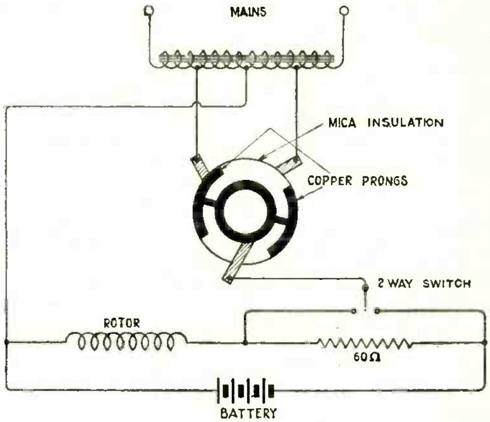


Fig. 3. The connection of the rectifier and the arrangement of the brushes.

Three brushes on a rocker are also mounted, two working on the interrupted section, and the third on the common or plain copper section. A glance at the diagram Fig. 3 will show this more clearly. The centre of the commutator diagrammatically represents the plain copper section, and if the path of the current is followed it will be seen that it alternately flows down first one brush and then the other, according to which ever happens to have the copper prong under it.

Now the commutator is so designed that the copper prong comes under the brush just after the curve (Fig. 1, curve 1) has left the zero line, and similarly the section leaves the brush just before the curve reaches the zero line.

This is done because the back E.M.F. of the battery would endeavour to discharge through the transformer if the make and break were made at absolute zero. The curve of the E.M.F. must reach a value equal to that of the accumulator.

A word of explanation about the diagram in Fig. 3 will be appropriate. The auto-transformer is wound for whatever the main supply is, the centre tapping going straight down, and forming one of the leads for the battery. The other two arms, which are tapped off according to the voltage required on the battery side, are led down on to the two brushes, working on the interrupted section of the commutator. The third brush (working on the section common to the other two) goes down to the two-way switch, one terminal of which goes to the battery. In parallel with the battery is the rotor winding, and it is so arranged that when the switch is in the off position ready for starting, about $\frac{1}{6}$ of an ampere will flow through the rotor, since there is 60 ohms approximately in series with the battery, assuming that it is a 12-volt one. This is done so as to make sure that the polarity will always be the same at the battery terminals.

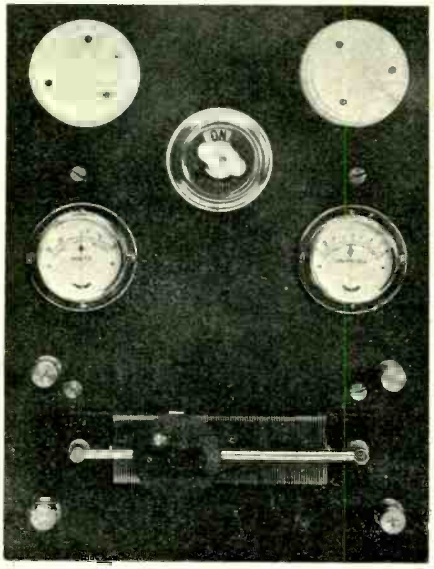


Fig. 4. Switchboard for use with the rectifier. A resistance is provided in order to regulate the charging rate to suit the voltage of the battery. The meters have scales with centre dezo to indicate charge and discharge.

On putting the switch down to the " on " position the rectified current flows straight to the battery, while the rotor now has the 60 ohms resistance in series with it, since the amount of current required in the rotor circuit once the machine is in synchronism, to make for efficiency on long running, was found to be about 75 per cent. less than on starting.

All that is necessary to charge the accumulators is to first see that the switch is in the " off " position. Then connect the accumulators to the battery terminals, next connect the terminals marked mains to a plug or lampholder, then give the shaft a sharp turn in the direction of the arrow, by means of the knurled head supplied, when the motor will run up into synchronism. Then press down the switch, when the battery will begin to charge straight off the rectifier, and since the only limitation to the current taken is the size of the auto-transformer winding, which generally exceeds the charging rate of the battery, it is advisable to have a variable resistance, and an ammeter in circuit.

It must be noted that when measuring the output of the rectifier, unless moving coil instruments are used, an erroneous impression will be gathered as to the amount of energy being put into the battery; since owing to the fact that the current is pulsating, the true value of the current will be the average value and not the R.M.S. value as indicated by the hot wire and moving iron instruments, which depend upon the square of the current through them.

Wireless Telephony on Lightships.

An experiment which should prove of immense value to vessels in distress is being attempted by Trinity House. Five lightships, viz., the North Goodwins, East and South Goodwins, and the Tongue and Gull Lightvessels, are being fitted with wireless telephones which will communicate with Ramsgate Post Office on a wavelength of 320 metres. The apparatus which is being fitted, says *Lloyds' List*, enables the ships to call up the Post Office only. Considerable expense is thus saved, and it is felt that no useful purpose would be served by equipping the Post Office with transmitting apparatus. The shore station will be called up at regular intervals during the day for testing purposes. If the experiment proves successful the scheme will be extended.

AN ARTICLE OF SPECIAL INTEREST TO THE EXPERIMENTER.

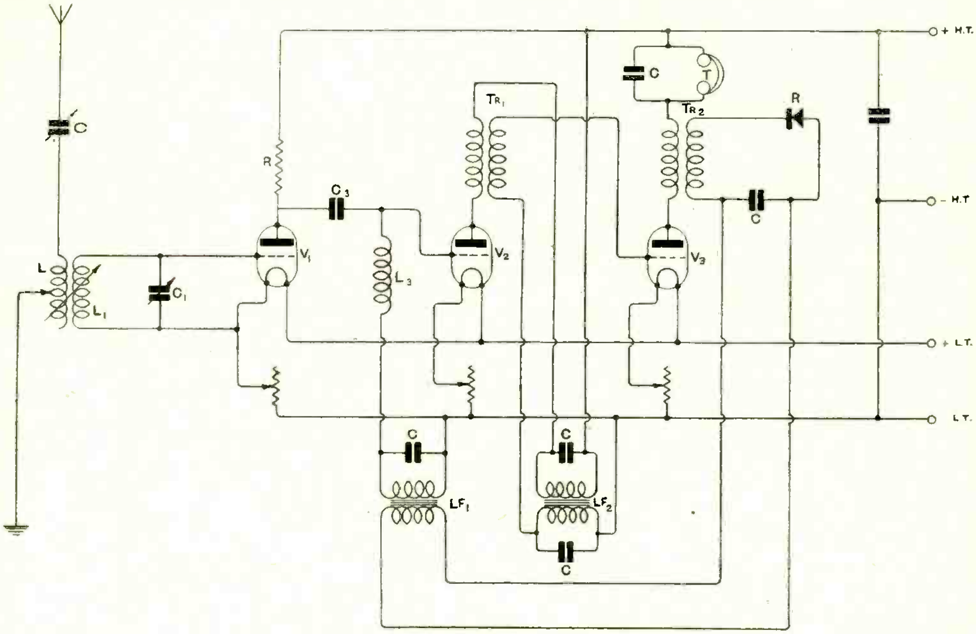
DOUBLE MAGNIFICATION CIRCUITS

In the previous issue the author dealt with the double magnification circuits of Round and Armstrong, and the four-valve circuit developed by the French. This article describes the circuits used in modern commercial receivers and includes a new principle in double magnification.

By W. James.

5.—Resistance and Transformer Circuit.

Another type of receiver is connected as shown in Fig. 7. Here valve V_1 operates as a high-frequency amplifier through the anode resistance R, and is coupled with valve V_2 through the condenser C_3. The coil L_3 acts in place of a leak resistance. Valves V_2 and V_3 are high-frequency amplifiers coupled with transformers Tr_1 and Tr_2. The signal is rectified by the crystal R, and is fed back through LF_1 to valve V_2, where it is magnified and passed on through LF_2 to valve V_3. The telephones are joined in the anode circuit of valve V_3. The usual condensers C are connected to by-pass the high-frequency energy. The special feature is the condenser and leak C_3 and L_3, which have valves of 0·001 mfds. and 10,000 μH.



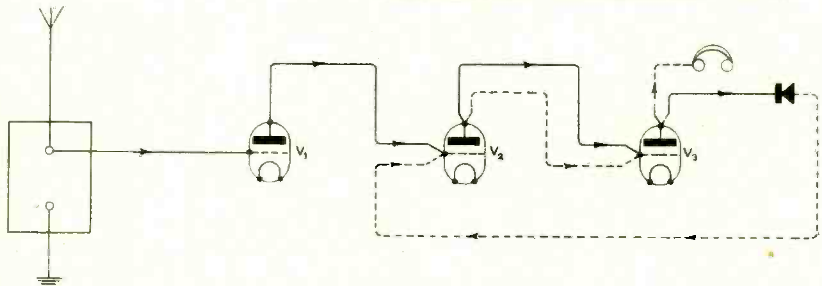


Fig. 7. Three-valves, Double magnification.
The valve V_1 has in its anode circuit the resistance R, which may be 100,000 ohms. Condenser C_3 = 0·001 mfds., and coil L_3 = 10,000μH which may be a coil $2\frac{1}{2}$ in. diameter and 3 in. long of No. 42 S.S.C. Other values as before.

6.—Tuned Anode and Choke Circuit.

Another three-valve receiver, in which the tuned anode method of high-frequency amplification is used, and choke coils are used to couple the low frequency circuits, is given in Fig. 8. The valves V_1 and V_2 operate as high-frequency amplifiers and are coupled with tuned anode circuits C_3, L_3, and the condensers and leaks C_4, R_1. Valve V_3 is coupled with the crystal rectifier through the high-frequency transformer Tr_1. The rectified energy is now applied across the choke coil CH_1, and the rectified energy is magnified by valve V_2. The low frequency voltages are then set up across choke coil CH_2, which is connected with valve V_3. The telephones are connected in the anode circuit of valve V_3. At CH, is an air core choke which may consist of a winding of 1 in. × 3 in. of No. 30 S.S.C. The condensers C_4 are each about 0·3 mfd. The usual high-frequency by-pass condensers are connected at C_5.

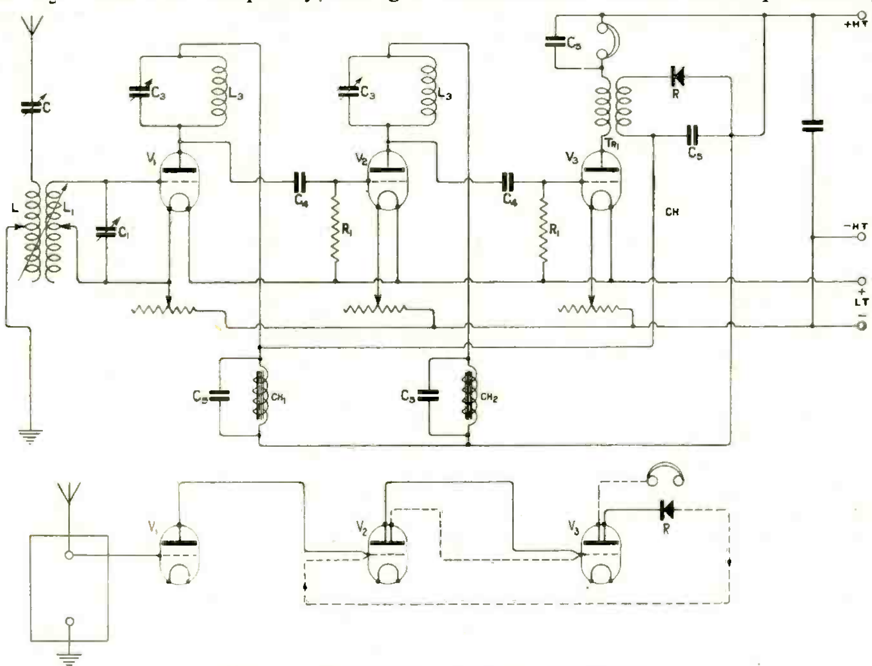


Fig. 8. Three-valves, Double magnification.
With this arrangement, valves V_1 and V_2 have connected in their anode circuits a tuned winding. The audio-frequency signal is applied to the grid circuits through choke coils CH_1 and CH_2. Condensers C_4 may be 0·3 mfds., connected between the junction of Tr_1 and C_5 and to the top of CH_1 may be connected on air core choke—1 in. by 3 in. of No. 30 S.S.C.

7.—New Principle of Double Magnification.

The methods of obtaining double-magnification just described have many disadvantages, and this accounts for the circuits not being used to any great extent. Thus, referring to Figs. 6, 7 and 8, it will be noticed the first valve carries radio-frequency energy only, the second carries strong radio and weak audio-frequency energy, while the third carries powerful radio and audio-frequency energy. The third valve is therefore likely to be overloaded, whilst the first and second valves are carrying smaller loads. This is a disadvantage, although the arrangement is more economical than if separate high and low-frequency connected valves were used. It will be noticed the first valve is used as a radio-amplifier only. This is because it was soon found that when the first valve operated as a double magnifier, there was a great tendency for the receiver to oscillate of its own accord, signals were distorted, and in the event of there being any neighbouring low-frequency disturbances, these were amplified. It was found that high frequency energy passed through the detector valve, which amplifies as well as rectifies, and this energy was handed back to the first valve again and further amplified. Hence the tendency for the circuits to be unstable. Connecting a crystal rectifier removes part of the trouble, because now practically no radio-frequency energy will flow in the output circuit of the rectifier. Recognising the defects of ordinary methods of double magnification our American friends have made modifications. The principle of the new circuits is illustrated in Fig. 9.

It will be seen that the radio frequency energy is amplified through the valves V_1 V_2 and V_3, and the energy is rectified by the crystal R. Now, instead of the audio-frequency energy being fed back to V_1 and then passing through V_2 to the telephones joined to V_3, the energy is fed back to V_3 where it is amplified and passed on to V_2 and afterwards to V_1 and the telephones. The cycle of events is different in this arrangement and several distinct advantages are secured. With this arrangement, valve V_1 carries weak radio and powerful audio frequency energy, valve V_2 carries strong radio and audio-frequency energy, while valve V_3 carries powerful radio and weak audio-frequency energy. The valves have now a

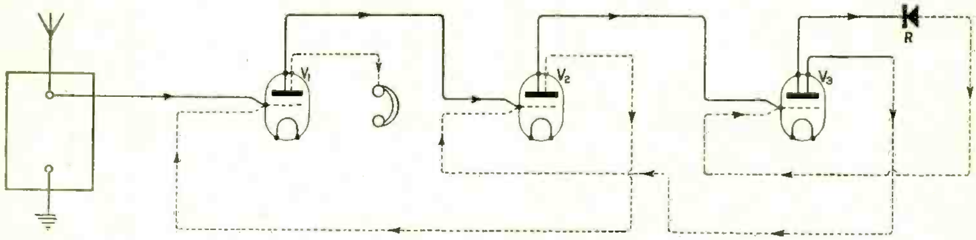


Fig. 9. New Principle of Double Magnification.
The diagram shows schematically a new arrangement which has many advantages. It will be noticed the radio-frequency energy is amplified by valves V_1, V_2 and V_3 and is rectified by the crystal R. The audio-frequency energy is fed back to the grid circuit of valve V_3, is magnified, and then passed back through V_2 to V_1, in whose anode circuit is the telephones.

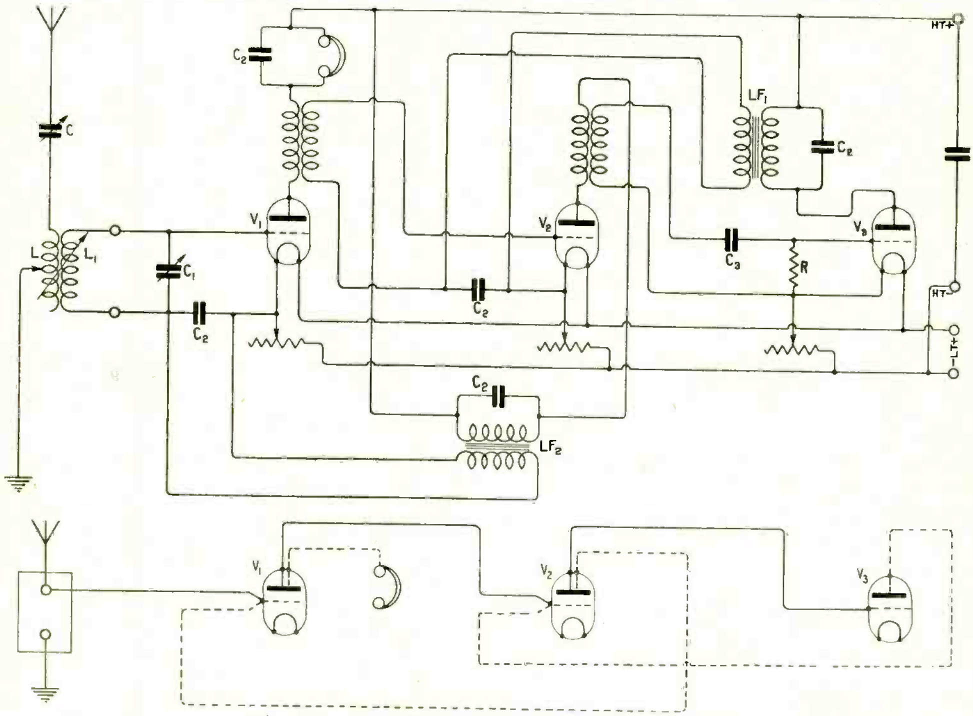


Fig. 10. New Double Magnification Circuit.
The radio-frequency energy is amplified through V_1 and V_2 and is rectified by the valve V_3. The audio-frequency energy is fed back to V_2, is magnified, and is passed on to V_1, where it is again magnified and operates the telephones.

much more even share of the load and there is no tendency for one valve to carry a much greater load than the others. In addition, the circuit is much more stable, and a valve rectifier may be used in place of the crystal if desired, because now we have any leakage radio-frequency energy confined to the rectifier and valve V_3 circuits. The leakage radio-frequency energy can only have one additional amplification by passing through V_3, whereas with the older circuit arrangements, the output from the detector was amplified by each valve between it and the valve which operated as a double magnifier. Another advantage gained lies in the fact that the telephones are connected in the anode circuit of the first valve. Therefore, in the event of low frequency disturbances, such as might be due to near-by generators, the disturbance is only amplified once—by the first valve. From the foregoing remarks one would expect that besides obtaining high amplification, signals are not distorted as they are with older arrangements, and such is the case. The amplification obtained is sufficient to give a good volume of signal strength when a receiver built according to the principles outlined is connected with a frame aerial.

8.—PRACTICAL CIRCUITS.

It should be a simple matter for the experimenter to provide his own circuits by modifying the circuits already described according to the information given in the last section. Thus in Fig. 10 we have the aerial circuit CL. The closed circuit $C_1 L_1$ has terminals provided so that a frame aerial may be connected. The first valve V_1 amplifies the high frequency energy which is passed through the high frequency transformer to valve V_2 where it is again amplified and so on to the rectifier V_3 which has a grid condenser and leak C_2 R. The output from the rectifier is now passed through the transformer LF_1 to the grid circuit of valve V_2 and it is magnified. The output from V_2 passes through transformer $L F_2$ to the grid circuit of the first valve, V_1, and it is again magnified and operates the telephones joined in the anode circuit. When receiving the signals of near-by stations signals are so powerful that the valves are overloaded. A non-inductive resistance of a few hundred ohms should then be joined in series with the grid circuit of the first valve, that is, between the junction of the filament side of the tuning coil and condenser L_1 and C_1 and the condenser C_2.

Broadcasted Opera in the Argentine.

By JOHN ENGLISH (in Buenos Aires).

THE time seems to have come when a history of the beginnings of broadcasting should be written. An example of how astonishingly little is known of this was given recently when a leading London paper printed a note on the first transmission of Opera from Covent Garden, with the suggestion that this was possibly the first time that Opera had been broadcasted from the actual stage (as distinct from concert performances at the transmitting station).

It would be of very great interest to know when this was really done for the first time, where, and on what power, and the Company or enthusiasts responsible., I believe the United States will be able to claim precedence.

Another date of even greater interest would be that of the inauguration of a regular service of broadcasted Opera, night after night throughout the season. In my opinion, this date will eventually be regarded as the "Birthday of Broadcasting," since it is my firm conviction that in the future such transmissions from the stage of operas and plays will be the main stock-in-trade of the broadcast service.

In this country, and I believe in this continent, the first time that Opera was broadcasted from the stage was on August 24th, 1920. The date of the inauguration of a regular service was two days later, August 26th, 1920, the opera being "Parsifal." This service continues to the present day.

The theatre in question is the Coliseo of Buenos Aires, and the promoters were a group of Argentine amateurs, now organised as the "Sociedad Radio Argentina." Prominent members at the present day are Dr. Enrique Telemaco Susini, Sr. Luis F. Romero, Sr. Cesar J. Guerrico, and Sr. Miguel Mujica.

At the start only 25 watts in the aerial was used. In those days wireless was only just starting in Buenos Aires, and few amateur stations existed. In 1921 the power was increased to 40 watts, and last year to 100 watts in the aerial.

At present we have various stations giving broadcast service, from the high power ($\frac{1}{2}$ kW) set belonging to the radio Sud America (a German-United States-British Company) down to amateurs who transmit bad discs on bad gramophones and apologise to their unwilling listeners when their gramophone completely breaks down, promising resumption the following night (I have heard this!). But from the point of view of interest, the Coliseo transmissions are far and away the best, and, within the area that their limited power can reach, I should say technically the most perfect.

The English experiment of a commentary on the action of the Opera has not yet been introduced here, but we are threatened with the broadcasting of the sessions of the *Congreso* (House of Commons, as it were), which should be worse.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER

WIRELESS THEORY—VII.

It is the purpose of the writer to deal with the principles underlying the action of wireless receivers and transmitters. Those who know *why*, obtain much pleasure which is not experienced by those who have no idea of the action of their wireless set.

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.

By reason of his work in supervising the replies to the queries and difficulties of readers, the writer has an experience which is not possessed by other engineers. Readers will appreciate that this experience will be reflected in both the selection and the method of presenting the subject.

By W. James.

19.—The Effect of Resistance in an Alternating Current Circuit.

When an alternating current is passed through a resistance R, by the application of an alternating voltage, the current which flows is given by Ohm's Law,

thus $I = \frac{E}{R}$

Thus, if the pressure is 100 volts and the resistance 20 ohms, the current which flows is $\frac{100}{20} = 5$ amperes. The relationship between the pressure and current is given in Fig. 38.

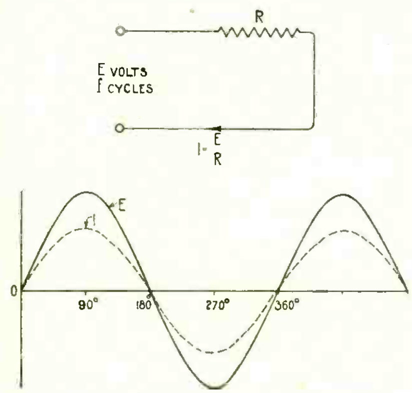


Fig. 38. When an alternating pressure is applied to a circuit consisting of resistance only, the current which flows is given by $I = \frac{E}{R}$. *The current and pressure are in phase, that is, both rise and fall together.*

20.—The Effect of Capacity in an Alternating Current Circuit.

We have shown previously how when a steady potential difference is applied to the plates of a condenser, the condenser becomes charged, the value of the charge being proportional to the capacity of the condenser and the voltage applied. The energy of the charge is stored in the dielectric of the condenser. The condenser will absorb no more energy when the back pressure due to the electric stress set up in the dielectric is equal in magnitude to that of the applied pressure. Further, the rate at which the electrons flow in the circuit varies with the charge.

At the instant the circuit is completed, there is a rush of electrons corresponding to a small back pressure. As the back pressure builds up so the rate of flow of the electrons is reduced, until when the back pressure and the applied pressures are equal, there is no electron flow. We may say then, when the back pressure is a maximum the current is zero, and conversely, when the current is maximum the pressure is zero. If we consider an alternating pressure connected across the condenser we shall expect to find that as the alternating pressure rises, so the current reduces. This is what happens. The current is said to *lead* the pressure by 90°. The angle 90° represents the angle between zero volts and maximum volts. If we draw a curve representing the pressure and current the result is as shown in Fig. 39.

Of course the current does not actually flow through the condenser. The electrons are flowing into the condenser until it is

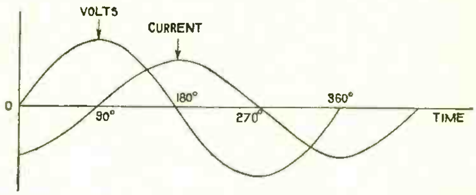


Fig. 39. When an alternating pressure is connected to a condenser, the current which flows, leads the applied pressure by 90°, that is the current flowing has its maximum value when the voltage applied to the condenser is zero. The current falls off as the pressure rises.

fully charged, then when the voltage is reversed they flow out, and it is this to-and-fro movement of the electrons which constitutes the alternating current in the circuit. When a condenser which has no losses due to faulty dielectric or resistance in the plates is connected to an alternating pressure, no power is taken from the supply. This is because the power which is required to charge it in one direction is given back to the supply when the pressure reverses. The power is represented by $EI \cos \theta$, when θ is the angle of lead of the current. In the case considered it is 90°, and the cosine of 90° is zero. The magnitude of the current i which flows is given by the equation—

$$I = E \div \frac{1}{2\pi fc} \text{ where } \pi = 3{\cdot}1416$$

f = the frequency or number of cycles per second.
C = the capacity in farads.

The quantity $\frac{1}{2\pi fC}$ is called the reactance of the condenser, and is denoted by X, see Fig. 46. When dealing with direct currents we spoke of the resistance of a conductor,

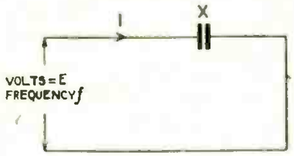


Fig. 40. The reactance of a condenser with capacity of C farods is $\frac{1}{2\pi fC}$ and is represented by X.

and we defined resistance as "that property of conductors which acts to impede the flow of electricity through them, and from Ohm's law $R = \frac{E}{I}$

In a similar manner the magnitude of the quantity $\frac{1}{2\pi fC}$ will determine the current flowing in a circuit when an alternating voltage is applied.

Thus $\frac{1}{2\pi fC} = \frac{E}{I}$ or $X = \frac{E}{I}$. We see the quantity $\frac{1}{2\pi fC}$ has the property of a resistance, and is expressed in ohms.

It should be noted that the value of the reactance depends upon the values of the capacity and frequency. An increase in the capacity reduces the reactance. This is expected, since the condensers will now be able to hold larger charges for a given applied pressure. The reactance is also reduced by an increase in the frequency. This also naturally follows, because with an increase in the frequency of the condenser charges and discharges a much larger quantity of electricity is set in motion in a given time, and current is equal to the quantity of electricity flowing per second.

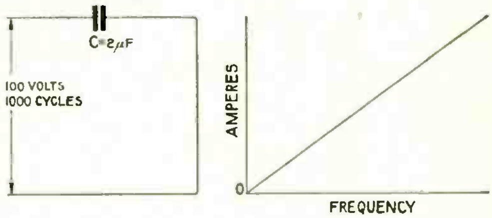


Fig. 41. When the quantities have the values given in the left-hand figure, the current which flows is 1·11 amperes. The condenser current increases with frequency as shown by the curve.

Example.—What is the reactance of a 2 microfarad condenser when the frequency is 1,000 cycles; and what current will flow when it is joined with a 100-volt alternating supply? Fig. 41.

The reactance of a condenser in ohms

$$= \frac{1}{2\pi fC.}$$

$\pi = 3{\cdot}1416$ and $2\pi = 6{\cdot}2832$.
$f = 1{,}000$.
$C = 2 \div 1{,}000{,}000$ farads.

$$\text{Reactance} = \frac{1}{6{\cdot}2832 \times 1000 \times 2 \div 1{,}000{,}000}$$

$$\text{or} \quad \frac{1{,}000{,}000}{6283{\cdot}2 \times 2}$$

$$\therefore \text{reactance} = \frac{1{,}000{,}000}{12566{\cdot}4}$$

which gives 80 ohms.

The current which flows is equal to $\frac{\text{pressure } (E)}{\text{reactance } (X)}$

Since the pressure is 100 volts
and the reactance is 80 ohms.

the current equals $\frac{100}{80} = 1{\cdot}2$ ampere.

If now the frequency is raised to 1,000,000 cycles, the reactance is reduced to ·08 ohms, and a current of $1 \cdot 2 \times 1000$ or 1200 amperes would flow.

21.—Resistance and Capacity in an Alternating Current Circuit.

When resistance is present in an alternating current circuit, power is lost in heating the resistance. The current which flows in the circuit is in two portions—one portion being the condenser charging current, which is 90° in advance of the applied pressure, and the second portion is the current which flows due to the resistance. The current and voltage in the resistance are in phase, that is as the voltage increases so does the current. The two currents combined give a resultant current which is between 0° and 90° leading the pressure. The angle of lead will be less the larger the resistance. The magnitude of the current is given by the relationship $I = \frac{E}{\sqrt{R^2 + X^2}}$. The resistance and reactance are added vectorially as shown in Fig. 42, and the result is termed the impedance Z of the circuit.

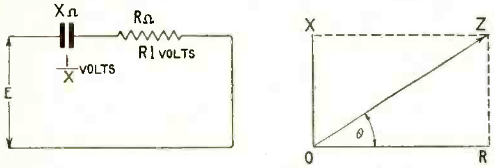


Fig. 42. Circuit containing capacity and resistance in series. The right-hand diagram shows the phase relationship.

In the figure the magnitude of OX represents to scale the reactance of the condenser; OR represents to scale the magnitude of the resistance. The resultant effect of OX and OR is given by OZ. In the above expression for current the denominator is $\sqrt{R^2 + X^2}$. In the figure it is seen that the magnitude of OZ is given by $\sqrt{R^2 + X^2}$. The angle of lead of the current is now equal to $\theta°$, which is the angle whose tangent $= \frac{X}{R}$. In the figure $\tan \theta = \frac{ZR = XO}{OR}$

When no resistance was present in the circuit, increasing the frequency of the pressure gave a corresponding increase in the current flowing. When resistance is present, however, the current does not increase proportionately with frequency as would be expected from the factors forming the impedance of the circuit $\sqrt{R^2 + \left(\frac{1}{2\pi fc}\right)^2}$. The current will increase as indicated by the curve in Fig. 43.

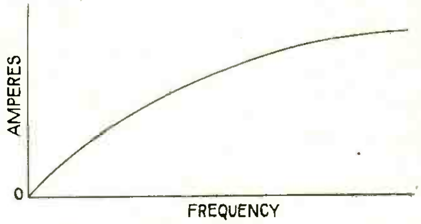


Fig. 43. The curve shows the increase in current in a circuit consisting of resistance and capacity in series. At very low frequencies, the condenser offers greatest opposition to the current flow. At infinitely great frequencies, the condenser offers little impedance to the current, and the resistance practically determines the magnitude.

The current increases rapidly at first because at low frequencies the capacity reactance predominates. At the higher frequencies the resistance is more effective in opposing the current flow. With the frequency infinitely great, the condenser reactance is zero and only resistance effects remain.

Example.—What is the impedance of a circuit consisting of a 2 mfd. condenser and a 40 ohm. resistance in series, the supply pressure

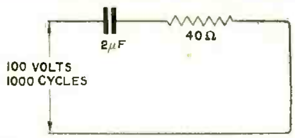


Fig. 44. Circuit consisting of capacity and resistance referred to in the example.

having a frequency of 1,000 cycles. What current will flow when the pressure is 100 volts. See Fig. 44.

The impedance is given by $\sqrt{R^2 + X^2}$.

From the last example the reactance X of the condenser was 80 ohms.

∴ The impedance of the series circuit

$= \sqrt{(40)^2 + (80)^2}$ ohms.

$= \sqrt{8{,}000}$ or 90 ohms.

The current in the circuit is given by

$\frac{100}{90} = 1 \cdot 11$ amperes.

Referring to the last example, the current flowing when only the condenser was joined in circuit was $1 \cdot 2$ amperes. The power lost in the circuit is given by i^2R, and is equal to $(1 \cdot 11)^2 \times 40$ or $49 \cdot 2$ watts.

(To be continued).

Wireless Club Reports.

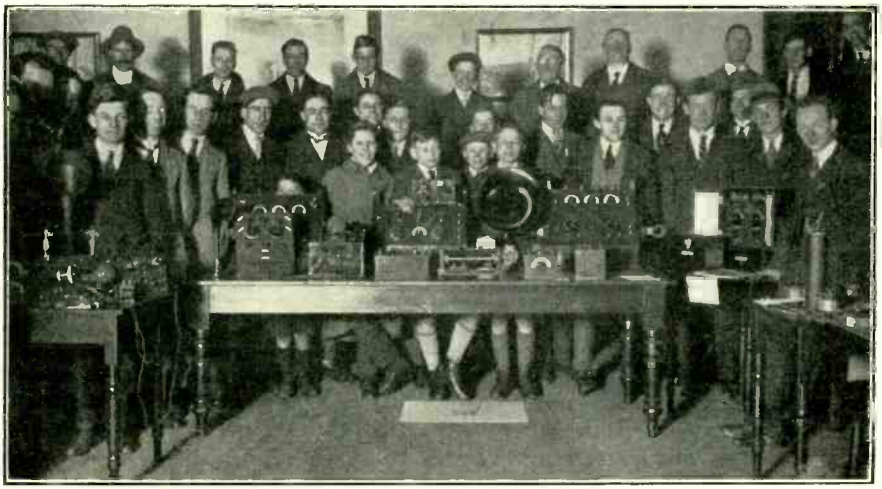
NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Cheltenham and District Wireless Association*

The Association held its first Exhibition of Members' Apparatus on April 30th, at the Lecture Hall of the United Services Club, Winchcombe Street.

The apparatus on view, and shown in the accompanying photograph, displayed great skill and ingenuity on the part of the constructors. The prize for the most ingenious amateur-constructed apparatus was won by Mr. J. H. Williams with a three-valve panel set entirely constructed at home from raw materials. Demonstrations were given during the evening with a Burndept Ethophone V loaned by Mr. H. E. Steel, the various items being heard clearly all over the hall. Various local firms exhibited sets and the numerous parts required by experimenters in constructing apparatus.



Members of the Cheltenham and District Wireless Association with their imposing display of apparatus. The Association held an exhibition on April 30th.

The Radio Society of Willesden.*

The annual general meeting of the Society was held at The Harlesden Public Library on April 17th.

The Committee formally resigned, and a new Committee was elected, the members being, Mr. D. G. Wyatt, Chairman; Mr. F. H. H. Coote, Hon. Secretary; Mr. J. E. Picker, Honorary Treasurer and Messrs. L. Bray, C. S. Swindin, E. Earnshaw-Wall, A. G. Greene, advisory members.

It was decided that the name of the Society should be changed from The Willesden Wireless Society to The Radio Society of Willesden.

All enquiries respecting the Society should be addressed to the Hon. Sec., F. H. H. Coote, 183, Carlton Vale, Kilburn, London, N.W.6.

Southampton and District Radio Society.*

At a recent meeting it was decided to meet in future at the Y.M.C.A., Ogle Road, Southampton, on Thursday evenings, weekly during the months October to May inclusive, and fortnightly during June to September inclusive.

The Hon. Secretary is now Mr. P. Sawyer, 55, Waterloo Road, Southampton, to whom all communications should be addressed.

The Prestwich and District Radio Society.*

A well attended meeting was held on Monday, April 23rd, in the National Schools library, when an excellent display of members' work, instruments and other apparatus excited general interest.

Hon. Sec., H. A. Wood, Spring Bank, Church Lane, Prestwich.

North Middlesex Wireless Club.*

On April 18th, owing to the unfortunate absence of the President, Mr. A. G. Arthur, through illness, the chair was taken by Mr. M. F. Symons.

Following "Question Time," conducted by Mr. L. C. Holton, Mr. R. Carriett, of the General Electric Company, gave a successful demonstration with the "Gecophone" amplifier and loud speaker (large model).

Mr. Carriett afterwards explained minutely the construction of the apparatus—luckily he had brought a screwdriver—and he was kept so busy answering the questions of his audience that it was only by extinguishing the lights one by one that the hall was cleared by closing time (11 p.m.)

Hon. Sec., H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

The Fulham and Putney Radio Society.*

At a crowded meeting held at Fulham House, Putney Bridge, on Friday, May 4th, Mr. H. B. Gardiner gave a lecture on "High Frequency Alternators and the Production of Wireless Waves."

Hon. Sec., J. W. Dewhurst, 52, North End Road, West Kensington, W.14.

Birmingham Experimental Wireless Club.*

The very remarkable advances recently made in amplification of wireless signals were ably demonstrated at a recent meeting by Mr. C. S. Baynton, who showed a particularly fine selection of apparatus. The lecturer first produced an ordinary crystal receiver and tuned in stations whose signals were just audible in the 'phones. These signals he then passed on to a two-valve power amplifier, using 300 volts H.T., the results being absolutely deafening in the loud speaker but quite free from distortion.

Hon. Sec., A. Leslie Lancaster, c/o Lancaster Bros. & Co., Shadwell Street, Birmingham.

Leyton Radio Association.*

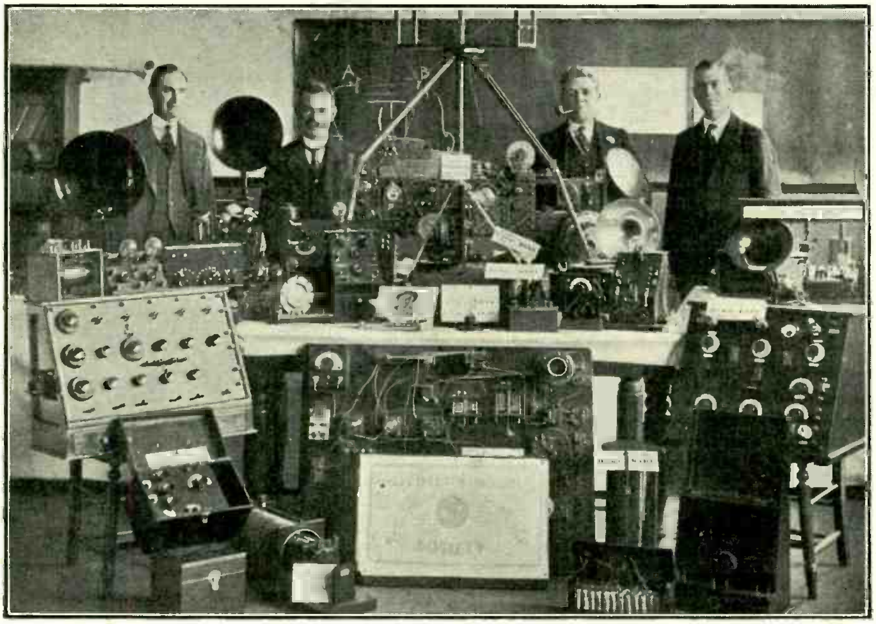
The ninth meeting of the Association was held at the Church Army Social Centre on May 1st.

After a short lecture by Mr. F. F. Betts, on the "Morse Code," the members listened in to **2 LO's** May Day concert.

New members will be welcomed by the Hon. Sec., Capt. H. Thorley, C.A., Church Army Social Centre, Goldsmith Road, E.10.

The Belvedere and District Radio and Scientific Society.*

On April 19th, 20th and 21st, a Radio Exhibition was held by the Society, when the fine display of members' apparatus seen in our illustration was on view. During the Exhibition, 1,321 people paid for admission, thus benefiting a local War Memorial Fund.



Photo, F. J. Fisher.

An admirable display of apparatus on view at the Exhibition held by the Belvedere and District Radio and Scientific Society on April 19th, 20th and 21st.

Lecturettes on "Popular Radio Subjects" were given by Mr. A. G. Warren, M.Sc., Mr. G. N. Hurst, A.M.I.E.E., Mr. T. E. Morriss and Mr. S. G. Meadows.

Hon. Sec., S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

Derby Wireless Club.*

The committee has been successful in obtaining a room for the use of the Club at Derby Chambers, St. Peter's Street, Derby.

Hon. Sec., "The Limes," Chellaston, Derby.

The West London Wireless and Experimental Association.*

On April 24th, Mr. T. W. Hyne Jones gave a supplementary paper to that given at the previous meeting, on "Charging Accumulators." The points dealt with were the ammeter and its uses; the resistance in form of lamps or potentiometer and method of using; the results obtained from too quick or too slow charging, etc., etc. Full particulars of the Association will gladly be furnished by the Hon. Sec., Horace W. Cotton, 19, Bushey Road, Harlington, Hayes, Middlesex.

Clubrooms: The Acton and Chiswick Polytechnic, Bath Road, Chiswick, W.4.

Oldham Wireless Society.

On Saturday, April 21st, 1923, the townspeople of Oldham were treated to the first wireless exhibition and demonstration ever held in the town. This was given by the Society in the S. Thomas's Schools, Coppice, Oldham.

The exhibition was held in the main central room, three stalls being apportioned to the members' exhibits, which were very varied and interesting, and four stalls to members of the trade. A demonstration was also held, consisting mainly of reception of speech and music from **2ZY**, being carried into the room and amplified by means of a Magnavox,

It is estimated that the proceeds will exceed £100.

Hon. Sec., Graham Halbert, 16, South Hill Street, Oldham.

Watford and District Radio Society.

On April 20th, Mr. E. C. Leader (Chairman) gave a lecture and demonstration on "The Unit System." Mr. Leader's home-constructed apparatus reflected the utmost credit on the Society's Chairman.

Hon. Sec., F. A. Moore, 175, Leavesden Road, Watford.

Evesham and District Radio Society.

The Society has now gone into vacation until September 18th. The Technical Committee has been instructed to have the Society's apparatus ready by that date. It is hoped, also, to have a library for the use of members.

All interested in wireless in the district are invited to communicate with the Hon. Sec., F. E. Mason, 50, Port Street, Evesham.

Haileybury College Wireless Society.

The Society has now been in existence for two terms. During the Easter term Lt.-Col. C. C. Champion, D.S.O., B.Sc., was elected President in place of Dr. T. Thomas, who has left the school.

Lectures have been given during the session on "Amplification Coupling," "Valves in Reception," "Elementary Wireless," "Condensers," and "Direction Finding."

The Society now possesses a two-valve receiver (H.F. and detector), and it is hoped to add two L.F. next term. Membership now amounts to 112.

Hon. Sec., D. K. Carter and J. B. Miller.

Radio Society of Birkenhead.

The last general meeting of the Society for the winter season was an open night and soirée, held on April 26th. The entertainment was contributed by members and by the Manchester Broadcasting Station, which was tuned in and rendered audible by means of a Gecophone two-valve receiver with power amplifier and loud speaker on the Society's indoor aerial. The lady members had very kindly undertaken to provide the refreshments, and to decorate the room, which was lighted by Japanese lanterns.

Hon. Sec., R. Watson, 35, Fairview Road, Oxton, Birkenhead.

New Society at Godalming.

A Society has been formed at Godalming for the study of Wireless and kindred subjects. Among the objects of the Society is the reduction of interference caused by the misuse of apparatus.

Full particulars of membership can be obtained from the Hon. Sec., A. T. Denyer, Godalming and District Radio Society, "Avisford," George Road, Farncombe, Godalming, Surrey.

Ashton-under-Lyne and District Radio Society.

The Society now meets on Monday evenings, instead of on alternate days, as previously. The Society's three-valve set is completed, and is made up of three units—high frequency, detector and low frequency. Extremely good results have been obtained. On Monday, April 30th, Mr. Ratcliffe, of Messrs. Meagher and Ratcliffe, Manchester, kindly lent a Brown amplifier and a new form of loud speaker for demonstration purposes.

Hon. Sec., James H. Marshall, 22, Warrington Street, Ashton-under-Lyne.

Fulham and Chelsea Amateur Radio and Social Society.

The Society held its first Dance and Soirée at the Chelsea Polytechnic on Saturday, April 21st. Nearly 150 people were present, and many of the members brought sets for exhibition. A four-valve Marconi set and a Concert Grand Loud speaker gave excellent results. Many interesting vocal items were provided, and on the whole the gathering was an immense success.

The Sunbeam (Moorfield) Wireless Society.

A very interesting demonstration of reception was given by the Society on Monday, April 23rd, to a company of about 200. The apparatus used was a two-valve receiving set with Western Electric loud speaking equipment, kindly loaned by Messrs Burns & Dodgeon, Dudley Street, Wolverhampton.

Hon. Sec., C. E. Beresford, Moorfield Works, Wolverhampton.

The Sydenham and Forest Hill Radio Society.

Mr. J. S. Cross recently gave an instructive lecture on "High Frequency and Low Frequency Amplification," fully explaining his remarks with diagrams.

A demonstration of the sensitising of telephones was recently given by the Secretary.

Local amateurs should communicate with the Hon. Sec., M. E. Hampshire, 139, Sydenham Road, S.E. 26.

Notes

Wireless Supersedes Cable in India.

The Madras Wireless Station is now being converted into a high speed automatic station. When the process of conversion is complete it will handle the Indo-Burma traffic, which has hitherto been dealt with by cable and land lines between Calcutta and Rangoon.

Another Experiment at 2 LO.

By the time these lines appear, an interesting experiment will have been made from **2 LO** to ascertain whether it is possible to broadcast one item simultaneously from every B.B.C. station in the country. An entertainment will be transmitted from the London station by land lines and then broadcast from each station.

New South Coast Broadcasting Station.

To the chagrin of other south coast towns, Bournemouth has been selected for the new B.B.C. station. Absence of shielding in the district has been the principal reason for the choice, and, in addition, there is said to be an abundance of local talent. Plymouth residents, in particular, are disappointed by the decision, and it is probable that some means of relaying concerts from **2 LO** or Bournemouth to the Plymouth area will have to be resorted to.

The accompanying portrait is of Mr. A. A. Campbell Swinton, F.R.S., who will be called as a witness before the Postmaster-General's Broadcast Committee. He will represent the interests of the amateurs and experimenters forming the membership of the Radio Society of Great Britain and affiliated Societies of Great Britain.

Miss Jessie Kenney, the first lady to qualify for the P.M.G.'s First Class Certificate in wireless operating since the severity of the test was increased in 1921. Miss Kenney has just passed the examination at a Cardiff wireless college.

A new broadcasting station is soon to be erected in the north of Scotland.

A Novel "Wireless Week."

Commencing on Monday, May 28th, a "Wireless Week" is to be inaugurated at the Electric Pavilion, 222, Lavender Hill, Clapham Junction, S.W.11. Some very interesting non-technical pictures entitled "Broadcasting: What it is and all about it," have been secured and will be exhibited each day at 3.30, 6.30 and 9.30 p.m.

The Theatre is also holding a competition for the best piece of home-made apparatus. There are no entrance fees and competitors will be divided into two classes—over and under sixteen years of age. The judges will be Mr. Harold S. Walker (**2 OM**) and Major Stevens, the prizes being presented by "The Pavilion."

During "Wireless Week," an exhibition of latest apparatus and novelties will be held in the Grand Vestibule, and many of the well-known manufacturing firms, as well as the press, will be represented.

East Indies Station Struck by Lightning.

On May 5th the Governor of the Dutch East Indies was to have inaugurated wireless communication with Holland from the station at Malabar by despatching a message to Queen Wilhelmina. Fate ruled otherwise, however, for the station was struck by lightning and so seriously damaged that communication will be impossible for some time.

British Amateurs Heard in Denmark.

Interesting extracts from his log have been sent to us by Mr. James Steffensen, of Ehlersvej 8, Hellerup, near Copenhagen. All reception has been accomplished on two valves (1 H.F. and Detector). The following stations have been heard by our correspondent during March and April :—

Call.	Date.	Wave-length.	Notes.
2 OD	Mar. 29	215 (?)	Fairly weak, steady, no A.C. hum.
8 AA	Mar. 29	225	Fairly strong, steady, unrectified A.C.
0 YS	Mar. 31	225	Fairly strong, steady, unrectified A.C.
2 JF	Apr. 8	(?)	Fairly strong, steady, no hum.
2 LG	Apr. 8	(?)	Fairly strong.
0 FN	Apr. 8	235	Fairly weak, steady, no A.C. hum.
5 NN	Apr. 8	225	Weak, steady, no hum, afternote, probably due to big H.T. condenser.
2 HF	Apr. 8	(?)	—
5 LC	Apr. 9	(?)	Readable 15 ft. from 'phones. No fading.
0 MX	Apr. 9	(?)	Strong, unrectified A.C.
2 KQ	Apr. 9	(?)	Fairly strong, unrectified A.C.

Mr. Steffensen would be glad to correspond with one or other of the many owners of low power transmitters.

The R.A.F. Pageant.

The Royal Air Force Pageant, which was instituted in 1920, will take place on Saturday, June 30th, at the London Aerodrome, Hendon, by arrangement with the Grahame White Company. It is hoped that H.M. the King will be present.

A programme fully equalling in interest those of previous years has been arranged, and will include demonstrations of aerial attack and defence. The proceeds will be devoted to Service charities.

P.M.G. and Broadcast Distress Calls.

Referring to the recent appeal from **2 LO** whereby a mother was enabled to reach the deathbed of her son, Sir W. Joynson Hicks stated in Parliamentary Debates that he did not think it desirable to make any permanent arrangement for the broadcasting of this kind of appeal. The general question, however, of the uses to which broadcasting should be put, he added, was one of the matters which the Broadcasting Committee had been asked to consider.

Praise for B.B.C. Staff.

In a letter we have received from Mr. Harry A. Epton, F.B.E.A., Chairman of the Hackney and District Radio Society, he describes as a wonderful experience his recent visit to **2 LO**. Mr. Epton was particularly impressed by the courtesy of Mr. Burrows, Mr. Palmer and the engineers, all of whom were willing to answer any questions. "Whatsoever is the outcome of the present broadcasting controversy," writes Mr. Epton, "I trust we shall not lose sight of the valuable and unselfish labour of the staff of the B.B.C."

The Late Dr. F. C. Knight.

It is with regret that we have to record the death on Monday, May 7th, of Dr. F. C. Knight, after an operation for appendicitis.

Dr. Knight was one of the original members of the London Wireless Club, which afterwards became the Wireless Society of London, and took a very active part in organising the Society. He was a keen experimenter in all branches of wireless and was probably one of the first in this country to use a valve. Before the war put an end to his experiments, he was practising with several American valves at his home in Islington. For two years prior to his death, Dr. Knight was President of the North London Radio Society.

Slow Speed Transmissions in Morse.

It is understood that for some months past daily instructional programmes of morse transmission have been sent out from Aldershot at graduated speeds on a wavelength of 1,900 metres. It has been possible to ascertain that the times of transmission etc., are as follows :—

Mondays, Wednesdays and Fridays.

2000–2004	Call up CQ v GGB.
2004–2022	Transmission at six words per minute.
2022–2023	Interval for changing operators.
2023–2041	Transmission at ten words per minute.
2041–2042	Interval for changing operators.
2042–2100	Transmission at fourteen words per minute.

Tuesdays and Thursdays.

2000–2004	Call up CQ v GGB.
2004–2022	Transmission at eight words per minute.
2022–2023	Interval for changing operators.
2023–2041	Transmission at twelve words per minute.
2041–2042	Interval for changing operators.
2042–2100	Transmission at sixteen words per minute.

These transmissions are made from a 6 kilowatt valve set, and it is understood that the purpose is for practice for Territorial Signal Units.

This information has been obtained through the Radio Society of Great Britain, which has ascertained that the War Office has no objection to its publication for the benefit of amateurs.

Air Ministry's Helicopter Competition.

Prizes amounting to £50,000 have been offered by the Air Council for the successful completion of tests applicable to a helicopter or equivalent type of flying machine. The closing date for entries is April 30th, 1924.

The flying machine must, among other tests, make a flight from a position of rest on the ground to a height of 2,000 feet and descend and land without damage in a wind exceeding ten but not exceeding twenty miles an hour. The machine will also be required to remain in a stable attitude for half-an-hour at an altitude of 2,000 feet. Other rigorous tests are included, so that the capture of the prize is hardly likely to be a "walk-over."

All communications in respect of the competition should be addressed to the Secretary, Air Ministry, Adastral House, Kingsway, London, W.C.2.

Improper Use of Call Sign.

A strong complaint is made by Mr. T. Hesketh, of Folkestone, of someone in the district who is regularly using his call sign (**2 SR**). Mr. Hesketh's attention has been drawn to the fact by reports of interference by his station, which, however, is not at present in use.

Book Review

Home Construction Made Easy is the subtitle of Mr. P. W. Harris's latest book,* and even a cursory glance through its pages proves the aptness of the description. Giving first some general hints for the constructor, such as the choice of raw materials, the most suitable gauges of wire and the laying out of panels, the author proceeds with clear and minute instructions for the making of five simple yet efficient sets and units, making use of components at present available on the market, where the building up of such parts is beyond the ability or facilities of the beginner. These comprise a Crystal Receiver, a Single-valve Magnifier, a Two-valve Set for wavelengths from 300 to 1,200 metres, a Two-valve Note Magnifier, and a Three-valve Universal Receiver. Each of these sets has stood the test of practical experience, for not only have they been built by the author and tested in his own private station, but they have also been reproduced in hundreds by readers of *Conquest*, in which magazine they were first described. The book concludes with a useful chapter on Indoor Aerials. Nearly 40 photographs and diagrams serve to simplify the explanations, and a commendable feature is the use of several photographs of each instrument taken from different angles.

This little book can be thoroughly recommended for the use of those who wish to take their first steps in the practical working of radio apparatus.

* *Practical Wireless Sets for All.* By Percy W. Harris. (London: The Wireless Press, Ltd., 12-13, Henrietta Street, Strand, W.C.2. Pp. 78. Price, 1s. 6d. Post free, 1s. 8d.).

Forthcoming Events

FRIDAY, MAY 18th.

Leeds and District Amateur Wireless Society. Lecture by Mr. A. F. Carter, A.M.I.E.E.

Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove. Lecture by Mr. C. T. Warren.

Belvedere and District Radio and Scientific Society. Lecture: "Insulators and Insulating Materials," by Mr. A. G. Warren, M.Sc., F.Inst.P.

MONDAY, MAY 21st.

Sydenham and Forest Hill Radio Society. At 8 p.m. At Greyhound Hotel, Sydenham, S.E.26. Lecture: "Elementary Electricity," by Mr. W. V. Pegden.

TUESDAY, MAY 22nd.

Plymouth Wireless and Scientific Society. At 8 p.m. At Plymouth Chambers, Old Town Street. Demonstration on Society's three-valve receiving set.

FRIDAY, MAY 25th.

Wireless Society of Hull and District. At 7.30 p.m. At the Co-operative Social Institute, Jarratt Street. Sale of members' surplus apparatus.

BROADCASTING.

GREAT BRITAIN.

Regular evening programmes, details of which appear in the daily Press, are now conducted from the following stations of the British Broadcasting Company:—

London	2 LO	369 metres.
Birmingham	5 IT	420 ,,
Manchester	2 ZY	385 ,,
Newcastle	5 NO	400 ,,
Cardiff	5 WA	353 ,,
Glasgow	5 SC	415 ,,

FRANCE.

Eiffel Tower. 2,600 metres. 12.15 a.m. weather reports (duration 10 mins.) 7.20 p.m., weather reports and concert (duration about 30 mins.) 11.10 p.m., weather reports (duration 10 mins.).

Radiola Concerts. 1,780 metres, 6.5 p.m. news; 6.15 p.m. concert till 7 p.m.; 9.45 p.m. news; 10 p.m., concert till 11 p.m.

L'Ecole Supérieure des Postes, Télégraphes et Téléphones de Paris. 450 metres. Tuesdays and Thursdays, 8.45 p.m. to 11 p.m. Saturdays, 5.30 p.m. to 8.30 p.m.

Lyons (YN). 3,100 metres, 1·5 kW. 11.45 a.m. to 12.15 p.m. daily (Sundays excepted). Gramophone records.

BELGIUM.

Brussels (BAV). 1,300 metres, 1 kW. Sunday, Tuesday and Thursday, 6 p.m.

HOLLAND.

PCGG. The Hague, 1,050 metres, Sunday: 4 to 6.40 p.m., Concert. Monday and Thursday: 9.40 to 10.40 p.m., Concert. (Monday concerts are sometimes given on 1,300 metres, notice of this being given on the previous Sunday.)

EXPERIMENTAL TRANSMITTING STATIONS

ALTERATIONS AND ADDITIONS.

The particulars given below include amendments and additions to the list of Experimental Transmitting Stations given in "The Year-Book of Wireless Telegraphy and Telephony, 1923," published by THE WIRELESS PRESS, LTD., which comprises 470 stations.

(*Previous amendment lists will be found on page* 116, *April 28th issue, and page* 157, *May 5th issue.*

5 HY	10 watts, Sp., C.W., I.C.W., Telephony & Duplex Telephony	Baynham Honri, Cromwell Hall, E. Finchley, N.2.
5 HZ	—	C. A. Carpenter, 10, Crossley Street, Sherwood, Nottingham.
5 ID	10 watts, C.W. & T., also Portable Set.	P. D. Coates, 55, Ennismore Street, Burnley.
5 IS	10 watts, C.W. & T.	J. S. Foord, 93, Herne Hill, S.E.24.
5 JN	10 watts, C.W. & T.	S. Wilkinson, Messrs. Bew & Co., Burslem, Staffs.
5 JZ	C.W., T. & T.T., Sp., Automatic Morse	H. J. Cheney, 363, Thimble Mill Lane, Nechells, Birmingham.
5 KB	10 watts, C.W. & T. Portable	F. Westrup Coomber, Electrical Engineer, 58, The Tything, Worcester.
5 KL	Artificial Aerial	G. M. Wood, 60, Pike's Lane, Glossop, Nr. Manchester.
5 KN	10 watts, C. W. & T.	E. J. Earnshaw, 95, Mayfield Road, Sanderstead.
5 KO	10 watts, C.W. & T.	I. W. Higgs and J. S. Hobbs, 45, Howard Road, Westbury Park, Bristol.
5 KY	—	E. E. G. Allsopp, Ingle Nook, Wigginton Road, Tamworth.
5 LA	Portable.	L. H. Soundy, 60, Bellevue Road, Ealing.
5 LO	C.W., T.T. & T.	J. W. Clough, 142, Revidge Road, Blackburn.
5 LP	10 watts, C.W. & T.	L. W. Pullman, 213, Golders Green Road, N.W.11.
5 LV	10 watts, C.W. & T.	N. Willson, "Claremont," Tenbury Road, Kings Heath, Birmingham.
5 LZ	10 watts, C.W. & T.	A. G. S. Gwinn, 61, Carnarvon Rd., Stratford, E. 5.
5 MD	10 watts, C.W. & T.	R. W. Hardisty, 5, Ethelbert Road, Canterbury.
5 MO	10 watts, C.W. & T.	W. Guthrie Dixon, "Dipwood," Rowlands Gill, Newcastle-on-Tyne.
5 MP	10 watts, C.W. & T.	Colin Bain, 51, Grainger St., Newcastle-on-Tyne.
5 MS	1,000 watts, C.W. T. & Sp.	Manchester W'less Society, Houldsworth Hall, Deansgate, Manchester.
5 MT	1 kW. ..	Manchester W'less Society, Houldsworth Hall, Deansgate, Manchester.
5 ND	—	J. H. Taylor & Co., Electrical Engineers, Macauley Street, Huddersfield.
5 NF	—	R. W. Galpin, Bank House, Herne Bay, Kent.
5 NH	10 watts, C.W., T. & T.T.	A. C. Hulme, 39, Poplar Avenue, Edgbaston, Birmingham.
5 NN	10 watts, C.W. & T.	J. H. R. Ridley, "Studley," 106, Woodside Gn., South Norwood, S.E.25.
5 NP	Telephony, C.W. & T.	Eric P. Burgess, 2, Queen's Road, Manningham, Bradford, Yorks.
5 OD	—	Ralph Bates, "Holmeside," St. Catherines, Lincoln.
5 OL	C.W., I.C.W.	John F. Cullen, 68, Queen's Drive, West Derby, Liverpool.
5 OT	10 watts, C.W. & T.	F. J. Wood, "Belmont," Upper Colwyn Bay, N. Wales.
5 OX	10 watts, C.W., T.T. and T. Portable.	C. H. F. Hubbard, 196, Putney Bridge Rd., S.W.15.
5 OY	—	Belvedere and District Radio and Scientific Soc., Erith Technical Institute.
5 PU	10 watts ..	T. Allison, 33, Wilton Gr., Merton Park, S.W.
5 PV	10 watts, C.W. & T.	R. G. Templar, 52, Alderville Road, Hurlingham.
5 QB	Telephony, C.W. & Sp., Artificial Aerial	A. G. Bainton, 8, Palace Road, Streatham Hill, S.W.2.
5 QV	10 watts, Sp., C.W. & T.	F. L. Stollery, "Fairmead," Vista Road, Clacton-on-Sea.
5 QX	—	Messrs. Holt & Dedman, Radio Engrs., 6, Raby Rd., New Malden, Surrey.
5 RC	C.W. & T. ..	W. Brierley, 59, Gayner Park, Filton, Bristol.

(*Further lists will appear in subsequent issues*).

Questions and Answers

"CURIOUS" (Epsom) *asks for the name and address of the manufacturers of a certain type of accumulator.*

We regret we do not know the manufacturers of the type of accumulator referred to, but we suggest you place the repair of the accumulator in the hands of any competent firm of electricians.

"W.G." (Watford) *asks* (1) *For criticism of circuit submitted.* (2) *Whether the arrangement for changing from valve to crystal rectifier is correct.* (3) *Is it an improvement to connect a variable condenser across the reaction coil.*

(1) and (2) The diagram of connections is practically correct, although we do not care for the method of connecting the switches to change from crystal to valve rectifier. We suggest you use the circuit given in reply to **"F.W.S." (Redditch)**, page 95, April 21st issue. (3) It is often of assistance to tune the reaction coil.

"J.D." (Surrey) *asks for a diagram of a five-valve receiver, with one high frequency, one detector, and three L.F. valves.*

The diagram is given in Fig. 1. The tuned anode method of high frequency amplification is used. Suitable condenser values are given. It will be noticed the reaction coil is coupled with the tuned anode winding.

"C.M.L.S." (Surrey) *asks* (1) *For a diagram of a one-valve receiver, suitable for the reception of long wavelength signals.* (2) *With reference to the diagram Fig. 5, page 678, is not the diagram incomplete, so far as the aerial circuit is concerned.* (3) *What is the approximate wavelength range of a coil 4″ in diameter and 8″ long, wound with No. 24.* (4) *What would be the dimensions of a suitable secondary coil to work with the coil mentioned in* (3).

(1) A suitable diagram is given in Fig. 2. (2) The diagram referred to is quite correct. The aerial tuning condenser is in parallel with the aerial tuning inductance. The grid leak and condenser is connected to one side of the inductance and the filament circuit to the other side. (3) If the coil is of the ordinary cylindrical type with a slider, the wavelength range will be approximately from 200 to 2,000 metres. (4) A suitable secondary coil would be 3″ in diameter and 8″ long, wound with No. 28 S.S.C. wire. Eight tappings should be taken.

"J.H." (Bishop's Stortford) *submits a diagram of his receiver, and asks* (1) *Is the circuit correct.* (2) *What is the cause of the howling.* (3) *Is the apparatus arranged too closely together.* (4) *Would it help to cover the box containing the apparatus with tinfoil.*

(1) and (2) The diagram is correct, except that the connection between the secondary of the high frequency transformer should be taken to + L.T.

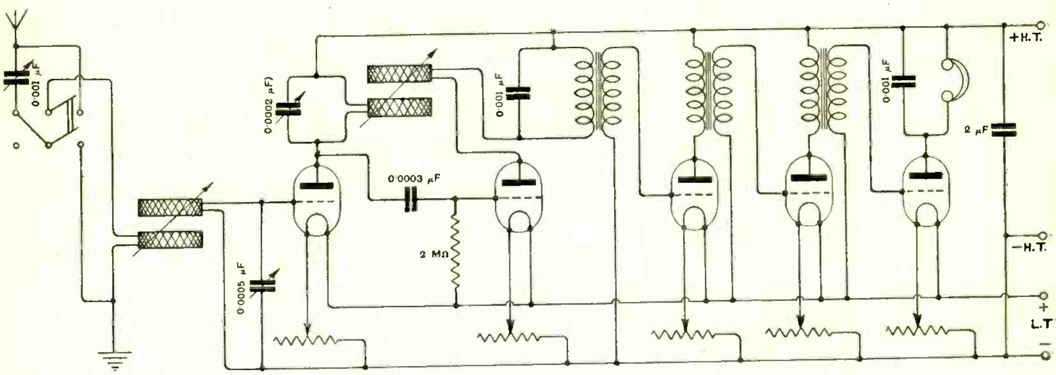


Fig. 1. **"J. D." (Surrey).** *A five-valve receiver with one H.F., rectifier, and three L.F. connected valves. Suitable for the reception of signals of any wavelength.*

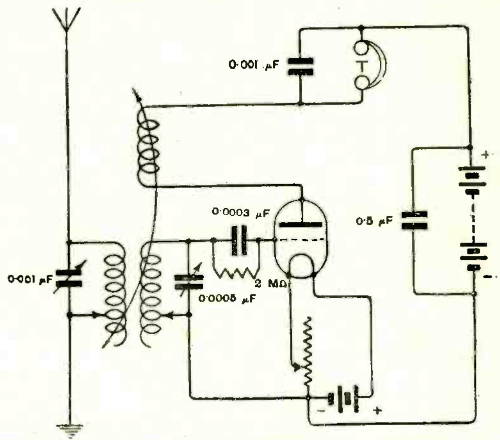


Fig. 2. **"C.M.L.S." (Surrey).** *Single-valve reacting receiver. Not suitable for the reception of broadcast transmissions, but very satisfactory for long wave work.*

When the detector valve alone is in circuit and the reaction coil is functioning properly, it will be necessary to reverse the reaction coil upon switching in the high frequency connected valve. (3) The apparatus is not too closely crowded together. (4) We do not think any great advantage will be gained through covering the box with tinfoil in the manner suggested.

"MORSE" (Penzance) *asks for particulars of high frequency transformers of the plug-in type suitable for use with wavelengths of 350 metres upwards.*

With a former of outside diameter of 2·6'' and $\frac{5}{8}$'' wide, slot $\frac{5}{16}$'' wide and $\frac{3}{8}$'' deep, 120 turns for the primary and secondary winding of No. 30 D.S.C. wire will be satisfactory for operation between 300 and 450 metres. For the higher wavelengths we suggest you wind transformers having 180, 250, 320, 400 and 500 turns for both primary and secondary windings. For the transformers with the larger number of turns, No. 36 double silk covered wire will be found satisfactory. With transformers of this description best results are only obtained after a little experimental work, but the values given will be found very useful as a guide in the work.

the receiver as shown in recent issues of *The Wireless World and Radio Review.* If you follow out the instructions carefully, you will be able to make the receiver without trouble. If, on the other hand, you wish to purchase a receiver, we suggest you examine the advertisement pages of this journal.

"ATOM" (Dulwich) *asks* (1) *For a diagram of a receiver with two high frequency and one rectifying valves. It is required that the first valve shall amplify either with the aid of a resistance or a tuned anode coupling. The second amplifier is to have in its anode circuit a resistance. A switch is to be provided, so that a crystal rectifier may be used in place of the valve rectifier when required.*

(1) The diagram is given in Fig. 3, and suitable values are given. In the aerial circuit we have a switch D which connects the aerial condenser in series or parallel with the aerial tuning coil. Switch E is the stand-by tuned switch. Switch C connects the reaction coil so that it may be coupled with either the tuned anode coil or the aerial coil. With switch A to the left, the tuned anode winding is in circuit, while when the switch is to the right, the anode resistance is connected in

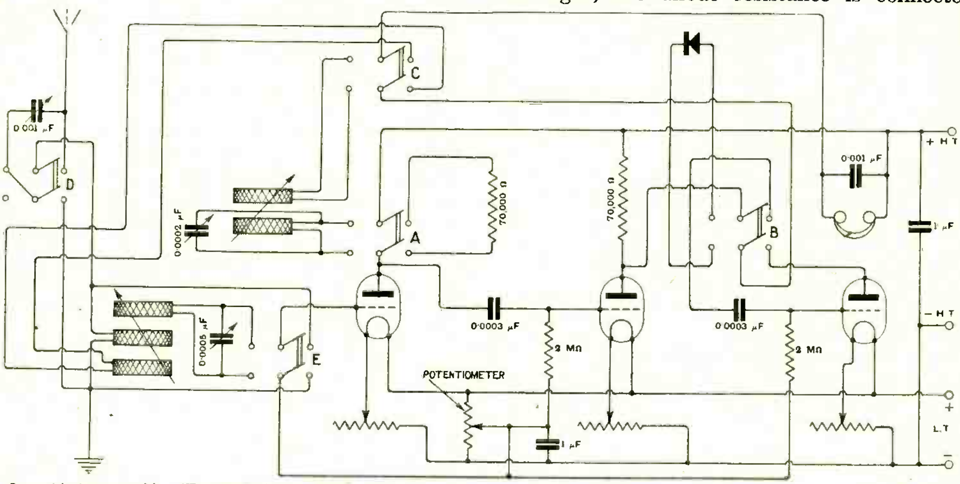


Fig. 3. **"Atom" (Dulwich).** *This is the diagram of a three-valve receiver. Switch D is a series-parallel switch, switch E a tune-stand-by switch. With the switch A in position A, the anode resistance is connected, while in the other position the tuned anode circuit is connected. Switch C is for reversing the reaction. With switch B in position B, the rectifying valve is connected, while when the switch is in the other position the crystal is used as a rectifier.*

circuit. With switch **B** to the left, the valve rectifier is used, the upper contact of the switch closing the circuit for the grid condenser and leak, while the lower contact closes the anode circuit through the telephone to +H.T. With the switch to the left the crystal rectifier is connected.

"L.S.G.H." (S.W.6) *asks for particulars of a coil which may be used as a tuned anode coil, and which will have a wavelength range from 150 to 4,000 metres.*

The exact design of such a coil, when it is to be wound in slots in a former of the dimensions given, can only be determined by experiment. We suggest you wind the slots with 90 turns of No. 36 single silk covered wire. Twelve slots should be used and 12 tappings taken.

"J.R." (Belfast).—We suggest you purchase a receiver comprising one high frequency valve, crystal rectifier, and one valve note magnifier. The receiver could be built from parts, and the cost would not exceed the amount which you are prepared to spend. We suggest you construct

"J.H." (W.4) *asks questions regarding the charging of his accumulators.*

We suggest you charge the 30 ampere hour accumulator at 3 amperes. The charging will probably have to be carried on for 14 hours. Assuming that the pressure across the accumulator when on charge is 7 volts, the pressure to be absorbed in the resistance is 230 minus 7 volts, or 223 volts. As the current is 3 amperes, the resistance may be obtained from Ohm's law, and is equal to the pressure divided by the current. In this case 223 divided by 3 gives 74 ohms. The watts taken from the circuit is given by the product of the pressure across the mains, and the current flowing in the circuit, which is 230 times 3, or 690 watts. The number of units used is given by the product of kilowatts and time. If you charge the accumulator for 14 hours, the units taken will be 12·36.

circuit of the rectifying valve. It would be an advantage to connect a 0·001 mfd. condenser across the telephones themselves, so that when the plug is inserted in any jack, the telephones are shunted by a 0·001 mfd. condenser. The method of connecting the transformers is correct, but the correct method depends upon the winding adopted by the manufacturers, and when you purchase a low frequency transformer you should enquire

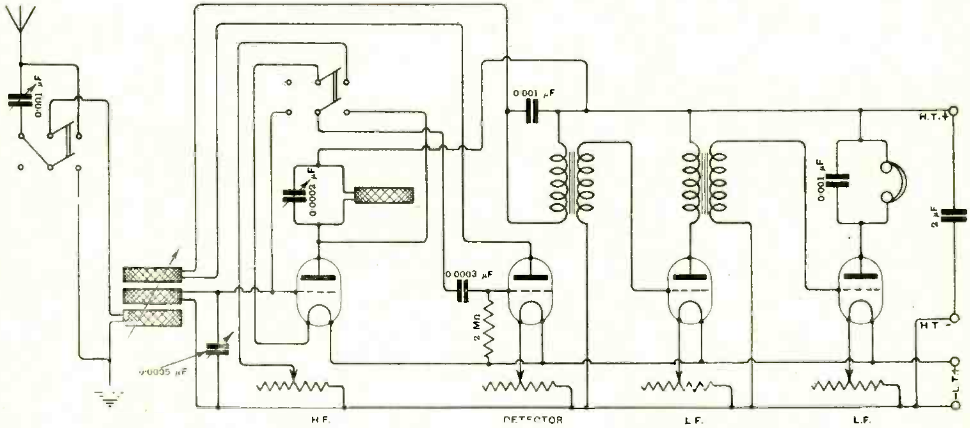


Fig. 4. **"Sparks" (Cheshire).** *Here is a four-valve receiver with one high frequency connected valve, rectifier and two note magnifiers. The first valve may be cut out when required with the switch. The circuit is quite suitable for the reception of broadcast transmissions, provided the reaction coil is not used.*

"SPARKS" (Cheshire) *asks for a diagram of a four-valve receiver, with a switch to cut out the first valve.*

The diagram is given in Fig. 4. The switch in the aerial circuit joins the aerial condenser in series or in parallel with the aerial tuning coil. A switch is provided to connect or disconnect the high frequency valve as required. The second valve operates as a rectifier, and the third and fourth as note magnifiers. Suitable values are given. To receive the broadcast transmissions, the anode coil may be a No. 75 honeycomb coil, the closed circuit a No. 50, and with the aerial condenser in series the aerial coil may be a No. 75. The reaction coil could be a No. 35.

"J.C." (N.W.8) *asks* (1) *Is there any advantage in connecting a fixed condenser across the primary winding of intervalve transformers.* (2) *With reference to the four-valve receiver described in the issue of March 24th, is the* 0·001 *mfd. fixed condenser permanently connected in the anode circuit of the detector valve.* (3) *Is it correct to connect the transformers as shown.* (4) *Could a diagram be given showing how to add another high frequency connected valve to use in conjunction with the four-valve receiver described in March 24th issue.*

(1) There is no advantage in connecting a fixed condenser across each of the primary windings of the transformers. (2) The 0·001 mfd. condenser shown in the diagram on page 822 of the March 24th issue is permanently connected across the primary winding of the transformer joined in the anode circuit of the rectifying valve. It would be an advantage to connect a 0·001 mfd. condenser across the telephones themselves, so that when the plug is inserted in any jack, the telephones are shunted by a 0·001 mfd. condenser. The method of connecting the transformers is correct, but the correct method depends upon the winding adopted by the manufacturers, and when you purchase a low frequency transformer you should enquire the correct method of joining it in the circuit. (4) The diagram is given in Fig. 5. The unit is connected in front of the four-valve receiver. The switch A is for the purpose of cutting out the grid leak and condenser when the second H.F. valve is cut out.

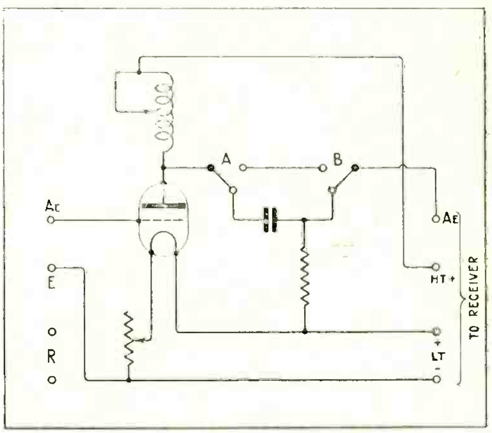


Fig. 5. **"J.C." (N.W.8).**

"L.C.T." (Birmingham) *submits a diagram of his receiver and asks why the results obtained are not good.*

The diagram is correct, except that the condenser and resistance marked R2 are not required. The H.T. battery should be connected between − L.T and one end of the telephone transformer, the intervalve transformer and the anode coil. The ¼ megohm resistance serves no useful purpose. You might connect the condenser across the telephone transformer if it has a value of the order of 0·001 or 0·002 mfds. The value of the H.T. battery should be adjusted, as the voltage is probably too high at present.

"G.L.R." (Falmouth) *asks* (1) *Whether the use of a closed circuit will help him to cut out interfering signals.* (2) *What is the dielectric constant of air.*

(1) The use of the circuit sketched in your diagram No. 2 is to be recommended; although you may find adjustments are rather critical, the results obtained will be very much worth while, if you succeed in cutting out the interfering signals. The condenser C should have a value of 0·0005 mfds. Coils A and B should each be No. 50 coils. The No. 50 coil which is connected with the receiver should be tuned with a 0·0005 mfd. condenser. (2) The dielectric constant of air is taken as unity.

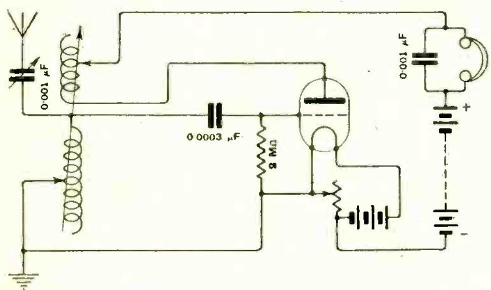


Fig. 6. **"W.H.T." (S.E.5).** *Diagram of a single valve receiver—not recommended for the reception of Broadcast transmissions.*

"W.H.T." (S.E.5) *asks for the wiring diagram of a single valve receiver, with particulars of winding.*

The diagram is given in Fig. 6. The aerial coil could be 4″ in diameter and 4″ long, wound full of No. 22 D.C.C., with twelve tappings. The reaction coil could be 3″ in diameter and 3″ long, wound full of No. 26 D.C.C., with four tappings. We do not recommend the use of single-valve reaction circuits for the reception of broadcast transmissions.

"H.T." (S.W.9) *asks* (1) *With reference to the four-valve receiver described in the issue of March 24th, will there be any great loss in efficiency if the jacks and filament resistances are mounted on a wooden panel.* (2) *Is it possible to construct the tapped anode reactance one's self.* (3) *Is the proposed loose coupler likely to be satisfactory.* (4) *Would an inductance coil consisting of a former 9¼ in. long × 5 in. in diameter, wound with 300 turns of No. 28 D.C.C. wire prove satisfactory. Would the results be better if plug-in type coils were used in conjunction with a coil holder.*

(1) It is better, of course, to mount the components on ebonite, but so long as you only mount the filament resistances and jacks upon the wood, there will not be any appreciable loss. The terminals for the aerial, earth, and positive + H.T. should be mounted upon ebonite. It is very bad practice to mount portions of the receiver which carry high frequency currents upon wood. If the wood becomes at all damp, leakage will be very serious, and the signal strength very much reduced. (2) We think you might construct the anode coil yourself. We suggest a single layer coil 4 in. in diameter and 6 in. long, wound with No. 32 single silk covered wire with 18 tappings. You could tune this coil with a small tuning condenser, such as a 0.0001 condenser. For longer wavelengths we suggest you use the resistance capacity method of high frequency amplification, and the anode resistance, which may be of 100,000 ohms, should be connected in place of the coil. (3) and (4). For the reception of short wavelength signals, we recommend the use of a single layer coil wound with No. 18 D.C.C. The coil could be 4 in. in diameter and 4 in. long, wound with this wire, with tappings taken from each 10 or 15 turns. The secondary coil could be 3½ in. in diameter and 4 in. long, wound with No. 22 D.C.C., with tappings from each 15 turns. For the longer wavelengths you could add plug-in coils. On the whole, we think you would do better by using a three-coil stand with a set of plug-in coils.

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 petents, 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.*

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Atmospherics in Wireless Reception.

One of the greatest hindrances in wireless development, especially in long distance communications, is the interference which is caused by atmospheric disturbances.

Atmospherics have always been and still are the bugbear of the radio engineer, and whilst vast strides are daily being made in improvements in methods of transmission and reception of radiotelegraphy and telephony, the old problem of atmospherics still remains. Many people in this country are experiencing this phenomenon for the first time, for with the advent of warmer weather during the past week or so there has been a marked increase in such interference, especially in some parts of the country. Those who are in touch with new users of wireless apparatus should make a special point of explaining the cause of these distressing interruptions in reception, for it has been brought to our notice through much correspondence that a large number of new users of apparatus are not able to understand the cause of the trouble, and in many cases are blaming their apparatus, or, in the case of broadcast transmissions, the actual transmitting station is blamed! Radio societies in particular are in a position to impart the necessary information in this direction.

A very important paper on the nature of atmospherics was read recently before the Royal Society by R. A. W. Watt and E. V. Appleton, in which experiments were described made between January 27th and February 12th of this year, mostly between the hours of 7 p.m. and 11 p.m. The number of atmospherics recorded during ten days was 590, and many interesting observations on their characteristics were made.

Another matter which is in the category of phenomena not yet fully explained is the variation in strength of signals during the transition period between daylight and darkness. This is a matter which is far more apparent with weak signals than with strong. Those who have been accustomed to listening in to broadcast transmissions will probably have noticed that since the change to Summer time, when a period of twilight occurs during broadcast hours, a variation in signal strength is quite apparent, particularly to those at a distance from a broadcast station.

The cause of this fading is of course distinct from the "normal" fading which is so frequently commented upon in connection with telephony transmissions.

EXPERIMENTAL FOUR-VALVE RECEIVER.

LOW FREQUENCY POWER AMPLIFIER UNIT.

By F. H. HAYNES.

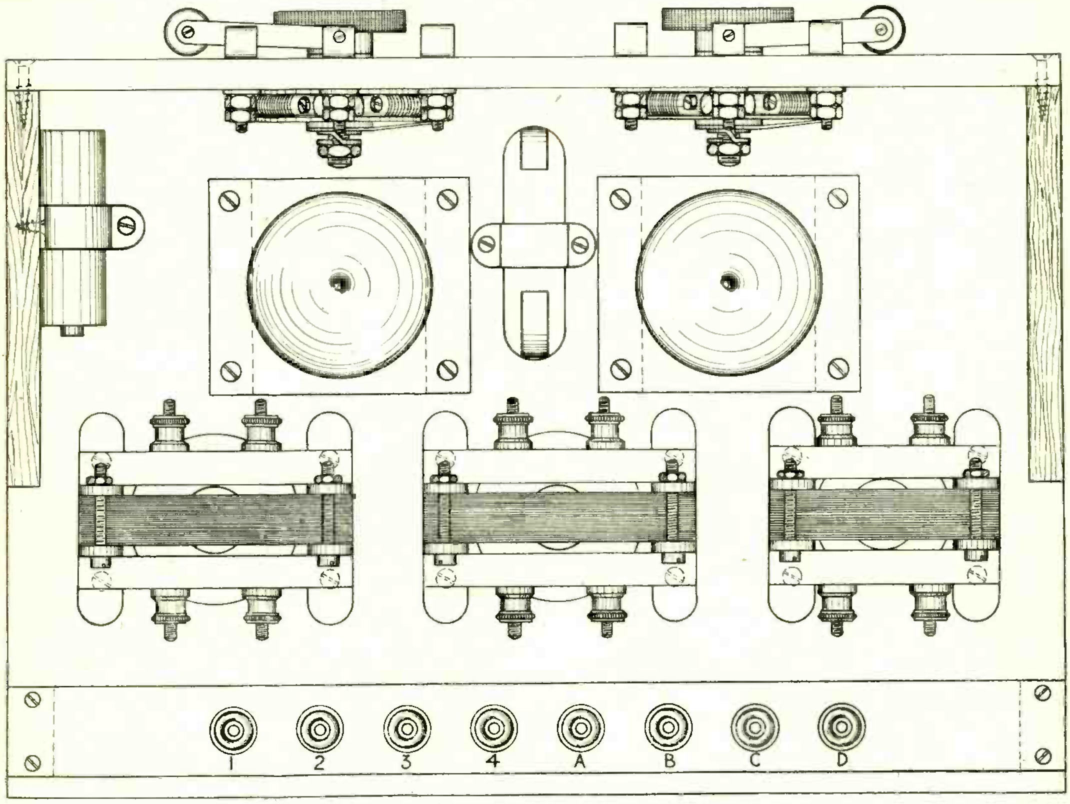
The principle of power amplification is employed when it is desired to get the maximum magnification in low frequency amplifying circuits. This unit, together with the tuning, detector and high frequency units already described, completes the construction of a highly efficient four-valve receiver.

INTENDED for use with the tuning, detector and high frequency units already described. this power amplifier can well be made up where it is desired to operate a loud speaker from any type of receiving apparatus. The design is based upon that adopted in the previous units, and consequently the general dimensions are ample for the size of the components to be supported, but if space is a consideration it is easy to build an equally effective instrument using a panel not quite so tall as that shown in the diagrams.

The following components are required for the construction of the unit :—

A piece of best quality polished ebonite $\frac{5}{16}$ in. in thickness, and of a size suitable for finishing a panel to $12\frac{1}{8}$ ins. by 8 ins., and a strip 12 ins. by 1 in.

Two circular pattern filament resistances.



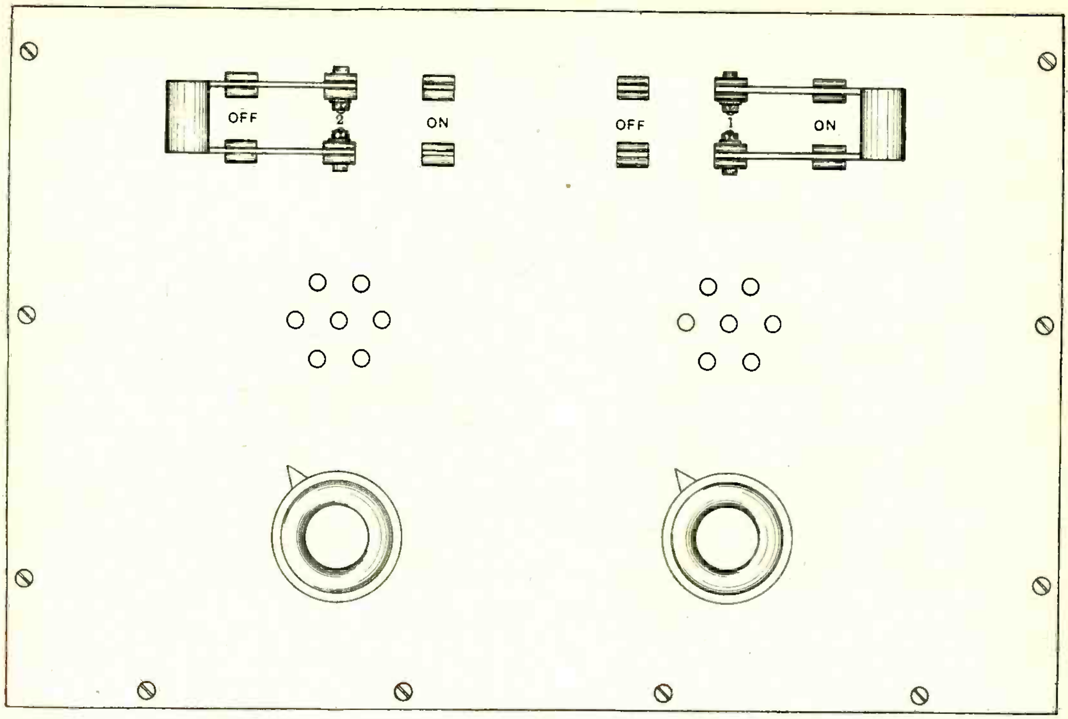
The layout of the components on the baseboard.

Two valve holders.

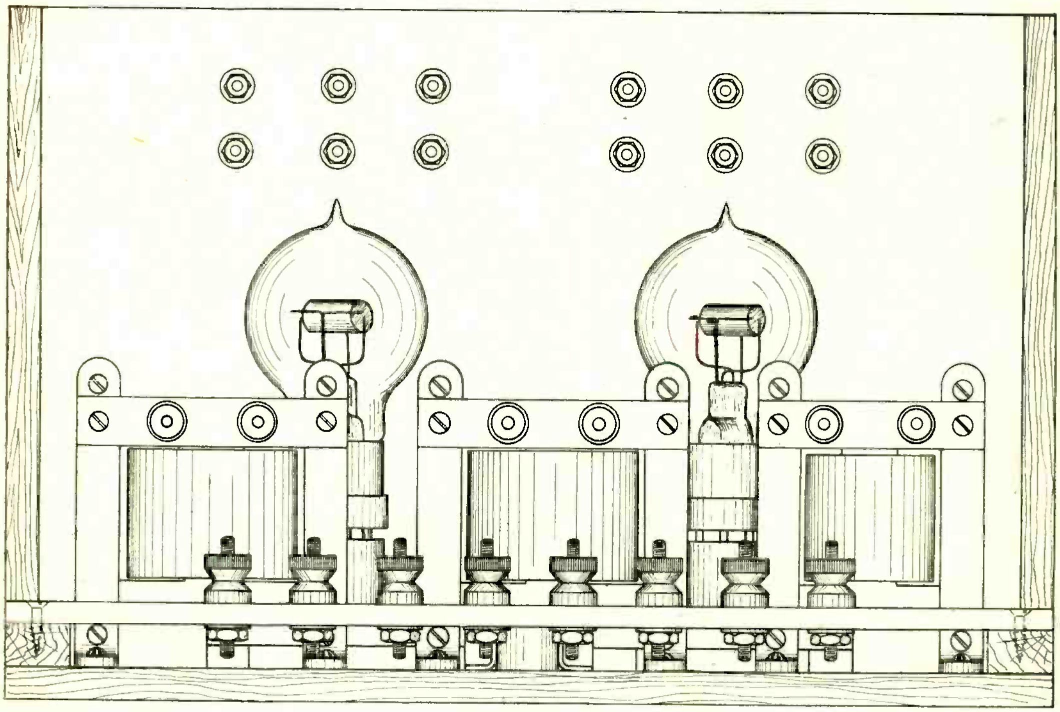
The arms and contacts of two double-pole two-position switches, as used previously.

Eight terminals.

A $4\frac{1}{2}$-volt battery such as is used in a

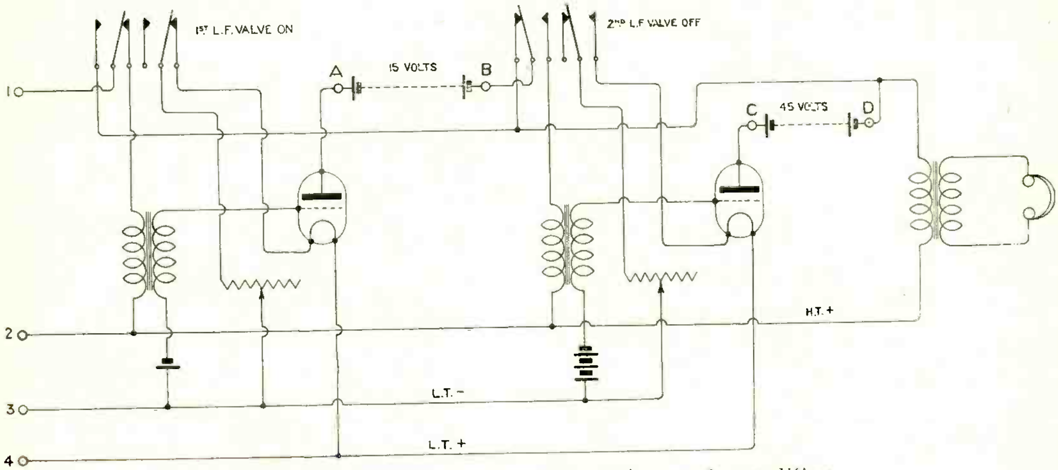


Front view of the panel.



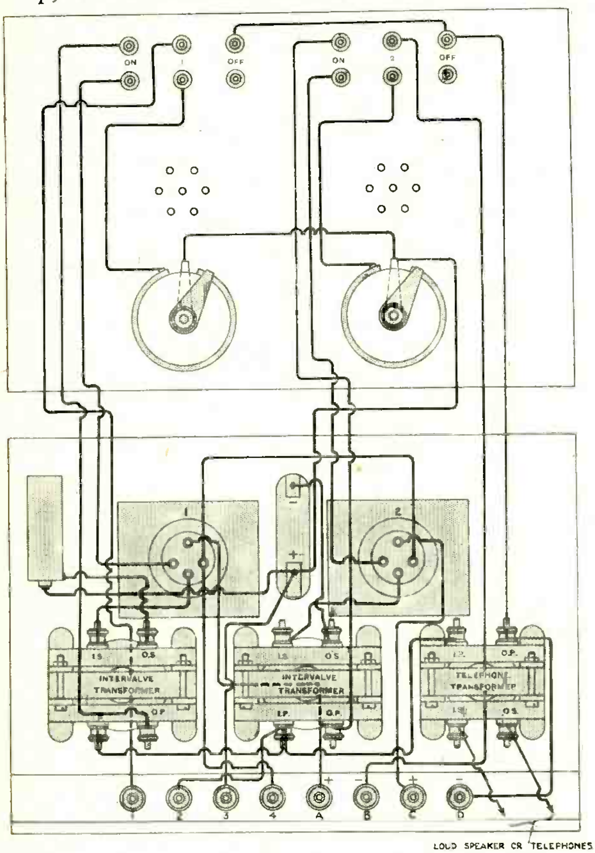
Back view.

pocket lamp, and also a single cell removed from such a battery.



Double pole switches are arranged for cutting out the amplifiers.

Wire and insulating tubing for connecting up, and various brass screws.



Practical diagram of connections.

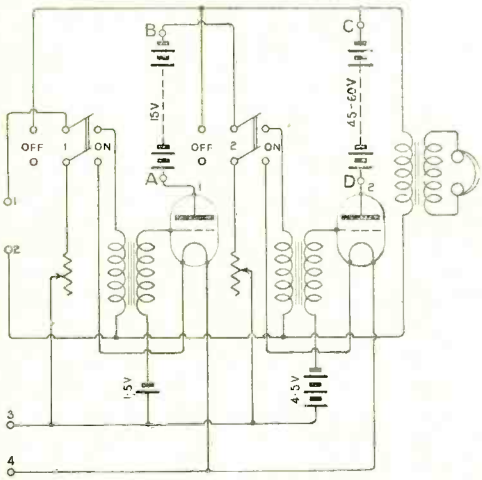
A piece of hard wood for a baseboard, which should measure 12 ins. by 6 ins. by $\frac{5}{8}$ in. Another piece of wood will also be required $7\frac{1}{2}$ ins. by 6 ins. by $\frac{1}{2}$ in., from which end pieces can be made when it is sawn diagonally.

Two intervalve transformers and a telephone transformer, all of reliable make.

With regard to the selecting of intervalve transformers, large types will be found the most reliable. A large transformer may be wound with wire of a gauge suitable to pass the required current, and the space provided for the winding allows of the use of ample turns. Small transformers invariably sacrifice one or both of these desirable features. When purchasing, one should ascertain the number of turns with which the transformer is wound. This should be 30,000 or more, and the ratio of the number of primary turns to the number of secondary turns should never exceed 1 to 4 when used with British "R" type valves.

Should it be the aim of the reader to construct an amplifier for use after a crystal detector, it is the recognised practice to adopt a lower ratio than this, the reason being that the crystal delivers a much smaller current than a valve, and consequently finer wire may be used and more turns included in a given space Especially is it desirable that ample turns be included for the purpose of building up the necessary ampere turns from the small current produced by the crystal. A transformer for this purpose should have a ratio of about 1 or $1\frac{1}{2}$ to 1.

In view of the tendency of closed core transformers to operate better on certain note frequencies than on others, thereby producing distortion, it will be found that in several modern power amplifiers open core transformers are employed, or those in which the core consists only of a bundle of fine wires in the centre of the winding and equal to it in length. Such transformers must not be assembled close together, as the lines of force around one may link up with those of another and produce oscillations at audio frequency. Partially closed core transformers are sometimes made by enclosing the open core type in iron boxes, which improves the efficiency to just such a degree as may be permitted without the introduction of serious distortion, at the same time obtaining thorough screening.



Circuit making use of key switches.

Returning to the design of the instrument, it will be noticed that a cell is arranged to provide an additional negative potential for the grid of the first valve, and that a small battery provides an additional $4\frac{1}{2}$ volts negative to the grid of the second valve. In addition, terminals A and B are arranged so that extra H.T. potential may be applied to the first valve, while C and D supply the second. With the additional voltages shown in the circuit diagram "R" or "L.S.3" valves may be used in the amplifier, whilst higher voltages can be arranged to suit special power amplifying valves such as "L.S.1" and "L.S.2." One is reminded that unless suitable transformers are employed the windings may be destroyed with the latter types of valves.

The switches for cutting out the valves of the amplifier are of the same type as used in the tuning and high frequency amplifying circuits, but it is not essential to the working of this unit to employ low capacity switches of this type. Should it be desired to use key or "Dewar" switches, a circuit is given showing an amended method of wiring. Only half of the contacts of each "Dewar" switch are made use of, and thus the two sides may be paralleled across.

When this unit is not used in conjunction with the corresponding detector unit it is necessary to connect a condenser having a value of between 1 and 2 microfarads across terminals 2 and 4, which then become H.T. plus and minus respectively, while terminals 3 and 4 become L.T. plus and minus. Terminals 1 and 2 are connected to the telephone terminals of the detector valve apparatus.

This article completes the construction of an effective four-valve station in which provision is made for just such circuit changes as are required by the experimenter, and from the principles embodied it may be expected to rival in results any receiving equipment however elaborate.

An interesting article will appear in our next issue, describing the broadcasting arrangements in Germany, and will be followed by details of the design of German broadcast receiving apparatus.

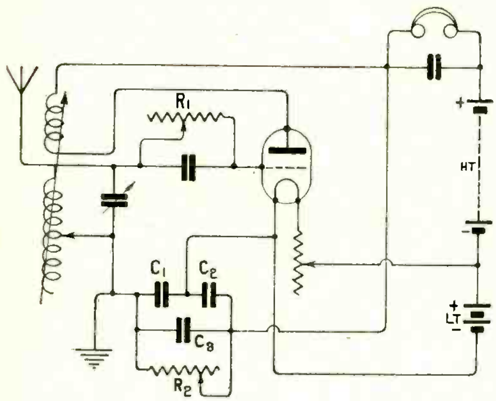
SOME PRACTICAL NOTES ON

THE FLEWELLING CIRCUIT

Since the publication for the first time in this country, in the issue of April 21st, 1923, of details of a new circuit attributed to Mr. E. T. Flewelling, many experimenters have carried out tests with the arrangement described. The results obtained by certain experimenters are given below. The Editor will be pleased to receive reports concerning the operation of this circuit, which it is believed give interesting results, and provides a field for research.

E. Plater and G. Oddie.

HAVING seen the article "A New Circuit" in *The Wireless World and Radio Review* of April 21st, we decided that the circuit given was well worth a trial. Accordingly we arranged the apparatus in the manner shown in the diagram. An outside aerial was not used for fear of radiation, but instead a wire about 4 ft. long was hung up.



Circuit described by Messrs. Plater & Oddie.

On switching on the filament and H.T. batteries the set was found to be oscillating strongly, although the reaction coil was at right angles to the A.T.I., and when the reaction coupling was increased considerably, the high-pitched whistle, mentioned in the article referred to above, was heard, whose frequency could be varied by adjustment of the grid leak, and to a smaller extent by means of the other variable resistance. On tuning the aerial circuit and adjusting the resistances, 2 LO was heard, distorted, and in the midst of about a dozen "carriers" which came in one after the other as the aerial condenser was varied. By adjusting the two resistances distortion was almost entirely eliminated, that which still remained being probably due to the high whistle which we have not succeeded in eliminating without also eliminating the good results.

The adjustment of the reaction coil is rather critical, and the adjustment of the two resistances R_1 and R_2 very critical for best results.

The H.T. used was almost 50 volts, with an "R" valve. C_2 may be omitted with very little corresponding alteration of results, or C_1 may be short circuited, but in this case it must be remembered that the H.T. will be leaking through R_2 which must therefore be kept high.

The A.T.C. should be kept as low as possible, and therefore a slider or fine tapping switch should be used. The condenser used in the experiments has a maximum of 0·0003 μF, and about 30° of this decreases the efficiency quite noticeably.

The A.T.I. used was 70 turns of No. 18 enamelled wire on a former $3\frac{1}{2}$ ins. in diameter, with a reaction coil of 125 turns of No. 30 D.C.C. on a $2\frac{1}{2}$-in. former.

The following values of the fixed condensers were used satisfactorily :—

$C_1 = 0{\cdot}25\mu F$
$C_2 = 0{\cdot}006\mu F$
$C_3 = 0{\cdot}006\mu F$

The valve which gave best results was a repaired "R."

After a few hours' experimenting the results were brought up to equal what we are able to obtain on a single-valve "super," the handling being much simpler.

Using the small aerial situated at Luton, many of the London amateurs came in quite strongly, particularly 2 FQ. With no aerial or earth, results were only very slightly decreased, and all the broadcasting stations have been heard without either. The outside aerial seems to affect the working of the set in some way and results are not much better.

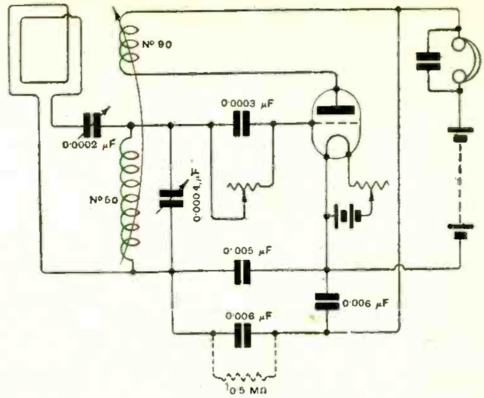
Dr. Wortley Talbot.

In response to your request for reports on the Flewelling circuit, I would draw the attention of readers to the fact that I have had very good results both with the single valve set and also with an amplifying valve. From here (Torquay) I have heard **2 LO** clearly, but faintly, on the one-valve, and I also received good spark signals. On the addition of the second valve I got splendid results as regards telephony. Recently I received Glasgow clearly and loudly, Birmingham very good and strong, Manchester good, London very good indeed, and Cardiff quite good. There was complete absence of interference. My aerial is the usual 100 feet of single wire about 40 feet high. On April 27th, I heard perfectly clearly the Post and Telegraphs in Paris broadcasting opera, and the clapping by the audience was quite plain. On the following evening I got Eiffel Tower at 7.30 p.m. and Radiola at 10.10 p.m. As regards C.W. reception, I heard St. Assize (**UFT**) calling Tuckerton (**WGG**) very strong indeed and most clearly. Spark transmission on 600 metres such as **GNF**, **GNI** and **BVY**, come in very well and I have heard **GLV** as if it were in Torbay.

The valve in the Flewelling circuit is a "QX" with 60 volts on the plate, and the amplifier is a "LS 2" with 90 volts used with a Radio Instruments transformer.

T. L Allison.

With reference to the circuit published on page 74 of the April 21st issue regarding a new circuit, I would like to say that I evolved an almost identical circuit about four months ago, and demonstrated it before the Acton Radio Society. I attacked the problems in a different manner, however, taking the capacity regenerative circuit and adding a reaction coil in series with phones and anode as well as the condensers. If of any interest I still have my original rough model, and I may say that I find a dull emitter valve to give the best results. It requires about 100 volts on the plate to produce oscillation. Referring to the circuit, a series condenser is shown in one lead of the frame to ensure regeneration.



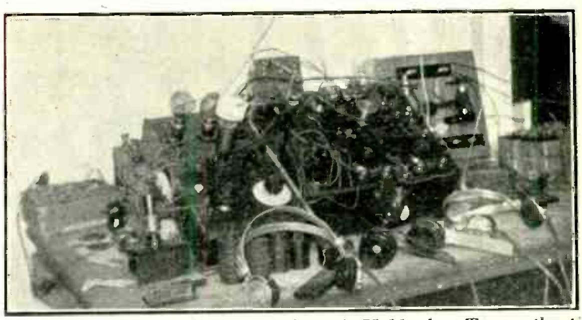
Circuit recommended by Mr. Allison.

This circuit, *without* frame aerial, was put on a table at the "Hightensite" works at Custom House about two months ago and the children's hour from **2 LO** was received quite well, just the set alone being used. It is a powerful re-radiating circuit, upsetting other tuned circuits up to about 30 feet away without any aerial.

However, it can hardly be called super-regenerative, but to my mind it should be "super-sensitive."

ANOTHER TRANSATLANTIC SET.

Our illustration shows the five-valve receiver used by Messrs. F. W. Higgs and J. S. Hobbs, of Bristol, in their successful attempts to tune in American amateurs in the Transatlantic Tests. During the greater part of the time three valves only



Apparatus used by Messrs. Higgs & Hobbs for Transatlantic amateur reception.

were used, viz., H.F., detector and L.F. The apparatus is all home-made, with the exception of the Mark III* tuner, used in its original form. Like many other amateurs, Messrs. Higgs and Hobbs were much troubled by harmonics from Leafield (**GBL**) and Ouessant (**FFU**).

FIVE-CIRCUIT RECEIVER.

The instrument is designed to provide for five different circuit arrangements in an efficient manner by means of a Barrel Switch.

By L. Bourchier.

NOTHING new is claimed in the functioning of the set, but its novelty lies in the fact that it is really five sets in one, the change from one to the other being made instantaneously by means of a rotary switch. As a means of comparing the respective merits of crystal versus valve rectification, or H.F. versus L.F. amplification, it forms a convenient and compact device. This set is well worth the trouble of making.

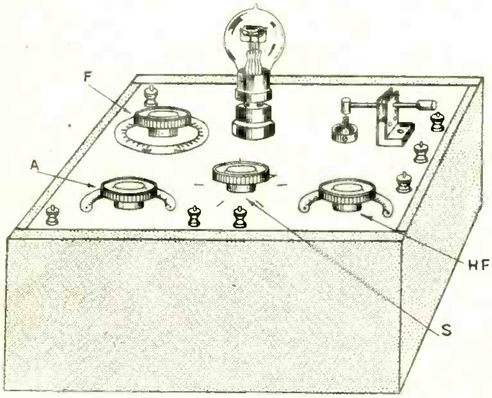


Fig. 1. The simple tuner provided with a barrel switch for five different circuit arrangements, without loss of efficiency.

A general view of the set is given in Fig. 1, the full wiring diagram is given in Fig. 2, and the five different circuits obtainable are shown in Figs. 3 to 7.

Referring to Fig. 2, it will be noticed that tuning of both the aerial and anode circuits is obtained by means of variometers. This method is efficient and simple to use provided that the wavelength range of the set is of the order of 200 to 600 metres. On longer waves the dimensions of the variometers would be such as to make them too cumbersome to use.

The variometers should be of the rotating ball type, the ball being about 3 ins. in diameter and the stator winding being carried on a cylinder $3\frac{1}{2}$ ins. in diameter. The aerial tuning variometer "V1" should be wound with No. 22 S.W.G. double silk covered wire, and the anode tuning variometer should be wound with No. 30.

The most difficult part of the set to construct is the rotary switch, and if due precautions are taken in regard to working "square," the job will not be nearly so difficult as it appears on paper.

A projection of this switch is shown in Fig. 8, and it should be specially noted that there are ten pairs of contact springs arranged on one side, numbered 1 to 9 and 18, and eight pairs of contact springs on the other side numbered 10 to 17. The figures refer to the upper contact springs and the letters to the lower contact springs, the lettering and numbering of these springs coinciding with the lettering and numbering of the springs in Fig. 2.

The top and bottom pieces are of $\frac{3}{8}$ in. ebonite, cut dead square; the end pieces, which also form the bearings for the cylinder, may be made from $\frac{1}{8}$ in. brass sheet. A drawing of these end pieces is shown in Fig. 9 (*b*).

The contact springs should be made from phosphor bronze strip $\frac{3}{16}$ in. wide, the longer contact springs having their "contact ends" bent over for $\frac{1}{16}$ in. at right angles. This edge and the inner contact face of the short brushes should be perfectly clean, or, if preferred,

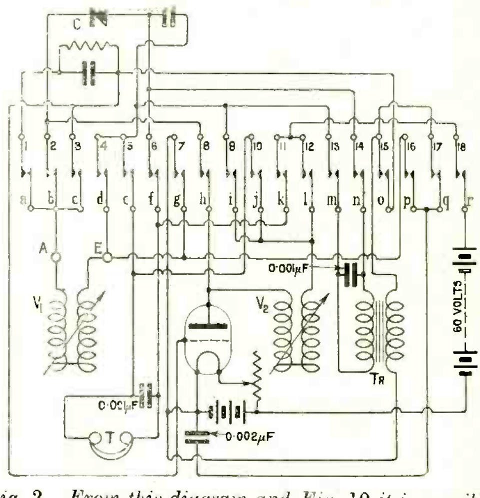


Fig. 2. From this diagram and Fig. 10 it is possible to trace out the circuits provided by the various settings of the switch.

small silver contacts may be rivetted to both sets of brushes.

Fig. 9 (*a*) gives an end view showing the arrangement of upper and lower brushes, also of

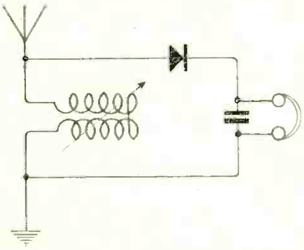


Fig. 3. Position 1. Simple Crystal Receiver.

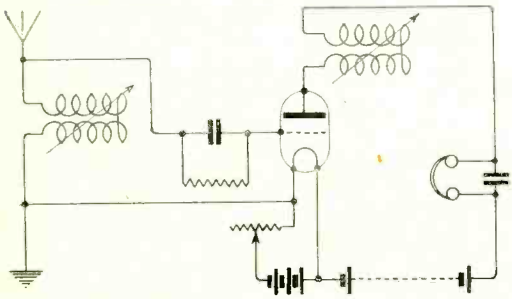


Fig. 4. Position 2. Valve detector with tuned plate circuit.

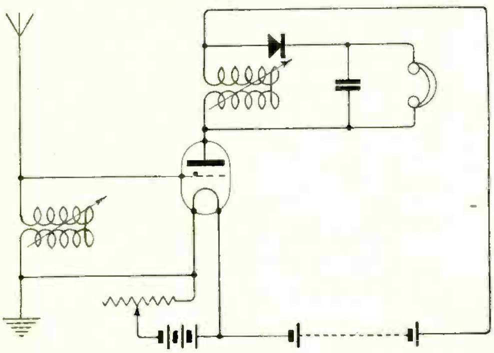


Fig. 5. Position 3. H.F. amplifier and crystal detector.

ebonite top and bottom pieces. It should be noted that the ebonite top piece is wider than the bottom piece. The rotating cylinder, which carries the contact pegs, press the respective contact springs together, thus establishing contact.

Regarding the construction of the cylinder a few remarks may be of assistance. Select a piece of straight ebonite rod of larger diameter than 1 in.—say $1\frac{1}{8}$ in. Centre this carefully in the chuck and bore the central hole for the spindle, making this a tight fit for the latter. Now cut off the required length, *i.e.*, $3\frac{1}{4}$ ins., and remove from the chuck. A mandrel should now be made to exactly fit the central

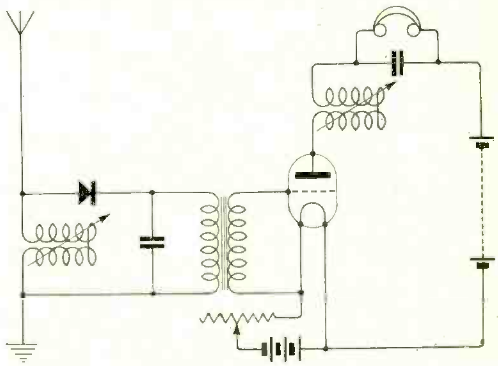


Fig. 6. Position 4. Crystal detector and note magnifier.

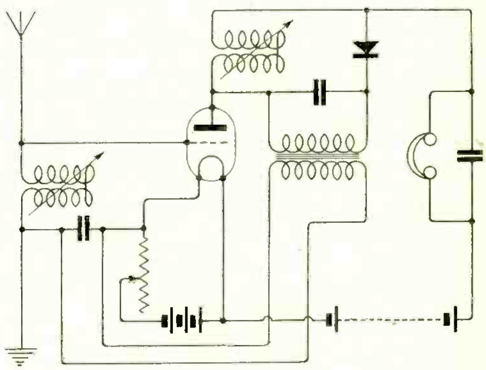


Fig. 7. Position 5. H.F. amplifier, crystal detector and note magnifier. A double magnification circuit. The diagrams show at a glance the circuits obtained.

hole in the ebonite rod, the cylinder being secured to it by two nuts, one at either end, leaving sufficient of the mandrel over at each end. Set up the ebonite rod in the lathe, chucking one end of the mandrel and assisting the other end by the use of the poppet head. Now turn down the cylinder to its proper diameter, *i.e.*, 1 in. Then take a fine cut from one end, thus reducing the length of the cylinder by about $\frac{1}{64}$ in. This is to give it a good fit between the brass bearings without undue end play.

Now, referring to Fig. 11, divide the circumference of the cylinder into ten equal parts and draw lines with a scriber parallel to the horizontal axis the whole length of the cylinder, and then mark off along the length of the cylinder ten lines spaced as shown. Revolve the rod in the lathe, and scratch these lines all the way round the circumference of the cylinder. A circular line $\frac{3}{4}$ in. in diameter

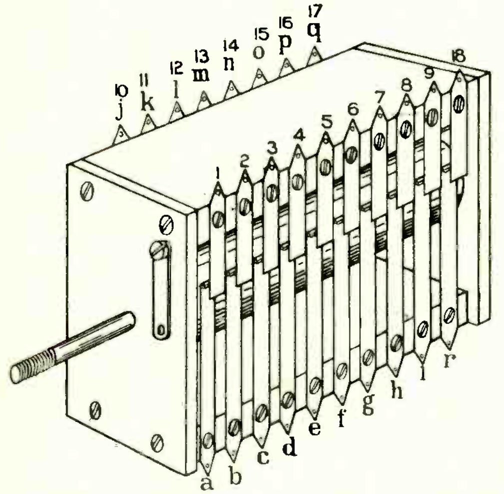


Fig. 8. Scale projection of barrel switch, half full size.

should now be scribed on one end of the cylinder, and the cylinder is then complete insomuch as lathe work is concerned. Before proceeding further it is best to mark the letters and numbers on the cylinder with a pencil, making sure that they correspond

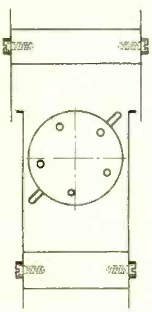


Fig. 9 (a).

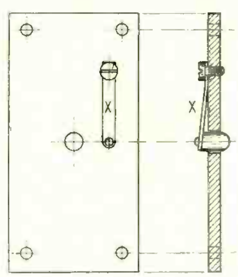


Fig. 9 (b).

Arrangement of contacts and end plate.

exactly to Fig. 11. The horizontal line marked 1 should have a centre-punch mark on it or some means used to identify it, as it is used as our zero line, and the "timing" of all the other contacts is taken from it. Join the lines across the end of the cylinder which has the $\frac{3}{4}$ in. circle scratched on it, and at every other point of intersection—beginning with No. 1—of a line and the circle, make a centre-punch mark. This gives us five marks at 1, 3, 5, 7 and 9, as shown in Fig. 11. Take an $\frac{1}{8}$ in. morse drill and bore in at each point, going just deep enough to take the point of the drill, thus making a small conical hole.

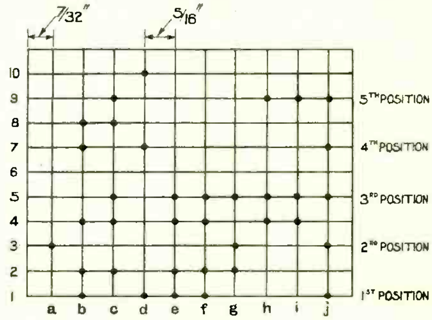


Fig. 10. Positions for inserting pegs in the revolving drum.

Now refer to Fig. 10. This is a plan of the surface of the cylinder, or, in other words, as if the cylinder were laid out flat. The horizontal numbered lines correspond to the

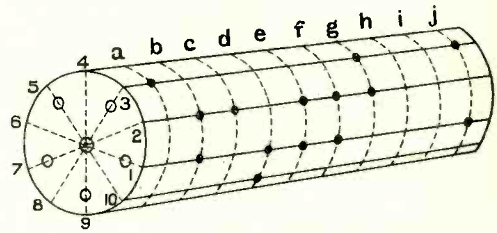


Fig. 11. Method of dividing the drum.

numbered lines on the cylinder, and the vertical lettered lines to the circular lettered rings on the cylinder, the bottom line 1 being

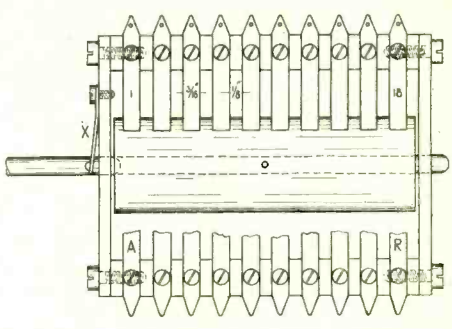


Fig. 12. The fitting up of the contacts.

our zero line. The black dots at the points of intersection of the horizontal and vertical lines denote the positions for the contact pegs.

These should be carefully marked on the cylinder, and at each spot a small hole drilled. When all the holes have been drilled they may be tapped to take the contact pegs. Care should, however, be taken to see that the length of each peg sticking out from the cylinder is $\frac{3}{16}$ in., the projecting end being rounded.

To attach the ebonite cylinder to the spindle, drill a small hole right through the cylinder and spindle, and drive in tightly a piece of brass wire, lightly riveting the ends.

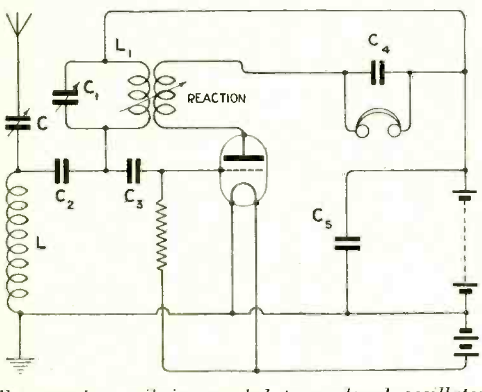
Before assembling the switch put a spot of white paint on the zero line so that this may be visible when the switch is assembled. When the contact pegs situated on this line close the contact springs on that side of the switch which carries ten pairs of springs, the switch is in No. 1 position.

To hold the rotating cylinder in its respective positions when in use, a stiff spring fitted with a rounded projection (marked " X " in Figs. 9 (*b*) and 12) passes through a hole drilled in the end brass bearing plate, engaging in turn the five conical holes in the end of the cylinder. Care should be taken that this end of the cylinder faces the correct way before fixing to the spindle.

The switch can easily be attached to the ebonite panel by four screws, a knob and pointer being fitted to the projecting end. The pointer should be screwed to the ebonite knob and the knob affixed to the spindle by a small brass peg passing through a hole.

Another New Circuit

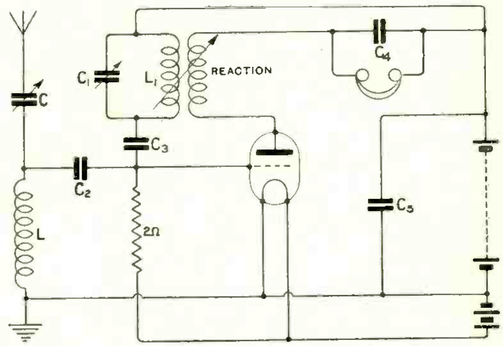
THIS new single valve circuit was discovered, more or less accidentally, by the writer, and as it has selective, and with suitable values for components, non-radiating properties, it may be of interest to experimenters.



The reaction coil is coupled to a closed oscillatory circuit, which is excited by the transference of the potentials developed across the aerial tuning inductance.

The modifications from the ordinary single valve retroactive circuit are apparent in the accompanying diagrams.

In operation it is similar in detail to the " Tuned Anode " system with reaction coupled to the anode coil. It has no tendency to burst into oscillation, and is easily controlled. Tuning is sharply defined and speech is pure. Note magnification may be added in the usual manner.



Another experimental method of obtaining somewhat similar results.

Suitable values are :—

L, C, L_1 and C_1—as for " tuned anode," but C and C_1 should be kept comparatively low in value.

C_2 - 0·0003 to 0·001 mfd.

C_3 - 0·0003 mfd.

C_4 - 0·001 to 0·002 mfd.

C_5 - 0·01 to 2 mfd.

Excellent speech has been received with this arrangement up to 200 miles, but its reliable range for telephony is not much greater than 70 miles.

Can anyone reconstruct the accident by which this circuit was evolved?

E.J.H.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER

WIRELESS THEORY—VIII.

It is the purpose of the writer to deal with the principles underlying the action of wireless receivers and transmitters. Those who know *why* obtain much pleasure which is not experienced by those who have no idea of the action of their wireless set.

The series has been specially designed 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.

In previous sections the writer has dealt with the principles of electricity such as the effect of resistance, capacity and inductance. The last two sections deal with alternating current work, the study of which is important to those who desire a clear understanding of wireless.

By W. James.

22.—The Effect of Inductance in an Alternating Current Circuit.

We know that when we have an inductance and it is connected to a source of electricity, the current which flows builds up a magnetic field. The magnetic field represents energy, because when the applied current is removed, the magnetic field collapses, and in so doing generates a pressure in the wires forming the inductance. When no resistance is present, the current which flows when the voltage is connected takes time to grow to its maximum value, and actually does not reach its maximum value so long as the magnetic field is growing and producing a back pressure. The current *lags behind* the applied pressure. It lags by 90°, that is, the current is zero and just about to increase when the applied pressure is a maximum and is just about to decrease in value as shown in Fig. 45. The back pressure, which of course is in direct opposition to the applied pressure, may be represented as in Fig. 46. It is easily seen that the current at point *o*, Fig. 46, is changing at its quickest rate, because a moment before this point is reached the current was positive, while a moment after point *o* is reached, the current is decreasing in a negative direction. At this point, then, the back pressure must be a maximum, which is shown in Fig. 46. The applied and back pressures must at every instant be equal and opposite in value, as we have considered the inductance to possess no resistance.

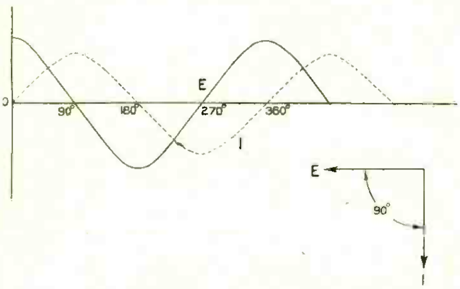


Fig. 45. The current flowing through a pure inductance lags behind the applied pressure by 90°, that is, the current has its maximum value when the pressure is passing through zero.

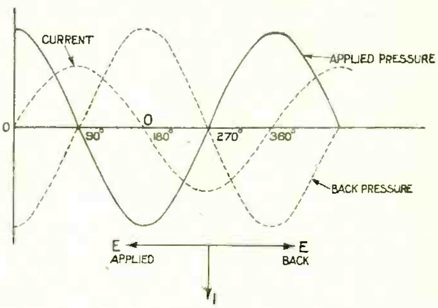


Fig. 46. While the current lags the pressure by 90°, the back pressure, or the induced pressure is 180° out of phase; that is, the back pressure acts in direct opposition to the applied pressure.

The magnitude of the current which flows is determined by the value of the inductance, the frequency of the applied pressure, and the voltage applied. With the simple circuit shown in Fig. 47, the current *I* is given by the

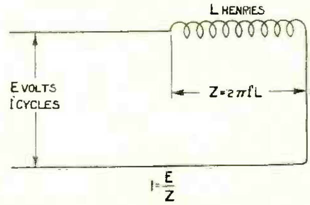


Fig. 47. The current flowing through a coil is given by the pressure divided by the reactance, the reactance being equal to 2 πfL where f is the frequency and L the inductance in henries.

pressure (E) divided by the reactance (Z), or in the form of an equation, $I = \frac{E}{Z}$

Now Z the reactance is equal to $2\pi fL$, where $\pi = 3 \cdot 1416$
$f =$ the frequency in cycles per second,
$L =$ the inductance in henries.

It is clear from the relationship that the reactance is increased by increasing either the frequency f, or the inductance L. In the case of the condenser, whose reactance is given by $\frac{1}{2\pi fC}$ the reactance is reduced if the frequency or the capacity are increased. The two things, inductance and capacity, therefore give opposite results so far as the current which flows is concerned, when a variation in the frequency, or of the capacity in one case and the inductance in the other, is made. The difference is important, as will be evident when we discuss the tuning of circuits.

Example.—Suppose we have an inductance of 10 henries, a voltage of 100 volts, and the frequency is 100 cycles per second. What

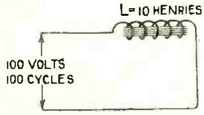


Fig. 48. In this case the reactance is equal to 6283·2 ohms, and the current is ·016 amperes.

is the reactance of the coil, and what current will flow in the circuit. The circuit is given in Fig. 48.

The reactance $Z = 2\pi fL$ ohms and here $f = 100$ and $L = 10$.

$$Z = 2 \times 3 \cdot 1416 \times 100 \times 10 \text{ ohms}$$

$$\text{or } Z = 6283 \cdot 2 \text{ ohms.}$$

The current $I = \frac{E}{Z}$ amperes.

Now $E = 100$ volts and $Z = 6283 \cdot 2$ ohms.

$$\therefore I = \frac{100}{6283 \cdot 2} \text{ or } \cdot 016 \text{ amperes.}$$

If the inductance of the coil was 2 henries instead of 10, the reactance would have been one-fifth or $\frac{6283 \cdot 2}{5} = 1256 \cdot 6$ ohms. The current would be increased five times. If we had a different frequency, the reactance and hence the current would also be different. Thus if the frequency were halved, that is reduced from 100 cycles to 50 cycles, the reactance is also halved and the current doubled. The curve, Fig. 49, gives an idea of the falling off of the current when the applied pressure remains fixed, while the frequency is increased.

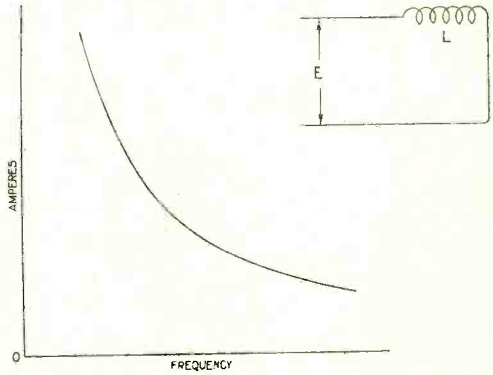


Fig. 49. The curve shows how the current flowing through a coil, when the applied pressure is held constant, varies with frequency.

23.—Inductance and Resistance in an Alternating Current Circuit.

We cannot have an inductance coil which has not the property of ohmic resistance, that is resistance due to the material of the conductor which forms the inductance. While in wireless circuits sometimes the resistance may be neglected and still a true idea of the circuit's behaviour obtained, it often happens that resistance is purposely included. A circuit containing inductance and resistance possesses impedance, which is due to the combined effort of ohmic resistance and inductance.

While when only inductance is present in a circuit no power is absorbed (power it will be remembered is the product of pressure and current, or the product of resistance times the current squared) because the product of the pressure and current over a cycle is zero, due to their being 90° out of phase, power is absorbed when resistance is present, and heats the coil. The power absorbed has the value I^2R, where I is the current in the circuit and R is the resistance in ohms. The pressure has therefore two components, which, when added vectorially, that is with due regard to their phases, must equal the applied pressure.

The reactance of the coil being $2\pi fL$ ohms, and that of the resistance R ohms (see Fig. 6), the pressures are $I \times (2\pi fL)$ volts and $I \times R$ ohms. The pressure due to the inductance is, of course, acting in opposition to that applied, while that due to resistance is in phase with the current. Thus in Fig. 50, if the vertical

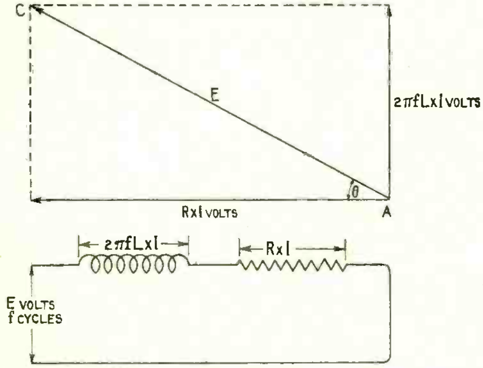


Fig. 50. When a coil and resistance are joined in series there is a pressure drop across the coil equal to $2\pi fLI$ volts, and another pressure drop across the resistance equal to R I volts. The two pressure drops must be added vectorially, as shown in the upper figure, to give the pressure across the coil and resistance.

line represents the drop due to inductance $I \times (2\pi fL)$ volts, and the horizontal line represents the drop due to resistance IR, the line joining A and C represents the applied pressure.

The angle θ represents the angle of lag between the applied pressure and the current. The current lags by θ degrees, or the angle whose tangent is $\frac{I \times (2\pi fL)}{IR}$.

It is easily seen from the figure that with the resistance zero, the angle θ would be 90°. This has been explained before. The larger the value of resistance the smaller does the angle of lag become, until with the resistance very large compared with the reactance of the inductance, the angle will be so small that practically the current and pressure are in phase. In this case the resistance alone

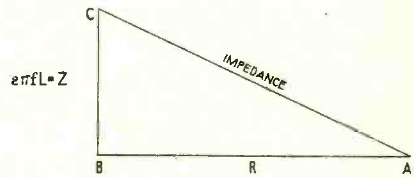


Fig. 51. The impedance of a series circuit containing resistance and inductance is given by $\sqrt{R^2 + Z^2}$ as seen from the figure.

would be the factor which controlled the current flow.

The impedance of the circuit consisting of inductance and resistance is expressed by

$$\sqrt{R^2 + (2\pi fL)^2} \text{ ohms.}$$

Thus in Fig. 51 the impedance AC, is given by the square root of $(AB)^2+(BC)^2$.

The current which will flow in a circuit with resistance and inductance is given by

$$I = \frac{\text{pressure}}{\text{impedance.}}$$

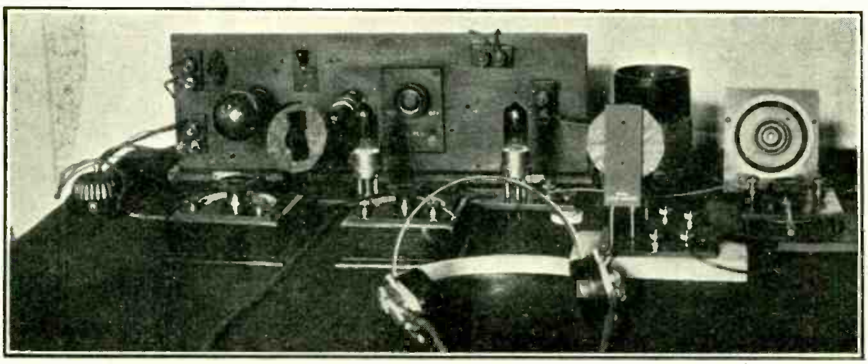
Thus if in the last example we had a resistance of 5,000 ohms in circuit the reactance would be

$$\sqrt{R^2 + (2\pi fL)^2} \text{ ohms}$$

and since $R = 5{,}000\omega$ and $2\pi fL = 6283{\cdot}2$ ohms, the impedance is $\sqrt{25{,}000{,}000 + 39{,}476{,}000}$ or 8030 ohms.

(To be continued in our next issue.)

A SUCCESSFUL AMATEUR IN THE TRANSATLANTIC TESTS.



Mr. Ernest C. Dorling, of Wandsworth, whose set appears in our illustration, found, like many other amateurs, that wet and stormy mornings were most favourable for Transatlantic reception. During the tests two H.F. valves and detector were employed, and several stations were received with great strength, notably **1 BDI** and **1 CMK**. The valve on the extreme left of the photograph is a L.F. magnifier, and was not used.

Wireless Club Reports.

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Wireless and Experimental Association.*

On May 2nd, at the Camberwell Central Library, the Secretary gave a short lecture on "Open and Closed Circuit Transformers," and the circuits in which they should preferably be used.

Mr. Joughin (member) followed with an historical sketch of "Transmitting Pictures by Wireless."

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

Wolverhampton and District Wireless Society.*

A lecture on "Intervalve Couplings" was given by Dr. W. Harvey-Marston of Willenhall, on April 25th. Transformers of types in common use, together with earlier types, were fully detailed, and Dr. Marston produced some excellent parts of his own construction.

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

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

At a meeting of the Society on Thursday, April 26th, Mr. A. Whalley (member), delivered an interesting and practical lecture on "Faults and Fault Tracing," explaining how the sets could be tested without any special testing apparatus, by an intelligent use of the telephone headpieces and the batteries.

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

The Hornsey and District Wireless Society.*

A demonstration was given on April 30th on the Society's new receiving set. The set, which was constructed by a member of the Committee, Mr. W. Trotman, is on the unit system, and contains five panels connected by brass strips. The first panel contains three condensers; this is followed by high frequency detector and two low frequency panels. The set is mounted on a baseboard 3 ft. long by 15 ins. wide, and each panel is easily detachable for inspection.

It is intended to take the set to the Wigmore Hall on Sunday afternoon, May 27th, for the purpose of receiving messages broadcast by various celebrities to the "Adair Wounded Fund," when 500 wounded soldiers, who are still patients in hospital, will be present.

Hon. Sec., H. Hyams, 188, Nelson Road, Hornsey, N.8.

The Manchester Radio Scientific Society.*

On Wednesday, April 25th, the Society discussed means of dealing with people using sets which oscillate on broadcast wavelengths, and it was agreed that two members should meet a special committee consisting of representatives of the B.B.C. and Manchester traders.

Mr. J. W. Hand then gave a paper on "Early Amateur Experiences."

A well-attended social was held on Friday, April 27th, when some excellent artistes provided entertainment. Dance music by wireless from **2 ZY** was received on a set belonging to Mr. Bailey, a member. Three loud speakers were in operation.

Meetings are now to be held fortnightly, and the committee is arranging outings to be held during the summer months.

Hon. Sec., H. D. Whitehouse, 16, Todd Street, Manchester.

North London Wireless Association.*

A lecture on "The Experimenter's Workshop," was given by Mr. V. J. Hinkley on April 30th.

Easy methods of making one's own tools were described, many tools being actually made on the spot. Among the items of special interest were, "How to Make Correct Solder Joints," and "Easy Ways of Handling and Marking Ebonite."

Many new members were enrolled as a direct result of the lecture, and it should be more fully realised by those who will not join a Radio Society on account of the subscription, that information gained from such lectures, when put to practical use, saves sufficient to pay a yearly subscription many times over.

Particulars of membership can be obtained on application to the Hon. Sec., J. C. Lane, Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.

Hackney and District Radio Society.*

On Thursday, April 26th, the Chairman reported that, in the company of the Secretary, he had paid a visit to the studio of **2 LO**, where he had been received most kindly by the various officials. He spent a pleasant and interesting evening in the studio, operating and receiving rooms.

The lecture of the evening was given by Mr. F. G. Francis, B.Sc., a member of the Society, on the subject of "The Characteristic Curves of Valves."

The Chairman announced that a visit was being arranged on a Sunday afternoon to the Croydon Aerodrome.

On Wednesday, May 2nd, by kind permission of the owners (Swedish Lloyd Line), several members of the Society spent an interesting evening on board the ss. *Patricia*, lying in Millwall Dock, and inspected the radio installation, which was greatly admired. Loud music was obtained from **2 LO** with the 'phones lying on the operator's table, a Telefunken crystal set being used.

Hon. Sec., C. C. Phillips, 247, Evering Road, E.5. (Letters only).

The Southampton and District Radio Society.

The Society held its first meeting at the new Headquarters, Y.M.C.A., Ogle Road, on Thursday, May 3rd, when several important items of business were disposed of by a good assembly of members.

Mr. Bateman afterwards gave a very interesting lecture on circuits, including the Flewelling, and notably a special dual amplification circuit, the latter being a discovery of his own, which he demonstrated with excellent results.

The Hon. Sec., P. Sawyer, 55, Waterloo Road, Southampton, would be pleased to hear from local radio enthusiasts desirous of joining the Society.

Dewsbury and District Wireless Society.

On Thursday, May 3rd, the Society met at the Central Liberal Club, Bond Street. This was the first "Difficulties" night, and several members brought up radio troubles for discussion.

It was decided that the Society should accept the offer of the Directors, and hold their future meetings and demonstrations in the Central Liberal Club, where conditions for Reception are more favourable than at the present rooms in Church Street. The members also decided to hold several field days during the coming summer.

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

Gorton and District Wireless Society.

This Society was formed on February 8th of the present year, and since that date several interesting lectures have been given. Special meetings have been devoted to the solution of members' wireless troubles. The Society is building a three-valve set.

A warm welcome to membership is extended to all radio enthusiasts in the district, who should communicate with the Hon. Sec., F. E. Rowe, Gorton Villa, Hyde Road, W. Gorton, Manchester.

The Battersea and District Radio Society.

The Society has now moved to more convenient Headquarters in the Board Room of the Latchmere Road Baths. It is hoped that a good deal of outdoor work will be done with the Society's apparatus during the summer months.

The Society is negotiating with the Radio Society of Great Britain regarding affiliation.

Full particulars of membership can be obtained from the Hon. Sec., A. E. P. Walters, 31, Holden Street, Lavender Hill, S.W.11.

The Prestwich and District Radio Society.

A well-attended meeting of the Society was held in the Library of the National Schools on May 3rd, when Mr. J. N. Southern, of the D.P. Accumulator Company, Ltd., delivered an instructive lecture on accumulators, their construction, use and abuse.

Hon. Sec., H. A. Wood, Spring Bank, Church Lane, Prestwich.

Bournemouth and District Radio and Electrical Society.

A discussion on "The Difficulties and Experiences of the Week," was held on April 27th. The difficulties were dealt with by Mr. E. T. Chapman, A.M.I.R.E., a member of the Society, and the programme proved such a success that further discussions on similar lines are being arranged.

Hon. Sec., A. Reynolds, Town Hall, Bournemouth.

Isle of Man Radio Society.

The first annual general meeting of the Society took place on Monday, April 30th, at the Secondary School, Douglas, the following officials being elected :—President, F. R. Grundey, Esq., B.Sc., F.C.S., Director of Education for the Isle of Man ; Vice-President, Councillor G. Gillmore ; Chairman, J. J. James, Esq., L.D.S. ; Committee, Messrs. Downward, Holmes, Legge, Fleming, Denny and Greenwood ; Hon. Secs. and Treas. (Joint) E. R. Greenwood, R. C. Cannell.

The utmost enthusiasm for the welfare of the Society was displayed, and special tributes were paid to the Press, both local and wireless, for their courtesy in publishing reports from time to time.

Joint Hon. Secs., E. R. Greenwood, 4, Thorny Road, Douglas ; R. C. Cannell, 14, Thorny Road, Douglas.

Salisbury and District Radio Society.

An interesting lecture was given on Thursday, April 19th, by Dr. G. E. Thornton on "X-Rays," which he followed with a demonstration on his portable set.

Meetings are held every Thursday, and new members are cordially invited. A number of interesting outings are being arranged for the summer months.

Headquarters, Old Billiard Room, Chough Hotel, Salisbury.

Hon. Sec., H. F. Futcher, 19, Fisherton Street, Salisbury.

Cambridge and District Radio Society.

On Monday, April 30th, at the Liberal Club, an instructive lecture was delivered by Dr. E. V. Appleton, M.A., on "Recent Investigations on the Elimination of Atmospherics." The lecturer described the Cathode-Ray Oscillograph used in the Cavendish Laboratories for the purpose of recording wave-forms of atmospherics, and illustrated a variety of these wave-forms on the blackboard.

Investigations had proved, stated the lecturer, that the volume of the X's varied with signal strength, and consequently any circuit so arranged that signals were stronger than the accompanying strays would prove a royal road to elimination of the latter, as amplification could be added to bring up the volume of signals proportionately.

It is hoped in the near future to provide some open-air parties for experimental purposes.

Hon. Sec., A. J. Webb, 44, Hertford Street, Cambridge.

The Radio Society of Bradford-on-Avon.

There was a good attendance on April 26th, when Mr. L. Boxwell delivered a lecture entitled "From Studio to Drawing Room."

The lecturer dealt with the transformation of the sound waves produced at the broadcasting station until they were reproduced by the diaphragm of the telephones or loud speaker.

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

Proposed New Radio Society.

Mr. G. R. E. Chapman, of "Roseau," The Drive, Coulsdon, is desirous of getting into communication with any gentlemen in his neighbourhood who are interested, with a view to forming a Radio Society.

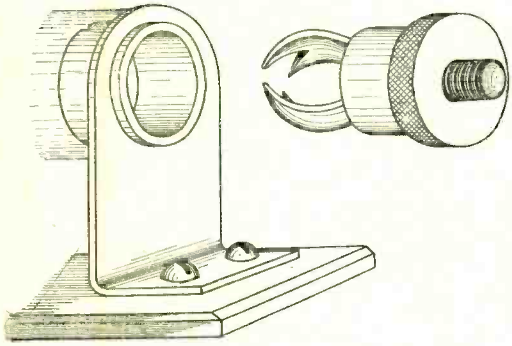
NEW DEVICES

SOME IDEAS OF PRACTICAL INTEREST.

Crystal Grip.

An attempt to solve the difficulty of mounting crystals is made in the new crystal grip device shown below. As the threaded stem seen on the right advances into the milled screw, the claws which hold the crystal are brought together. The action is very similar to the way in which the jaws of a carpenter's brace close upon the bit.

Another improvement which has been introduced into the crystal detector shown is



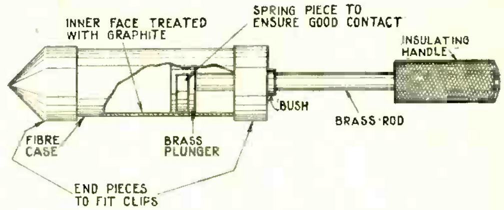
Claw grip crystal holder.

the manner in which the crystal holder can be withdrawn from the tube which is a spring fit on the lower part of the milled screw.

Variable Grid Leak.

Made to fit into the spring contacts with which grid condensers are now fitted, this grid leak is made variable by means of a brass plunger sliding across a conducting surface of a high resistance. The expanding ring on the plunger ensures good contact with the surface of the tube, and the bush in one of the end caps gives reliable contact with the adjusting rod.

This device should prove useful in the making up of apparatus as the value of the grid leak can be conveniently adjusted to suit the particular valve or circuit arrangement adopted. Frequent adjustment should not be necessary, and the leak may be set to the most suitable value when first assembled in circuit.



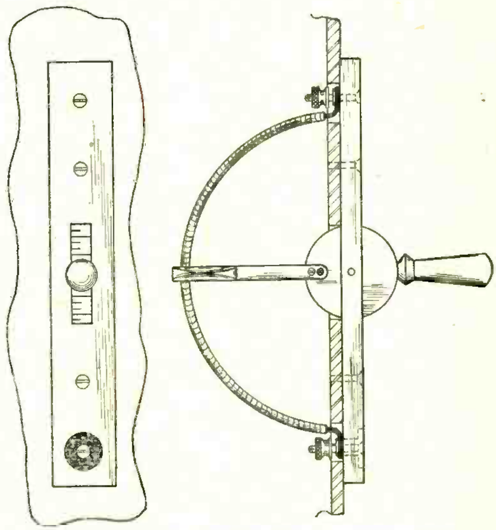
Adjustable grid leak.

Edgewise Potentiometer.

The potentiometer shown is of a new design, and has recently made its appearance in America. The resistance winding is held by a fibre or insulated metal strip, and the bush contact is operated by a calibrated revolving lever on the front of the instrument.

The pivot about which the brush moves is not the centre of a circle which forms the potentiometer winding, so that a radial effect is obtained as the brush moves across the winding.

This is a particularly convenient type of potentiometer, and should recommend itself



Front and side views of the new potentiometer. It occupies very little space on the panel.

for panel mounting in view of the small space it occupies and the ease with which it can be fitted.

A Schools Radio Society for Great Britain

By R. J. HIBBERD, Member I.R.E.

(Organising Secretary of the Schools Radio Society).

THREE years ago, as far as the writer is aware, there was only one school equipped with a valve receiving station, and about half-a-dozen others possessing crystal sets throughout the whole of the British Isles.

For several years I have been greatly interested in the development of radio in schools, and have made a careful study of its progress.

Some time ago I appealed to school readers of *The Wireless World and Radio Review* to send me particulars of their school radio stations. It surprised me to find what a large number of schools had taken up this fascinating science.

The growth of interest in the subject during the past year has been much more rapid than any of us had anticipated, and I feel the time has now come when we should put our house in order. In other words, we must unite if we are going to develop radio in the educational world and to give it its proper place in the curriculum.

At the present time there is a great danger that wireless may become merely a source of amusement in many schools instead of being utilised in various lessons in an instructive manner, and therefore, in order to give it its true educational value, schools should express ideas which they may have on the subject, and, through a central organisation, pass their suggestions on to other schools.

The question of licences is still a stumbling-block, and nearly every day I receive communications asking for the best means of obtaining licences for carrying out various radio experiments in schools, and how to get permits in order to allow pupils to construct their own sets. The general tone of the correspondence seems to suggest that special facilities should be granted to educational bodies to meet their exceptional needs. There are strong grounds for this, for we must bear in mind that it is from the schools that we shall obtain our future scientists and research workers. Consequently the natural characteristics of curiosity which every boy possesses should be encouraged rather than retarded by hard-and-fast regulations. I have known many boys who have made receiving sets out of the most unbelievable things, and who have shown exceptional ingenuity in their efforts. Yet, owing to financial limits and official restrictions, they are unable to obtain a licence. We know, however, that the matter of licences is now receiving the studied attention of a special committee well qualified to deal with the matter satisfactorily, and we are fully aware that the Postmaster-General wishes to handicap no one, his great desire being to create an orderly and undisturbing system of radio reception. Therefore it behoves the educational community not to raise further difficulties, but rather to assist and advise the P.M.G. as far as school radio work is concerned.

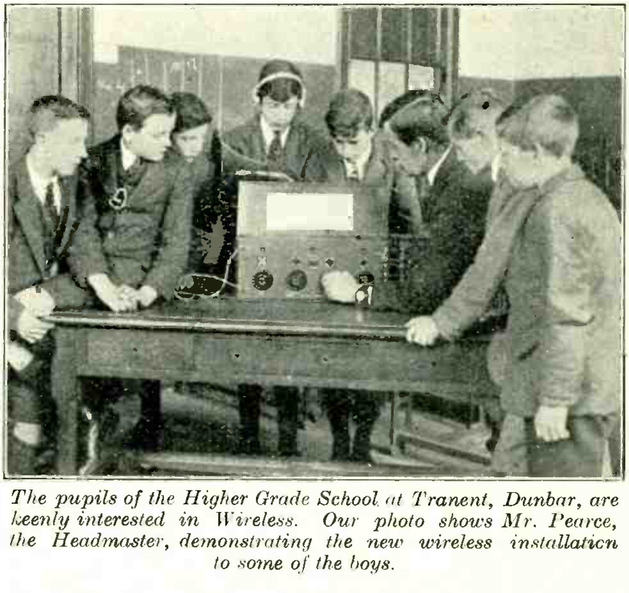
The proposal to form a "Schools Radio Society of Great Britain" was recently put up to the Radio Society of Great Britain with the proposal that the Schools Society should be affiliated to, and under the guidance and control of the Radio Society of Great Britain. The matter was carefully considered by the Committee, and it was decided to give support to such a scheme. Dr. Eccles, F.R.S., has undertaken to act as president of the Schools' Section, whilst it is suggested that two vice-presidents might be selected from prominent educationists.

The formation of such a society should have a far-reaching influence. In the first place it will form a training-ground for future members of the Radio Society of Great Britain, and I suggest that students, on leaving school, might become eligible for full membership to the parent society provided they passed a certain school test and received some sort of certificate of proficiency.

I append herewith a list of other aims which the Society might keep in view.

(1) To obtain greater facilities for and to safeguard the interests of schools possessing wireless equipment, and to gain greater freedom in school experimental work.

(2) To enlist the sympathy and financial support of school governors, managers and educational authorities.



The pupils of the Higher Grade School at Tranent, Dunbar, are keenly interested in Wireless. Our photo shows Mr. Pearce, the Headmaster, demonstrating the new wireless installation to some of the boys.

(3) To have special facilities for students to obtain licences.
(4) To organise inter-school tests and competitions.
(5) To award radio scholarships.
(6) To devise a standard syllabus for radio work in schools.
(7) *The Wireless World and Radio Review*, as the official organ of the Radio Society of Great Britain and affiliated societies, to be asked to devote space to matters of general interest concerning the Schools Radio Society.
(8) To hold periodical meetings during vacations to deal with school radio matters.

These are only a few suggested aims of the society. Any further suggestions from any schools who are interested in the scheme will be welcomed.

The Schools Radio Society of Great Britain is to be open to all types of schools, and the writer will be pleased to hear from any of the public, secondary or primary schools, who would like to join the society. Communications should be addressed to R. J. Hibberd, Organising Secretary, Schools' Radio Society, c/o *The Wireless World and Radio Review*, 12/13, Henrietta Street, W.C.

In order to find out the exact numerical strength of the schools possessing wireless equipment a list appears below of some schools who have already supplied particulars.*

BISHOP'S STORTFORD School.
BRADFORD.—Hanson School.
BUSHEY.—Royal Masonic School.
CHELTENHAM.—The College.
DOVER.—County School.
EDINBURGH.—Fettes' College.
EXETER, Grammar School.
HARROGATE.—Grammar School.
HASLEMERE.—Grayswood School.
HARROW School.
LOWESTOFT.—Secondary School.
LOWESTOFT.—Central School.
OUNDLE School.
PANGBOURNE.—Nautical College.
PETERBOROUGH.—King's School.
TRANENT.—H.G. School.
WAKEFIELD.—St. Catherine's School.
WAKEFIELD.—Grammar School.
WIMBLEDON College, S.W.
WINCHESTER.—Winchester School.
YORK.—Bootham School.
25 L.C.C. Schools, names at present not available.

* Further lists will appear from time to time as particulars become available.—EDITOR.

Broadcasting.

Regular Programmes are Broadcast from the following European Stations :—

Locality.	Call Sign.	Wave-length.	Times.	Nature of Transmission.
GREAT BRITAIN.				
London ..	**2 LO**	369	Weekdays 11.30-12.30 a.m. 5 p.m.-10.30 Sundays 8.30-10.30 p.m.	Regular morning and evening programmes, particulars of which appear in the daily press, are conducted from these stations by the British Broadcasting Company.
Manchester	**2 ZY**	385		
Birmingham	**5 IT**	420		
Cardiff ..	**5 WA**	353		
Newcastle ..	**5 NO**	400		
Glasgow ..	**5 SC**	415		
FRANCE.				
Paris (Eiffel Tower).	**FL**	2,600	Daily 7.40 a.m.	Meteorological Forecast.
			12.15 p.m.	,, Report and Forecast.
			4.30 p.m.	Financial Bulletin (Paris Bourse).
			7.20 p.m.	Meteorological Forecast and Concert.
			11.10 p.m.	,, Report and Forecast.
Levallois-Perret (Radiola)	**SFR**	1,780	Sundays 3-4 p.m.	Concert.
			Weekdays 6.5 p.m.	Financial Bulletin.
			6.15-7.15 p.m.	Instrumental Music.
			9.45 p.m.	Miscellaneous News.
			10.30-11.30 p.m.	Concert.
Ecole Supérieure des Postes et Télégraphes.	—	450	Tuesday and Thursday 8.45-11.0 p.m.	Concert.
			Saturday 3.30-8.30 p.m.	,,
Radio-Riviera (Nice).	—	460	Daily 12.0 noon	News and Concert.
			6- 7 p.m.	,, ,,
			10 11 p.m.	,, ,,
HOLLAND.				
The Hague	**PCGG**	1,050	Sunday 4-6 p.m.	Concert.
			Monday and Thursday 9.40-10.40 p.m.	,,
The Hague (Heussen Laboratory).	**PCUU**	1,050	Tuesday 8.45-11 p.m.	,,
			Sunday 10.40-11.40 a.m.	—
The Hague (Velthuyzen).	**PCKK**	1,050	Friday 9.40-10.40 p.m.	Miscellaneous.
Ijmuiden ..	**PCMM**	1,050	Saturday 9.40-10.40 p.m.	Concert.
Amsterdam	**PA5**	1,050	Wednesday 9.10-10.10 p.m.	Concert and News.
BELGIUM.				
Brussels ..	—	1,100	Various days 1 p.m. ..	Meteorological Bulletin.
			Daily 5.50 p.m. ..	,,
			Sunday 7 p.m. ..	Concert. Concert.
			Tuesday and Thursday 10 p.m. ..	Concert.
GERMANY.				
Berlin (Koenigswusterhausen	**LP** ..	2,800	Daily 7-8 a.m. ..	Financial and other news.
			12-1.30 p.m.	,, ,,
			5-6.30 p.m.	,, ,,
CZECHO-SLOVAKIA				
Prague ..	**PRG** ..	1,800	8 a.m. 12noon and 4 p.m.	Meteorological Bulletin and News.
		4,500	10 a.m., 3 p.m. and 10 p.m.	Concert
SWITZERLAND				
Geneva ..	**HB 1**	1,200	Daily 7-8 p.m. ..	Concert ("Utilitas").
Lausanne	**HB 2**	—	7-8 p.m. ..	,, ,,

A PRACTICAL COURSE IN THE PRINCIPLES OF WIRELESS

EXPERIMENTS FOR THE RADIO AMATEUR

The author having described experiments showing the effects of induction, the action of the crystal detector and the setting up of a simple wavemeter, deals in this article with the method of measuring the capacity of variable condensers. The reader should have obtained a sufficient grasp of the fundamental principles from the experiments so far described to enable him to understand the action of receiving apparatus, to conduct thoughtful experimental work, and, in the opinion of the author, should be entitled to be granted an Experimental Licence.

By MAURICE CHILD.

Vice-Chairman of the Radio Society of Great Britain.

EXPERIMENT NO. 6.

To calibrate a variable condenser and measure the capacity of small fixed condensers.

1 wavemeter as constructed in Experiment 5.
2 inductance coils, 1 of 50 turns and 1 of 100 turns.
A shunted buzzer
A calibrated standard condenser.
4 fixed condensers: 0·0003, 0·0006, 0·001, 0·002 mfd. (exact values not essential) respectively.
1 2-way switch.

A calibrated standard condenser may usually be borrowed from a local radio society. Alternatively, some other radio experimenter would probably be willing to allow the use of his for the particular experiment in question. The procedure is as follows :—

A circuit is constructed as in Fig. 10, consisting of a shunted buzzer, a dry cell, an inductance coil (say 50 turns), and a 0·0003 mfds.

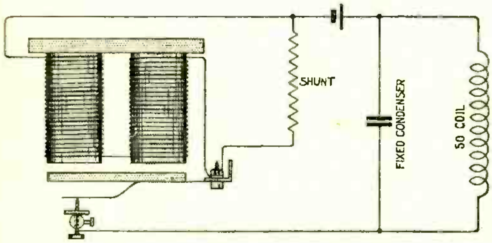


Fig. 10. The shunted buzzer arranged to produce oscillations of definite frequency for use in conjunction with the circuit shown in Fig. 11 for calibrating a variable condenser.

fixed condenser. A second circuit is shown in Fig. 11, consisting of an inductance (say 100 turns) connected through the 2-way switch with the variable condenser to be calibrated, and also the standard instrument. Across the inductance is placed the crystal detector and telephones. The two inductance coils should be set up so that they are from 6 ins. to 1 ft. apart, and in the same plane, and opposite each other.

On setting the buzzer working, the circuit to which it is connected is caused to generate high frequency oscillations, the exact frequency

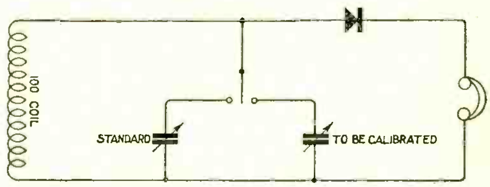


Fig. 11. The circuit arrangement by which a variable condenser of unknown capacity may be compared with a standard.

of which is not very material for this experiment.

On placing the two-way switch in the position which places the standard variable condenser in circuit, and adjusting the latter, a position will be found where the maximum strength of signal from the buzzer will be heard. If these signals are strong, the coils should be placed further apart. (Whenever experiments involving the tuning of two circuits are to be made, it is advisable that such circuits should be placed as far apart as possible, as inaccuracies are likely to occur unless this precaution is taken.

The capacity of the standard condenser at the position of resonance should be noted. The switch can now be thrown over to connect in the condenser to be tested, and the circuit re-tuned until the maximum sound is again obtained. The two capacities are now equal. The condenser of 0·0006 mfds. should now be placed across the inductance in the buzzer circuit, and the 0·0003 removed. The whole experiment should be repeated as before, and it will be found that two new values of the respective variable condensers are obtained when the resonance point is reached.

On repeating the tests again with the values 0·001 and 0·002 across the buzzer inductance, four useful capacity values of the standard, and also of the condenser to be calibrated, will be obtained. It is now possible to plot a capacity or condenser curve, an example of which is given in Fig. 12.

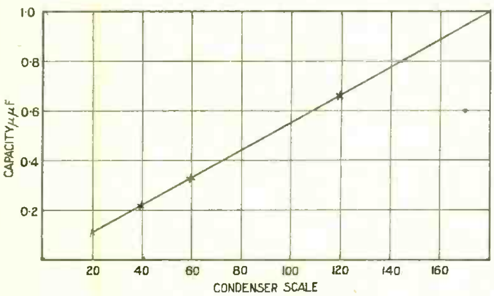


Fig. 12. A simple graph may be used, plotted from points obtained from several determinations, for giving approximate values over the full condenser scale.

Care should be taken that these tests are made with the buzzer working steadily and the crystal detector setting constant throughout. As an example :—Suppose in the buzzer circuit we use capacity 0·0003; the first adjustment may correspond to 20 degrees on the condenser scale of the instrument to be calibrated. Comparing this with the standard condenser, we may find that it corresponds to an actual capacity of 0·0001 microfarads or 0·1 milli-microfarads.

The second reading with the 0·0006 mfds. condenser in the buzzer circuit, may give us somehwere about 40 degrees, which will correspond to approximately 0·0002 mfds., and so on.

These capacity values can now be marked off on a sheet of square paper, and finally, a curve drawn through all four points. Reference to this curve at any time will give the capacity being employed in the circuit in which this condenser is associated, provided of course that no other condenser is in parallel with the calibrated one.

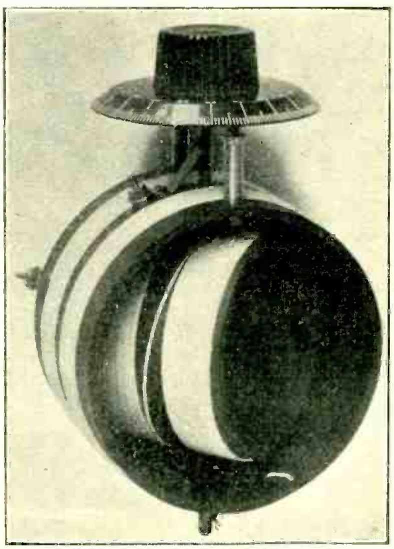
The next article under this heading will deal with a simple method for measuring the natural wavelength of an aerial.

A NEW VARIOMETER

The use of variometers and loose couplers in short-wave receiving circuits is receiving increased attention, and the introduction of this variometer will greatly facilitate the trying out of the many circuits at present making use of this method of tuning.

The design illustrated here is particularly simple, and it is specially arranged so that it can be easily secured to the instrument panel.

Contact with the rotating winding is made by two stiff springs which is divided in the centre, and consequently this winding can be revolved, and is not restricted in its movement to 180 degrees. Should the experimenter only require a 180 degrees movement, however, this can be arranged by inserting a small screw in the face of the panel which operates in a slot, which will be found on the underside of the dial.



Notes

Lightning Stops Eiffel Tower Transmissions.

On Thursday evening, May 10th, a severe thunderstorm broke over Paris and the Eiffel Tower was struck by lightning. Considerable damage was done by the snapping of a steel hawser, which short-circuited the aerial leads, preventing wireless transmission and reception.

Wireless Declined with Thanks.

Preferring to remain "far from the madding crowd" in every sense of the phrase, the 75 inhabitants of St. Kilda, in the Outer Hebrides, have declined with thanks the offer of a wireless station. The island possesses a telegraph, installed there by the Admiralty during the war, but the inhabitants will not use it. No steamer has visited St. Kilda since last August.

French Musicians and Broadcasting.

Artistes who gain a livelihood by playing in Parisian cafés and dancing halls are becoming apprehensive at the progress of broadcasting, fearing that they may soon lose their employment. The Musicians' Union is meeting shortly to discuss the position.

Amateurs Heard in Lincolnshire.

Mr. J. Marlow, of Mablethorpe, Lincolnshire, reports that since January 14th of this year he has heard the following amateur transmitters with one, two or three valves :—**2 AW, 2 BZ, 2 DU, 2 DS, 2 FA, 2 DJ, 2 FQ, 2 GJ, 2 IQ, 2 NM, 2 OM, 2 ON, 2 SS, 2 SY, 2 SZ, 2 TN, 2 TV, 2 UY, 2 VQ, 2 ZK, 5 HY, 5 LY, 5 BS, 5 GL, 5 DT, 5 HI, 5 SU, 5 BM** and **5 IO.** The distances of these stations vary from 70 to 194 miles.

Experiments from 2LO.

Readers who are interested in broadcasting experiments should listen in occasionally for **2 LO** on Sundays, from 3 to 4 p.m. Further attempts at simultaneous transmission from all broadcasting stations are "in the air," and will probably be made at the time mentioned. The last experiment of this kind was on Sunday, May 13th, and it is understood that transmission was faulty in certain districts.

An Emissary of Krassin.

A weird figure, it is stated, has been haunting the precincts of **2 LO** with the request that, as an emissary of Krassin, he may broadcast a message to the British public. Up to the present, we believe, his offer of free entertainment has been refused.

B.B.C and Concert Artistes.

The decision of the Concert Artistes' Association to call on its members not to take part in concerts arranged by the B.B.C. is responsible for a new move on the part of the latter. The Company is to furnish its own plays and concerts, and Mr. Percy Pitt, the new musical director, is now drawing up contracts with artistes who are willing to ignore the ban.

Australian Radio Plans.

Important developments in wireless are taking place in Australia. The Amalgamated Wireless Company, in which the Commonwealth has a half interest, is proceeding almost immediately with a direct wireless scheme between Australia, England and Canada. All the preliminary obstacles have been removed, and it is expected that complete proposals will be finally settled at an early date.

The organisation of broadcasting in Australia is under consideration.

Wireless Concert in Swansea Gaol.

On Wednesday, May 2nd, an enjoyable evening was spent by the inmates of Swansea prison, who listened to wireless music from Cardiff, Glasgow and London. Canon Watkins Jones presided, and the apparatus was supplied by Messrs. Morgan, Bros., of Swansea.

It may be expected that a few more entertainments of this kind in the prison will lead to an increase of crime in the district.

New Wireless Stations in West Indies.

Definite proposals have been submitted for the establishment of wireless stations in Barbados, the Windward Islands, and the Leeward Islands. At a meeting held on May 9th, the Cable and Wireless Communications Committee of the Empire Press Union urged the Government to take steps immediately to establish communication, either by wireless telegraphy or otherwise, between Jamaica and British Honduras, which is at present without a British telegraph service.

New Pattern Aerial Wire.

Messrs. Ward & Goldstone, Ltd., the well-known wireless specialists, of Pendleton, Manchester, have recently produced a new type of stranded wire for use in aerials. The many strands necessary to give a large surface and flexibility, are interlaced, instead of being twisted, considerably reducing the tendency to kink.

A 62-page illustrated catalogue (Radio List No. 101) has been issued by the firm, dealing with their wide range of apparatus for the amateur and experimenter.

Wireless in Norwegian Ships.

According to the Shipowners' Association of Norway, on January 1st, 1923, only 15 Norwegian ships of over 1,600 tons were not equipped with wireless. None of these 15 vessels is engaged in traffic with Great Britain, and it is therefore claimed that the Norwegian merchant fleet will satisfy the British demand for all ships to be equipped with a radio installation during calls at ports in Great Britain. Steps are being taken to cope with the demand for qualified Norwegian operators, but it is expected that the supply will not be adequate for another year.

Wireless Telephony in Denmark.

King Christian was the first person to speak by wireless telephony from Copenhagen to the Island of Bornholm, in the Baltic, when the new service was opened on May 11th. The transmission is stated to be very clear, and the new facilities are now open to the public. It is stated that communication will be possible from any ordinary telephone.

Amateur Difficulties in Ceylon.

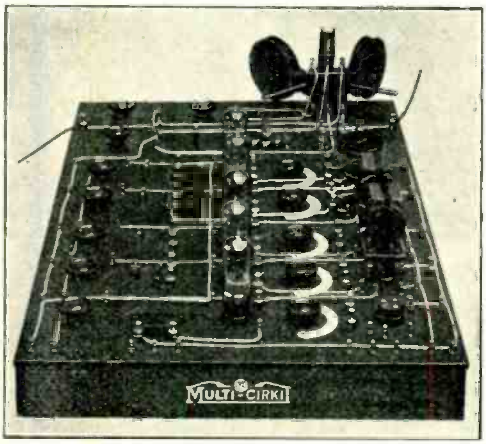
The position of the wireless amateur in Ceylon is at present a disheartening one. The Government proposes to restrict the issue of receiving licences to amateurs who prove themselves to be experimenters with a knowledge of electricity, and even these can only obtain a licence for a single-valve set. Moreover, there will probably be delay before the necessary ordinance is passed in the Legislative Council.

These facts have been received from the Hon. Secretary of the Ceylon Wireless Club, Mr. J. S. Dinwiddie, who adds that Ceylon amateurs are fortunate in having the support of *The Times of Ceylon.*

The Government attitude is prompted by the possibility of amateur interference with the official wireless services, and the amateur is given to understand that the projected facilities are a magnanimous concession. In the columns of *The Times of Ceylon* there appears a well-reasoned statement by the Wireless Club, criticising the proposed regulations, and requesting the institution of a Committee which could examine the whole question with a view to arriving at a more satisfactory scheme.

English amateurs and experimenters will join in wishing their brothers in Ceylon every success in their efforts to obtain reasonable freedom of the ether.

The Multi-Cirkit Panel for the Experimenter.



The arrangement of the components permits of particularly short wiring. It is a valuable instrument for trying out and investigating the many new circuits which have recently been developed. The makers are the Clarophone Radio Co., Palace Chambers, Bridge Street, Westminster, S.W.1.

Books and Catalogues Received.

Philip's Wireless Map of Great Britain. (London : George Philip & Son, Ltd., 32, Fleet Street, E.C.4. Compiled from information supplied by the Wireless Press, Ltd. Price 2s. 6d., 5s. 6d., and 7s. 6d. net, according to mounting).

"Draadlooze Telegrafie en Telefonie voor Jedereen" (A.B.C. of Wireless). By Percy W. Harris. (Amsterdam : Technische Boekhandel Ned. Persbureau Radio, Keizersgracht 562. Pp. 64., xii.)

Le Radio. A popular journal for amateurs and others, edited by M. Louis Françon, and published weekly. (Lausanne : Rue de Geneve 5. Price 15 centimes.)

Messrs. Radiophones, Ltd., of 1a, Granville Place, Marble Arch, W.1., have issued an attractive leaflet describing and illustrating their Listoleon Radiophone de Luxe Cabinet.

Grafton Electric Company.—A comprehensive and fully illustrated catalogue describing a complete range of wireless and electrical apparatus for the amateur. Obtainable from the Company, at 54, Grafton Street, Tottenham Court Road, W.1.

The D.P. Battery Co., Ltd.—An illustrated catalogue with tabulated particulars of D.P. Wireless Accumulators, and instructions for charging and management. Obtainable from the Company, at 11, Victoria Street, Westminster, S.W.1.

Messrs. Mitchell's Electrical and Wireless, Ltd., of 188, Rye Lane, Peckham, S.E.15, the well-known specialists in radio apparatus, have issued a comprehensive and well illustrated catalogue describing their extensive range of wireless sets and accessories.

Lecture by Dr. J. A. Fleming.

The Fourteenth Kelvin lecture on "Problems in Telephony, Solved and Unsolved," was delivered by Dr. J. A. Fleming before the Institute of Electrical Engineers recently. The problems of line telephony, involving the design of apparatus for the proper reproduction of the transmitted signal, are of much interest to wireless engineers now that efforts are made to transmit correctly speech and music by wireless. In addition, it would seem that economy is possible through the use of "wired wireless," several conversations, as well as telegraph signalling, being conducted over considerable distances through a pair of wires.

The three-electrode valve may be successfully applied to line telephony for the purpose of magnifying the signals. With correct balancing and loading of the lines, signals do not suffer distortion, but they are, of course, attenuated. If a two-way repeater is connected, signals from either direction may be amplified and passed on.

Dr. Fleming is well known as the inventor of the two-electrode valve. The first valves were used as rectifiers in place of crystal rectifiers. In the research laboratories of the American Telephone & Telegraph Co. a study has been made of large power transmitting valves, and it would appear the two-electrode valve may be of great use as a transmitting valve. The energy supplied to the filament may be of the order of kilowatts, and it is found that when an alternating current is applied the magnetic field set up around it will vary the anode-filament current so that an oscillating current flows in the attached circuits. The temperature of the filament remains sensibly uniform, but when the current is, say, falling to zero, the magnetic field is also falling, hence the increasing anode-filament current.

A tribute was paid to the organisation and facilities for research work enjoyed by the larger American manufacturers, and the lecturer expressed regret that there is so little research work conducted in this country through lack of proper equipment and research laboratories.

Correspondence

To the Editor of The Wireless World and Radio Review.

Sir,—In the joint capacity of radio experimenter and music lover, I would like to say just a few words with regard to the present controversy over the broadcasting in this country.

Firstly, I would like to point out a remedy, to my mind, for the perpetual grumbling at the programmes submitted by the B.B.C. Mr. "X" writes to the papers complaining that there is "too much 'high-brow' stuff, and why don't they give us more dance music." Mr. "Y" addresses to the Editor of his morning paper an appeal for "some really decent music, and not all this jazz stuff." Obviously both parties have got to be satisfied to a certain extent, seeing that both are users of wireless apparatus, and therefore clients of the B.B.C.

Now it seems to me that the best way to bring about this very desirable result, is to make use of the method so successfully employed by Sir Henry Wood at the Promenade Concerts, by which the programmes are selected to appeal to a certain section of the public each evening. Thus we have a Wagner night, a Classical night, a Popular night, a Russian night, and so on. It appears to me that this should be as easily worked from the Broadcasting stations. Let us have the week say, divided as follows :—

Monday.—Popular night. Dance Music, Music-hall turns, etc.

Tuesday.—Operatic night. Selections, vocal and orchestral from different Operas.

Wednesday.—Musical Comedy.

Thursday.—Instructional night. Lectures by well-known people.

Friday.—Classical night. String quartets, Symphonies.

Saturday. — Popular night. Light music, Bands, etc.

Sunday.—Good sacred music, but not too dull.

Let us see how this would work out. For instance, at present, being a lover of opera, I say to myself, "John X is singing the aria from 'Herodiade' to-night, I would like to hear him. But I don't think it's worth while waiting in this fine evening till 9.45 to hear this one item of six or seven minutes' duration." But if I knew that I could sit down and hear a whole operatic evening on Tuesday, I should think it an evening well spent! The same remarks will doubtless apply in their different ways to the lovers of ragtime or musical comedy. Better a couple of really delightful evenings a week than a few snippets of what we want to hear every evening.

With regard to the broadcasting of plays, I think one can see why the London Theatrical Managers do not want their productions broadcast! If one act (I do not say the whole play, mind you) of a really good play is broadcast, is it not common sense to suppose that those whose appetite has been whetted in this manner shall want to make the whole meal, and see the play in its entirety? Naturally if the play is bad, one act will be quite sufficient to make people stay away. (Another of the blessings of wireless!) Therefore I say that if a manager has a good play and decides to broadcast the first act, say up to a particularly intriguing point, I know which way the box-office receipts will go—up, not down. Wireless is the finest publicity agent a good show could possibly have, but it shows up the bad ones, and I think the Theatrical Managers Association's ban tells its own tale!

With best wishes for the future of music and wireless in Great Britain.

Gilsen MacCormack.

Forthcoming Events

THURSDAY, MAY 24th.

Liverpool Wireless Society. At 7.30 p.m. At the Liverpool Royal Institution, Colquitt Street. Display of apparatus and demonstration of new type of aerial by Messrs. L. McMichael, Ltd.

Stoke-on-Trent Wireless and Experimental Society. Lecture: "Adding a Valve to a Crystal Set," by Mr. T. R. Clark (Vice-Chairman).

FRIDAY, MAY 25th.

Leeds and District Amateur Wireless Society. Lecture by Mr. T. Brown Thomson.

Radio Society of Highgate. At 8 p.m. At the 1919 Club, South Grove, N.6. Informal concert (admission free).

Bath Radio Club. Inspection of Mr. J. G. Young's set at the Somerset Boys' Home.

MONDAY, MAY 28th.

The North London Wireless Association. In the Physics Theatre, Northern Polytechnic Institute, Holloway Road, N. Lecture: "Practical Demonstration of Valve Characteristic Curves," by Mr. V. J. Hinckley.

Sydenham and Forest Hill Radio Society. At 8 p.m. In the Chess Room, Greyhound Hotel, Sydenham. Lecture: "How I Found **2 LO**," by Mr. Leonard Dowling.

TUESDAY, MAY 29th.

Plymouth Wireless and Scientific Society. At 7.30 p.m. At Plymouth Chambers, Old Town Street. Buzzer practice. At 8 p.m., General discussion.

WEDNESDAY, MAY 30th.

The Battersea and District Radio Society. At the Latchmere Road Baths. Social evening.

Swansea and District Radio Experimental Society. Lecture arranged by Mr. Guy Hodge, of the B.T.H.

THURSDAY, MAY 31st.

The Institution of Electrical Engineers. Annual General Meeting at 6 p.m.

Ilford and District Radio Society. Annual General Meeting.

Historical Notes on Radiotelegraphy and Telephony*

By G. G. Blake, M.I.E.E., A.Inst.P.

In order to give a really complete history of Radiotelegraphy and Telephony, it would be necessary to go right back to the earliest experiment in electricity conducted by Gilbert, during the reign of Queen Elizabeth, and record the great discoveries of Ampère, Volta, Faraday, Cavendish, Kelvin, and all the other great men of science, who by their work and discoveries first brought the science of electricity to a sufficient state of advancement for radiotelegraphy to be even thought of.

Probably the first suggestion of making use of electricity for the wireless transmission of signals is to be attributed to Professor Steinheil of Munich, who had been carrying out a test (in the year 1838), in line telegraphy between Nuremberg and Fürth endeavouring to use the railway lines in the place of properly insulated telegraph wires. Although this proved a failure, it led to a most important discovery.

Attributing the failure to leakage of electricity through the earth between the rails, the idea occurred to him that if the earth were so good a conductor of electricity, possibly it could be used for the return of a current after it had passed along a single telegraph line, in place of the return wire which had always been employed up to that time. The experiment proved entirely successful and is one of the most important contributions towards successful telegraphy.

Steinheil then continued his experiments and endeavoured to trace out the area covered by the current, as it returned through the earth, and he was able to detect earth currents, which he picked up in another circuit having no metallic connection with the transmitting circuit. I will quote a paragraph from his own account of these experiments. "For distances up to 50 feet, I have found the possibility of such electric communication by experiment; for greater distances we can only conceive it feasible by augmenting the power," and again, "It only holds good, however, for small distances, and we must leave it to the future to decide whether it will ever be possible to telegraph to great distances entirely without metallic connections."

In 1842, Prof. S. F. B. Morse (Superintendent of Telegraphs to U.S.A. Government), when giving a demonstration of line telegraphy at the request of the American Institute of New York, between Governor's Island and Castle Garden, a distance of one mile, had the demonstration entirely spoiled owing to a vessel weighing its anchor, and in so doing cutting his submerged cables. Owing to this accident the idea occurred to him that possibly the water itself might be employed to carry the electricity across.

This experiment proved entirely successful. Metallic plates on each side of the river had to be placed, however, further apart than the width of the river, necessitating the use of considerably more wire than would have been needed for a direct connection across the river.

In Great Britain, in 1845, Cook and Wheatstone carried out similar experiments and used an instrument (a forerunner of Lord Kelvin's Syphon Recorder) designed by Wilkins.

In 1843, Bowman Lindsay, who by the way predicted the universal adoption of electricity for lighting, heating, and power, successfully carried out experiments very similar to those of Morse, across the Tay, where the river was three-quarters of a mile wide, and by placing his line wires at an angle he eliminated any effects due to induction.

We now come to an American dentist, Mahlom Loomis, who took out a patent in 1872 (four years after the introduction of the high bicycle). He speaks of his discovery as a means of turning natural electricity to account for "establishing an electrical current or circuit for telegraphic or other purposes without the aid of wires, batteries, or cables." By this method he hoped to telegraph from one continent to another. He ran up two kites on adjacent mountain tops and succeeded in signalling from one to the other by discharging electricity collected from the atmosphere to earth from his transmitter; but nothing further appears to have come of his scheme although it is interesting to note that Mahlom Loomis was the first to employ vertical conductors or antennæ for the transmission of signals to a distance.

It may be of interest here to mention that Mr. Maurice Child, of the London Telegraph Training College, successfully carried out a somewhat similar experiment in 1909. One day during a very heavy hailstorm he used the induced static charge on the aerial produced by a dense black cloud overhead and succeeded by its aid in signalling three miles (to Charminster). The cloud raised the aerial (which was 180 feet high) to a potential of some 25,000 volts for a period of some five or six minutes.

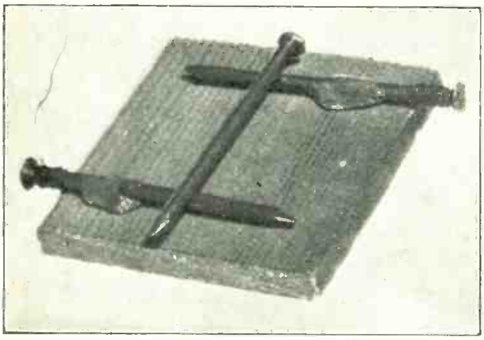
In about 1880 Professor Trowbridge carried out a number of experiments in radio communication between ship and ship, similar to those of Morse and Lindsay, and he also made use of an entirely different principle, *i.e.* electro-magnetic induction, in another set of experiments.

To communicate between two ships, a wire was stretched 10 or 12 times to and fro from the vessels' yardarms and connected to a telephone or to his transmitting instruments (which consisted of a battery, an interrupter and a Morse key). The coils would only work when in the same plane. Here we have suggested, I believe, for the first time, the possibility of "direction finding" between vessels when in a fog.

* A paper read before the Radio Society of Great Britain on April 25th, 1923.

This method proved unpractical, as the induction effects were only workable over very short distances.

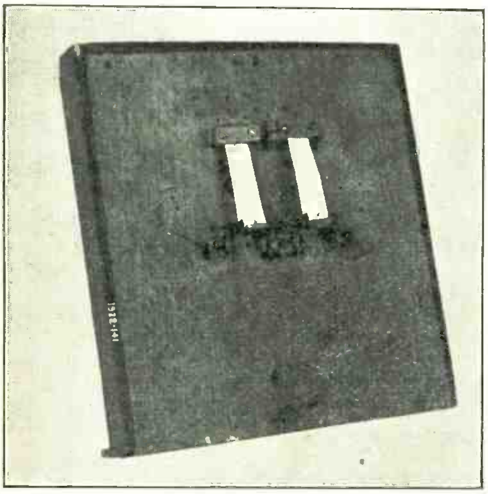
We now come to the work of Professor Hughes.* Unfortunately, none of his investigations were published until 1899, although he gave a private



By courtesy of the South Kensington Science Museum.
Hughes' first microphone, made with three iron nails fastened to wood with sealing wax.

demonstration in 1879 to several members of the Royal Society, Sir Wm. Crookes, Sir Roberts Austen, Sir Wm. Preece and Professor Adams. In February 1880, he gave a similar demonstration to Mr. Spottiswoode (President of the Royal Society) to Professor Huxley, and to Sir Geo. Stokes, and again in 1888 to Professor Dewar and Mr. Lennox, so that his work is fully authenticated.

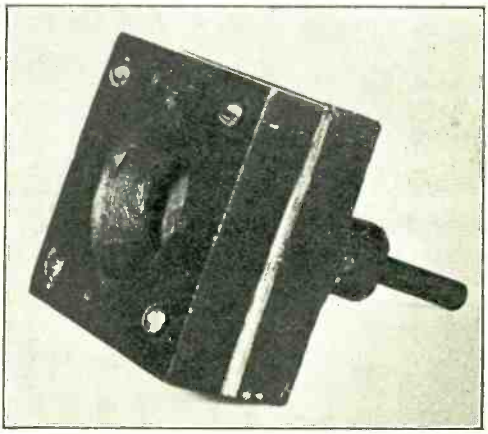
Briefly the following were his discoveries. When engaged on some work with an induction balance, he noticed some peculiarities in the behaviour of



By courtesy of the South Kensington Science Museum.
The photo shows an early form of Hughes microphone made by himself.

* An account of his experiments by Mr. A. A. Campbell Swinton, appears in the *Journal of the I.E.E.*, 1922.

a loose contact in the circuit. This caused him to carry out a series of experiments with loose contacts, and he discovered that on the sudden interruption of a current in any coil the extra current at break caused the emission of "invisible electric waves," which became evident if a microphonic joint were used as a receiver with a telephone, and he showed that these waves penetrated through solid walls and apparently travelled to great distances. He transmitted signals in this manner to a distance of about 60 feet about his house, and on several occasions he walked up and down Great Portland Street with the telephone to his ear, and heard signals to a distance of 500 yards. He also noticed that the waves were reflected by some of the buildings. The following statement appeared in the *Globe* of May 12th, 1899. "Hughes' experiments of 1879 were virtually a discovery of Hertzian waves before Hertz, of the coherer before



By courtesy of the South Kensington Science Museum.
Another form of microphone invented and made by Hughes.

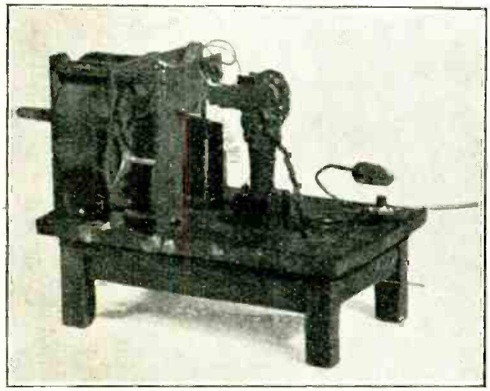
Branley, and of Wireless Telegraphy before Marconi and others."

Speaking of the work of Professor Hughes, Mr. Munro says, "Professor Hughes had, step by step, put together all the principal elements of the wireless telegraph as we know it to-day, and although groping in the dark before the light of Hertz arose, it is little short of magical that in a few months, even weeks, by using the simplest means, he has forestalled the great advances of Marconi by nearly twenty years."

Mr. Campbell Swinton collected a quantity of Hughes' early apparatus which is now deposited in the Science Museum at South Kensington, and he has very kindly borrowed it to illustrate this lecture.

In an article which appeared in the March number of the *Telegraph and Telephone Journal* for 1923, Mr. J. J. Tyrrell describes the tests of Hughes' Type-printing Telegraph now proceeding on a duplex system between the G.P.O. London and Berlin. There is another route working the other way direct from Königswusterhausen to an aerial on the roof of the G.P.O. in London. The writer says: "Hughes' wireless trial between London and

Berlin has been succeeded by two or three weeks working live traffic, several hundreds of telegrams having been successfully and expeditiously dealt with for the first time by means of this printing system. There is no doubt in the writer's opinion that the Hughes apparatus lends itself well to



By courtesy of the South Kensington Science Museum.

Clockwork interrupter used by Hughes as an automatic transmitter.

wireless transmission owing to the practical absence of any lag due to long submarine or other metallic conductors."

I have since ascertained that this duplex system commenced handling serious traffic in an auxiliary service on January 23rd, working between the hours of 11 and 4. Twenty-five messages an hour are handled each way simultaneously.

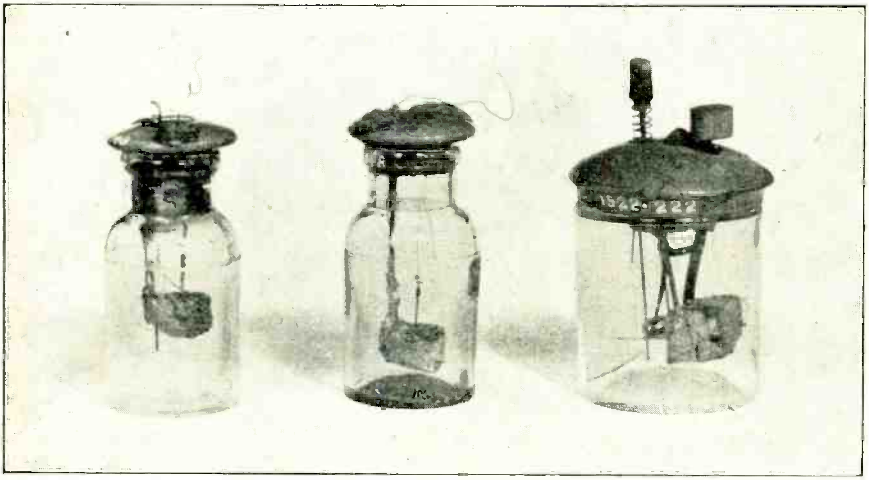
Three or four years after I first became infatuated with the study of wireless, I succeeded in 1907 in signalling from my father's house to that of a friend (a distance of some 200 yards), using the spark at the contacts of an electric bell to energise the aerial, and receiving the signals by aid of my iron sulphide detector and a telephone. I described the transmitter and detector in the *Model Engineer and Electrician*, November 26th, 1908 and October 7th, 1909, and afterwards succeeded in transmitting signals from a primary spark to a distance of one mile.

In 1882, long before the publication of the work of Professor Hughes, Professor A. E. Dolbear, of Tuft's College, Boston, America, almost achieved success in radiotelephony. He succeeded in telephoning to a distance of half a mile and, it is said, telegraphing nearly twelve miles.

With his arrangement, the earth was charged to 100 volts or more positive by a coil, at the transmitting end, and to 100 volts negative at the receiving end. At first he used condensers, but later he used aerial wires to kites. He suggested using this method for communicating between vessels at sea. He also used a Morse key and replaced the microphone by an interrupter.

When we come to speak of the early Marconi system a little later in the lecture, we shall see how very near Dolbear got to complete success, yet, being before the time of Hertz's discovery of the means of propagating electro-magnetic waves or the invention of Righi's oscillator, he just missed the one essential part of the apparatus, *i.e.*, the spark-gap, which, had he connected it across his coil between the aerial and the earth, would have converted his electro-static effects into electric-magnetic waves, which would then have travelled far into space, and instead of only being able to work to short distances he might have achieved the astounding results of Marconi.

At the conclusion of Prof. A. E. Dolbear's book, "The Telephone," published in 1878, the following striking phrase occurs: "Mechanism is all that stands between us and aerial navigation, all that is necessary to reproduce human speech in writing and all that is needed to realise completely the



By courtesy of the South Kensington Science Museum.

Three of the microphone detectors with which Hughes carried out his investigations.

prophetic picture of the *Graphic* of the orator who shall at the same instant address an audience in every city in the world."

In 1885 Edison invented a system for telegraphing to and from trains in motion, making use of existing telegraph lines, running parallel to the track, and he was able to signal along them simultaneously with the ordinary messages, which they were conveying across the country, without interfering with them in any way, and without any interference from them. This was the forerunner of our wired wireless.

Referring to later days, it is well known that on November 3rd, 1922, the Lord Mayor of Bristol spoke from Bristol to Marconi House, from whence his voice was broadcast far and wide. He did this by wired wireless over the ordinary trunk telephone lines between London and Bristol, and all the while ordinary conversation was carried on along the same lines without any mutual interference. Of course the system used was very different, Edison's scheme being only the germ of the idea. The Bristol demonstration was the first occasion of such a public demonstration in England; in America wired-wireless has been in use for several years.

Charles A. Stevenson, in 1892, signalled from the mainland to the North Unst Lighthouse on the island of Muckle Flugga by an induction method between two coils, one consisting of five or six turns of wire supported on telegraph poles around the circumference of the island and the other on the mainland.

In March, 1882, the telegraph broke down between the Isle of Wight and Hurst Castle, and while the cable was being repaired, Preece succeeded in signalling across the Solent, using earth plates in the water at Portsmouth and Ryde, and again at Sconce Point and Hurst Castle. Having succeeded in this, he experimented further in the Bristol Channel in 1892, between Lavernock Point near Cardiff, and the two islands of Flatholm and Steepholm.

A wire about 1,500 yards long was run along the mainland and earthed at each end. In the length of this wire a dynamo was included, which supplied a steady current of some 15 amperes, broken into pulsations by an interrupter, and the signals were sent by a Morse key. A similar wire was stretched right across each island in a position parallel to that on the mainland, and signals were picked up on a telephone receiver inserted in the line.

Willoughby Smith's method was suggested in 1887, and on the recommendation of the Royal Commission for Lighthouse and Lightship Communication, was adopted in 1896 for communication between Crookhaven in Ireland and the Fastnet Rock Lighthouse, and used there for several years. This lighthouse is situated off the extreme S.W. corner of Ireland, in a very exposed position; consequently every time a submarine cable was laid across, it was quickly chafed against the rocks by the rough seas and broken. To remedy this, Willoughby Smith laid a cable from the mainland which entered the sea in a sheltered cove and was laid to within about 100 feet of Fastnet Rock, where it was connected to a large mushroom-shaped anchor of metal. The two ends of the cable across Fastnet Rock were let down into grooves specially cut in the rock to protect them from the seas, and made electrical connection with the sea by means of metal plates cemented to the rock. On the rock fifteen Leclanche cells were employed, giving a current of 1.5 amperes, and the current received at Crookhaven was 0·15 milliamperes.

As far back as 1864 Clerk-Maxwell, in his paper, "On the Dynamical Theory of the Electro-Magnetic Field," assuming the existence of the ether, deduced mathematically the existence of electro-magnetic waves therein. He defined the laws which would govern such waves if they existed, predicted all the properties they should possess, and even the exact speed at which they should travel. In the words of Sir Oliver Lodge, in a lecture he delivered at Finsbury Technical College on February 1st, 1923: "He legislated for them before they were born." He also showed that conductors of electricity must be opaque to light.

In 1883 Fitzgerald, at a meeting of the British Association, surmised that the oscillatory discharge of a Leyden jar would produce etheric waves, "if only a means could be devised for their detection."

In 1888 Lodge produced stationary waves along wires by condenser discharges.

We now come to a man whose work can never be sufficiently appreciated, and, in the light of modern tendencies, it is interesting to note that he freely gave his results to the world and took out no patents.

In 1888 Hertz, in his paper, "On the Action of a Rectilinear Oscillation on a Neighbouring Circuit," gave to the world the result of his epoch-making researches, and for the first time established the existence of free electro-magnetic waves.

It is interesting to note that he described them as "outspreading of electric force"—not as waves. Kelvin, in translating his work into English, designated them "ether waves."

At this date "self-induction" was not understood. Sir Wm. Preece jocularly said it was a "bug-a-boo." Kelvin spoke of it as electro-dynamic capacity, whilst Maxwell was the first to term it self-induction. Heaviside called it induction and also pointed out this ionized condition of the upper atmosphere, whilst Dr. Eccles, in postulating his theory of the transmission of waves round the earth in 1911, gave to it the name of "Heaviside layer."

In 1889 Lodge showed the phenomenon of cohesion between two metallic spheres (see "Proceedings of the Institute of Electrical Engineers, 1890"), and later made a coherer consisting of a microphonic contact between a watch spring and a plate of aluminium.

In the year 1884 Professor Calzecchi Onesti had shown that if metal filings were placed in a tube between two copper electrodes and inserted in circuit with a battery and galvanometer or telephone, the application of a fairly high voltage across the filings caused them to stick together, or cohere sufficiently to allow a current to pass through them, and he showed that revolving the tube decohered them.

(*To be continued.*)

Questions and Answers

"**CIRCUIT**" (**Suffolk**) *asks* (1) *Which of the tuning arrangements submitted is the best.* (2) *For a circuit in which a switch is included so that the reaction coil may be coupled with either the closed circuit coil or with the tuned anode coil.* (3) *Is it safe for him to attach his earth wire to the gaspipe.* (4) *What would be suitable dimensions for the anode and reaction coil.*

(1), (2) and (4) A suitable diagram of connections is given in Fig. 1. With the aerial tuning condenser in series as shown, the aerial coil would be a No. 75 honeycomb coil, the closed circuit a No. 50 coil, and the reaction coil probably a No. 35, although you may require to use a much larger coil for the reaction. The anode coil would be a No. 75. No. 100 would give better results, although you must use a very small value of tuning condenser. (3) We do not recommend the use of a gaspipe as an earth. We suggest you use a lower capacity or a counterpoise in place of the earth. This could conveniently consist of three or four wires spaced about 4 ft. running along underneath the aerial. In your case the wires could be run on a level with the window. The wires should be carefully insulated from ground connections, and the lead-in from the counterpoise should be connected with the earth terminal. The signal strength is very materially reduced when an earth wire which is 40 ft. long has to be used.

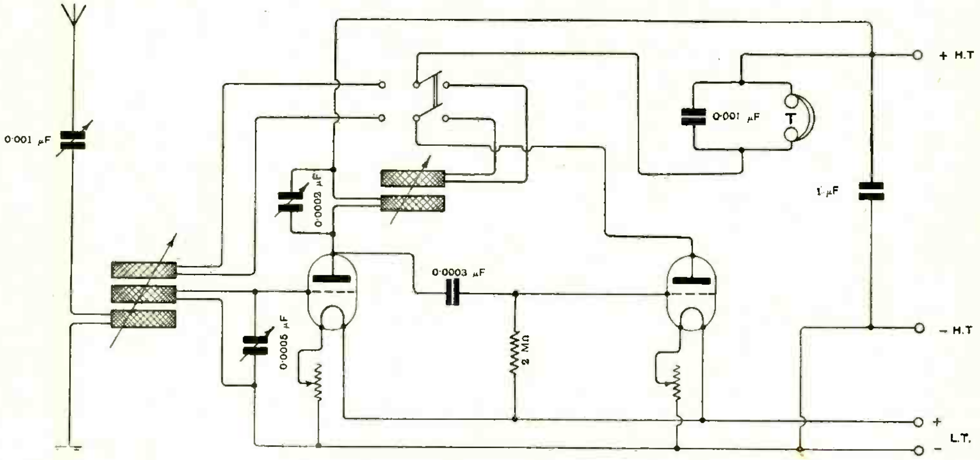


Fig. 1. "**CIRCUIT**" (**Suffolk**). *The figure gives the connections of a two-valve receiver. The first valve operates as a high frequency amplifier, the second as a rectifier. The reaction coil may be coupled with either the closed circuit coil or the anode coil with the aid of the throw-over switch.*

"**VERNIER**" (**Leeds**) *refers to Fig.* 4, *page* 64, *in the issue of April 14th, and asks for a diagram of a tuning panel to use in conjunction with a receiver. It is proposed to use a two-coil holder and a* 0·0005 *mfd. tuning condenser.*

See Fig. 2. A series parallel switch is shown connected.

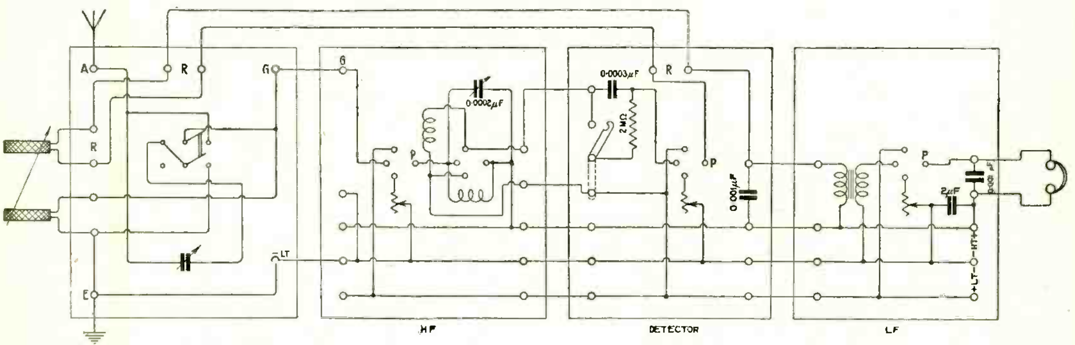


Fig. 2. "**VERNIER**" (**Leeds**). *The diagram gives the connections of a unit system, comprising a tuner, high frequency amplifier, detector and note magnifier.*

"FISH" (Grimsby) *asks* (1) *What is the gauge of samples of wire submitted.* (2) *What gauge of wire, and about how much would be required to wind a magnet of the dimensions given.*

(1) The piece of wire labelled No. 1 is No. 44 single silk covered copper wire. That labelled No. 2 is No. 40 double silk covered copper. (2) We suggest you use No. 24 D.S.C. copper wire. About 25 feet will be required.

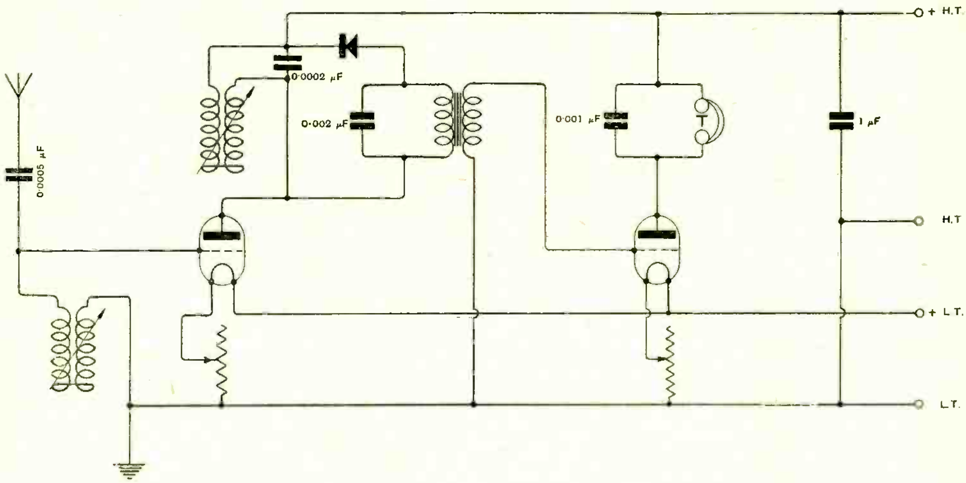


Fig. 3. **"E.A.D." (Surrey).** *Here we have a two-valve receiver. The first valve operates as a high frequency amplifier, a crystal is used as a rectifier, and the second valve operates as a note magnifier. Variometer tuning is used. See Fig.* 4.

"E.A.D." (Surrey) *asks for a diagram of a receiver with one high frequency, crystal rectifier, and note magnifying valves.*

The diagram is given in Fig. 3. The dimensions of the coils used in the aerial and closed circuits are given on page 72 of the issue of April 27th. The coils are wound in the form of basket coils upon a cardboard former. Suitable condenser values are given. A 6-volt filament battery and a 60-volt high tension battery should be used.

"ALFREDA" (Staffs.) *refers to the diagram given on page* 646, *Fig.* 7, *February* 10*th issue, and asks* (1) *Whether the components which he has used in constructing a receiver built along the lines suggested are suitable.* (2) *Whether he should be able to receive broadcast transmissions other than the local one.* (3) *The address of a querist.*

(1) The diagram referred to is quite correct, and is very suitable for the reception of broadcast transmissions. With a receiver of this description, you should be able to hear any of the broadcast stations provided you live a reasonable distance away from the local station, and you should be able to operate a loud speaker. (2) The components are suitable, except that Dewar type switches generally do not give satisfactory results when connected in the aerial circuit or in the anode circuit of high frequency operating valves. It would be better if you replaced the Dewar switches mentioned with an anti-capacity type of switch. These may be purchased for quite a small sum, and you would find them satisfactory. With the aerial condenser in series, use a No. 50 or a No. 75 coil in the aerial circuit. The closed circuit coil should be a No. 50, and the anode coils No. 75, when receiving broadcast transmissions. With careful tuning you should be able to tune in the broadcast transmissions desired. (3) We regret we cannot give you the name and address of the querist referred to. The name and address of a querist is considered as confidential. If, however, you would care to write a letter addressed to the querist, via this office, we shall have pleasure in forwarding your communication.

"J.H.W." (Cheltenham) *asks for a diagram of a two-valve receiver with one H.F., crystal rectifier, and one note magnifier.*

The diagram is given in Fig. 4. The first valve has a tuned anode circuit, across which is joined a crystal rectifier and a transformer. Suitable values are given. Also see Fig. 3.

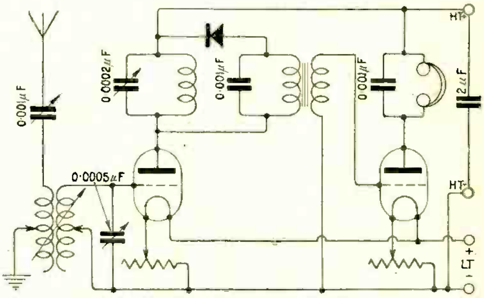


Fig. 4. **"J.H.W." (Cheltenham).** *This diagram gives the connections of a receiver similar to that of Fig. 3, but instead of variometer tuning the coils are tuned with variable condensers.*

"QUERY" (Sussex) *asks* (1) *For a diagram of a receiver with two high frequency, crystal rectifier, and two L.F. valves, for use with a frame aerial. It is desired to use the first high frequency valve with a tuned anode circuit, and the second with a transformer circuit. Switches should be connected to control the number of valves in circuit and to connect resistances in the anode circuit in place of the tuned anode or high frequency transformer.*

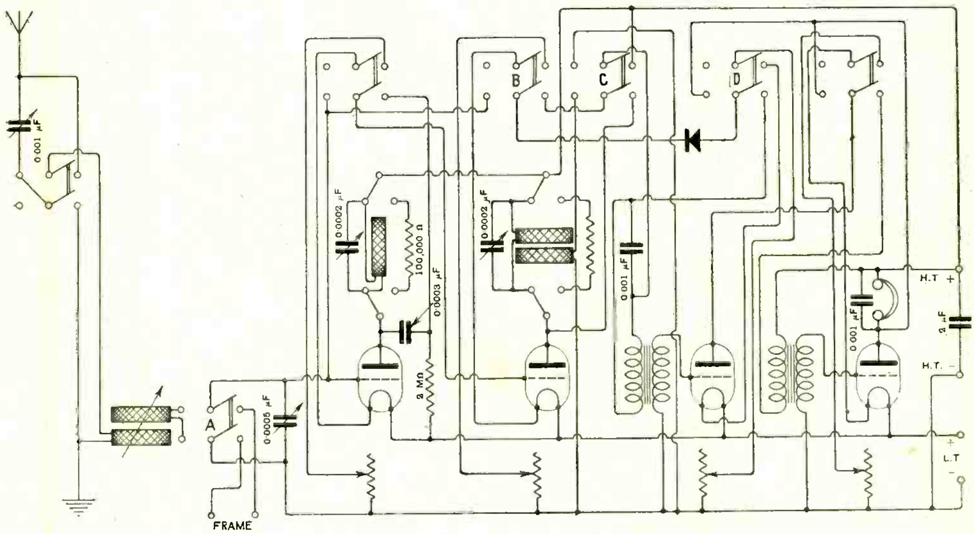


Fig. 5. **"QUERY" (Sussex).** *The diagram gives the connections of a four-valve receiver. A frame aerial may be used in place of the ordinary aerial and tuned circuit. The first valve operates as a high frequency amplifier, and with the aid of the switches either the tuned anode or the resistance capacity method of coupling may be used. The switch enables the valve to be disconnected when required. The second valve is connected so that either a H.F. transformer or an anode resistance may be connected. With switch B to the right, switch C to the left, and switch D to the right, the crystal rectifier is connected to the H.F. transformer and the L.F. transformer. With switch C to the right, others as before, the crystal is connected across the anode resistance. The remaining switches cut out the L.F. valves when required.*

(1) The diagram is given in Fig. 5. Suitable values are given.

"AERIAL" (Southfields) *proposes to erect a cage aerial about* 10 *feet above his ordinary receiving aerial and asks* (1) *Will the proximity of the aerials cause any ill effect.* (2) *What would be the best diameter for the rings for use with the cage aerial.* (3) *How many wires should be used.* (4) *Should he expect that results will be better when the cage aerial is used for reception.*

(1) When you are receiving on the single wire aerial, we think you will find the signals are very much reduced in strength on account of the proximity of the cage aerial. When transmitting use the cage aerial. It will be found the receiving aerial will absorb a good deal of energy. (2) For a small station, we suggest you use rings 2 feet in diameter. (3) We think you might use six No. 16 S.W.G. wires. (4) The use of a cage type aerial is recommended when transmitting. No great advantage is gained, however, in the use of a cage aerial for reception.

"AMATEUR ELECTRIC" (Cheshire) *asks for a diagram of a panel containing a tuner and amplifying valve.*

The diagram, drawn according to your wishes, is given in Fig. 6. The tuner has an aerial and closed circuits. The H.F. valve is coupled to the next valve through a H.F transformer.

"A.P.B." (W.5) *asks for a diagram of a Reinartz tuner suitable for use with a three-valve receiver.* (2) *Suitable values of components used in the tuner.* (3) *Method of making the inductance coil for the tuner.*

We would refer you to *The Amateurs' Book of Wireless Circuits*, by Mr. F. H. Haynes. Diagram 65 gives the connections of the Reinartz tuner with

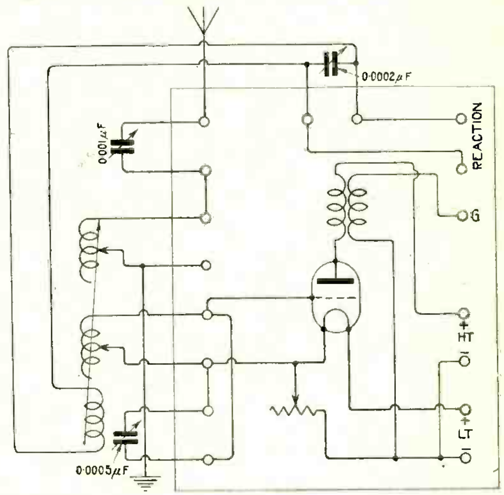


Fig. 6. **"AMATEUR ELECTRIC" (Cheshire).** *Diagram of a tuning and H.F. panel.*

a detector valve. Diagram 66 shows how the Reinartz tuner is connected with a high frequency amplifier tuned anode coupled. Diagram 67 shows how the Reinartz tuner is connected with a high frequency amplifier transformer coupled. Referring to the diagrams, the coil which is connected in the anode circuit consists of 30 turns of No. 22 D.C.C. on a former 2¾ ins. in diameter. Tappings are made at 10, 20 and 30 turns. The coil which is connected in the aerial and grid circuits has 50 turns of No. 20 D.C.C. The winding is tapped out at every five turns. The coils are both wound on one former. Particulars of a tuner are given on page 66 of the circuit book referred to.

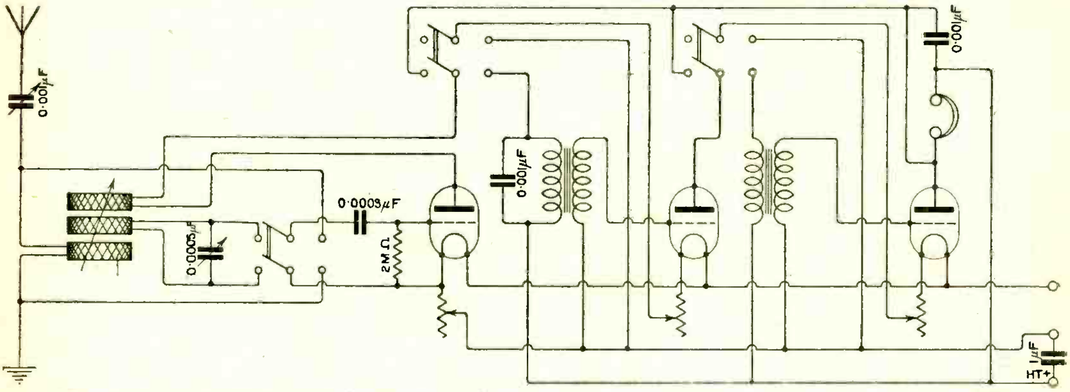


Fig. 7. "**R.M.**" **(N.2).** *Diagram of a three-valve receiver. The first valve operates as a rectifier, and the others as note magnifiers. Switches are connected for the purpose of controlling the number of valves in circuit.*

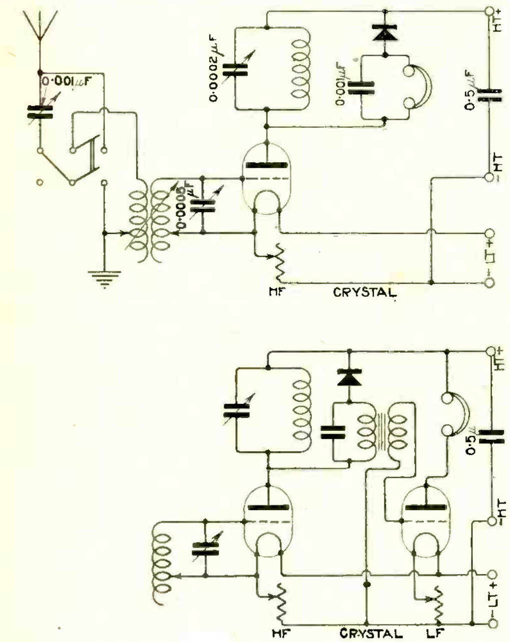


Fig. 8. "**E.H.**" **(W 10).** *The upper figure gives the connections of a valve with a tuned anode circuit across which is a crystal rectifier. The lower diagram shows the upper diagram with a note magnifier added.*

"**R.M.**" **(N.2)** *asks for a diagram of a three-valve receiver consisting of a detector valve and two note magnifiers.*

The diagram is given in Fig. 7. A switch is connected so that the aerial or closed circuits may be connected with the detector valve. Switches are provided to vary the number of valves in circuit.

"**E.H.**" **(W.10)** *asks for a diagram of* (1) *A receiver with one H.F. connected valve and a crystal rectifier.* (2) *A receiver with one H.F. connected valve, crystal rectifier and note magnifier.*

(1) and (2) The diagrams are given in Fig. 8.

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.*