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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

THE CHRISTMAS SEASON.

EVERY year, as the Christmas season approaches, our thoughts naturally turn to a consideration of what can be done in the way of providing for Christmas entertainment. In many cases wireless itself has simplified this task by bringing music of a seasonable character to every home, but to a great extent the mere novelty of wireless has begun to wear off, and we now regard it as an essential rather than an additional and novel form of entertainment. As a consequence, we must look round in other directions for novelty.

This must be our excuse for introducing in the present issue of *The Wireless World* some ideas for Christmas entertainment which are not all of them strictly wireless in character. No attempt has, of course, been made to deal with more than a representative few of the many ideas which could be adopted, but, no doubt, the reader with wireless experience will be able to modify and extend these schemes in many directions to suit his own requirements.

Wireless has another advantage at this time of the year, since it solves for us so easily the question of what to give as a Christmas present. To those who already own a wireless set there are always many accessories in a wide range of prices which provide most attractive presents, whilst one could scarcely imagine a more acceptable present than a complete valve receiver or even a simple crystal set for those who have not yet installed a set of their own. Christmas provides an excellent opportunity for extending interest in wireless, and there is every prospect that under the new control in 1927 the broadcast service will be improved, due to the fact that a very considerably greater sum will be available for expenditure on the programmes, whilst, in addition, the higher powered stations and alternative programme policy already approved will do much to add to the attractiveness and utility of the broadcasting service throughout the country.

CONTENTS.

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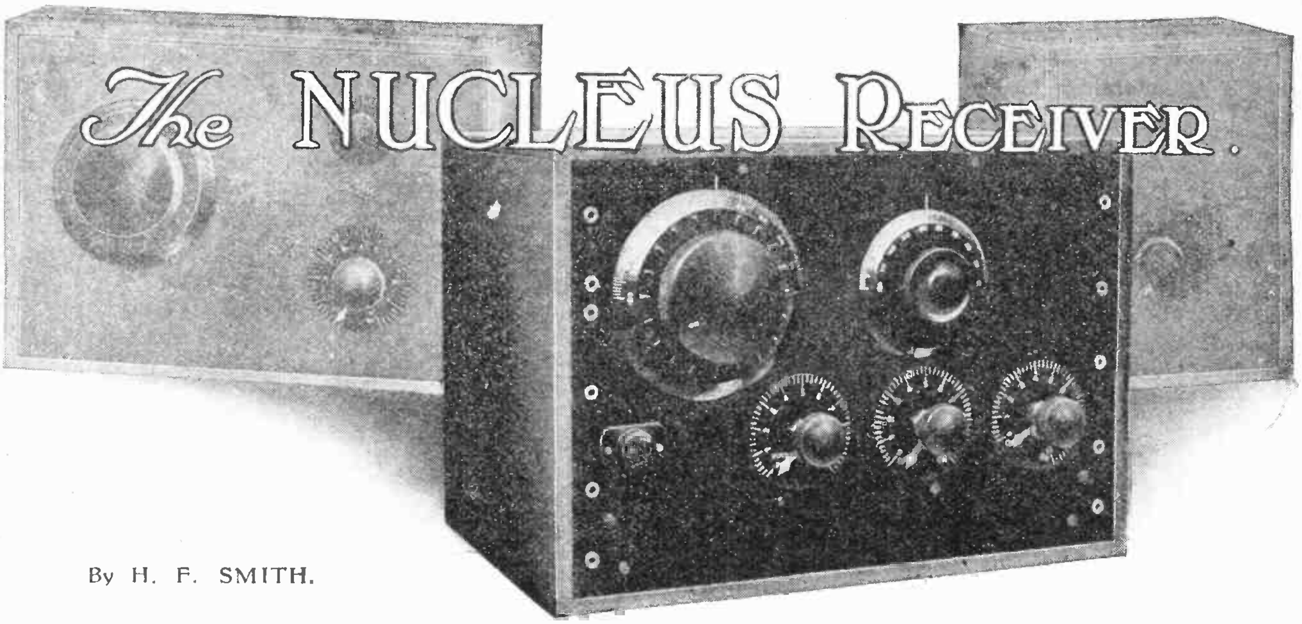
WIRELESS AND THE BLIND.

CAPT. Ian Fraser, M.P., the blind chairman of St. Dunstan's, is to be congratulated on the success of his Bill exempting blind persons from requiring a broadcast receiving licence, which has now passed through all its stages in the Commons and is expected to pass through the Upper House before Christmas. Capt. Fraser, in introducing the Bill, expressed the hope that it might become law before Christmas and thereby constitute a Christmas gift to the blind. Wireless is appreciated by the blind to an extent probably far greater than it is possible in the case of those who have the advantage of their sight.

Capt. Fraser's name is so intimately associated with broadcasting to-day that all those interested in wireless must naturally feel that they have a special link with the work of St. Dunstan's. The eleventh annual report of St. Dunstan's has just been issued, and is a revelation to those unacquainted with the splendid work which is being done by this growing organisation.

The NUCLEUS Receiver.



By H. F. SMITH.

A "Local Station" Loud-speaker Set Arranged for the Addition of H.F. and L.F. Amplifiers.

IN the earliest days of broadcasting the so-called "unit" receiver enjoyed very considerable popularity; indeed, a large proportion of the ready-made sets offered for sale were constructed on this plan. It is rather interesting to speculate on the probable cause of its decline in favour; although the arrangement is undeniably convenient, it is seldom advocated at the present time. The writer has a shrewd suspicion that it was due to the fact that the addition of amplifying valves, whether H.F. or L.F., did little more than make evident the poverty of the land in a most convincing manner, and thus caused the user to become dissatisfied with his receiver. The L.F. stages, while certainly increasing volume, amplified distortion to a still greater extent, while the H.F. valves, as far as the shorter wavelengths were concerned, did little more than render the whole set unstable and extraordinarily difficult to operate.

Luckily, our knowledge of H.F. work has increased enormously since those "bad old days," and it is now possible to construct a single-valve amplifier which, on the broadcast wavelengths, will magnify the voltage due to an incoming signal about forty times; this by pure valve amplification, without taking into account the very considerable increase possible by the judicious use of reaction. On the L.F. side an equally happy state of affairs exists, as valves and couplings are available which will give a high degree of amplification without appreciable distortion.

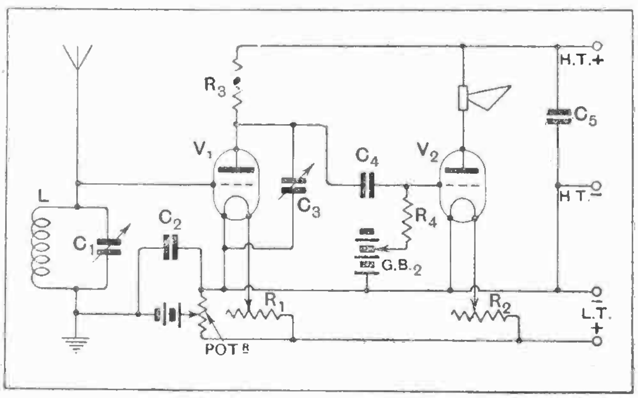


Fig. 1.—The simplified circuit diagram.

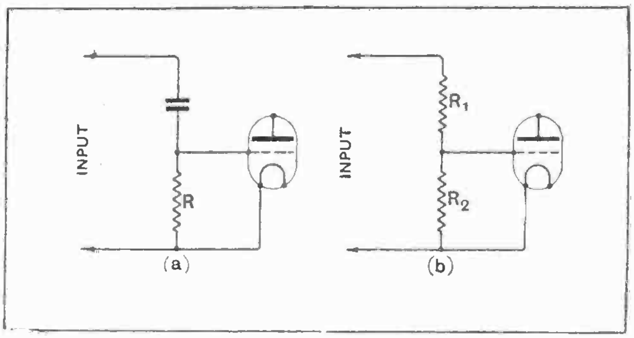


Fig. 2.—Showing the effect of grid condenser reactance.

Advantages of the Unit System.

It has been urged by opponents of the unit system that the apparatus occupies a very large amount of table space, and it must be admitted that there is some justification for this complaint, although the instrument to be described in this article, consisting of detector and L.F. amplifier, together with an additional H.F. and an L.F. unit, only measures about 32ins. long, which can hardly be considered as excessive.

The Nucleus Receiver.—

Readers of this journal will have noticed that the designers of the majority of receivers making use of highly efficient H.F. amplification have only made provision for covering the broadcast wavelengths, or have compromised, for long-wave work, by cutting out the high-frequency amplifying stage entirely. It is difficult to express a definite opinion as to whether means will be found for overcoming these difficulties without any appreciable sacrifice of efficiency, but it is certain that very considerable difficulty will be experienced in designing a reasonably simple set, as a single instrument, to cover all broadcasting wavelengths from about 30 metres upwards, and at the same time retaining H.F. amplification at all frequencies where its use is found to be practicable. It is in this direction that the unit set scores heavily.

Having briefly discussed some of the pros and cons of the system, we will consider the circuit of the nucleus to which both H.F. and L.F. amplification may be added. It is given in simplified form in Fig. 1, and will be recognised as embodying the essentials of the receiver recently described by the present writer under the title of "The Economy Two."[1] With slight modifications as to capacities and resistance values, etc., to suit its special functions, it is similar in principle to the detector and first L.F. stage of the "Everyman's Four" receiver,[2] which has been extremely popular with readers of this journal. The first valve functions as a "bottom bend" detector, and to enable a critical adjustment of grid potential to

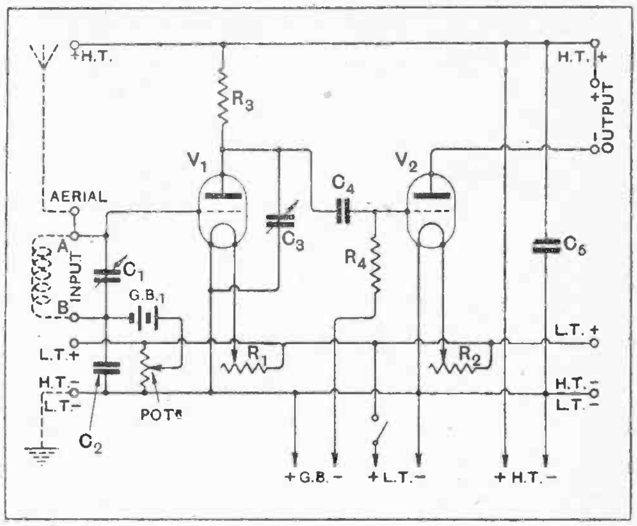
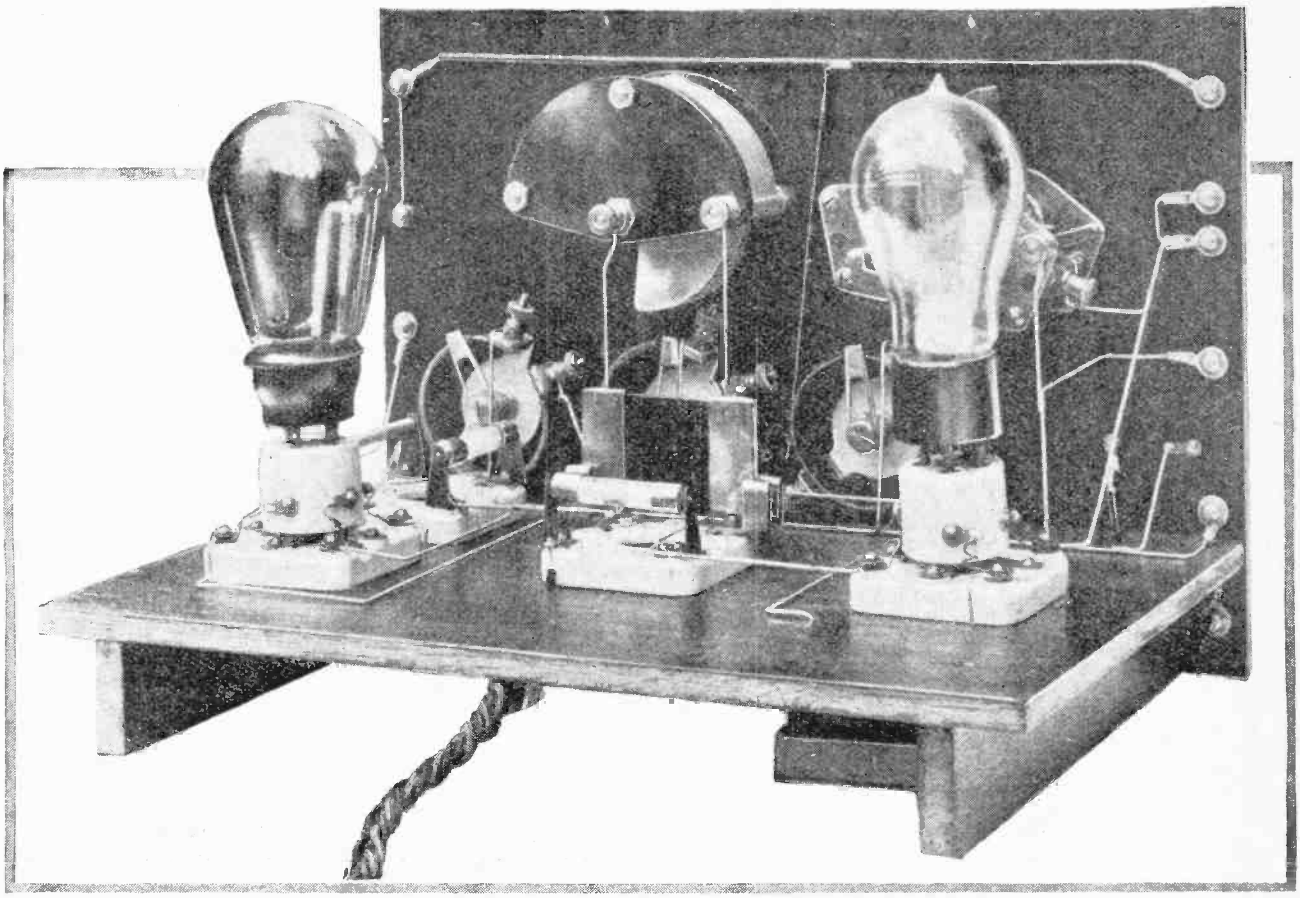


Fig. 3.—The schematic circuit diagram showing connections to sockets for joining to other units. C_1=0.0003 mfd.; C_2=0.1 mfd.; C_3=0.0003 mfd.; C_4=0.001 mfd.; C_5=2 mfds.; R_1=15 ohms; R_2=6 ohms; R_3=1 megohm; R_4=5 megohms.

[1] *The Wireless World*, October 27th, 1926.
[2] *The Wireless World*, October 13th, 1926.



Rear view of the receiver. Note the mounti 3 of resistance and condenser clips on porcelain bases.

The Nucleus Receiver.—be made, a potentiometer is fitted in addition to a bias battery. This refinement is only necessary when dealing with very weak signals.

The detector is coupled to the L.F. amplifying valve through a high anode resistance and a condenser of considerably lower capacity than usual. Lest there should be any uneasiness as to whether the use of this small condenser will result in an undue reduction of voltages corresponding to the lower audible frequencies, it will be as well to consider for a moment what is actually happening. The essentials of the circuit are shown in Fig. 2 (*a*), the input voltages, of course, being those set up across the anode resistance. We can regard the grid condenser and the leak as two resistances in series, and they are accordingly shown in this manner in Fig. 2 (*b*). Our object is to apply the highest possible voltages between the grid and filament of the valve, so clearly any drop across R_1 (the resistance of the condenser) will be wasted, while the drop across R_2 (the grid leak) will be doing useful work. Now, the condenser of 0.001 mfd., which is suggested here, behaves, at the very low frequency of 100 cycles, as a resistance of, roughly, 1.6 megohms, while the grid leak is of 5 megohms. On the higher audible frequencies (4,000 or 5,000 cycles) the resistance (or reactance) of the condenser amounts to some 40,000 ohms only, which is almost negligible. Thus we see that the low 100-cycle note is reduced in strength in the proportion of about 1.6 to 5, which is not very serious, and compares favourably with most other forms of coupling. The actual state of affairs, however, is even better than this, as a small capacity is deliberately introduced across the anode resistance (or, rather, between anode and filament, which amounts to practically the same thing). This condenser may be considered as a partial short-circuit, its effect being more pronounced as the frequency increases. Thus there is a tendency to reduce amplification on the higher tones, retaining the lower ones as much as possible. The by-pass condenser

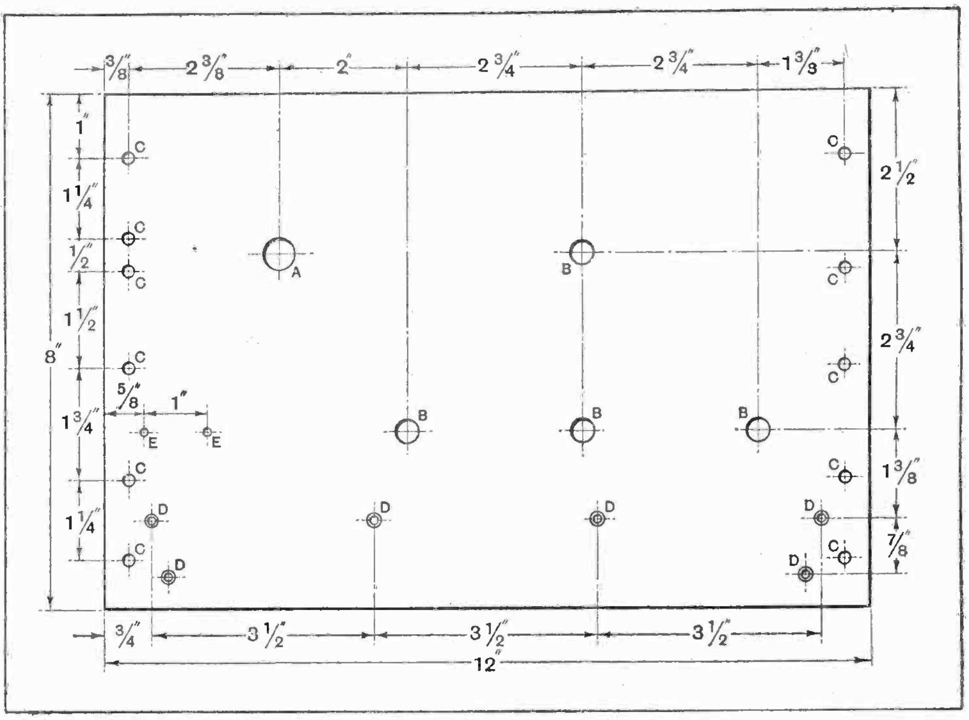
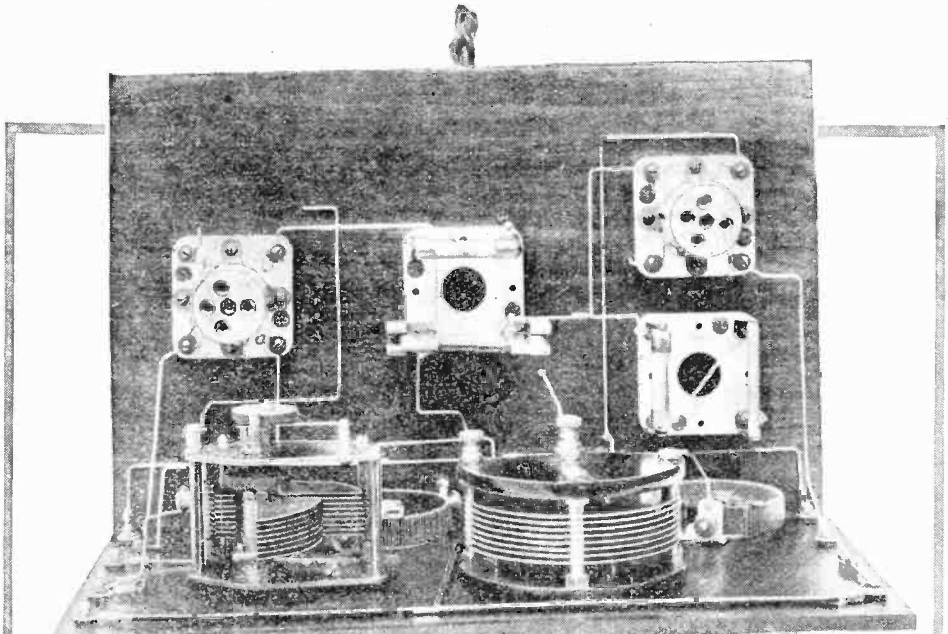


Fig. 4.—Drilling details of the panel. A, 1/2 in. dia.; B, 3/8 in. dia.; C, drilled and tapped 1BA; D, 1/8 in. dia., countersunk for No. 4 wood screws; E, 3/32 in. dia. The two holes marked E are for the on–off switch.



View of the receiver from above.

The Nucleus Receiver.—

(C_3 in the diagram) is variable, in order that a certain amount of control over the tone of reproduction may be obtained. Its presence also has a bearing on the efficiency of the detector valve.

It is possible to strengthen the low tones still further by using a higher value of grid leak, and this is often quite permissible, although the bad effects of overloading, with consequent grid currents, will be more pronounced with a high resistance.

Fig. 3 shows in schematic form the actual circuit of the receiver, and the arrangement of battery, input, and output terminal sockets for connection to H.F. and L.F. units. In the original form of unit set, it was usual to connect both H.T. and L.T. supplies to the output side of the last unit; this plan was not altogether convenient, and that adopted in the present set, where the batteries are permanently connected up to the "nucleus" set, seems to have several advantages, particularly when a quick change-over is desired.

It should be emphasised that the anode resistor R_3 must be of a type guaranteed by the makers to carry an appreciable current without an undue change in resistance. The coupling condenser C_4 must also have a high insulation resistance.

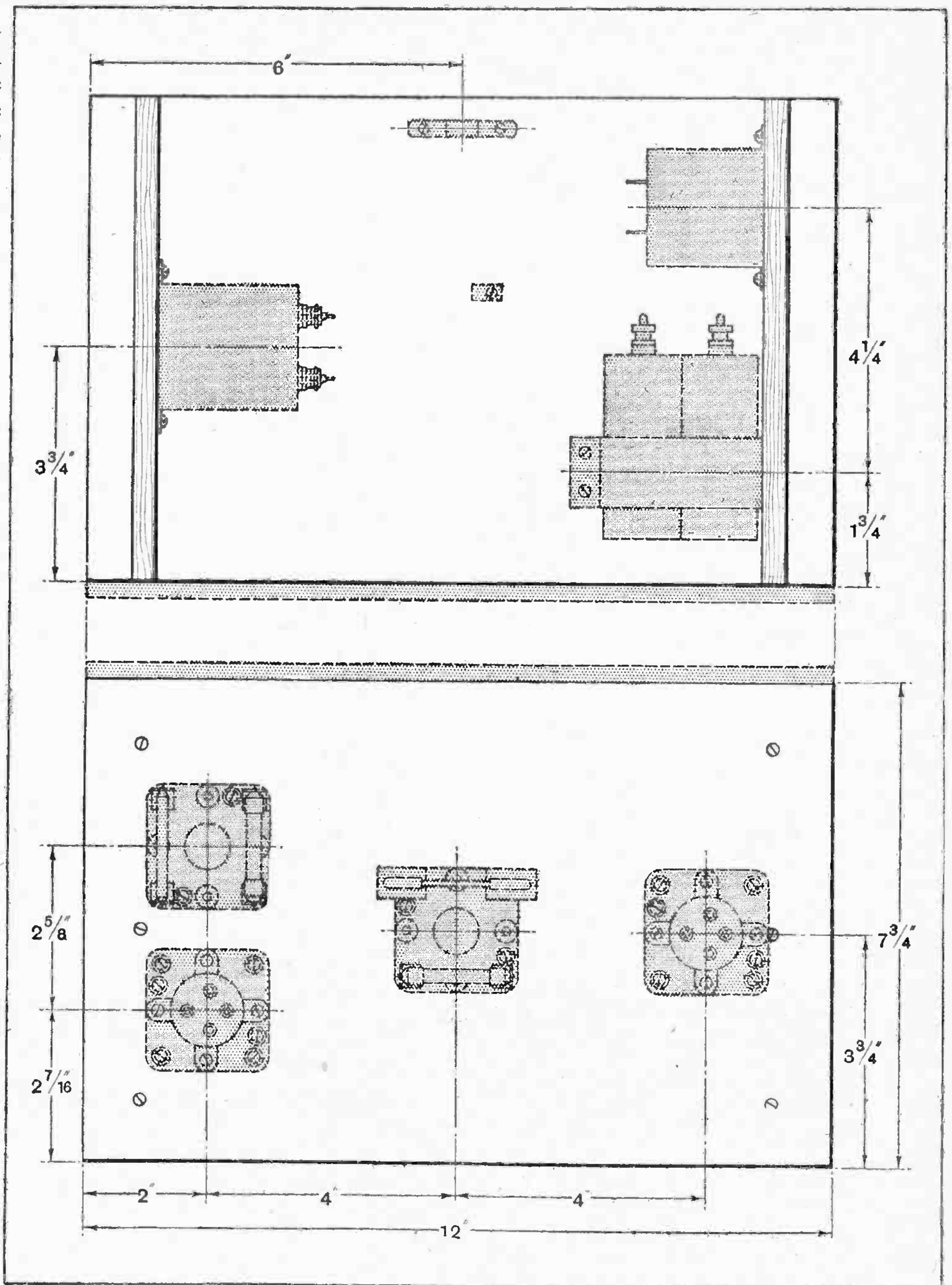


Fig. 5.—Mounting of components on the under-side of the baseboard and (below) on its upper surface.

Constructional Details.

The baseboard is raised by wooden battens to a height of 1¼in. above the bottom of the panel, in order that the grid battery and by-pass condensers may be accommodated underneath it, thus leaving plenty of room above for high-frequency components, for wiring, or for any alterations which may subsequently be desired. The set has been made as simple as possible, consistent with efficient operation, although it is possible to substitute the anode by-pass condenser with a fixed capacity of about 0.0001 mfd., and to eliminate the potentiometer entirely without a great sacrifice of effectiveness.

The clips for the coupling condenser and anode resistance are mounted on porcelain bases supplied as a separate fitting for the "Athol" reversible valve holders. These bases are sold with a bronze spring which, when performing its normal function, acts as a shock-absorbing mounting for the valve holder proper, and must be removed before attaching the clips. It was found that the spacing of the holes was sufficiently correct for the purpose. Two pairs of clips are connected in series on one of the bases, in order that an extra grid leak may be connected, if desired, in series with one of 5 megohms (this seems to be the maximum resistance generally obtainable). When this extra resistance is not in use, the spare pair of

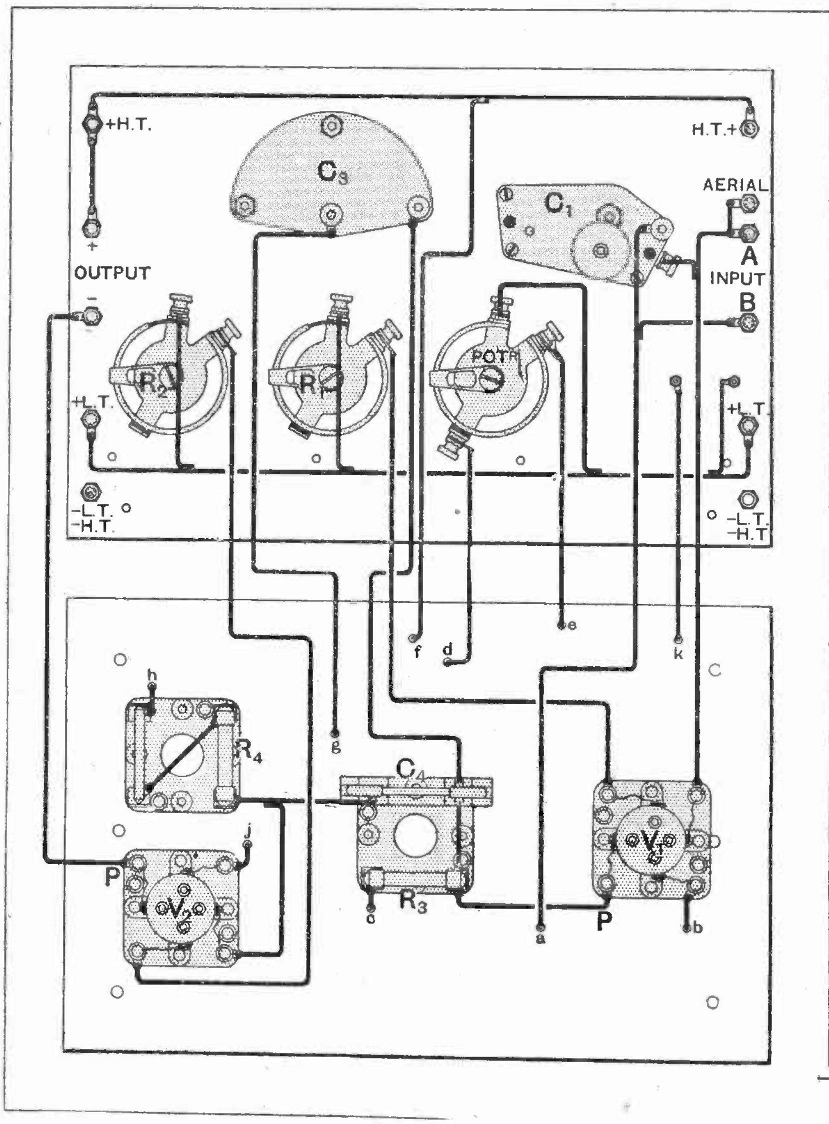


Fig. 6.—The practical wiring plan. The lettering of components corresponds to that of Figs. 1 and 3, while the markings a, b, c, d, e, f, g, h, j refer to leads passing through the baseboard the ultimate connections of which may be traced by referring to Fig. 7.

not at low potential pass through the baseboard. The flexible battery wires leading out through a hole in the back of the cabinet are joined to the most convenient points on the wiring. It will be noticed that a small "on-off" switch is inserted in the positive L.T. lead in order that the set may be controlled without turning the rheostats.

Capabilities of the Unit.

The wooden case is of simple construction, and should not be beyond the capabilities of the amateur cabinet maker. Mahogany ⅜in. thick was used throughout; this was purchased with a planed surface. All essential measurements are given in Fig. 8. A wooden fillet, ⅜in. square in cross section, is fixed along the under-side of the upper front crosspiece, and to it is screwed the upper edge of the panel, which is further secured in position by passing a screw through the bottom into each of the battens under the baseboard.

The unit as it stands is suitable for loud-speaker work on the local station at distances of 5 miles or more, depending on the efficiency of the aerial-earth system. It can be relied on to give ample volume for ordinary requirements under conditions where a crystal set gives 'phone signals of sufficient strength to be audible with the earpieces held a few inches away. Daventry can be received comfortably at distances of 30 miles or more, depending, of course, on the aerial with which the set is used. These clips must be short-circuited by means of a short length of metal rod. High insulation is particularly necessary when large ohmic values are used in any circuit, and porcelain has been found to be very dependable, although there is no reason why ebonite or any other good insulator should not be used, with the clips supplied for the condenser, and the usual pattern obtainable from most dealers for the resistances.

The majority of the connections are made with No. 18 S.W.G. tinned copper wire, a few lengths of insulating sleeving being used where there is any risk of short circuiting, and also where leads

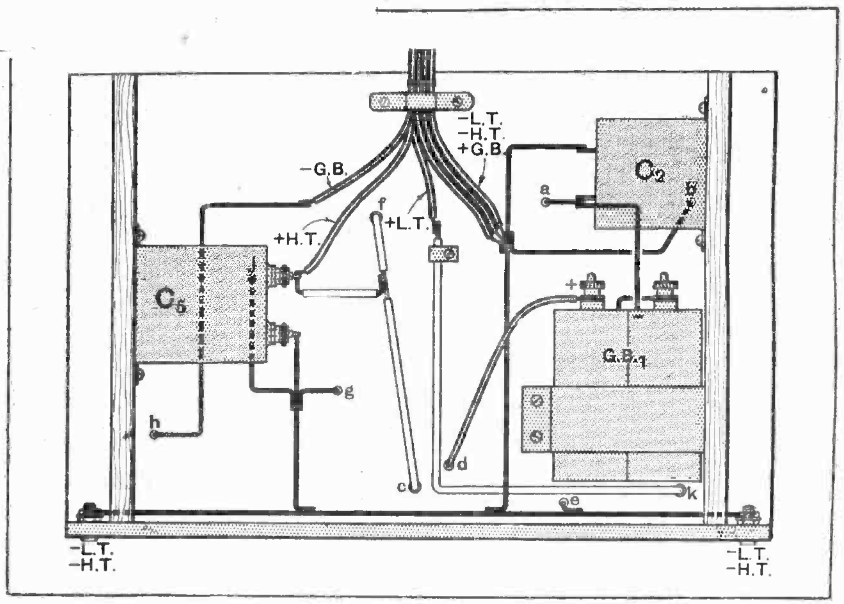


Fig. 7.—Wiring of components on the under-side of the baseboard.

LIST OF PARTS.

1 Variable condenser, 0·0003 (Brandes).
1 Variable condenser, 0·0003 (Ormond, type No. 3).
10 Plug sockets (Lisenin).
1 Rheostat, 6 ohms (Ormond).
1 Rheostat, 15 ohms (Ormond).
1 Potentiometer (Ormond).
1 Fixed condenser, 0·1 mfd. (T.C.C.).
1 Fixed condenser, 2 mfds. (T.C.C.).
1 Fixed condenser, 0·001 mfd. (McMichael).
2 Valve holders (Athol).
4 Valve holder bases, two for mounting resistances and coupling condenser (Athol Flexifonic).
1 On-off switch (Wearite).
2 Dry cells (Siemens' T size).
1 Ebonite Panel, 12in. × 8in. × ¼in.
1 Resistance, 1 megohm (Ediswan).
1 Resistance, 5 megohms (Ediswan).
1 Coil holder.
Wood for cabinet and baseboard.
Wire, screws, etc.

Approximate cost .. £3 8 6

results will only be attained when a "high magnification" valve, such as the Cosmos S.P.55B., S.P.18B., and similar types in the Benjamin or Amplion ranges, is used as a detector (V_1). Another suitable valve is the Ediswan R.C. the reader is referred for further information on this subject to page 505 of *The Wireless World* for October 27th, 1926. For local work, a power valve will be necessary as an L.F. amplifier.

A tuning coil must be connected across the input sockets A and B; its holder may be mounted on the back of the cabinet, and should be fitted with flexible leads carrying plugs for insertion into these sockets. The earth is connected to the –L.T. socket; thus the by-pass condenser (C_2) across the potentiometer and bias is included in the aerial circuit; this arrangement is quite permissible, and avoids the necessity of fitting an extra earth terminal.

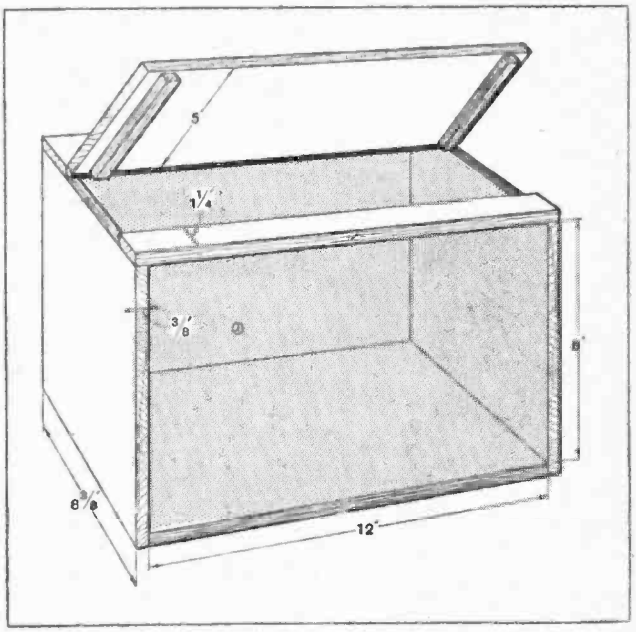
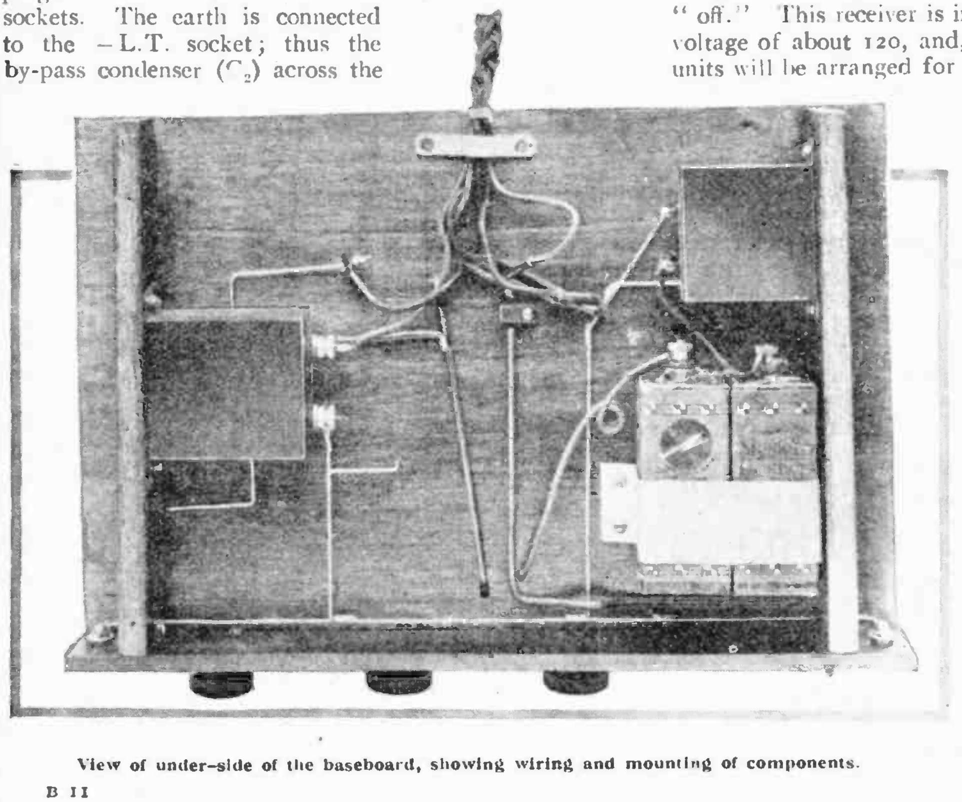


Fig. 8.—Details of the cabinet. The internal measurement from back to front is 8 ins.

A red celluloid disc is mounted under the H.T.+ sockets on the face of the panel, and serves as a reminder that the wiring associated with any units added to the nucleus is "safe" when the connections from these sockets are removed and the L.T. switch is at "off." This receiver is intended to operate on an H.T. voltage of about 120, and, as far as possible, subsequent units will be arranged for the same pressure, thus avoiding a multiplicity of leads.

Regarding the operation of the potentiometer, it should be pointed out that the possible range of applied grid voltages will depend partly on the L.T. battery. With a single accumulator cell, grid potential may be varied between 1 volt negative and 3 volts negative. This is assuming that a 3-volt bias battery is used.

A high-frequency stage for the broadcast wavelengths will be described in a very early issue, and is to be followed by articles dealing with a long-wave amplifier, and a short-wave unit particularly designed for the American transmissions which are receivable at the present time at considerable strength. An additional L.F. stage will also be dealt with.



View of under-side of the baseboard, showing wiring and mounting of components.

READERS' NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

FIXING EXTENSION WIRES.

When running telephone extension wires along the papered wall of a room there is no necessity to damage the plaster by driving in staples.

The wires can be effectively secured by using small pieces of passe-partout binding, which may be obtained from photographic dealers and music sellers. This material is coated with a very strong gum, and can be obtained in any colour to match the wallpaper.—M. W.

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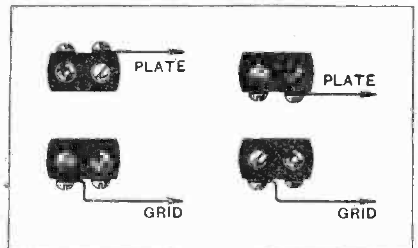
REACTION COIL CONNECTIONS.

In wiring up the plugs and sockets of a two-coil holder it is customary first of all to make the reaction coil connections temporarily, and to change them over when the set is first tried out in order to ascertain the correct connections for positive reaction. The connections may be made permanently in the first instance if the following simple rule is remembered:



Universal rule for reaction coil connections

Diagonally opposite plugs (or sockets) are connected to grid and plate of the detector valve.

This rule is universal, and is independent of the method of mounting the coil plugs as the diagram shows. It is also independent of the type of circuit employed, being equally applicable to the Hartley and Reinartz circuits.—W. W.

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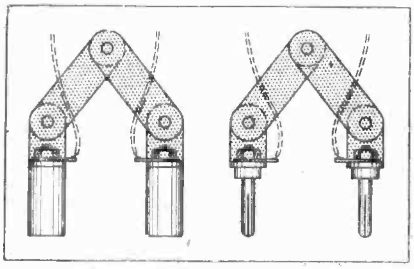
ADJUSTABLE PLUGS AND SOCKETS.

The amateur will find the adjustable plugs and sockets illustrated in the diagram of great use in experimental work. The device is not only useful in picking up contact with plugs and sockets of different spacing, in which case the connecting strips should be of ebonite, but may also be used for short-circuiting purposes by using brass instead of ebonite links.—W. H. G.

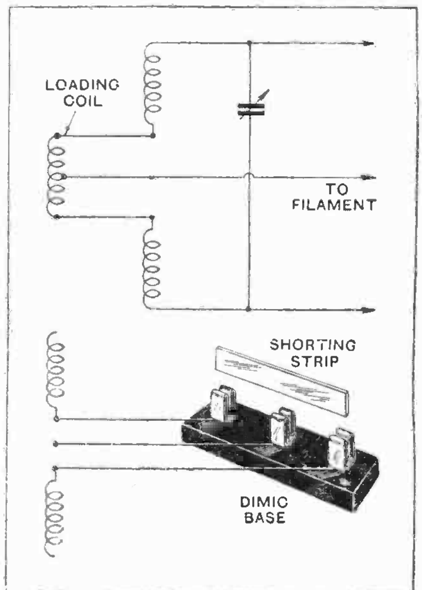


Plugs and sockets with variable spacing.

FRAME AERIAL LOAD COIL.

The Hartley circuit is frequently used in portable receivers working with a frame aerial, in which case a tapping is taken from the centre of the coil winding, making the addition of loading coils rather difficult.

The diagram shows a convenient method of overcoming this difficulty. A Dimic coil base is connected in the centre of the frame, as shown in the lower part of the diagram. Normally, the three spring contacts are closed with a brass shorting strip, but when it is desired to raise the wavelength of the receiver, a loading coil of appropriate inductance with a centre tapping may be plugged into the coil base in place of the shorting strip. The wavelength is thus raised to the appropriate value without upsetting the symmetry of the circuit.



Centre-tapped loading coil for frame aerial Hartley receivers.

Instructive and Amusing Experiments for Christmas Entertainments.

By A. P. CASTELLAIN, B.Sc., A.C.G.I., D.I.C.

THE stunts described in this article are put forward by the writer as suggestions for something a little out of the ordinary in Christmas entertainments, in that some of them may be classed as conjuring tricks illustrating various scientific principles which are not common knowledge to the general public, and even, be it said, some of them unknown to our suburban "experts" who profess to know all about "how it is done."

Seeing is Believing.

One of the most striking of these stunts may be performed under conditions that no amateur conjurer would even dream of attempting a trick—namely, with the audience all around him as close to the apparatus as they like to get. This particular trick serves to show to what degree we may trust our senses, for it shows as stationary objects that are *known* (and can be proved) to be moving.

The stunt will first be described as it appears to the audience, and then it will be shown how it is done, and on what scientific principles it depends for its success.

A little electric motor has a wooden clamp on its shaft so that cardboard discs may be fitted on. One such disc has a cross painted on it in black, the cross forming two diameters, as shown in Fig. 1 (a).

This disc is fitted on to the motor and the current switched on, so that the disc is rapidly spun round, and all that is visible is a grey blur instead of the cross. The *magic light* is then switched on from the *magic box* and the cross begins to appear travelling slower and slower and finally becomes stationary, although the motor is still rotating fast.

The Caged Canary.

The cross will rotate slowly in either direction or remain stationary according to the will of the conjurer. The latter then proceeds to stop the motor, take off the disc with the cross on it, and replaces it with another disc on which a canary has been painted on one side and a cage on the other, as shown in Fig. 1 (b). He then says that with the aid of the *magic box* he is going to put the canary in the cage. He starts the motor up with the disc on, switches on the *magic light*, when the canary appears in the cage on the disc. Just to show that there is no deception, the canary and cage then appear at opposite sides of the disc with the motor still running.

With the *magic light* switched off, all that appears is a blur.

Now, as to how it is done. Take the case of the cross first, as if this is understood, the other follows at once. If the cross is illuminated every time that one is vertical and not illuminated at any other time, then the cross will appear stationary with one arm vertical. If the speed of rotation of the disc is sufficiently high (of the order of 300 r.p.m., or greater for a four-armed cross), the cross will appear perfectly steady and clear, but if much lower speeds are used there will be a flicker effect. This is due to the fact that the average eye can perceive up to about sixteen pictures a second as separate entities, but above this number they become merged into each other,

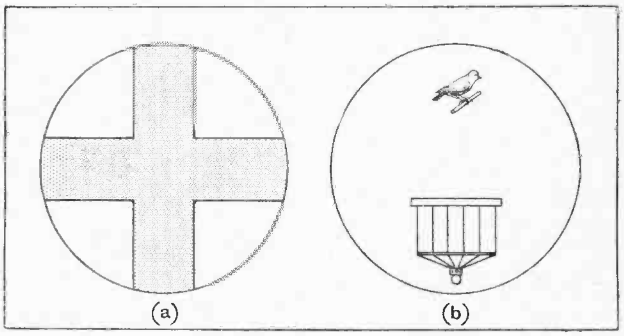


Fig. 1.—Showing two forms of discs for the magic box experiments. In (a) the cross shown shaded should actually be blacked in, and in (b) note that the cage should be drawn upside down.

giving the effect of continuous vision. Incidentally, this effect of persistence of vision, as it is called, is what makes the cinematograph possible.

The magic light, therefore, must illuminate the disc *only* when the cross on the latter is in similar positions—*i.e.*, in the case of a four armed cross with the arms exactly similar, the disc may be illuminated four times, twice, or once per revolution.

If the disc is illuminated eight times per revolution, then the cross will appear to have eight arms, and if the frequency of the illumination is very slightly less or slightly greater than those specified, the cross will

Christmas Novelties.—

appear to be moving slowly backwards or slowly forwards.

We see, then, that if the disc with the canary and cage on it is illuminated *once* per revolution, say, when the canary is at the top of the disc, then the disc will be seen

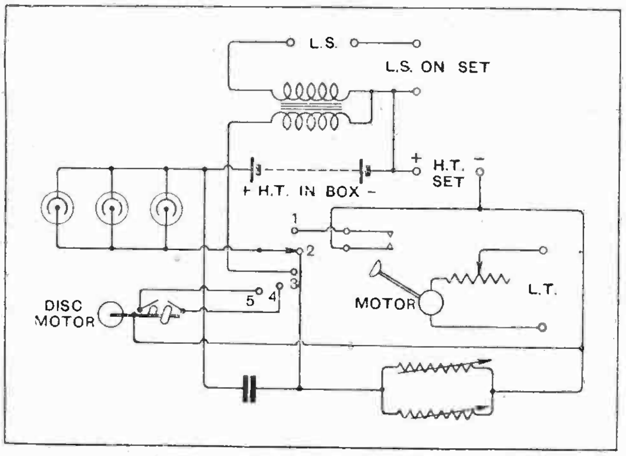


Fig. 2.—Circuit of the magic box.

as if stationary, but if illuminated *twice* per revolution, once when the canary is at the top and once when the cage is at the top, then the canary will be seen *inside* the cage. As a matter of fact, two canaries in two cages will be seen, one right side up at the top of the disc and one upside down at the bottom, but the latter may be blocked out if desired by illuminating only the top half of the disc. The scientific effect illustrated by this is called the *stroboscopic effect*.

The *magic light* consists of neon lamps, which will follow rapid fluctuations of voltage, and the interruption of the supply in the first case is obtained by another small electric motor driving a cam which completes the neon lamp circuit twice per revolution of the motor. These neon lamps are commercially called "Osglim" lamps, and require about 200 volts D.C. to run them, which may be provided by D.C. mains, if available, or by dry battery H.T. if these are not available.

To test whether the house lighting system is D.C. or A.C. put an Osglim lamp into one of the sockets and switch the light on. If *both* electrodes glow, then the supply is A.C., and if only one, then it is D.C. If neither glow, but an ordinary lamp lights in the socket, then the supply voltage is probably 120 volts or below, and a 100-volt H.T. battery should be used for the above test in series with the neon lamp. If nothing happens, then the H.T. battery should be connected the other way round, and if the neon lamp does not light up then on one electrode only, the mains will be of no use.

Flashing Lamp.

Another interesting thing that may be shown with neon lamps is the "flashing lamp." If a large condenser is put in parallel with the neons and a large resistance of the order of megohms used in series with the neons and a 200-volt supply the lamps will not light up directly, but after a time will flash up, then go out for an interval, then flash up again, and so on, and the interval between flashes may be controlled by altering the capacity of the condenser, the value of the resistance, or the supply voltage.

This effect is obtained in the *magic box* by varying the resistance.

Visible Broadcast.

Quite an amusing thing to show is a neon lamp flashing in time to dance music as received on a radio set.

If large H.T. valves (140 volts or so) are in use in the radio set, then visible indications will be obtained by connecting a neon lamp across plate and filament of the last valve, with the loud-speaker in its usual position. If the H.T. voltage is lower than this, then it is best to connect the primary of an ordinary intervalve transformer in series with the loud-speaker, and to connect the neon lamp either in series with an extra 100 volts or so H.T., or directly across the secondary of this transformer.

This demonstration is most amusing when used with dance music, as the lamp can be made to go out between the beats and to glow brightly in time with the beats.

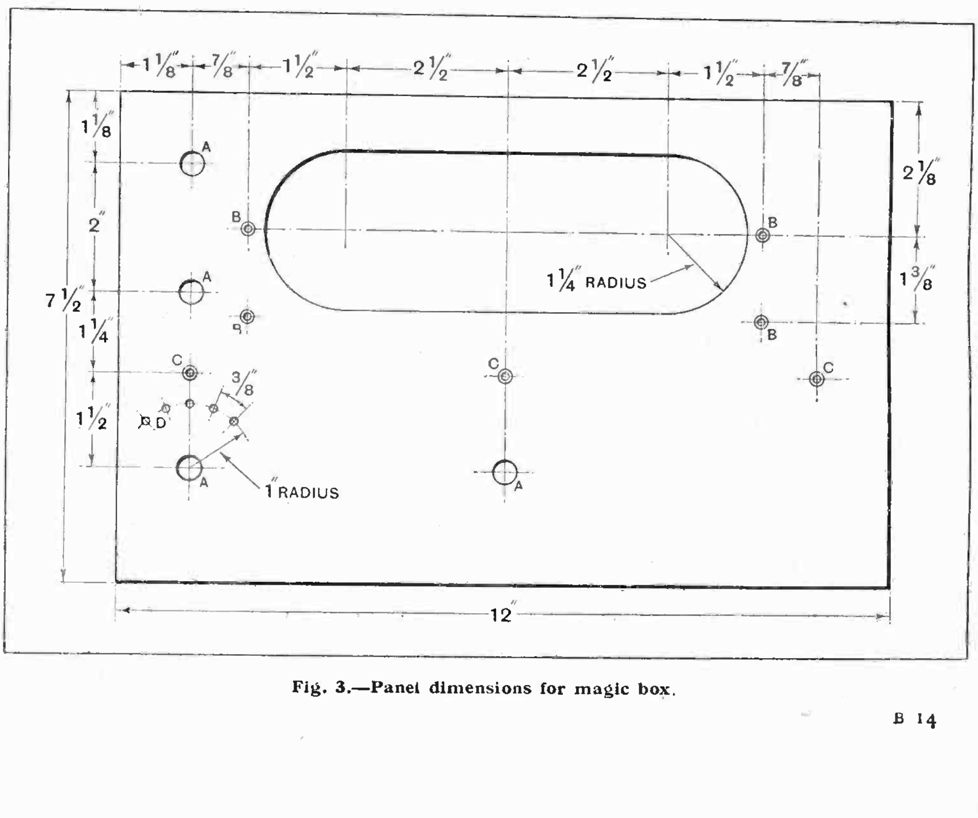


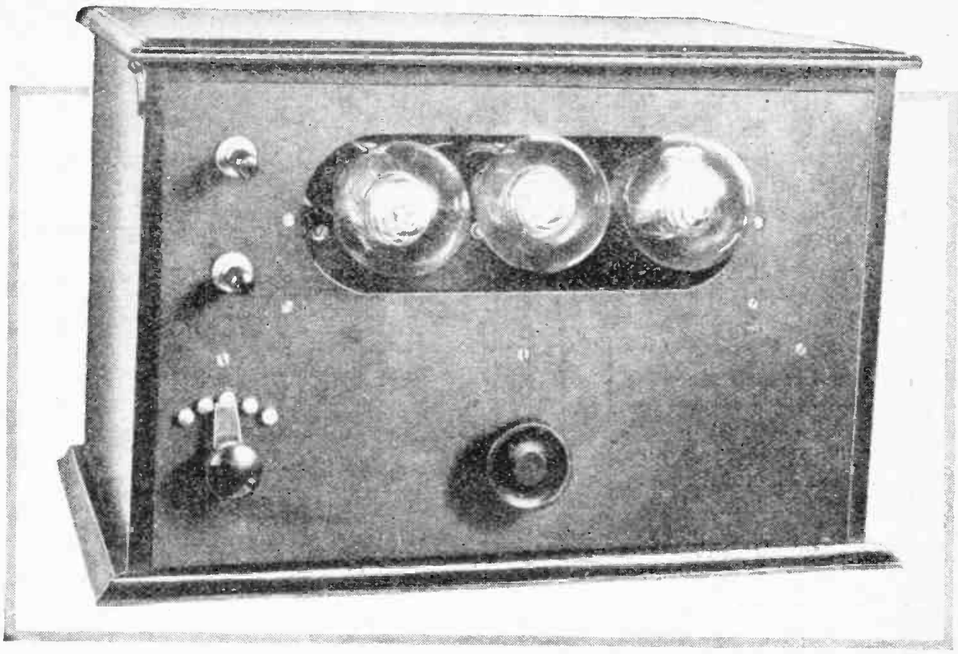
Fig. 3.—Panel dimensions for magic box.

Christmas Novelties.—

Before proceeding to describe other stunts, the constructional details of a suitable *magic box* will be given. The box is intended to be used in conjunction with the batteries of an existing valve receiving set if no 200-volt D.C. mains are available, and contains 100 volts of small-size dry-battery H.T. cells, which may be of the cheapest possible quality, if desired.

These constructional details are not at all rigid as to dimensions or components, and the box illustrated is given as one form in which it may be made up.

The circuit of the box is given in Fig. 2, and the panel sizes and layout of components in Figs. 3, 4, 5, and 6.



View of the front of the magic box.

The switch shown in Fig. 2 enables the neons to be changed over from the motor interruptors to the condenser and resistance for the "flashing neon," or to the "visible" broadcast, so that the three stunts already described may all be performed with the box.

Besides the box there is another motor mounted on a block of wood arranged for spinning the cardboard discs. Both this motor and the one in the box have a little driving pulley when bought, and these pulleys may easily be converted into interruptor cams by having flats filed on their edges and a piece of springy brass or phosphor-bronze arranged to touch these flattened pulleys or cams, which will occur twice per revolution in the case of the motor in the box. For the motor driving the disc, the pulley is pushed up the shaft so as to leave room for a wooden disc about two inches diameter with three terminals fixed in it so as to clamp on the cardboard discs. The pulley on this motor is filed so as to give two interruptor cams, one giving two, and one giving one interruption per revolution. The type of pulley usually found on these small motors is grooved, so that if two flats are filed on it, as described above, and then one-half of one flange filed away at right angles to the flats, it is then possible, by using a contact strip on to each flange, to obtain two contacts and one contact respectively per revolution. This double cam is shown in Fig. 7.

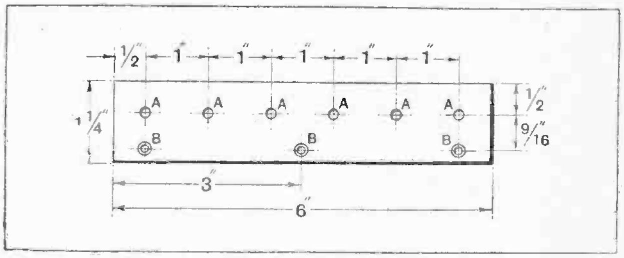


Fig. 5.—Dimensions of terminal strip.

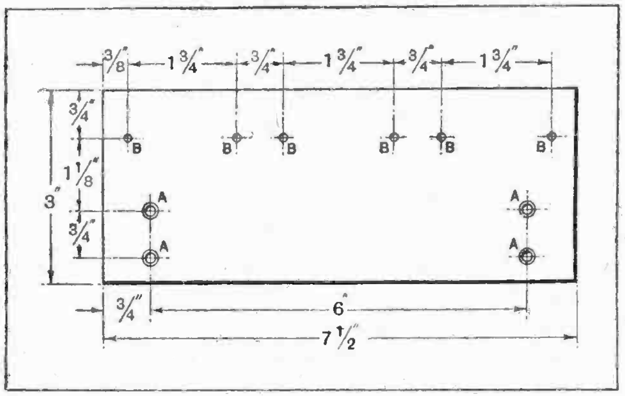


Fig. 4.—Dimensions of sub-panel for lamp holders.

Light Control Stunts.

Another class of stunt which comes into the realm of telearchics may be performed with the aid of a selenium cell. Many interesting, as well as amusing, experiments may be done with such a cell, which alters its resistance on exposure to light. The auxiliary apparatus required consists of a Weston relay, about 20 volts H.T., a single 1½-volt cell, and a more robust type of relay, which may be made out of an old electric bell, if desired.

By connecting up the apparatus as shown in Fig. 8, the contacts of the last relay may be closed by shining a light of suitable strength on the selenium cell, and that when this light is removed the last relay contacts open. Thus shining a light on the selenium cell closes the circuit between A and B in Fig. 8, and as A and B may be connected to various external circuits, so various controls may be obtained.

Christmas Novelties.—

The Light that Won't Stay On.

It is very amusing to use an electric bell for the last relay with the gong removed and to utilise the existing contacts as the relay contacts. Thus when no current is flowing round the bell coils the bell armature is pressing against the contact, and thus the external circuit is closed. This contact may be put in series with the ordinary room lamp, the latter turned on and the selenium cell placed near it. Very soon after the lamp has been turned on, its illumination will be sufficient to reduce the resistance of the selenium cell and thus operate the Weston relay, which will in turn open the contacts of the bell relay and turn the light out. The selenium cell, now being in the dark, will increase its resistance, and the bell relay will consequently be released, and the lamp will light again, and so on, the frequency with which these operations are carried on depending on the "lag" in the selenium cell and the relays.

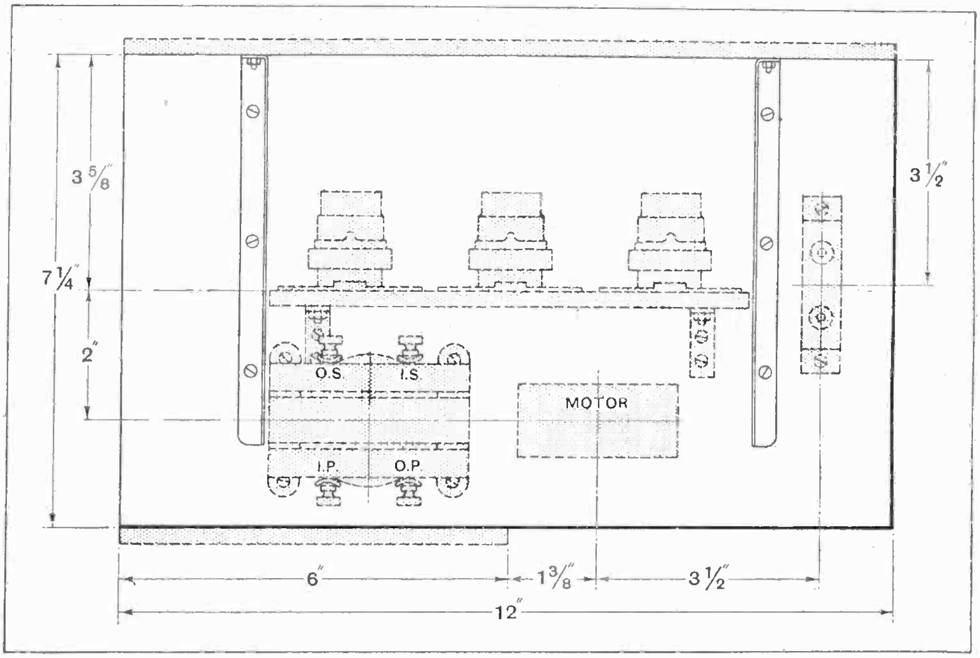


Fig. 6.—Layout of components in magic box.

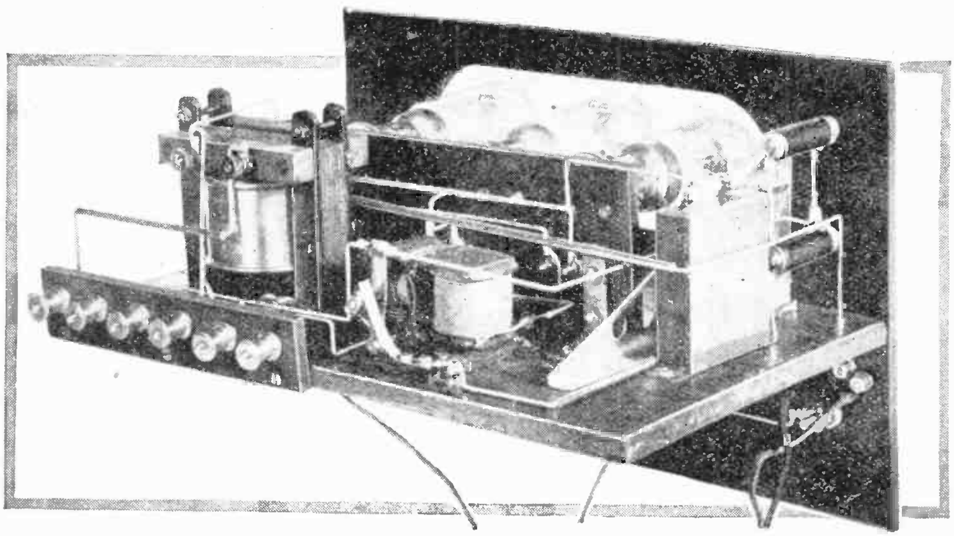
This experiment may be carried out with other lights on in the room, provided that the illumination of the cell due to these other lights is not sufficient to work the relays. Of course, instead of using the room light, a flash lamp may be used if desired.

By connecting a bell and battery across the last relay contacts, the bell may be rung by illuminating the selenium cell with a pocket torch, and thus a realistic imitation is obtained of a burglar alarm set in operation by the light from a burglar's torch.

Another thing which may be done is to connect an accumulator and a piece of very fine copper wire across the last relay contacts and to pile a little gunpowder over the copper wire. When the selenium cell is illuminated the gunpowder will be exploded. Needless to say, the experiment should be performed in a safe manner—on an old plate, for example.

No doubt many other amusing ways of using the selenium outfit will occur to the reader.

Selenium cells suitable for the above stunts and experiments may be obtained from Priorsells, Ltd., Cannon Street House, 110, Cannon Street, London, E.C.4, price 15s. for the small size of 10 to 1 dark-to-light ratio, and these cells are thoroughly recommended by the writer for giving good results.


A back view showing the general arrangement of the components in the magic box.

Other stunts which may be performed by those who have suitable radio receiving sets include the Human Aerial, the Human Telephone Receiver, and Comic Broadcasting.

The Human Aerial is a stunt which is probably well known to most readers, but the arrangements advisable for complete success may not be so well known.

If a chain of people are holding hands, and the last one touches the aerial

Christmas Novelties.—

terminal of a valve receiving set—somewhat as shown in the sketch—it is usually possible to receive the local station on retuning. If the set incorporates a loose-coupled aerial circuit, then practically no retuning will be necessary, and reception of the local station will be steady even though the "aerial" is moving about, but if the set is direct coupled then movements on the part of the "aerial" are likely to upset the tuning. For direct-coupled sets, then, it is advisable to use a small coil of, say, 20-30 turns coupled to the tuning coil, one end being earthed and the other connected to the human aerial.

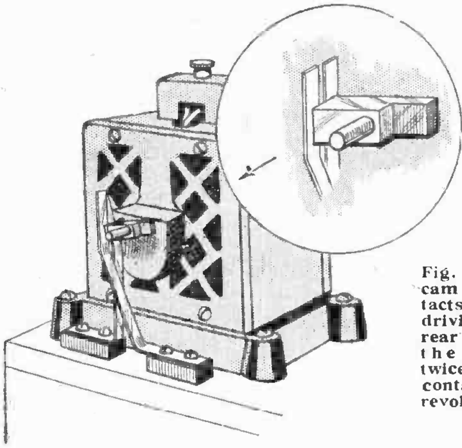


Fig. 7.—Showing the cam and the two contacts on the disc driving motor. The rear contact closes the lamp circuit twice, and the front contact once per revolution of the disc.

The Human Telephone Receiver is not so well known and requires the use of a set which will operate a loud-speaker on the local station. The loud-speaker is disconnected, and two people requested each to take hold of one of the bared ends of the loud-speaker leads. If one of them presses a piece of ordinary paper against the other's ear, the latter person will hear the broadcast quite plainly, though faintly. If both sit down and pass a piece of paper between adjacent ears, both will hear the programme. It is not advised, however, that they try and do without the paper, for if they do they

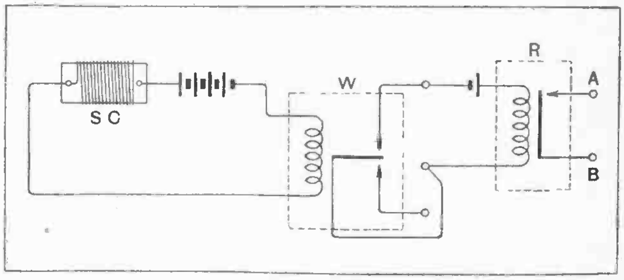


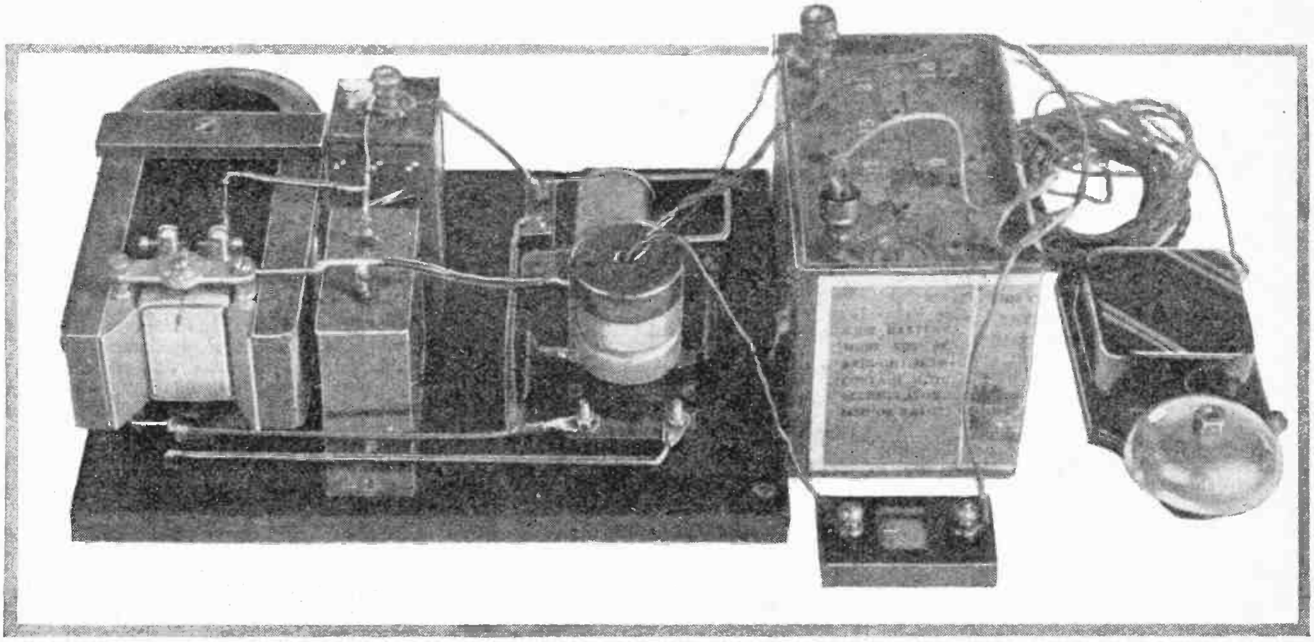
Fig. 8.—Circuit for use with selenium cell. When light shines on the cell SC the Weston relay W operates the second relay R which completes the external circuit between A and B.

will get an appreciable shock. This stunt does not work with only one person holding the wires and the paper, but any kind of paper will do so long as it is dry. The principle on which the receiver acts is the one which applies to the electrostatic loud-speaker.

Comic Broadcasting.

This stunt requires a loud-speaker set with an extra loud-speaker—preferably of the cone type. This extra speaker is put in the detector valve plate circuit, and words spoken into it will be reproduced in the ordinary loud-speaker at the end of the set.

The extra speaker should be concealed in another room, so that comic announcements may be made by somebody "in the know" in the intervals of the legitimate broadcasting—or the latter may be switched off altogether and a comic programme (supplied locally) substituted. Much

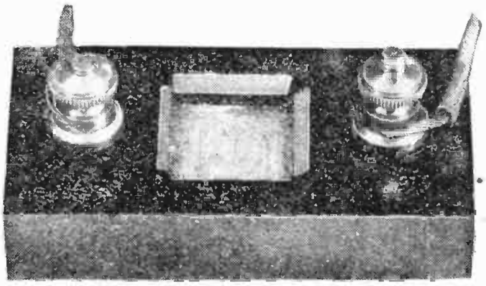


Showing apparatus connected up as in Fig. 8 for using the selenium cell when illuminated to ring a bell.

Christmas Novelties.—
amusement may be caused to those not in the know by introducing "home made" efforts at intervals during the legitimate article.

Ghosts.

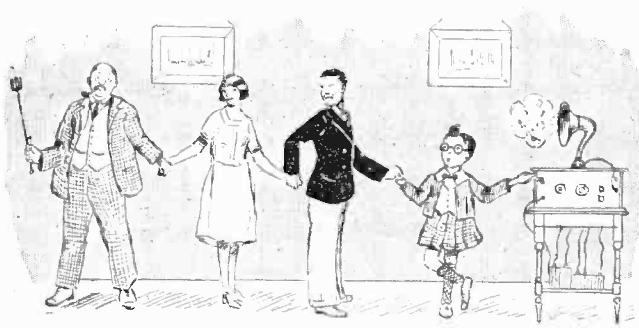
The last stunt to be described is the production of realistic ghosts. By means of the comic broadcasting



Showing a selenium cell made by Priorsells, Ltd., suitable for the experiments described.

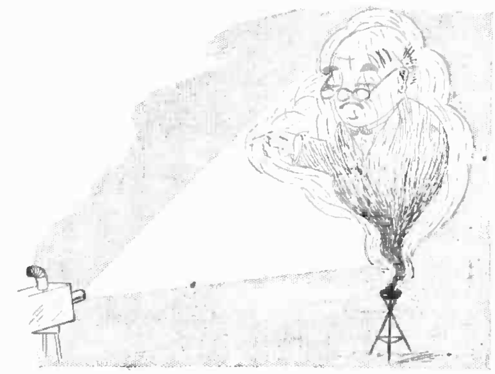
outfit referred to above, the audible part of the ghosts may be attended to—the clanking of chains, and so forth—and the visible part by the use of a magic lantern.

The fortunate possessor of a home cinema projector will be able to do more in the ghost line than those without, still, very realistic results may be obtained with the aid of a magic lantern and a photographic negative of a person.



Broadcast reception with the human aerial.

The "screen" for the lantern picture is made of smoke, which introduces movements and distortion into an otherwise lifeless and flat "ghost." The smoke may conveniently be made chemically by mixing household ammonia and hydrochloric acid. A suggested method which has been found convenient is to fill a saucer with sand, soak it with ammonia, and then to allow a small quantity of hydrochloric acid to drop on to the sand. The chemical smoke thus produced is dense and white and very suitable for the reception of a lantern picture. The illumination in the lantern should *not* be good, or else the trick will be too obvious, but a few rehearsals



A ghostly effect is obtained by projecting a faint image into a smoke screen.

beforehand will enable the reader to get the right illumination.

It is best to have three people concerned in the production of ghosts—one to deal with the audible side, one to make the smoke and switch on the lantern, and one among the audience to conjure up the ghost.

It is possible to get very realistic effects if the lantern, etc., are hidden behind screens and the ghost kept as far away from the audience as possible. Sometimes it is possible to arrange a walking ghost by making the smoke on one side of the room and using a draught to carry it across—the lantern being moved to follow, of course.

The purpose of this article will have been fulfilled if the stunts described will help any reader with Christmas entertainments.

TRADE NOTES.

A Ferranti Handbook.

"The Way to True Radio Reproduction" is the title of an extremely useful brochure produced by Messrs. Ferranti, Ltd., of Hollinwood, Lancashire. In it the beginner will find many useful hints on securing maximum results from his set, making use of Ferranti transformers. Various circuits are given and the brochure includes a list of the leading makes of valve with characteristics and notes on the choice of valves for a variety of purposes.

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Address Wanted.

Messrs. The Dubilier Condenser Co. (1925), Ltd., would be glad if Mr. R. Anderson, of London, who recently wrote for details of the "Hiloten" Battery Eliminator, would forward his address.

Co-operation in Battery Service.

In connection with the establishment of a special battery service by the three firms Messrs. Lucas, C.A.V., and Rotax, the following is a list of the first six agencies appointed to act as service stations: Knox Bros., 25, Bridge Street, Berwick-on-Tweed; Alex. Shaw & Sons, 66-68, Brook Street, Hull; F. Wingfield, 13, High Street, Croydon; Adams Bros. & Co., 47, Poole Road, Bournemouth W.; Lewis Electric Sedan Co., 72, Eastbank Street, Southport; A. W. Bridges, Bells Court, Pilgrim Street, Newcastle-on-Tyne.

"Becol" Successes.

Messrs. The British Ebonite Co., Ltd., are justly proud of the fact that low-loss formers of their manufacture were incorporated in the sets winning the 1st, 2nd, 3rd, and 4th prizes at the Manchester Wireless Show, and also in a set which secured a gold medal at the Amsterdam Wireless Exhibition.

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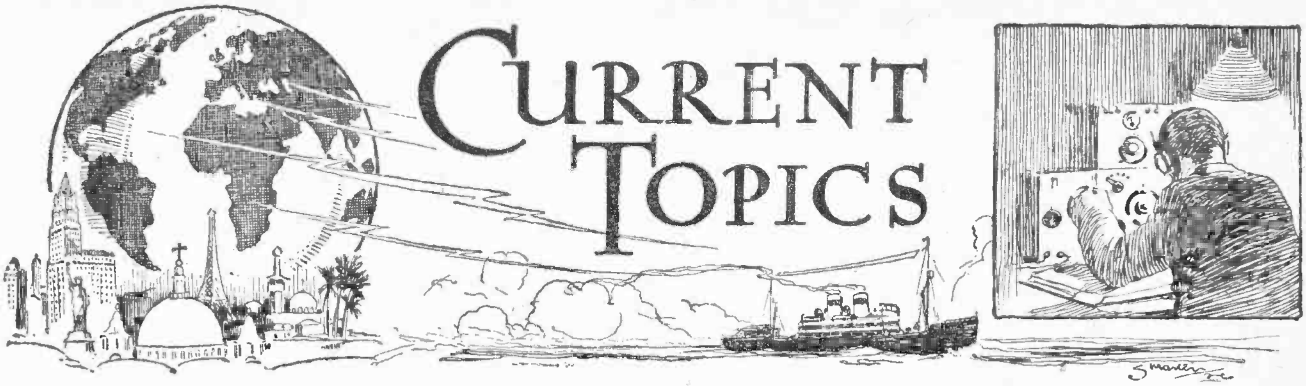
For Free State Readers.

Messrs. The M.A.P. Company, of 246, Gt. Lister St., Birmingham, wish to remind readers in the Irish Free State that they have an office and warehouse at 38, Upper O'Connell Street, Dublin, whose goods can be purchased either wholesale or retail at inclusive prices, thus avoiding the trouble of Customs charges, etc.



Current Topics

Events of the Week in Brief Review.

CONCERTS IN THE AIR.

The monster Empire airship, known as the R101, now under construction at Howden, Yorkshire, will carry broadcast receiving apparatus for the entertainment of passengers.

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LOUD-SPEAKER BOOM.

"The wireless set . . . is proving such a boom to the inmates of the Barnstaple Poor Law Institution."—Local Paper.

Personally, we always manage best without the boom.

oooo

LESSONS ON THE BARGE.

The Netherlands Minister for Public Instruction has opened an official service of instruction from the Hilversum station for the benefit of the children of bargemen. Leading a wandering life, the children never attend school.

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WIRELESS SHOW AT HULL.

Saturday next, December 4th, will see the opening of the Hull Wireless Exhibition at the Park Street Drill Hall. The Exhibition promises to be an even greater success than last year, when 38,000 people attended. It will remain open for a week.

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WIRELESS DEVELOPMENT ON IMPERIAL AIRWAYS.

Air liners on the Imperial Airways are shortly to be equipped both with wireless telegraphy and telephony transmitters. This move is due to the present congestion on the telephones used for communication between the air liners in flight and the aerodromes. In future service messages will be sent out in morse on a different wavelength, and a wireless operator will be carried.

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AUSTRIAN RAILWAY WIRELESS SUCCESS.

An interesting little report has been issued by the Austrian Federal Railways dealing with the results attending the installation of broadcast receivers on certain express coaches. The supply of "radio" tickets, thought to be sufficient for three months, was used up in one. In the first week there were 642 listeners, the number increasing by 40 per cent. in the second week, 70 per cent. in the third, and 130 per cent. in the fourth. Two more trains have been equipped.

COLLAPSE OF PERUVIAN WIRELESS MONOPOLY.

The monopoly conceded in January last to the Peruvian Broadcasting Company for the importation of wireless apparatus has been abolished by a recent Peruvian decree, and goods of this description can now be admitted to the country on payment of import duty.

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AN "EVERYMAN 4" AWARD.

A photograph of the cup awarded to Mr. H. Budd in the International Amateur Set Competition held in Chicago recently. The set entered by Mr. Budd was an "Everyman 4" constructed by himself, and obtained the second place amongst all entries irrespective of the number of valves. In addition to the cup a money award of 50 dollars was made to Mr. Budd.

FAIR LISTENERS IN AMERICA.

Mrs. Lotta Harrauff, well-known in American broadcasting circles, asserts that women constitute 80 per cent. of the U.S. listening public.

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INTERNATIONAL SHOW IN SWITZERLAND.

An international wireless exhibition is at present being held in Basle, Switzerland, and will remain open until the end of the week.

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RADIO SOCIETY OF GREAT BRITAIN.

It is understood that the proposal to combine the Radio Society of Great Britain and the Transmitter and Relay Section as one organisation is still under discussion. No definite step has yet been taken.

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BOLIVIAN WIRELESS SPLASH.

A chain of five new wireless stations, to cost approximately £11,875, is to be erected in Bolivia. We are informed by the Bolivian Legation that the chosen sites are at Sucre, Potosi, Tarija, Monteagudo and Azurdoy.

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ESPERANTO AND WIRELESS.

The Falun broadcasting station (Sweden) has admitted Esperanto to its programmes. New courses in the language have been opened at Munich and Nuremberg, while three Japanese stations are also giving Esperanto broadcasts.

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DEARER WIRELESS TO SPAIN.

The fees for wireless telegrams "via Marconi" exchanged between Great Britain and Spain are increased as from to-day (December 1st) to 3d. per word for ordinary messages and 9d. per word for urgent telegrams. These increases, which are common to all routes, are due to adjustments of terminal rates by the Governments concerned.

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PLAN FOR FRENCH "DAVENTRY."

The Association of French Wireless Manufacturers (Syndicat des Industries Radio-Electrique) proposes to erect a powerful new broadcasting station of 60,000 watts on the lines of that of Daventry (says *The Times*). It is to be used to broadcast performances at the Opéra-Comique, Comédie-Francaise, and other Paris theatre, the principal concerts, public meetings, lectures, etc. Its radius will be sufficiently great to cover the whole of Europe, Northern Africa, and the Eastern States of North America. The proposal has not yet been sanctioned by the Government, and a site has consequently not yet been chosen for the station, but it will necessarily be situated at some distance from Paris in order to avoid interfering with the wireless communications of the capital.

oooo

AMATEUR BROADCASTING IN U.S.A.

Full details of the recent dedication of Mt. Grant, claimed to be Nevada's most beautiful mountain peak, as well as results of a motor race to the summit, were broadcast to hundreds of points in the United States through a portable amateur station operated by C. B. Newcombe at the top of the mountain. Operating on short waves under the call 6ACU, the station was in constant communication with other amateurs throughout the country.

oooo

BROADCASTING BILL FOR FREE STATE.

The Irish Free State Wireless Telegraphy Bill, which has just been issued, provides for a penalty of £10 and forfeiture of the apparatus for the crime of operating or possessing wireless gear without a licence, and a further fine of £1 for every day during which the offence continues. The Bill empowers the Postmaster-General to grant licences and regulations, and includes provision for the issue of search warrants to the Civic Guard to enter, if necessary by force, any place or ship where unlicensed apparatus is believed to be kept, and to seize the apparatus.

With regard to broadcasting, the P.M.G. will be granted authority to establish an advisory committee to assist in the conduct of the stations and the control of the programmes.

The second reading of the Bill will probably be taken by the Dail early next week.

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SENATORE MARCONI AND THE BEAM.

A large audience, including the King and Queen of Italy and members of the Italian Cabinet, listened to a lecture by Senatore Marconi in the Augusteum Hall, Rome, on November 21st.

In the course of the lecture, in which he dealt with the development of "beam" wireless, Senatore Marconi read a telegram from London which ran: "Beam system functioning satisfactorily in communications between England and Canada. There is great speed in transmission between London and Montreal."

Senatore Marconi expressed gratitude both to the British and Dominion Governments for helping to materialise the invention, and added—"I am proud that, thanks to the work of an Italian, more rapid and precise transmission of thought has been made possible." He declared that the influence of atmospheric disturbances upon the new system will be insignificant, as he has been able to verify this in the course of the experiments between England and North America.

"WIRELESS WORLD" LECTURE IN GLASGOW.

Under the auspices of *The Wireless World* a Lecture will be delivered by Dr. N. W. McLachlan, M.I.E.E., on

"Quality in Broadcast Reception"

(with Demonstrations),
at
The McLellan Galleries, Sauchiehall Street, Glasgow,
on Saturday, Dec. 11th, 1926, at 8 p.m.

Chairman: Prof. G. W. O. Howe, D.Sc., M.I.E.E.,
Professor of Electrical Engineering, Glasgow University.

(Admission Free by Ticket. Doors open at 7.30.)

Tickets are obtainable from the Hon. Secretary, Glasgow and District Radio Society, 620, Eglington Street, Glasgow. and 27, Moray Avenue, Scotstoun; also from Wireless Dealers in Glasgow.

WIRELESS AT WESTMINSTER.

By Our Parliamentary Correspondent.

PAYMENTS TO ARTISTES.

The question of broadcasting was again raised in the House of Commons last week on the second reading of the Consolidated Fund Bill. Mr. Day referred to the fees paid to artistes who broadcast, and said that on one occasion 12 artistes, the majority of them "star" performers, were paid £21 by the British Broadcasting Company for an hour's broadcasting. That was a "disgusting" fee. First-class entertainments by first-class artistes could not be expected for fees of that kind. Further, some of the broadcast talks were indistinct, and, as they are usually written, he suggested that they might be spoken by people who could articulate properly. He also urged that it was unfair that owners of crystal sets should have to pay the same fee as owners of powerful valve sets, and he asked if the Postmaster-General was looking after the fees for portable wireless sets.

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TRACKING UNLICENSED PORTABLES.

Lord Wolmer, the Assistant Postmaster-General, said that the Postmaster-General could not interfere with the B.B.C., nor with the new Corporation, in regard to fees paid to the artistes. The Post Office, he assured Mr. Day, was taking very elaborate measures to see the licences were paid. Experienced and able officials were devoting their whole time to this matter, and their activities had resulted in a marked increase in the licences taken out. He was not allowed to tell Mr. Day how portable sets were detected, but they were being detected. Up to date 430 successful prosecutions had taken place, and others were pending. The idea of making the licence fee lower for crystals than for powerful sets had been very carefully considered, but its enforcement would cause a great deal of friction and administrative difficulties. The complaint as to lectures was a matter more for the Corporation than for the Government, but it was the fact that the yearly programme, taking it altogether, was better than that of any other single broadcasting body in the whole world.

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TWO TYPES OF PROGRAMME?

Mr. Montague suggested that there should be two stations—one for entertainments and the other for lectures and classical music.

Lord Wolmer said that the question of two stations was under consideration, and although there were difficulties with respect to wavelengths, it was probable that in a year or two the scheme would be in operation.

oooo

BEAM INTERFERENCE IN CORNWALL.

Sir William Mitchell-Thomson, in reply to Mr. Pilcher, stated that he was informed that the operation of the Post Office Beam Station at Bodmin did not interfere with broadcast reception in Cornwall, provided that suitable receiving apparatus was used. Some interference had been experienced by persons in Cornwall conducting experiments in transmission and reception on short waves, but he was afraid that this might be unavoidable.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 1st.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "Notes on Design and Details of a High Power Radio Transmitter, using Thermionic Valves," by Messrs. R. V. Hanssard and H. Faulkner.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Monthly Business Meeting, followed by "Some Gadgets," by Mr. H. A. Brown.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street, Barnsley. Demonstration of Loud-speaker Work, by Mr. R. H. Morgans (of the G.E.C.).

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Business Meeting, followed by Demonstration.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Guessing Competition with Members' Loud-speakers.

THURSDAY, DECEMBER 2nd.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Lecture by Mr. Scanlon.

FRIDAY, DECEMBER 3rd.

Radio Experimental Society of Manchester.—Talk on Research Work, by Dr. F. A. St. John (President).

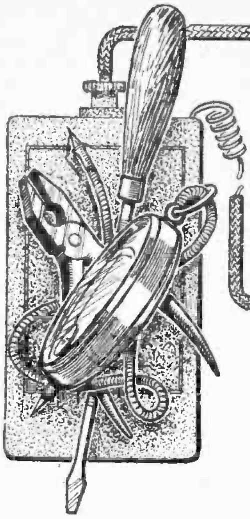
Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Lecture: "Tuning, Capacity and Inductance," by Mr. W. G. Marshall.

Sheffield and District Wireless Society.—Lecture: "The Superheterodyne in Practice," by Mr. C. F. Peck.

MONDAY, DECEMBER 6th.

Ipswich and District Radio Society.—At 8 p.m. At 55, Fonnereau Road. Lecture: "Amplion Loud-speakers," by Alfred Graham and Co.

Southport and District Radio Society.—At St. Andrew's Hall, Part Street. Lecture by Mr. Bird, Engineer-in-Charge at 2ZY.



PRACTICAL HINTS & TIPS

A Section Mainly for the New Reader.

WINDING ANODE RESISTANCES.

Wire-wound anode resistances are now obtainable so readily and cheaply that, for most practical purposes, it is almost a waste of effort for the average amateur to construct his own. There are occasions, however, when the commercial article is unsuitable, perhaps because it is not available in a suitable value, or because its current-carrying capacity is insufficient. Under such circumstances, a hint as to the winding of a simple and reasonably non-inductive resistance may be of interest.

A suitable former, made up of three ebonite discs of about $\frac{1}{8}$in. in thickness, is shown in Fig. 1. The discs are held together by two screws fitted with nuts, which will also serve as terminals for the ends of the winding. The inner disc may have a diameter of 1in., while that of the two outer ones, depending on the amount of wire to be wound into the slot, will be up to about $2\frac{3}{4}$in.

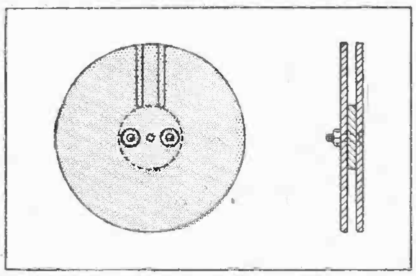


Fig. 1.—Bobbin former for a non-inductive wire resistance.

Two parallel saw cuts are made in one of the outer discs; their edges should be carefully smoothed and rounded off, as it is fatally easy to break the fine wire which is often used, if it is allowed to catch in any projection.

To wind the resistance, a screw or an old terminal should be passed through the centre hole of the bobbin former, and the whole mounted in the chuck of a lathe or a geared drill. If the latter is used, it may be secured in a vice. An arbitrary number of turns (say, 100) should now be wound on, and the wire then passed out through one of the slots and in through the other. Another 100 turns is now wound on in the opposite direction, and the process is repeated until the necessary resistance is obtained.

Silk-covered Eureka wire, of No. 45 or 47 S.W.G., is suitable for resistors of up to 200,000 ohms. These two gauges have resistances respectively of roughly 100 and 200 ohms per yard. Enamelled wire is often suitable, although it should be pointed out that a coil wound with this material will have a higher self-capacity, and, moreover, will be rather more difficult to wind, due to the absence of the "cushioning" effect of the silk covering.

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A TEST FOR DISTORTION.

The critical listener often finds difficulty in correctly apportioning the blame for observed imperfections in loud-speaker reproduction, and is sometimes at a loss to know whether the receiver or the loud-speaker itself is at fault. The problem is admittedly not an easy one, and for its solution a critical ear, in conjunction with some knowledge of the functioning of the apparatus, is necessary, combined with a large measure of patience.

Although telephone receivers are by no means distortionless reproducers of telephony, their use in place of the loud-speaker will often enable the source of poor quality to be located more easily than by listening to the latter instrument. It is essential, however, that the volume should be reduced, but without changing the input to the amplifier or cutting down its magnification. This end is most easily attained by inserting in series with the anode of the output valve the circuit shown in Fig. 2. The L.F. choke may be of any type suitable for use in filter circuits, while the resistance R must be sufficiently high to reduce volume to a comfortable degree of loudness. About 100,000 ohms or even considerably more will be necessary, depending on the degree of amplification, etc.

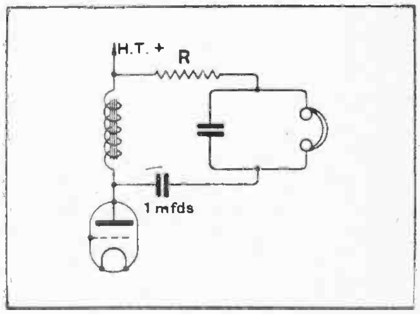


Fig. 2.—Filter output circuit with a resistance for reducing volume.

It has been found that it is easier to observe the effect of alterations to the amplifier when listening to signals in this manner, than to depend entirely on the loud-speaker. Moreover, it is possible to get a fair idea of the amount of distortion actually due to the amplifier by inserting the testing circuit (with resistance short-circuited) in series with the anode of the detector valve, thus making a comparison between the amplified and unamplified signal.

"IF YOU HAVEN'T A METER, YOU'RE GUESSING."

The above heading is taken from an advertisement in an American radio journal, but the value of the implied advice cannot be discounted merely because it is intended to stimulate the sale of a particular manufacturer's products. The statement is essentially true, and, moreover, it puts the whole matter in the most concise form possible.

Even the expert, who is continually working with valves, is unable to say definitely, merely as a result of visual observation, that a dull-emitter filament is glowing at its proper brilliancy, nor is he able to assert that the H.T. battery is giving its rated voltage by listening to signals. Thus, if not provided with some indicating device, he would be unable to express an opinion as to whether a certain form of distortion was due to decreased filament emission or to an insufficient H.T. voltage, as in either case the observed symptoms might be about the same.

It is not suggested that the average listener, or even the amateur with only a superficial interest in technical matters, should equip himself with an elaborate battery of meters, but it is no exaggeration to say that every user of valves should possess a moderately reliable instrument for reading the voltages of his L.T., H.T., and grid bias batteries. If a voltmeter can be obtained with even an approximate calibration of the low-voltage scale in milliamperes, so much the better.

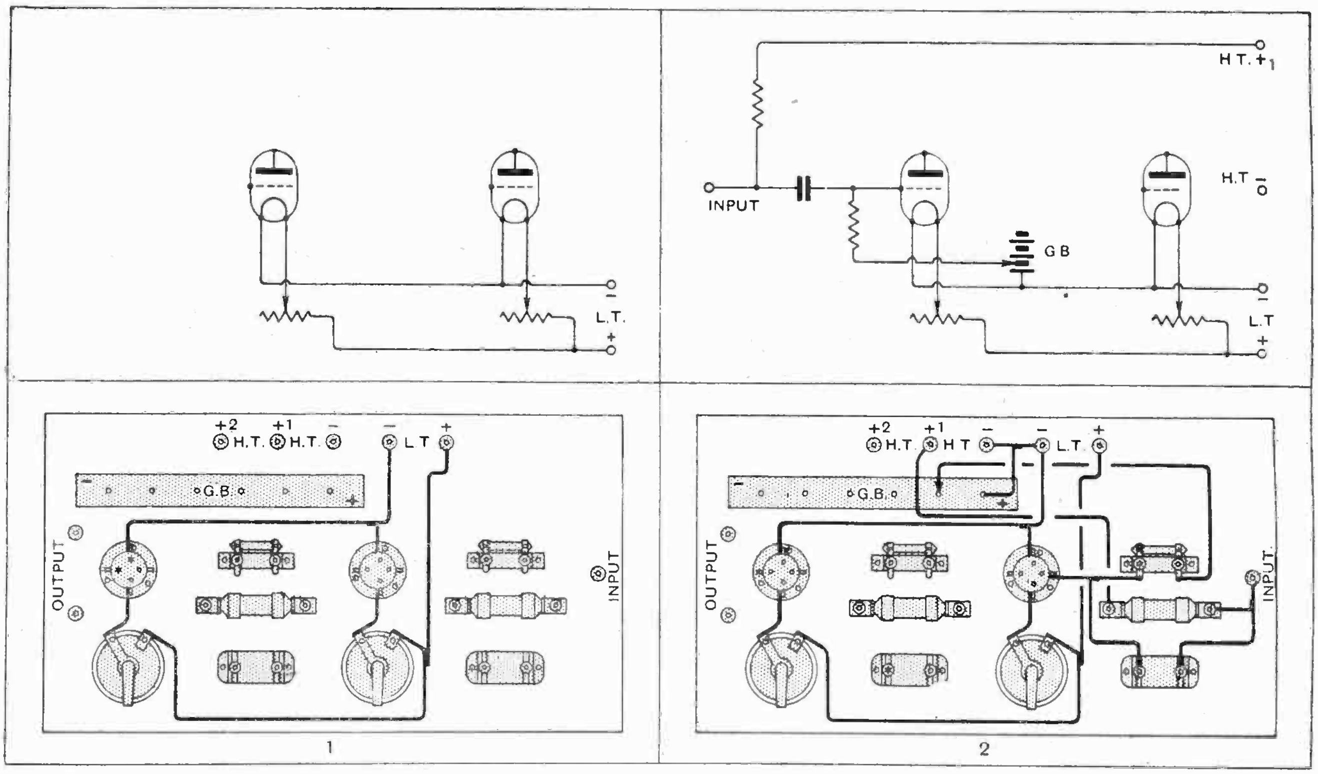
DISSECTED DIAGRAMS.

Step-by-step Wiring in Theory and Practice.

No. 50 (a).—A Two-valve Resistance-coupled Amplifier.

(To be concluded in next week's issue.)

In this series of diagrams it is hoped to make clear the steps to be taken in converting theory into practice in the construction of various typical wireless instruments. The amplifier shown below is suitable for adding to a valve detector, with or without H.F. amplification; the plate of this detector is joined to the input terminal. Unless common batteries are used for receiver and amplifier, an extra connection must be necessary between the negative L.T. terminals of each.



The filament circuits are wired in the conventional manner with resistances in the positive leads. It is unnecessary to use separate rheostats if the valves have the same L.T. rating.

The coupling between the detector and the first L.F. valve is completed. Note that the detector valve anode is fed through the resistance by the H.T. supply of the amplifier.

WIRELESS CIRCUITS

in Theory and Practice.

23 (*conclusion*).—Valves for the Low-frequency Amplifier.

By S. O. PEARSON, B.Sc., A.M.I.E.E.

THE chief desire of everyone who constructs a broadcast receiving set is to obtain reproduction of the highest possible quality, and where the set is to operate a loud-speaker the amplifier must be capable of giving the required volume of sound without introducing valve distortion. Under normal conditions the transmissions from the British Broadcasting Company's stations are remarkably free from distortion of any kind, and a properly-designed receiver operating a good loud-speaker renders very pleasing results.

Most of the latest types of loud-speaker are capable of dealing with much greater power than the older forms without becoming magnetically saturated, and therefore can be made to give much greater volume without any appreciable distortion in the loud-speaker itself. The volume of sound from an actual orchestra is very considerable, and a loud-speaker will give a very much more realistic rendering of orchestral music if the volume obtained is comparable with that of the actual orchestra, but of course the degree of loudness must be regulated to suit the size of room in which the loud-speaker is situated. In any case the volume should be very much greater for orchestral and choral music than when listening to an individual talking, and some sort of volume control should be provided in all cases where the set is capable of giving loud results. When listening to a topical talk, for instance, it is most unpleasant to have the speaker shouting in a voice which is unnaturally loud, especially when we know that the speaker in the broadcasting studio is talking in a normal voice as if he were merely addressing a few people in an ordinary room.

Assuming that the loud-speaker is a first-class instrument and that all precautions have been taken to prevent distortion in the high-frequency circuits and detector, we can turn our attention to the low-frequency amplifier. The general design and number and types of valves will depend on the degree of volume required, the properties of the loud-speaker itself, and on the strength of the signals received. One of the chief factors in the design is the choice of suitable valves for the low-frequency amplifier, and this section is devoted to the discussion of the various aspects of valve characteristics in relation to the quality of reproduction. In particular the last valve needs special consideration as its function in the set is quite different from that of all the other valves, inasmuch as it has to give a considerable energy output from its plate circuit whereas, in the case of all the preceding valves, only a voltage output is required and the smaller the amount of energy wasted the better.

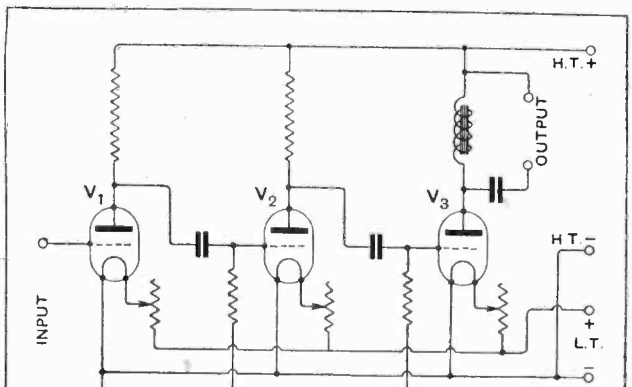


Fig. 1.—Circuit of typical three-valve low-frequency amplifier.

"Grid Swing" and Grid Bias.

For the sake of simplicity we shall consider a three-valve low-frequency amplifier circuit in which resistance-capacity coupling is used, such a circuit being given in Fig. 1. We shall assume that the couplings have been correctly designed so that all frequencies within the audible range are amplified to the same extent. As it is much more helpful in a case like this to consider actual figures rather than symbols we shall refer to typical valves the characteristics of which are known. For instance, suppose that the first valve V_1 is a Marconi or Osram type D.E.5B, which has an amplification factor of 20 and an internal impedance of 30,000 ohms. The anode characteristic of this valve, with an anode voltage of 120, is given by the lower curve of Fig. 2.

Now suppose that the greatest amplitude of low-frequency alternating voltage which is applied between the grid and filament of the first valve during reception is 0.1 volt; then with an anode resistance of 100,000 ohms the voltage amplification given by V_1 will be $20 \times \frac{100{,}000}{130{,}000} = 15.3$, and the voltage passed on to grid and filament of the succeeding valve will be $15.3 \times 0.1 = 1.53$. To eliminate valve distortion each valve must be operated on the straight portion of its anode characteristic *lying between zero grid potential and the lower bend in the curve.* We shall call the range of grid potentials lying between these limits the permissible grid swing of the valve. Thus the grid must be given a mean negative potential lying about mid-way between these two points. If the amplitude of the alternating voltage applied to the grid is sufficiently great to cause the grid to become positive with respect to the negative end of the filament when passing through its positive maximum values, grid current will flow during these intervals and the tendency will be to flatten the tops of the waves and distortion will

Wireless Circuits in Theory and Practice.—
result. Similarly, if the negative half-waves are of sufficient amplitude to operate the valve round the lower bend in the characteristic a certain amount of anode rectification will occur, resulting in further distortion.

From the above it will be clear that *twice* the amplitude of the grid oscillation must not be greater than the permissible grid swing of the particular valve. In the example given above we found that the greatest amplitude of oscillation applied to the grid of the second valve was 1.53 volts, and therefore the permissible grid swing of the second valve must be at least 3.06 volts or, say, 3.5 volts, allowing a margin of safety. Referring again to the lower curve of Fig. 2 we see that the permissible grid swing for the D.E.5B valve is not more than about 3 volts, and therefore another of these valves will not be suitable for the second stage. Of course, the permissible grid swing can be increased by raising the H.T. voltage applied to the valve, but it is always a desirable feature to use the same H.T. voltage on all the valves in the low-frequency amplifier, especially when a battery eliminator working from the lighting supply is employed.

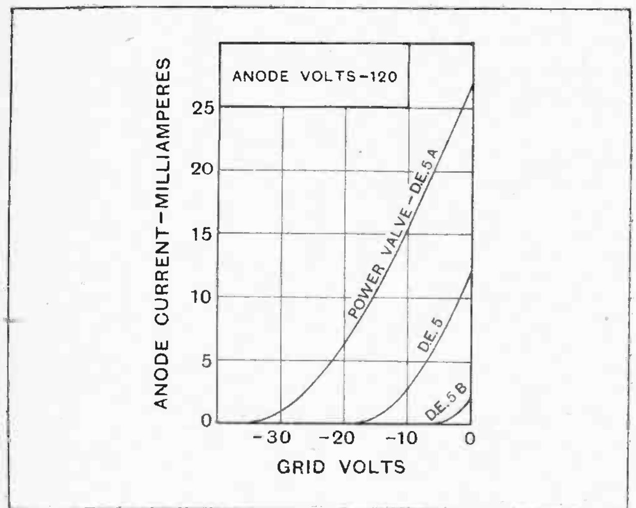


Fig. 2.—Anode characteristic curves of valves suitable for the successive stages of a low-frequency amplifier.

For the second stage, then, we choose another type of valve capable of dealing with larger amplitudes of grid voltage, such, for instance, as a D.E.5, the anode characteristic of which is given by the middle curve of Fig. 2. The permissible grid swing of this valve is nearly 10 volts with an anode voltage of 120. In this case the negative grid bias would be adjusted to about 6 volts, giving an ample margin of safety. The amplification factor of this valve is about 7 and its internal impedance 8,000 ohms. Therefore with an anode resistance of 100,000 ohms the voltage amplification obtained will be approximately $7 \times \frac{100,000}{108,000} = 6.5$, and the amplitude of voltage applied to the third and last valve will be $1.53 \times 6.5 = 10$ volts. Hence the grid voltage of the last valve will vary over a range of 20 volts, and accordingly we choose a valve such as the D.E.5A which will permit of a grid swing of about this range with a plate voltage of 120 and a grid bias of about 12 or 13 volts negative. This will be clear on referring to the upper curve of Fig. 2.

The permissible grid swing of a particular valve depends chiefly upon the mesh of the grid, that is to say, on the number of turns of wire constituting the grid. For instance, the respective plates and filaments of all three valves mentioned above are identical; but in the first the grid consists of a large number of turns of fine wire wound with the successive turns fairly close together, there being about 25 to the inch. In the second valve there are about 16 to the inch, and in the last the grid consists of comparatively few turns of the order of 8 or 10 to the inch.

Output from the Plate Circuits.

So far the choice of the three valves V_1, V_2 and V_3 in Fig. 1 has been determined purely and simply by the amplitude of oscillation applied to the respective grids, this consideration being of paramount importance if valve distortion due to overloading is to be avoided. But we must also look to the plate circuits and make sure that the internal impedances are suited to the general arrangement. Now the output from the plate circuits of the first two valves V_1 and V_2 are merely voltage outputs and thus the internal impedances of these two valves are of secondary importance. All that is necessary is that the impedance of the coupling, whether it be in the form of a resistance, a choke or a low-frequency transformer, shall be high compared with the internal impedance of the valve in the plate circuit of which it is connected.

In the case of the last valve, however, the conditions are quite different as we require the greatest possible energy output from the plate circuit to operate the loud-speaker. For this reason the internal impedance of the last valve should be of such a value as to suit the impedance of the loud-speaker or other output circuits. Generally speaking, the internal impedance of the valve should be of about the same order of magnitude as the impedance of the loud-speaker at the lower note frequencies. This point is referred to again below. Another consideration is that the last valve must have a filament capable of giving ample electronic emission in order to provide the necessary power in the plate circuit. Now in general it will be found that those valves capable of dealing with large grid voltage variations have low amplification constants and also low internal impedances. Hence they take more plate current and are capable of giving a much greater energy output from the plate circuit, and are for this reason called "power valves." Of the three valves chosen in the above example, the first is a special one of high amplification factor and moderately high internal impedance, capable of dealing with small oscillation amplitudes only; the second is a general-purpose valve of moderate amplification factor and fairly low internal impedance, capable of dealing with moderate amplitudes of oscillation; the last is a power valve of low internal impedance and fairly low amplification factor, capable of dealing with oscillation amplitudes up to about 10 volts on the grid.

Whether the last valve, with a permissible grid swing of 20 volts, is sufficiently powerful to operate the loud-

Wireless Circuits in Theory and Practice.—

speaker or not depends on the construction of the latter. For most ordinary horn-type loud-speakers the power available is ample, and in some cases sufficient to saturate and overload the loud-speaker. With this type of loud-speaker the sound coming from the diaphragm is greatly magnified by the "megaphonic" effect of the horn, with the result that a comparatively small amount of energy is required to operate it. With loud-speakers of the cone type where no horn is used the sound comes direct from the diaphragm without the assistance of a horn to enhance it, so that in general this type of loud-speaker requires more power to operate it than one of the horn type. In a case like this it is probable that a valve with characteristics similar to those of the last valve in the amplifier discussed above will not be capable of giving out the required amount of power, in which case a still more powerful valve would be required, such, for instance, as an L.S.5 or L.S.5A. For very powerful valves of this nature it is usually necessary to use a high tension voltage of 250 to 300 volts, and where dry batteries are used the upkeep expenses are very considerable. In any case a power valve takes a much larger plate current than ordinary valves, and the usual type of high tension dry battery soon runs down. Without a doubt the most suitable source of H.T. supply is a battery eliminator working from the lighting mains.

Testing for Valve Distortion.

It is a very easy matter to test for valve distortion in a low-frequency amplifier if one has a milliammeter. First the instrument is connected in the plate circuit of the first low-frequency valve (not the detector valve), and the pointer is carefully watched whilst signals are being received. If the valve is functioning correctly there will be no movement of the pointer even when the loudest notes are coming through. The reason is, of course, that when the valve is operating on the straight part of its anode characteristic the application of an oscillating voltage to the grid does not cause any change in the mean value of the plate current. If the grid is given too high a negative bias bottom bend rectification will occur on the louder notes, and the needle of the milliammeter will fluctuate *upwards* whenever a loud note occurs. Similarly, if the negative grid bias is insufficient grid rectification will occur on the loud notes and the needle will dip down. It is possible to find a value of grid bias which will maintain the milliammeter pointer stationary even though the amplitude of oscillating voltage applied to the grid is greater than the permissible grid swing of the valve will allow. For instance, the grid bias may have such a negative value that bottom bend rectification and grid rectification occur simultaneously and to the same extent, so that one balances the other out. However, if it is found that on changing the grid bias by a small amount the needle still remains stationary (at a different point of the scale of course), then no rectification is taking place and no distortion is being introduced by that valve.

The same process is repeated for the next valves taken in order. If it is found that the mean current in the plate circuit of the second valve is caused to fluctuate by the signals, it is of no use making any tests on the third valve until the fault has been corrected, because these fluctuations are passed on through the low-frequency coupling to the next valve, and so on. Having tested all the valves in the low-frequency amplifier in this manner, and having found that all the respective plate currents remain constant during reception, we know that the valves themselves are not causing any distortion.

Drums and Bass Notes.

By connecting a milliammeter in the plate circuit of the last valve, we are enabled to observe an interesting fact about the broadcasting of orchestral music, namely, that the electrical variations representing the sounds of drums and bass instruments have a very much greater amplitude than the oscillations representing the higher pitched notes even though the loudness is about the same in each case. With the milliammeter in the plate circuit, the grid bias is gradually increased in a negative direction, and it will be found that a point can be reached where the pointer jumps every time the sound of a drum comes through, but remains stationary on the other sounds, and the bias has to be further increased to a considerable extent before the "normal" sounds begin to show their effect on the pointer of the milliammeter. It is thus important to see that the tests for valve distortion are made on loud orchestral music when drums are being used.

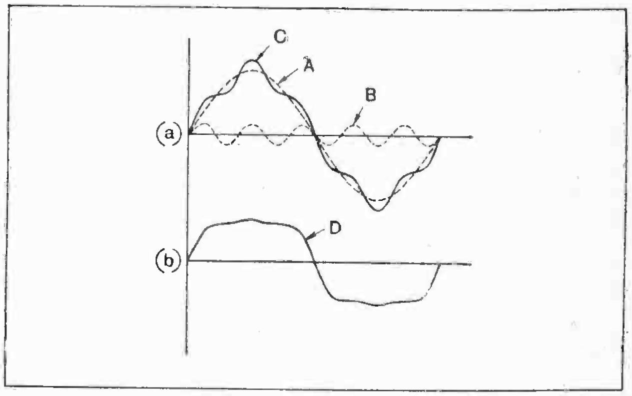


Fig. 3.—Curves showing the type of distortion due to overloading of a L.F. valve.

If the valves are incapable of dealing with the amplitudes representing the drums, but operate fairly well on the amplitudes representing the other instruments, it might at first appear that the only effect would be to suppress the drums relatively to all the other sounds, but as a matter of fact these other sounds are seriously distorted every time the very low-frequency oscillation representing the drums comes through. The reason for this can be clearly seen by considering a simple case where a very low-frequency voltage of high amplitude and a moderate-frequency voltage of medium amplitude are applied simultaneously to the grid of the valve. The dotted curves A and B in Fig. 3 (a) represent these respective voltages, and the full line curve C gives the true wave form applied to the grid, being the sum of the curves A and B. Now if the amplitude of A is sufficiently great to overload the valve, it is obvious that the

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tops of the resulting wave in the plate circuit will be flattened, as shown at D in Fig. 3 (b). This is not all, however; during the time that the lower frequency component of the wave is passing through, say, its negative maximum values, as far as the higher frequency component is concerned, the valve is operating well round the lower bend in the anode characteristic, with the result that this higher frequency oscillation is amplified to a much smaller extent during those times when the lower frequency wave is passing through its maximum values than under the normal conditions. The resulting wave obtained in the plate circuit is totally changed, and so also is that representing the higher frequency note. When there are a number of these higher frequencies, the reader can well imagine the serious distortion that will take place if the amplitudes of the bass notes are too high for the valve. When this occurs in a valve receiver all the higher notes seem to be broken up every time the drum is struck. In an actual orchestra, although the big drum may be very loud, it does not overpower and break up the vibrations from the other instruments, and the same thing applies to a wireless receiver, if the valves are all capable of dealing with the highest amplitudes without any overloading.

The range of audio-frequencies efficiently reproduced by loud-speakers varies a great deal with the different makes and qualities, with the size of the horn used, etc. Some loud-speakers are incapable of reproducing the notes in the lower register in anything like the correct proportion, and in many instances drums, about the loudest instruments in an orchestra, are hardly audible at all, whilst at the same time a violin sounds more or less natural. It is futile to include special refinements in the low-frequency amplifier if the loud-speaker is a bad one, and *vice versa*. Assuming that we have a loud-speaker which is capable of giving at least a passable rendering of such sounds as those of a drum as well as the more usual sounds, we naturally want to make quite sure that none of the lower frequencies are lost in the amplifier itself, and design our intervalve couplings accordingly.

But there is another point in this connection which does not seem to be very widely appreciated, namely, the effect that the impedance of the last valve has on the rendering of the lower notes in the musical scale. By using a final valve, the internal resistance of which is high compared with the impedance of the loud-speaker measured at one of the lower frequencies, the bass notes are weakened relatively to the trebles, and by using a low-impedance valve the bass notes are enhanced and a better balance is obtained. A simple calculation will make the reason for this evident: Suppose that we had a power valve with an internal impedance of 2,000 ohms, and, connected in the plate circuit, a loud-speaker with an impedance of 2,000 ohms at 100 cycles per second and 12,000 ohms at 1,000 cycles per second. Now, interchanging this valve for one of 12,000 ohms, but having the same amplification factor, is equivalent to inserting an extra resistance of 10,000 ohms in series with the original valve. As far as the 1,000-cycle note is concerned, we have added in series with the loud-speaker a resistance of the same order as the impedance of the loud-speaker itself, and so have cut the current down to about half the original value. But at 100 cycles the loud-speaker impedance is only 2,000 ohms, and adding the 10,000-ohm resistance in series will cut the low-frequency current down to about a quarter of its original value. Thus the lower notes are reduced to a much greater extent than the higher ones. Anyone can observe the effect in practice by connecting a high resistance in series with the loud-speaker.

Impedance of the Last Valve.

Of course, the comparison of amplitudes given above is only a rough approximation, because the differences of phase have not been taken into account, a procedure beyond the scope of this article. Nevertheless, the figures are sufficient to show that the internal impedance of the last valve should be at least as low as the impedance of the loud-speaker at a frequency of about 100 cycles per second. The D.C. resistance of the loud-speaker really plays no part in the conversion of electrical variations into mechanical vibrations, but it serves as a useful guide as to the impedance. In general the internal impedance of the last valve should not be greater than about four times the D.C. resistance of the loud-speaker unless, of course, a transformer is used.

It is hardly necessary to add that, where a power valve is used for the last stage, the D.C. component of the plate current should not be allowed to pass through the windings of the loud-speaker, the usual filter circuit with a choke and condenser being included; a choke of high inductance is connected in the plate circuit, and the loud-speaker is connected across this choke in series with a large condenser of one of two microfarads, as shown in Fig. 1. The inclusion of the filter circuit does not in any way affect the arguments regarding the relative impedances of valve and loud-speaker.

Catalogues Received.

Streetly Manufacturing Co., Ltd., Aldridge Road, Streetly, nr. Sutton Coldfield. Leaflet giving useful information regarding synthetic mouldings, such as knobs, dials, etc., for wireless purposes.

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Metro-Vick Supplies, Limited, 145, Charing Cross Road, London, W.C.2. 46-page art catalogue of Cosmos Radio Products, including sets, loud-speakers, valves, accessories and components.

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The Great Northern Telegraph Company (Ltd.), Copenhagen, Denmark. Catalogue of the products of the Company's instrument factory including telegraph apparatus, testing instruments and electrical gear.

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Darimont Electric Batteries, Limited, Darimont Works, Abbey Road, Park Royal, London, N.W.10. Pamphlet No. 14, giving particulars of the Darimont "Home Service" battery with list of suitable valves.

H. Clarke and Co. (M/C), Ltd., Atlas Works, Eastnor Street, Old Trafford, Manchester. New radio catalogue of Atlas components with coil pamphlet No. 11, and folders Nos. 17 and 18, dealing with Atlas high tension battery eliminators for D.C. and A.C. respectively.

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Marconiphone Company, Limited, 210-212, Tottenham Court Road, London, W.1. Publication No. 450, dealing with Marconiphone high tension supply units for A.C. and D.C. Publication No. 440a, dealing with Sterling condensers.

Broadcast Brevities

News from All Quarters: By Our Special Correspondent.

Geneva Scheme Revisions—A Scottish "Daventry"—A Hectic Autumn—Christmas Programmes—Brightening the News—Doings in Spain.

Wavelength Changes and the Relays.

We are not yet out of the wavelength wood. At the last moment I hear that further changes are likely to be made within a week or two.

A great problem at the moment is what is to happen to the relay stations. Savoy Hill may decide after all to refer to Geneva's original plan and place all the relays on the common wave allocated to them by the central authority.

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A Scottish "Daventry."

Several correspondents have sent me spirited letters on the topic of Scotland's hypothetical high-power broadcasting station. A fortnight ago, when the subject was first broached in these columns, one thing at least seemed certain, viz., that Scotland either *did* or *did not* desire such a station. Now even this is uncertain. One writer, criticising my remark that there must be many places in the Hebrides where only a multi-valve set would pick up a broadcast programme, says that in the Inner Hebrides high mountains may cause complete screening, but that after dark in the Outer Isles a good valve set in efficient hands will bring in most European stations. Other correspondents of the same persuasion suggest that the "Land o' Cakes" is getting along splendidly and needs no spoon feeding in the shape of high-power transmissions.

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The Other Side.

Another side of the picture is revealed by correspondents who are unequivocally in favour of a high-power station in the centre of Scotland. One writer remarks that such a station "would give an alternative programme to Northern Ireland, and would make wireless much more popular in the Highlands."

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What Savoy Hill Thinks.

What has the B.B.C. to say on the question? At Savoy Hill I gained the impression that Scotland will have to wait at least two years, *i.e.*, until the projected regional scheme is proceeded with. If and when the regional scheme materialises, the whole of Great Britain will probably be covered by three or four high-power stations, with a sprinkling of relay stations serving areas still "in the cold."

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Regional Scheme for Europe?

The potentialities of a regional scheme of this description may be recognised in Europe during the next ten years; and the time may come when the whole Continent may be linked by invisible bonds of friendship simply through a chain of high-power regional stations. Such transmitters, limited in number but not in power, could operate on widely separated wavelengths, so that every listener in Europe would have at least three or four programmes, from which to choose.

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Christmas Carols.

Carols will be broadcast through 2LO and 5XX from St. Mary's Church, Whitechapel, on Christmas Eve.

The Last Act.

The British Broadcasting Company, when we come to think of it, has entered upon a quite extraordinary phase of its career. Its present position is not unlike that of the traditional fat lady in the opera who, while rapidly dying of consumption, is required to sustain a continuous pæan of joyous melody.

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A Hectic Autumn.

The autumn hours of this moribund organisation have been lively enough. In the first place the engineers of the Company, in collaboration with the Union Internationale de Radiotelephonie, are to be congratulated on carrying out an eleventh-hour wavelength change of considerable magnitude with remarkable success; second, the programme staff has carried on nobly with rapidly diminishing funds amid all the uncer

LEARNING TO ROUSE THE ETHER. Boys receiving wireless instruction on the famous flagship "Iron Duke." A thorough grounding in Morse is an indispensable preliminary, though broadcast listeners on the coast may think otherwise!

tainties of pending liquidation: and thirdly, the company has bravely encountered those critics, who, like carrion crows, invariably encircle the head of one whose days are numbered.

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Good Counsel.

The Company has never suffered from lack of advice. Every post arriving at Savoy Hill contains helpful information, especially on the subject of talks. The only snag is a lack of unanimity. About 2 per cent. of the letters are in entire agreement with each other.

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Disgraceful!

Mention of talks and the criticism which they receive reminds me of a conversation I had recently with Mr. J. H. A. Whitehouse, the official lecturer of the B.B.C. Mr. Whitehouse had been lecturing in a provincial town on the preparation of programmes; the discussion centred round broadcast talks and the unsuitability of certain subjects. "It's disgraceful!" said a man in the audience. "I was sitting down to dinner with my wife the other night, and had begun carving the leg of mutton, when they put on a talk entitled "The Diseases of Sheep"!

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An Important Question.

One night, during a particularly lively discussion, Mr. Whitehouse observed an unobtrusive little man at the back who seemed burning to ask a question. For a few minutes other speakers prevented the little man from putting his query. In a momentary lull Mr. Whitehouse expressed his willingness to answer questions. "What I want to know," said the little man, "is the colour of the paint on the Daventry mast."

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A Watching Brief.

During the first fortnight with the Geneva wavelengths the B.B.C. obtained most of its information on how the scheme was working by means of the receiver at Keston. In addition, a number of amateurs and others, specially deputed by the Engineers' Department, kept watch in various parts of the Kingdom. Most of these amateur "watchers" are experimenters of long standing, who have rendered the company similar service in the past.

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Strange Bedfellows.

That either Birmingham or Aberdeen would have to shift its wavelength was generally expected; indeed, right from the first, a good many people questioned the sanity of putting these two powerful stations on the same wavelength. At the moment of writing Aberdeen has been moved up a 10 kilocycle stage to 500 metres; but I wonder how long this state of affairs will be tolerated by Zurich, Helsingfors, Palmero, Tromsoe and Bourges, all of which are on the 500 metre wavelength. Not one of these uses as much power as Aberdeen—even Zurich has only ½kW—so with all due respect to the Granite City, it looks rather like an interloper!

Parsifal.

"Parsifal," Act 2, Scene 2, will be relayed from the Prince of Wales Theatre, Birmingham, on December 15 to 2LO and 5XX.

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On Christmas Morning.

The religious service chosen for broadcasting from 2LO and 5XX on Christmas morning will be that which is taking place in York Minster.

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Engineers in the Fireplace.

B.B.C. engineers forecast that one of the best theatrical broadcasts of the year will take place from the Playhouse on December 13, when a twenty-five minutes' excerpt from Act 1 of "Romance" is to be given, in which Miss Doris Keane and Owen Nares are taking part. It will be their first broadcast. The engineers will supervise the relay from behind the fireplace on the stage.

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John Henry Calling.

John Henry will broadcast his burlesque opera from the Glasgow station on December 18.

FUTURE FEATURES.

Sunday, December 5th.

LONDON.—"The Lotus Eaters," a choric song by Alfred Lord Tennyson.

ABERDEEN.—Concert relayed from the Cowdray Hall.

Monday, December 6th.

LONDON.—"The Piper," a lyric drama in one act founded upon Browning's "Pied Piper of Hamelin," by Herbert Ferrers.

Tuesday, December 7th.

LONDON.—B.B.C. International Concert relayed from Grotrian Hall.

DAVENTRY.—Military band programme.

BELFAST.—"Polyglot," a competition.

Wednesday, December 8th.

BIRMINGHAM.—City of Birmingham Police Band.

GLASGOW. — "The Glittering Gate," fantastic play by Lord Dunsany.

Thursday, December 9th.

LONDON.—Old Italian Music.

BOURNEMOUTH. — "Landing the Shark," by Vivien Tidmarsh.

CARDIFF.—Handel's "Samson."

NEWCASTLE.—Community singing relayed from Victoria Hall, Sunderland.

Friday, December 10th.

LONDON. — "The Barber of Seville."

Saturday, December 11th.

LONDON.—"My Programme," by George Grossmith.

GLASGOW. — Pantomime "Cinderella."

The News Bulletin.

Last week I referred to that dreary recital known as the First News Bulletin. In view of a meeting which has been arranged between officials of the B.B.C. and members of the Newspaper Proprietors' Association, I should not be surprised if, in the New Year, striking changes occur on the news side of the programme. Very probably the First News Bulletin will be scrapped and the present Second News Bulletin elaborated considerably.

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Broadcasting v. The Newspaper.

It is difficult to imagine, however, that the broadcast news bulletin could ever approximate to the newspaper as a vehicle of news and thought. I calculate that one of the larger "dailies," read aloud and at the same rate as the broadcast news bulletin, would occupy an announcer for twenty-four hours! When readers have a little time to spare they might try the experiment themselves!

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Great Spanish Broadcasting Group.

One of the most enterprising of the European broadcasting concerns seems to be the "Union Radio" group in Spain. This company now controls six stations, viz., Madrid, EAJ7, and Radio Castilla, EAJ4, Cadiz, EAJ3, Bilbao, EAJ9, Seville, EAJ17, and Barcelona, EAJ1. The new Seville station, with a power of 1kW., replaces two smaller ones, and is proving so satisfactory that there is still a doubt as to whether the proposed new high-power station in that city will be erected after all. The taking over of Radio Barcelona by "Union Radio" is regarded as a very important step among Spanish listeners, and already inter-relaying between Madrid and Barcelona has satisfied all expectation. Listeners in Madrid are delighted at having an opportunity to hear the operas which are played at the "Gran Teatro del Liceo," in Barcelona, as the "Gran Teatro" is considered to be the best Opera House in Spain.

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"My Programme" at Bournemouth.

The series of broadcasts now being given from 2LO under the title of "My Programme" have induced the Bournemouth station to arrange a similar programme for December 8, when members of the station will co-operate in providing suggestions and requests for an evening's entertainment to be broadcast from 6BM.

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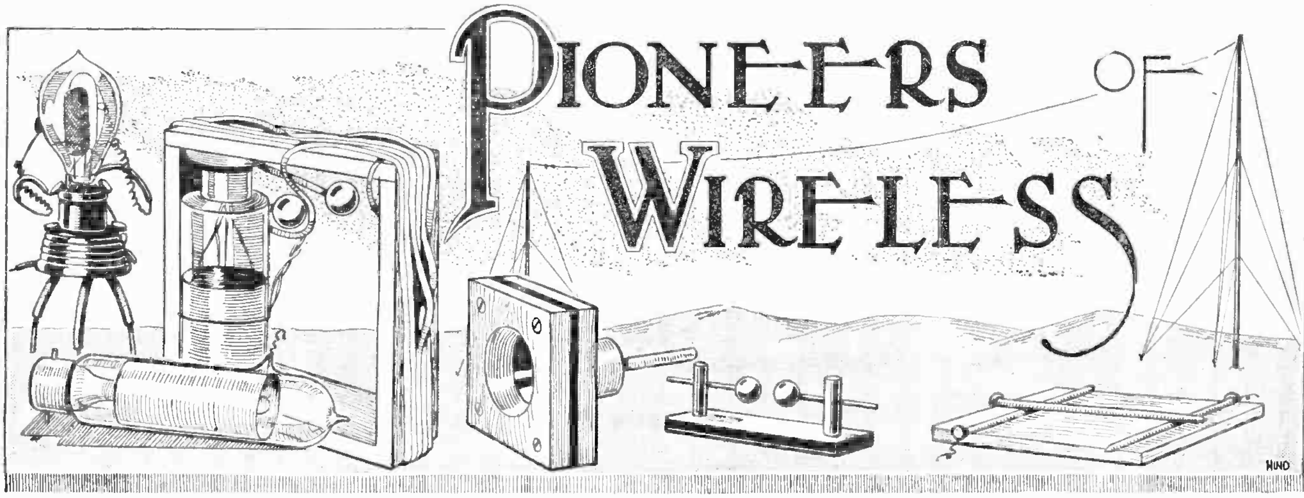
A Powerful Voice.

Bach's Christmas Oratorio, which was broadcast from the London studio during the Christmas season of 1925, will be repeated this year, and, as previously, Mr. Leonard Gowings will take part. Mr. Gowings tells an amusing story against himself. A friend of his with a very fine, powerful voice was at his house, singing. Mr. Gowings' little daughter, on hearing the visitor sing, exclaimed, "Why, he's worse than father!"



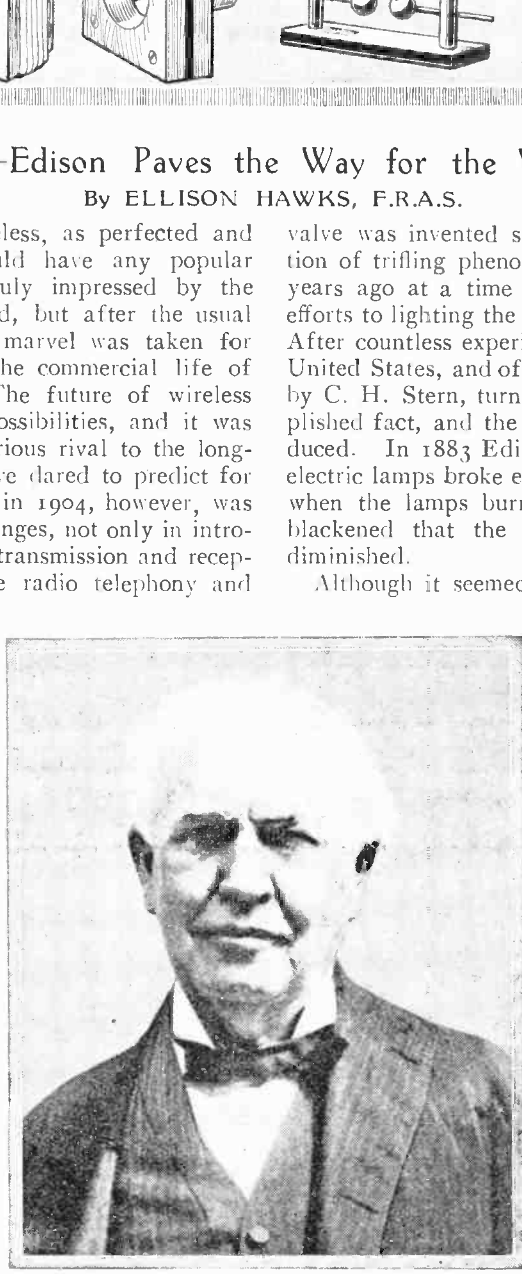
37.—Edison Paves the Way for the Valve.

By ELLISON HAWKS, F.R.A.S.

IT cannot be claimed that wireless, as perfected and established by Marconi, could have any popular appeal. The public were duly impressed by the momentous discovery of the world, but after the usual "nine days' wonder" the new marvel was taken for granted and became a part of the commercial life of nearly all civilised countries. The future of wireless seemed to lie in its commercial possibilities, and it was expected that it would prove a serious rival to the long-distance cable. No one could have dared to predict for it any other future. A discovery in 1904, however, was destined to make revolutionary changes, not only in introducing an entirely new method of transmission and reception, but also in making possible radio telephony and consequently broadcasting as enjoyed to-day by millions of listeners.

The Modern Aladdin's Lamp.

This discovery was the thermionic valve, the work of John Ambrose Fleming, Professor of Electrical Engineering at the University of London. It followed on the researches of Edison into the origin of a peculiar effect that he observed in electric lamps, and is one of the most wonderful inventions of recent years. It has been called "the modern Aladdin's lamp," but even the wonders that Aladdin was able to conjure up with the aid of his old lamp are surpassed by the valve, which brings to its owner wonders never dreamed of even by the highly imaginative author of *A Thousand and One Nights*.



Thomas Alva Edison.

The manner in which the valve was invented shows the value of detailed observation of trifling phenomena. The story commences many years ago at a time when scientists were devoting their efforts to lighting the homes of the people with electricity. After countless experiments, the labours of Edison in the United States, and of Sir Joseph Swan in England, aided by C. H. Stern, turned a scientific theory into an accomplished fact, and the electric incandescent lamp was produced. In 1883 Edison noticed that the filaments of the electric lamps broke easily at the slightest shock, and that when the lamps burned out, the glass bulbs became so blackened that the amount of light was considerably diminished.

Although it seemed almost too trifling a matter to call for serious notice, Edison determined to investigate the matter. He noticed that in many burned-out lamps there was a line of glass that was not discoloured as was the remainder of the globe. It was as though someone had taken a smoked glass, drawn a finger down it, and left a perfectly clean line behind. Lamps with these sharply defined clean spaces were covered elsewhere with a deposit of carbon or metal, the clean line being immediately in the plane of the filament and on the side of the loop opposite to the burnt-out point of the filament.

Molecular Bombardment.

The unbroken part of the filament appeared to act as a screen to that particular line of clear glass, and that the discharge from the overheated point bombarded the remainder

Pioneers of Wireless.—

of the bulb with molecules of carbon or vaporised metal.

In his experiments to investigate this action Edison fixed a small metal plate inside the globe. This plate was suspended near the filament, but insulated from it. He was surprised to notice that when this plate was connected to the positive terminal of a battery the negative terminal of which was joined to the filament, an electric current passed along the wire from the plate, although there was no metallic connection between the filament and the plate. The passing of the current was indicated by a galvanometer, connected between the plate and the battery. In puzzling over this remarkable effect, Edison came to the conclusion that there could be no doubt that the current jumped across the gap between the filament and the plate.

Continuing his experiments, he noticed that the current would not leap the gap when the negative terminal was connected to the plate. No matter how strong the battery current, the galvanometer showed that not even the minutest current passed when the connection was made in this manner.

The modern explanation of the phenomenon is as follows: When the filament was heated, a stream of electrons flew off and attached themselves to the plate. They were encouraged to do this because the plate was positively charged, and the electrons in the filament were all negative. Arriving at the plate, they continued their course to the positive terminal of the battery, and registered their passage through the galvanometer. When the plate was connected to the negative terminal of the battery it became charged with negative electrons. The electrons of the filament, being also negative, did not leap the gap between the filament and the plate, for "like repels like."

Desiring to perfect his incandescent electric lamp, Edison did not immediately pursue his discovery of the peculiar action, which became known as the "Edison effect." That he realised its importance, however, is demonstrated by the fact that he took out a patent protecting the discovery. This patent was subsequently acquired by Marconi.

In our next instalment we shall learn how Professor J. A. Fleming used Edison's discovery as a basis of the thermionic valve.

TRANSMITTING NOTES AND QUERIES.

Reception of American Broadcasting.

Mr. A. S. Watford (G 2BVK), of Windsor, received U 2XG on 22.5 metres telephony on Sunday, November 7th, at 9.35 a.m. G.M.T. He was using an 0-v-1 receiver without an aerial, but with an earth counterpoise.

Another correspondent in Newport, Mon., heard the same station at 8.45 a.m. on Sunday, October 10th, the signals being clear and steady at about R4, and the wavelength about 40 metres. The receiver used was an 0-v-1 Reinartz working with a 25ft. single wire indoor aerial and 20ft. single wire counterpoise.

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General Notes.

With reference to the list of voluntary distributors for overseas QSL cards, published on page 664 of our issue of November 17th, we understand that the present address of Herr Oswald Kruschwitz (K L4 and K 4ABI), who undertakes the forwarding of cards to German amateurs, is now Richard Wagnerstrasse 19, Halle-am-Salle.

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Mr. F. G. Turner (G 2DB), 88, Chesterton Road, Cambridge, tells us that at 0445 G.M.T. on November 7th he established 2-way working with U 4WJ, using an input of 5 watts to a Marconi LS5A valve. His signals were reported R3, the distance being approximately 4,200 miles.

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A correspondent in Yorkshire states that at 0216 G.M.T. on September 27th he heard U 2AYE calling U 9LF using less than 1 watt input with 94 volts H.T. on a Hartley circuit and a 6-volt receiving valve. The signals were about R5 in Yorkshire on a 2-valve Reinartz receiver.

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Mr. Claude S. Crooks (Y 2JY) asks that all correspondence relating to transmissions from his station should be addressed to him c/o Messrs. Alfred Herbert (India), Ltd., 13, British Indian Street, Calcutta.

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Morse Abbreviations.

In addition to the recognised International "Q" code and those unofficial atrocities (*e.g.*, "sum" for "some," "sori" for "sorry," "trub" for "trouble") which, though convenient, as a kind of shorthand in Morse transmission, are detestable in written correspondence, there are several amplifications of the "Q" code which are coming into general use among transmitters. These we give below for the benefit of our readers: —

QRAR Is your address in the "Call Book" correct?
QRDD In what direction are you transmitting your message?
QRFF From which station have you received message No. —— ?
QSLL Please acknowledge my reception by card. I will do the same.
QSRM Please forward message No. —— by post if you cannot transmit it by wireless at once.
QSSS Are my signals unstable (as distinguishable from ordinary fading)?
QSUF Please call me up by telephone (land line) at once.
QSTI I am going to change my wavelength to —— metres.
QSYU Please change your wavelength to —— metres.

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New Call-signs Allotted and Stations Identified.

G 2AB L. E. Owen, 10, The Mead, Sandy Lane, Wallington, Surrey. Transmits on 32, 34, 44 and 46 metres.
G 6JD C. Jordan, 45, Lower Park, Loughton, Essex. Transmits on 90 and 150-200 metres.
G 6QL (Ex 2BMD) P. H. Berry, Gills Hill, Radlett, Herts. Transmits on 45, 90 and 150-200 metres.
G 2ANW (Art. A.) R. Bottomley, "Glynwood," Brighouse, Yorks.
BVJ R. N. College, Dartmouth.
CHA 1CRS C. Shekury, 81, Avenue Dubail, Shanghai.
F 8IH R. Desgrouas, Vire, Calvados.
FC 8AG A. L. Guillabert, 370, Avenue Joffre, Shanghai.
FC 8FR F. Jules, Ecole St. Joan d'Arc, Avenue Haig, Shanghai.
FC 8ZW E. Gherzi, Zikawei Observatory, Shanghai.
SSV Swedish Motor-Ship "Kronprinz Gustav Adolf."

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South African Transmitters.

We are indebted to our South African contemporary, "Radio," for the following QRA's:—

A 7L (Portable.) W. Todd, P.O. Box 5439, Johannesburg.
A 7M H. St. John Randall, M.B., 84, Caledon Street, Uitenhage.
A 7N A. V. Hollins, 21, Railway Cottage, Sydenham, Port Elizabeth.
A 7O A. T. Law, 49, Sixth Avenue, Parktown North, Johannesburg.
A 7P W. Shakespear, 29, Railway Cottage, Sydenham, Port Elizabeth.
A 7Q S. Larsen, P.O., Mayville, Durban.
A 7R A. G. Curtin, 45, Fifth Avenue, Parktown North, Johannesburg.
A 7S W. Wilson, 12, Lanadown Place, Port Elizabeth.
A 7T T. Kleyn, Irrigation Department, Addo, Cape.
A 7U D. B. Truter, 40, Coleridge Road, Salt River, C.P.
A 7V W. H. Rhodes, 9, Sidney Road, Bertrams, Johannesburg.
A 7W N. Paver, 72, Smith Street, Aliwal North, C.P.
A 7Y J. Downing, Fordyce Road, Walmer, Port Elizabeth.
A 7Z E. M. Aspeling, 18, Mackay Street, Port Elizabeth.

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South Australian QRA's

We also give the following Australian QRA's from "Radio in Australia and New Zealand":—

5BR Blackwood Radio Club (O. K. Griffith), Main Street, Blackwood.
5BW J. G. Phillips, 31, Partridge Street, Glenelg.
5BX A. L. Saunders, 17, Esplanade, Glenelg.
5HG H. H. Cooper, 51, Gastings Street, Glenelg.
5HS M. W. Trudgeon, 41, Florence Street, Fullerton Estate (ex 5MW).
5HY A. Cotton, Harvey Street, Kilkenny.

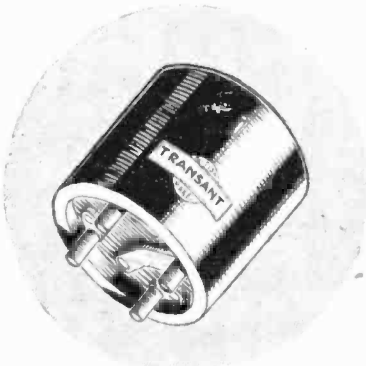
NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

ADAPTOR FOR AMERICAN VALVES.

Several of the American receiving sets now appearing on the market in this country are fitted with valve sockets arranged to accommodate the American type of valve.

In order that British valves may be used with sets fitted with American sockets W. H. Tant and Co., Dollman



Adaptor to permit of the use of British valves in receiving sets fitted with American type valve holders.

Street, Vauxhall, Birmingham, have introduced an adaptor. It consists of a cylinder which is turned from solid ebonite rod and drilled at one end so as to accommodate the sockets of the British valve-holder. At the other end is the four-pin American valve mount, the necessary connections being made by means of stampings of nickel-plated brass. While in the British valve-holder the grid and plate connections are on opposite sides of the socket, the pins of the American base are arranged so that the grid and plate connections are side by side. Being made from solid ebonite, this adaptor possesses good insulating properties.

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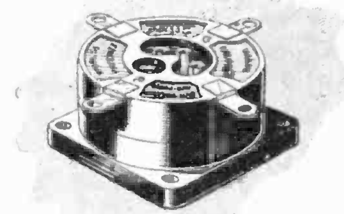
THE ARTIC VALVE-HOLDER.

A new principle has been introduced in the construction of the "Artic" valve-holder, a product of the Artic Fuse and Electrical Manufacturing Co., Ltd., Birtley, Co. Durham, for the purpose of eliminating mechanical shock and reducing to a minimum valve microphonic noises.

The four valve sockets are carried on a thin stamping of insulating material so as to keep losses down to a minimum, whilst part of the supporting piece is cut away between the sockets in order to extend the leakage path and maintain good insulation. This piece of insulating material carrying the valve sockets is supported on a substantial "Bakelite" former, attachment being made by means of four strips of copper wire gauze instead of the usual spiral springs so often fitted. The strips of gauze are cut so that the strands of wire lie obliquely, and no individual strand which is attached to the valve socket continues right through to the connecting terminal. Microphonic noises in the form of vibrations at audio-frequency are readily transmitted along a wire, and by breaking up the individual strands in this way it is to be expected that microphonic noise will be largely eliminated.



The sockets of the Artic valve holder are suspended by means of gauze strips, the wire strands of the gauze being arranged obliquely to minimise the transmission of microphonic noises between the socket and the Bakelite mounting piece.

A few strands of supple wire, however, bridge the piece of supporting gauze to ensure good electrical connection with the terminals. By mounting on a moulded "Bakelite" sub-base the supports for the suspended socket become totally enclosed.

The mouldings possess a clean and bright finish. When screwed down to a baseboard the connecting tags, being elevated, provide for the connecting leads being raised about 1in., thus obviating the need for mounting the valve-holder on a sub-base.

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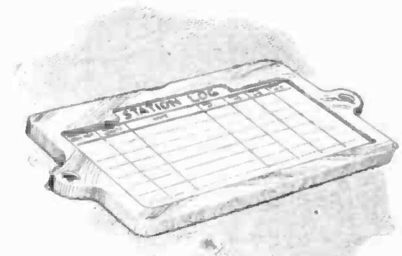
STATION LOG.

With the increasing use of superheterodyne and stabilised receiving sets which



The Decko station log is easily attached to the cabinet of a receiving set and provides for recording the dial settings of the various stations within range.

are capable of an accurate calibration it has become possible to record the exact tuning positions of given stations. A modern set is, therefore, not complete without a calibration chart showing the dial settings required to tune to the transmissions of various stations. An accessory which is likely to become exceedingly popular, therefore, is the radio station log produced by A. F. Bulgin and Co., 9-11, Cursitor Street, Chancery Lane, London. E.C.4.

It consists of a substantial metal frame having a nickel-plated, oxidised copper, or oxidised silver finish, measuring approximately 5¼in. × 3¼in., and open at the top for the insertion of record cards. The frame, which is attached to the cabinet with a pair of screws, holds a supply of cards ruled with columns for recording call sign, wavelength, name of station, and dial settings.

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

IDENTIFYING BROADCAST TRANSMISSIONS.

Sir,—As the only unfortunate individual who would lose his job of trying to inform puzzled listeners "Which station was that?" were the Continental broadcasters to adopt the international system of call signs suggested by Mr. C. F. Carr in your issue of November 17th, may I be allowed to express an opinion regarding the value of a different method to that now in more or less general use?

Although at first sight your correspondent's suggestion is theoretically excellent, in practice it would be found that the limitation of the individual calls to a code word followed by a number, whether in Esperanto or any other language, would not in any way facilitate the identification of the transmitter.

From my experience announcers at most of the foreign stations have the unfortunate habit of dropping their voices towards the end of the call, which, in most instances, contains the name of the city in which the transmitter is situated, and I find from most of the queries I have received that listeners invariably pick up the first words, such as "Achtung!" or "Allo!" also clearly hear "Radio," and then the actual name is lost. Exactly the same thing would occur if, as suggested, the station were to call, say, "Germana Stacio Unu" and such Esperanto numerals as *du* or *nau*, or, again, *ses* or *sep*, would, most probably, lead to confusion.

Personally, I consider that such stations as Stuttgart and Munich, which have adopted as an interval call both Morse and musical notes produced by oscillating valves, are doing much to solve the problem. Whereas it frequently happens that the human voice is only faintly perceptible, a few Morse signs are always clearly heard, and the penetrative power of these note signals is remarkable.

A code could easily be made and based on the combinations of three Morse signs and three different notes would allow of an individual signal being allotted to every European transmitter.

JAY COOTE.

November 17th, 1926.

Sir,—With reference to the article by C. F. Carr appearing in your November 17th issue under the heading "Identifying Foreign Transmissions," it would be redundant for me to say why this Association would support Mr. Carr's proposal as being the most feasible and acceptable, because our motto is "Esperanto for Radio, Radio by Esperanto."

The most extraordinary part about the scheme is that very little or no effort would be required to learn the Esperanto equivalents for the various countries, as they are for the most part from roots already in our own and other languages, and only ten figures have to be learnt because dekunu (ten one) is the Esperanto for eleven and du dek (two tens) twenty, and so on.

I mention the above because it is usual amongst humans to avoid anything laborious, but here you have a very quick return for practically no expenditure.

An ordinary person will learn all that is necessary in a few moments, whereas Morse is far more difficult to learn and memorise, and a musical sound would be far too difficult to be comprehended by untrained people; for example, how many people, untrained, could repeat a musical note immediately after hearing one? thus proving the difficulty in memorising that sort of identification signal; but I feel sure almost anybody could pronounce "Brita" after hearing it pronounced, which proves the ability mentally to assimilate such a method of announcing.

For those who would try a little further there is a promise of many a surprise in Continental programmes, as Mr. Carr says, for many stations are now broadcasting in Esperanto. A list of these is given every month in *International Language*, and many will be found in *World Radio*.

Mr. Carr's suggestion I shall pass on to our members in some twenty-three countries, asking them to put the proposal before their broadcasting authorities and also to recommend it to "General Union Internationale de Radiophonie" in Geneva, as I shall do.

W. H. MATTHEWS,
Secretary for Gt. Britain, Internacia Radio-Asocio.

Chadwell Heath.
November 20th, 1926.

Sir,—The most important point in any scheme of station identification is to make the call sign stand out, and the best way to do this is to have a definite and standard preparatory signal to precede the call sign.

Either three beats of a gong or three piano notes struck at intervals of one second should be followed, after a second's interval, by the name of the transmitting station.

As things are at present we hear an item to a finish and wait breathless for the next words. We wait for perhaps two minutes, and are just giving up in despair when, on our unprepared ears, comes a jumble of foreign words which may or may not contain the information required. If my plan were adopted the three gong-beats would come through and prepare us for the next word, which we would then know absolutely to be the call sign. This call sign could be in Esperanto, but I consider the usual call, or an easily recognised code word, would be just as good.

It is high time that some exit was made from the present chaotic state of call signs, and I hope all listeners will unite to effect an improvement.

B. N. BLOOD.

Bristol.
November 19th, 1926.

Sir,—Under the new wavelength scheme stations and groups of stations are separated by a frequency of 10,000 cycles. Could not the stations be given a number which would correspond with the frequency divided by 10,000 of the emitted wave, as printed in your list in the September 1st issue? They could then transmit this number in the same manner as the six dot seconds of the time signal, giving pauses between the different figures. This would be much more easily readable than the usual announcements of distant stations, and, incidentally, would get people into the way of thinking of a station's wavelength in the more scientific form of frequency, such as 2LO=83 (×10,000), instead of 361.4.

Some difficulty might be experienced when two or more stations share the same wavelength, such as the British relay stations, but it could be easily got over by an auxiliary number, such as Dundee 104–1, Edinburgh 104–2, which could be given after the main number and would cause no confusion.

Leigh-on-Sea. E. BARRETT.

November 21st, 1926.

Sir,—The system of international call signs suggested by Mr. C. F. Carr in the issue of *The Wireless World* for November 17th appears to be the most suitable scheme that has yet been put forward.

One amendment might be suggested. The serial numbers could be allotted irrespective of the importance of the station. Otherwise, in the case of a new station of greater importance than an existing one being established, it would be necessary to change the number of the latter to keep the correct order.

Redcar. T. E. HOWARD.

November 17th, 1926.

Sir,—I welcome Mr. C. F. Carr's contribution towards a solution of identifying broadcasting transmissions, and, whilst the scheme may appeal to certain quarters, I regret that for several reasons I am unable to endorse it as the best.

In my original article in *The Wireless World*, March 17th, 1926, I pointed out the inherent disadvantages of the use of any international language, and I am convinced that the standard pronunciation and interpretation of Esperanto are not so simple a matter as Mr. Carr would have us believe.

One must consider wireless as serving millions of people in all walks of life, and by the introduction of Esperanto or Morse the listener would be faced with the necessity of learning a language or a code. Whilst a few enthusiasts might think this worth while, the great majority would not put themselves to such trouble, nor is there any necessity why they should be called upon to do so.

Regarding the suggestion that the call-sign should first be given in the national language and then in Esperanto, I feel this would be a little trying to the announcer, and he would soon fall into the prevailing attitude of giving the call-sign as seldom as possible.

It is, therefore, necessary that the call-sign should be so arranged as to relieve the announcer of all strain, especially if we are to receive it at each interval, and it is very desirable that we should. I even go so far as to say it is desirable that the call-sign should be given *several times* during an interval to enable listeners to get and keep in touch with a station during that period, and for the avoidance of oscillation.

This brings us to the point that the call-sign should be capable of being understood by the listener without the necessity of study, and that it be suited to automatic transmission. The more I study the problem of international call-signs the more convinced I become that these are essential qualifications. Further, I believe that a call-sign given out in a series of harmonious notes would come through much more clearly than the human voice. In evidence of this I would call the listeners' attention to the interval signals of Stuttgart and Munich, where the notes C, D, G and A, F♯, D are used respectively and transmitted (I believe) automatically on the oscillating valve principle. Hence it will be apparent to the intelligent listener that there are numerous ways of arranging an international call-sign. When considering the problem I had a score of methods before me, such as Esperanto, Morse, distinctive note or notes, notes arranged as in a chime, and bars of music from well-known airs, to quote only a few, but none was found to have the simplicity combined with the utility of the method advanced by me.

Your readers now having before them several workable schemes, the questions arise as to which scheme approaches nearest to the ideal, and as to how we are to get the B.B.C. sufficiently interested to give any of them a trial.

Glasgow. A. A. SCHASCHKE.

November 22nd, 1926.

MANUFACTURERS AND THE RADIO SOCIETIES.

Sir,—I sympathise with the Secretary of the Thornton Heath Radio Society and any other radio society which is genuinely out to gain knowledge and not try to obtain wireless goods at a discount for its members. I do not propose to criticise the spirit of Mr. Banwell's letter in the November 17th issue, but consider that the way it is written leaves it open to severe criticism.

Certain members of radio societies, and I include their secretaries and other officials, are under the mistaken apprehension that as such they are entitled to trade discounts for wireless and even electrical apparatus. They are not, of course, and this has been laid down by the Radio Manufacturers' Association in circulars issued to manufacturers.

I have personally, and at times on behalf of my companies, assisted with the loan of apparatus, but recently have had to decline both owing to the fact that, with one exception, we have been pestered by the members attempting to obtain goods on trade terms with their membership cards, whereas their trade was that of butcher, baker, or candlestick maker. Ask any of these individuals if they will reciprocate and the invariable reply is: "We could not do that, you are not in the trade."

It is a great gag for the secretary of a radio society to call and ask you to give a lecture or to loan apparatus. Following this he or another member will come along with glowing tales of the number of members and huge attendances, being the largest in London or the Kingdom, and declaring that if arrangements can be made for suitable terms a turnover of £50 or £100 per month can be assured.

Innumerable pirate builders of radio sets belong to these societies who must damage the legitimate radio manufacturer.

Why do radio societies issue membership cards at all, as no decent club or other institution does so, as it can have no object as far as the society is directly concerned?

It may be that this sort of thing is too prevalent, hence the complaint made by Mr. Banwell. GEO. K. FIELD,

London, W.14. Chartered Electrical Engineer.

Sir,—I am writing to dispute the letter in your issue of November 17th from the secretary of the Thornton Heath Radio Society. I refuse to admit that manufacturers refuse to answer letters asking for lecturers. I have found that manufacturers are extremely obliging in this respect. It is only natural that a manufacturer is not going to send a lecturer perhaps hundreds of miles unless he is going to reap some benefit.

Perhaps your correspondent's ideas of a big attendance are slightly distorted. He claims to have the highest attendance in the country. At our last public lecture by a well-known transformer manufacturer we had over 300 people in the audience. Can he beat this?

We have so many manufacturers offering to lecture for us that we have had to refuse quite a number, otherwise we would have had no time for our own lectures. This shows no reluctance on the part of manufacturers.

JOHN B. COOKSON,

Hon. Sec., Preston and District Research Society.

November 19th, 1926.

BRITISH-MADE COMPONENTS.

Sir,—Perhaps you will allow me, through the medium of your correspondence column, to illustrate why readers should insist on reputable and advertised British-made goods when making a purchase.

Some time ago I purchased an A.C. H.T. eliminator from a firm whose advertisements I had seen from time to time in *The Wireless World* during the past five years. Solely on that account I made the purchase without having the instrument tested, my faith in your advertising policy and British-made goods being sufficient guarantee. On putting the eliminator into use I found that it was faulty, and, seeing that it was sealed and guaranteed, I communicated with the makers, who instantly consigned another to me. This instrument also arrived faulty, and the firm instantly replaced again together with two special valves. Examination of the faulty instruments later revealed that rough handling in transport was the cause of the trouble.

The firm in their correspondence unconditionally guaranteed me satisfaction, and I estimate that to give me such satisfaction the cost to the firm was far greater than the manufacturing profit on the instrument I have purchased.

Another experience: I purchased a special purpose valve and found that it was faulty, and when I communicated with the makers they actually replaced four valves. All these valves were out of one consignment, and the faults again may be attributed to rough handling in transport.

Of course, I acknowledge that I may have been unlucky in both these instances, but the fact remains that if I had purchased goods of foreign manufacture instead of relying on reputable advertised British goods, I should not have been able to obtain redress.

I might add that to-day I am grateful to the firms concerned and to your paper for the policy of reliable goods being advertised in a reputable advertising medium.

In conclusion, may I urge readers to "Buy British, which cannot be bettered," and practise the principle of "Support your own country first"? HERBERT K. MORRIS.

Sheffield, November 19th, 1926.

"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Crystal Clarity and Valve Volume.

I am situated at a distance of about twenty miles from a broadcasting station, and I wish to build a receiver which will bring in the local station at good loud-speaker strength, but with the utmost possible purity. It is also desired to receive one or two other stations on the telephones. Can you suggest a suitable circuit?

E.D.S.

Undoubtedly the best possible arrangement for obtaining real loud-speaker quality from a broadcasting station, consists of a crystal rectifier followed by a single stage of low-frequency amplification, using a transformer of reputable make and a power valve. At your distance from a broadcasting station, however, it will obviously be necessary to add a stage of H.F. amplification in order to bring up the strength of signals before rectification, at the same time the presence of the H.F. stage will enable several stations to be tuned in on the headphones. We give the necessary circuit in Fig. 1.

The secondary of the aerial input transformer can consist of 70 turns of No. 24 D.C.C. wound on a former of 3 inches diameter. The primary can consist of 15 turns of No. 30 D.S.C. with a tapping at the 7th turn, this winding being supported on ebonite spacers and wound over the "filament" end of the secondary in the manner repeatedly given in this journal, notably on page 502 of the issue dated October 13th, 1926. Since the H.F. valve is not to be reflexed, a valve having a long straight line portion of grid volts-anode current curve is not called for, and we can therefore use a valve of higher impedance, such as the D.E.5 B, and so take advantage of the much greater amplification factor. The H.F. intervalve transformer can be constructed in a similar manner to the aerial input transformer, except that the total "primary" winding should consist of 30 turns of No. 40 D.S.C., the first fifteen turns of this winding being the primary winding proper, and the second fifteen turns the neutralising winding. Alternatively, instead of winding the primary and neutralising winding as a continuous winding, the method described on page 502 of the issue dated October 13th, 1926, to which we have already referred, may be used. Those readers who intend to use a low impedance valve of the D.E.5 type in the H.F. stage should make the primary and neutralising windings have ten turns each instead of fifteen.

The crystal must not be connected directly to the high-potential end of the H.F. transformer secondary, because the damping effect of crystal and transformer primary being thus shunted across the whole coil would reduce both signal strength and selectivity. A tapping should be made somewhere about the middle of the secondary winding for connection to the crystal, the actual position of the tapping point being by no means critical. Owing to the low resistance of the crystal, it is possible to make use of quite a high-ratio transformer such as the Marconiphone 8 to 1 "Ideal" transformer. Many modern L.F. transformers have a built-in fixed condenser permanently shunting the primary winding, and so no condenser is shown in the diagram, although if none is provided in the transformer it will be necessary to connect a 0.001 mfd. fixed condenser across the primary winding in order to ensure rectification efficiency. The output valve must, of course, be of the low impedance type with an H.T. voltage of 120, and grid bias of about 6 volts, the same value of H.T. being used for the H.F. valve, but, of course, not the same grid bias value, $1\frac{1}{2}$ volts being correct for this valve.

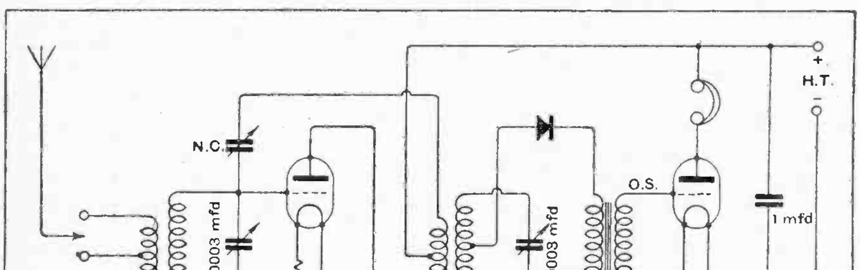


Fig. 1.—Valve-crystal circuit for high quality reception.

○○○○

A Crystal Query.

I am well aware of the fact that strongest signals and greatest selectivity are obtained in a crystal set by not tapping crystal and telephones across the whole of the tuned circuit, because of the damping set up by the comparatively low resistance of the crystal. Does this hold good for the Perikon combination, and for carborundum, which I understand are of much higher resistance? F. H. D.

If the resistance of a crystal were infinitely high, it is obvious that maximum signal strength would be obtained by connecting the crystal and telephones across the whole of the tuned circuit where the full voltage set up across the tuned coil would be applied to the crystal. Since, however, the resistance of a galena crystal is very low, the tuned circuit is heavily damped, and consequently the voltage set up across the tuned circuit is greatly reduced. By tapping the crystal a few turns down, the damping effect is greatly reduced, and the voltage across the tuned circuit rises considerably, so that although the full voltage developed across the coil is no longer applied to the crystal, there is actually a nett gain, and louder signals are experienced. The actual tapping point for best results must be found by experiment, and with the usual type of crystal it will be found that when the crystal and telephones are tapped across about half the coil, results are best. The Perikon combination is of much higher resistance, and therefore does not exert so great a damping effect, and the best tapping point will be found higher up than in the case of most "catwhisker" combinations. The carborundum crystal is of higher resistance still, and consequently the best position for tapping will be found still higher up the coil, approximately more nearly to the theoretical case of a crystal of infinitely high resistance which would require to be tapped to the top end of the coil for best results.

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QUALITY IN BROADCAST RECEPTION.

THE little stir created recently by the Press report of the outburst of Sir Thomas Beecham on the subject of broadcasting was nowhere taken very seriously, and even Sir Thomas himself has since claimed that his views were somewhat misrepresented. But be this as it may, in our eagerness to repudiate the accusations made against broadcasting we should yet be very careful that we, on our side, do not exaggerate the true position by attempting to claim that the broadcasting service brings beautiful music into any home where a wireless set is installed. Unfortunately, we are forced to the admission that it is but a comparatively small proportion of the listening community which listens to broadcast reception of a quality approaching that which is transmitted from the broadcasting stations.

It seems to us that the time has come when efforts should be made to demonstrate to the public all over the country what may be expected when satisfactory apparatus is installed for reception. It is of vital importance to the broadcasting organisation, and to the industry generally, that education of this character should be extended everywhere, and we strongly urge that some machinery should be put into operation whereby the broadcasting authorities and the manufacturers of wireless apparatus should combine in this endeavour.

We are convinced that wireless is still absent from many homes because a large section of the population is still prepared to think that perhaps, after all, there may be a good deal of justification for Sir Thomas Beecham's recent outburst. Until some means is found for correcting this impression, broadcasting is only likely to go ahead slowly and will never be appreciated at its true worth. The broadcasting organisation has a wonderful opportunity for assisting in educating the public up to a proper standard in broadcast reception. Instead of, or supplementary to, the B.B.C. concerts, concert halls all over the country might be thrown open to the public as frequently as possible and the programmes of the local station reproduced with suitable apparatus and loud-speakers. Similarly, it is up to the manufacturers collectively, through their Association, to undertake similar work as a form of co-operative advertising which must be helpful to every member of the manufacturing section of the industry. The policy of *The Wireless World* has always been to encourage a taste for the best reproduction, and the conditions necessary for achieving this result have formed the subject matter of probably the bulk of the articles published. We have recently extended the activities of the journal in this direction by a public lecture and demonstration on "Quality in Broadcast Reception." The first lecture, which was given by Dr. N. W. McLachlan, M.I.E.E., was held recently in Birmingham, and on the 11th of this month this lecture is being repeated in Glasgow, as announced elsewhere in this issue. Further lectures in other centres will shortly be announced

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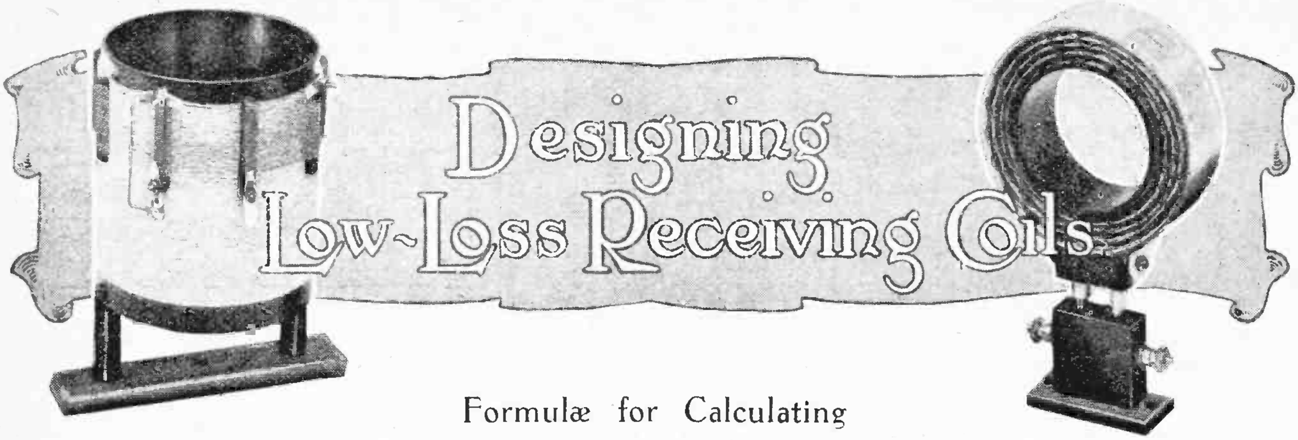


Designing Low-Loss Receiving Coils

Formulæ for Calculating Correct Dimensions of Litz and Solid Wire Coils.

By S. BUTTERWORTH.

THE theory of the losses in inductance coils has now been brought to such a state that it is possible to lay down a definite scheme of design which is so simple that it may be used by a non-mathematical reader to enable him to produce coils having the lowest losses at any specified frequency.

The logical development of this scheme will be found in a series of articles by the present writer in the issues of *Experimental Wireless*, of April, May, July and August, 1926. In the present article the formal procedure of design will be given without stressing the reasons leading to this procedure, the only mathematics required being simple multiplications and divisions, together with the reading of the design charts and tables.

High-frequency Resistance.

Before entering into the question of design it is of interest to show what is the present position of amateur and commercial coils in regard to losses. For this purpose we need to settle what property of the coil shall be used as a basis of comparison of various coils. If the coils compared were all of the same inductance and used at the same frequency, it would be merely necessary to compare their resistances at that frequency, the coil having the lowest resistance being, of course, the most efficient coil in regard to losses. For coils of different inductances, but still used at the same frequency, we could take the resistance per unit of inductance (ohms per millihenry or ohms per microhenry). It is found, with well-designed coils occupying the same space, that the number of ohms per millihenry is roughly proportional to the frequency for which the coils are designed. This rule may be taken to hold over the whole range of radio frequencies. Thus if a coil designed for use at a million cycles per second (a wavelength of 300 metres) is found to have a resistance of 30 ohms per millihenry, we should expect from this rule that a coil of the same size designed for use at 100,000 cycles per second (3,000 metres) should have a resistance of only 3 ohms per millihenry. If, then, instead of specifying the efficiency of the coil as so many ohms per millihenry at a particular frequency, we give this number divided by the frequency, we get a very convenient measure of the efficiency of any coil. If, further, we divide this result by $2\pi/1,000$, we obtain the power factor of the coil, a quantity continually arising in circuit formulæ. For good receiving coils of the normal size and working at their normal frequency, the power factor of the coil should be less than 0.005.

Voltage Magnification.

Instead, however, of using the power factor as a measure of the efficiency of the coil, we will take the reciprocal of the power factor, not only because this quantity may be expressed with sufficient accuracy by a whole number, but also because it gives us a very simple property of the coil.

If the coil is used in conjunction with a perfect condenser to form a tuned wavemeter circuit picking up a small signal voltage, the voltage developed across the plates of the condenser is got by dividing the signal voltage by the power factor, so that the reciprocal of the power factor gives us the voltage magnification of the system at resonance. We will, therefore, always refer to the reciprocal of the power factor as the *magnification*. In algebraical symbols, if L be the inductance of the coil in henries, and R be the resistance in ohms at a frequency f, we have:

$$\text{Power factor} = R/2\pi f L.$$
$$\text{Magnification} = 2\pi f L/R.$$

As a single criterion for assessing the efficiency of any coil in regard to losses, we may now say that the magnification of a receiving coil of normal size when working at its normal frequency should exceed 200. In this connection a normal-sized coil may be taken as one, the winding of which can be enclosed in a cylinder 3in. in diameter and $1\frac{1}{4}$in. long, or in any other volume whose surface area is the same as this cylinder.

As it will turn out that very few coils as at present constructed can satisfy this test of efficiency, the following classification will be used:—

First-class coils.—Magnifications greater than 200.

Designing Low-loss Receiving Coils.—

Second-class coils.—Magnifications between 150 and 200.

Third-class coils.—Magnifications between 100 and 150.

Fourth-class coils.—Magnifications less than 100.

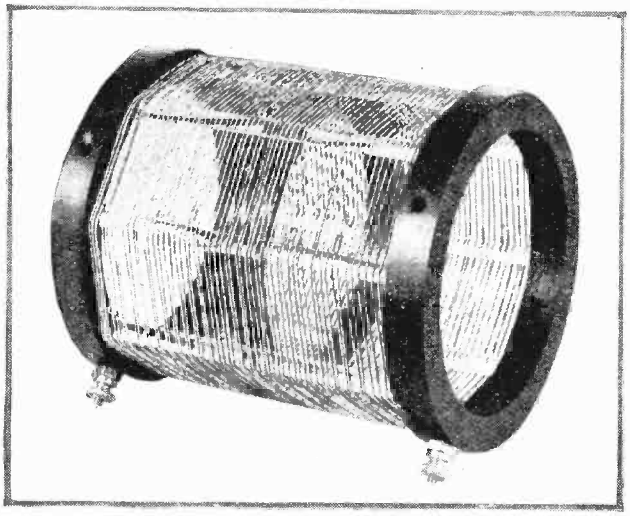
We will now use this system of classification to judge amateur and commercial coils.

Amateur Coils.

In the issues of *The Wireless World* for February 17th, February 24th, and March 3rd, 1926, the details of sixty coils submitted for *The Wireless World* competition were given, and these coils may be taken as fairly representing the state of amateur coils in general. The inductances of the coils ranged from about 30 to 300 microhenries, and all the resistances were measured at 400 metres. The details were such that it was possible to calculate the magnification of each coil and to classify them according to the above scheme. The results are as follow:—

First-class.—	16 coils,	or 27	per cent.
Second- „ —	11	„ 18	„
Third- „ —	17	„ 28	„
Fourth- „ —	16	„ 27	„

Now, the first-class coils were, in general, bulkier than the normal coil, their surface areas ranging from 29 square inches to 89 square inches, while the normal coil would have a surface area of only 26 square inches. It is estimated that of the sixteen coils placed in the first class nine reached that position owing to their increased bulk. Thus only about 12 per cent. of the amateur coils can be regarded as in the first class when the space occupied is taken into consideration. In other words, nine out of ten home constructed coils are in need of improvement, while, since 27 per cent. are in the fourth class, three out of every ten amateur coils cannot be regarded as low-loss coils at all.



The prize-winning coil in "The Wireless World" competition. This coil has an inductance of 134 microhenries and the H.F. resistance at 400 metres is 2.05 ohms; the mean diameter is 2 15/16in. and the length 3⅛in.

Commercial Coils.

The state of commercial coils is even more interesting. In order to get a representative set of results for such coils the writer asked eight firms for details in regard to the H.F. resistances of their particular type of coil. Those firms were chosen which made a speciality of advertising the lowness of the losses. No replies were obtained from three firms, two firms did not know the resistances but were going to measure them, and one firm supplied a table of H.F. resistances, but did not specify the wavelength of measurement. Full details were supplied by only two firms. The data thus obtained, together with measurements made by the writer, and others in the Calibration Department of *Experimental Wireless*, gave information in regard to fifty-seven coils having inductance values ranging from a few microhenries to 5,000 microhenries, of which thirty had inductances less than 400 microhenries and were thus intended for the usual broadcast band of frequencies.

These fifty-seven coils are classified in the following tables, the firms producing them being lettered A to J. Table I refers to coils of inductances less than 400 microhenries, and can thus be used to compare the state of commercial and amateur coils. The percentages show that the commercial coils are distinctly worse than the amateur coils, but as the latter are in general larger than the commercial coils, it may be concluded that, bulk for bulk, both amateur and commercial coils are in about the same state.

Classification of Commercial Coils.

TABLE I.—COILS OF INDUCTANCE LESS THAN 400 MICROHENRIES.

Firm	Class			
	1st	2nd	3rd	4th
A	—	—	1	1
B	—	—	—	1
C	—	—	1	3
D	—	—	—	2
E	—	—	—	1
F (3 types)	—	—	1	2
	—	—	3	—
	—	—	3	—
G	—	1	—	—
H	3	3	—	—
I	—	—	1	—
J	—	—	3	—
Totals	3	4	13	10
Percentage	10	13.3	43.3	33.3

In Table II, where coils of higher inductance are classified, it is seen that only one coil falls into the first class, the remainder being third- and fourth-class coils. As the inductance of this solitary coil was 540 microhenries it may be concluded that manufacturers have, so far, been unable to produce a low-loss coil of considerable inductance.

The writer would like to feel that he has been unfortunate in the coils he has measured, and would welcome data from commercial coil constructors which would swell the total of first-class coils. The writer has supplied the Editor with the names of the firms producing the above

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coils in order that he may be assured that they fairly represent standard practice.

TABLE II.—COILS OF INDUCTANCE GREATER THAN 400 MICROHENRIES.

Firm	Class			
	1st	2nd	3rd	4th
A	—	—	—	3
C	—	—	—	2
D	—	—	—	3
	—	—	—	3
F (3 types)	—	—	3	—
	—	—	2	—
G	—	—	1	1
H	1	—	4	—
J	—	—	—	4
Totals	1	0	10	16
Percentage	4	0	36	60

Examples of Efficient Coils.

In order to show what sort of magnification may be obtained with really good coils we may take the prize-winning coil of *The Wireless World* competition. This is described in the issue for March 3rd, 1926. It was wound on a skeleton frame with 20/42 S.W.G. Litz, had a diameter of $2\frac{15}{16}$in. and a length of $3\frac{1}{8}$in. Its magnification at 400 metres was 306. Again, in the issue of *The Wireless World* for March 17th, 1926, Mr. James gave a series of results for a set of simple single layer coils of varying sizes all wound with solid wire, and their magnifications varied from 200 to 342 at 400 metres. It must not be concluded from this that solid wire will produce coils as good as those wound with the correct diameter of Litz, as the prize coil had a surface area of only 42 square inches, and, in order to beat its magnification with a solid wire coil, Mr. James had to wind a coil with a surface area as large as 68 square inches.

In the issue of *The Wireless World* for March 31st, 1926, the writer ventured to predict that it was possible to wind a coil which would have considerably lower loss than the prize coil and yet be not much greater in bulk. The coil recommended was a coil of 200 microhenries wound with forty-four turns of 27/42 Litz, and had a diameter of 4in. and a length of 2in, and thus having a surface area of 50 square inches. He predicted that the H.F. resistances due to copper losses alone should be as follows:—

Wavelength	500	400	350	300 metres.
Resistance	1.44	1.63	1.80	2.05 ohm.

Now in *The Wireless World* laboratory a coil was recently constructed of the above dimensions, measurement giving the following resistances:—

1.65 2.0 2.35 2.7 ohm.

Comparing with the theoretical values, these give the ratios of copper to total losses as:—

0.87 0.81 0.77 0.76

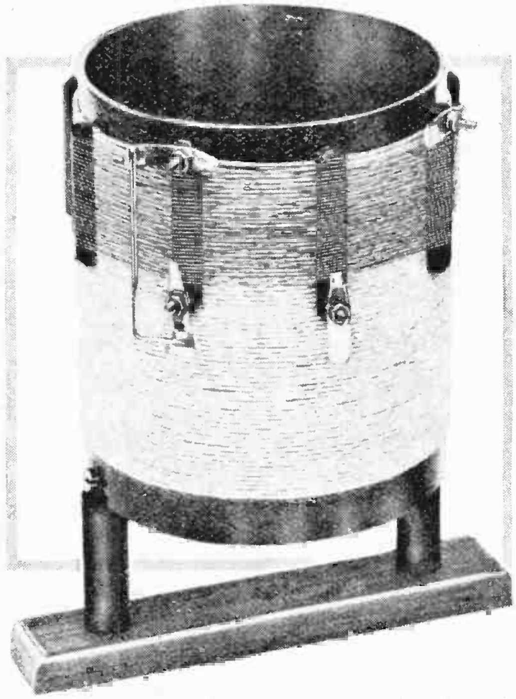
results which are in accord with previous experience.

As the measured inductance turned out to be 205 microhenries, the coil magnification at 400 metres is 480. This is a considerable step forward from the magnification of 306 given by the prize coil, and, even so, does not represent the best single layer coil that can be made of this size. If one is out to get the greatest magnification regardless of cost, the writer recommends the use of 81/45 Litz. A coil 4in. by 2in. wound with this wire gave the following results when tested by the National Physical Laboratory:—

Inductance: 189 microhenries. Self-capacity: 7 micromicrofarads.

Wavelength	H.F. Resistance.	Magnification.
500 metres	1.26 ohms	565
400 ,,	1.58 ,,	565
300 ,,	2.38 ,,	500

I have again to thank Mr. James for the construction of this coil, which probably represents the most efficient coil obtainable with the size chosen. The reasons why



An example of efficient coil construction. The H.F. transformer used in the "Everyman Four" receiver.

one cannot proceed further (say, by using 243 strands) are, first, that the theoretical best diameter of each strand is so very small that the wire would be difficult to manipulate, and, second, that the overall diameter is such that the turns required to produce the necessary inductance cannot be accommodated in a winding length of 2in.

In producing these highly efficient coils the essential thing is a knowledge of the correct diameter of strand to choose. Otherwise there is nothing mysterious. We should, of course, use good insulating material both for the former and for the terminal blocks. Mr. James recommends Paxolin tube for the cylinder, but the writer has found that *good quality* ebonite need not cause any serious increase in resistance.

Effect of Diameter of Wire on H.F. Resistance of a Coil.

In order to emphasise the importance of wire diameter, the curves shown in Fig. 1 have been constructed. These curves refer to a multilayer coil having an overall diameter

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of 10 cm., a winding length of 1.25 cm., and a winding depth of 2 cm. The coil is supposed to have forty turns, and the chosen dimensions are obtained for the various wire diameters by supplying spacers of suitable dimensions. The resistances given are those due to the losses in the copper of the winding, and are calculated from formulæ to be given later. The actual measured H.F. resistances would be somewhat greater than those indicated by the curves, but the general trend of the curves is unaltered. Experience has shown that these theoretical resistances represent on the average more than 80 per cent. of the total measured resistance.

The coil chosen for illustration would have an inductance of about 150 microhenries, which is suitable for a wavelength of, say, 300 metres. In consequence, the calculated H.F. resistances refer to this wavelength.

Curve A gives the variation of the ordinary D.C. resistance of the wire of the coil, and curve B gives the H.F. resistance of the wire *provided it is laid out in one straight length.* When, however, the wire is coiled up there is a further increase in resistance, due to the fact that each turn of the coil is bathed in the alternating magnetic field due to current in the remaining turns. Curve C gives the resistances to be added to those of curve B owing to this cause, and, finally, curve D gives the total resistance of the coil.

It is seen from curves B and C that we have two factors in the total resistance, one of which diminishes as the diameter of the wire increases, while the other increases as the wire becomes thicker. The net result is an optimum diameter giving a minimum resistance. In the present case the optimum diameter is 0.5 mm., but the minimum is so flat that the resistance remains practically unaffected

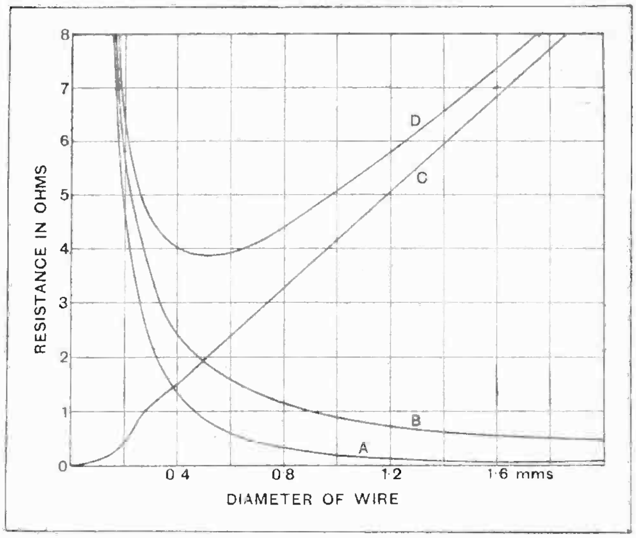
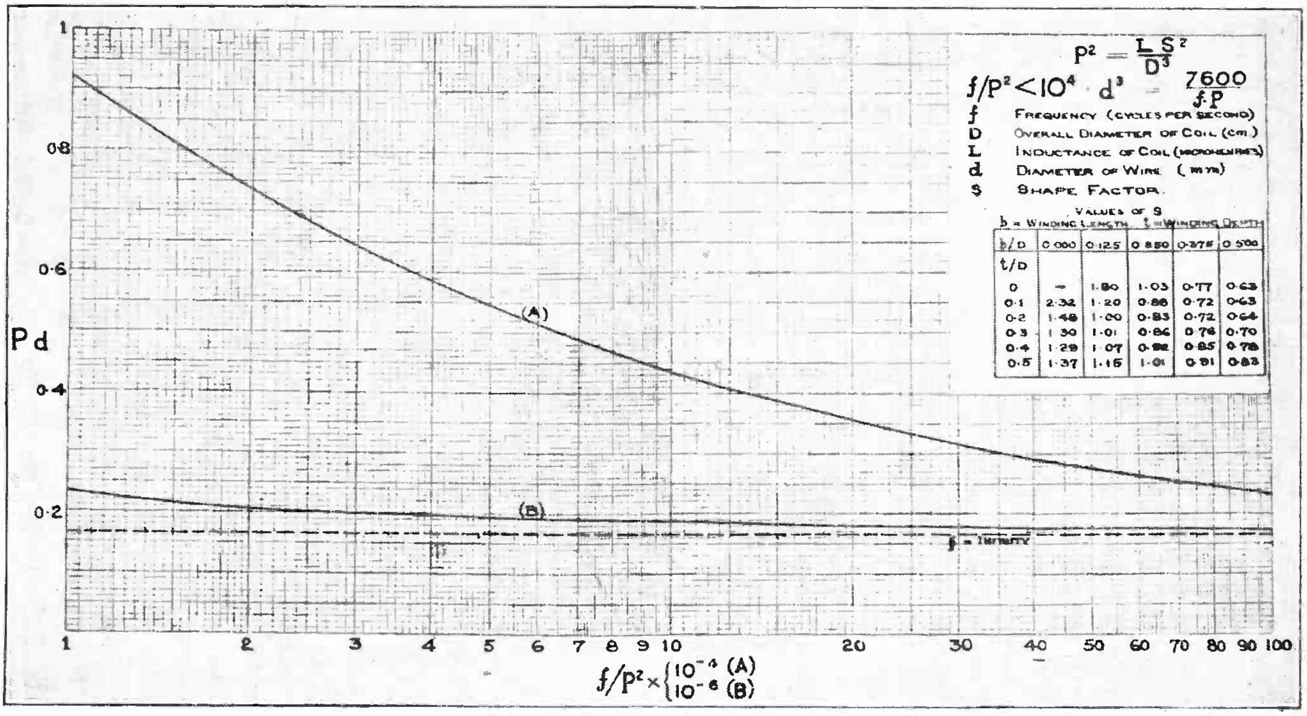


Fig. 1.—Curves showing variation of H.F. resistance of a multi-layer coil with diameter of wire. Coil dimensions are as follow: Overall diameter, 10 cm.; winding length, 1.25 cm.; winding depth, 2.0 cm.; number of turns, 40; inductance, 146 microhenries.

between 0.4 mm. and 0.6 mm. Such a coil, if intended for use at 300 metres, should therefore be wound with No. 26 S.W.G. wire (diameter 0.457 mm.).

It would clearly be very laborious if we had to adopt this method for all possible types of coil and for all possible frequencies. Fortunately, however, the H.F. resistance formulæ enable us to develop a simple method for determining the optimum diameter for any specified frequency and for a wide variety of shapes of coil whether



VALUES OF S
b = WINDING LENGTH. t = WINDING DEPTH

b/D	0.000	0.125	0.250	0.375	0.500
t/D					
0	–	1.80	1.03	0.77	0.63
0.1	2.32	1.20	0.88	0.72	0.63
0.2	1.48	1.00	0.83	0.72	0.64
0.3	1.30	1.01	0.86	0.76	0.70
0.4	1.29	1.07	0.92	0.85	0.78
0.5	1.37	1.15	1.01	0.91	0.83

Fig. 2.—Curves for determining best diameter of wire.

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these are wound with solid or with stranded wire. This method we proceed to explain.

Determination of Optimum Diameter for Single Layer Coils.

This is the most important case, as there is no doubt that, bulk for bulk, single layer coils are more efficient than multi-layer coils for wavelengths less than 600 metres. Referring to the chart of Fig. 2, it will be seen that we have a curve connecting a quantity Pd with a quantity f/P^2. f is the frequency and d the optimum diameter of the wire in millimetres, while P is a coil factor which we will show how to calculate. The horizontal scale (that of f/P^2) is logarithmic in order to bring a large range of frequencies into reasonable compass, while the curve is split into two sections (A and B), referring to values of f/P^2 from 10^4 to 10^6, and 10^6 to 10^8 respectively. If in any case it turns out that f/P^2 is greater than 10^8, it is seen from the curve that Pd has practically settled down to the value 0.165, so that, when this is so, we have the simple formula :—

$$(f/P^2 \text{ greater than } 10^8) \quad d = 0.165/P.$$

If, on the other hand, f/P^2 turns out to be less than 10^4, the formula for the optimum diameter of wire is

$$(f/P^2 \text{ less than } 10^4) \quad d^3 = 7{,}600/f.P.$$

Calculation of Coil Factor P.

The coil factor P depends upon the inductance required, the size and shape of the coil, and on the nature of the wire (solid or stranded) that one intends to use.

For solid wire coils the formula for P is

$$P^2 = \frac{LS^2}{D^3}$$

in which L is the inductance of the coil in microhenries, D is the overall diameter of the coil in centimetres, and S is a shape factor. For single layer coils, if the coil length lies anywhere between one-eighth and a whole diameter, S is calculated from the formula

$$S = 0.20 + 0.140\ D/b$$

in which b is the coil length.

Thus, if the length of the coil is equal to its diameter, S = 0.34, while if it is only one-eighth the diameter S = 1.32.

Example :

L = 200 microhenries and $f = 10^6$ (300 metres).

Coil diameter D = 4″ = 10.16 cm.

Coil length b = 2″ or $D/b = 2$.

From the "S" formula, S = 0.48, and then from the "P" formula,

$$P^2 = \frac{200\ (0.48)^2}{(10.16)^3} = 0.044, \text{ and } P = 0.21$$

For a frequency of 10^6, $f/P^2 = 22.7 \times 10^6$. We must, therefore, use curve B of chart, and we find that $P.d = 0.180$. Dividing by P the optimum diameter is 0.86 mm. The nearest S.W.G. is No. 20. At this stage we should test whether this diameter is possible. Now to obtain 200 microhenries for this coil, we require 44 turns and the length available is 2in. Each turn must therefore occupy $\frac{2 \times 25.4}{44}$ mm. = 1.156 mm. This is more than enough for No. 20 wire. In winding the coil we must keep to the 22 turns per inch. If wound tightly, the inductance would be reached before a winding length of 2in. had been reached, and the resulting coil would have a greater resistance than the spaced coil of the right winding length. It sometimes turns out, however, that the optimum diameter is greater than the available diameter. In this case, a tightly wound coil is the best single layer coil for the length chosen. Also it may turn out in such a case that a multi-layer coil of the same diameter and winding length will give a lower H.F. resistance. As an exercise, the reader may take a coil of size 4in. × 2in. wound with 139 turns and intended for use at 1,600 metres (f = 188,000). This coil would have an inductance of 2,000 microhenries. The space available per turn is 0.366 mm., and the optimum diameter 0.58 mm.

Stranded Wire Coils.

The type of stranded wire referred to is that known as Litz, in which each strand is separately insulated. The strands are usually twisted together on the 3 system, that is, three insulated strands are interlaced to form a single cable. Then three of these 3-strand cables are again interlaced to form a 9-strand cable, and the process may be repeated indefinitely so that we may have 3, 9, 27, 81, 243 strands. The gauges usually employed for each strand of Litz cable are from 36 S.W.G. to 44 S.W.G.

The utility of stranded wire in reducing losses has long been recognised when working on long wavelengths. Thus the Rugby Radio Station employs 729/36 Litz for the construction of some of its transmitting coils. The use of Litz, however, for the shorter wavelengths is not so generally appreciated. This seems to be because the importance of the optimum diameter for each strand has not been realised. It is quite easy to wind a Litz coil with the wrong diameter of strand, and then to find that it is worse than a solid wire coil of the same size, simply because the latter coil happens to be wound with wire of approximately the correct diameter. If, however, the following method is adopted we will arrive at the correct diameter of strand, and a coil constructed with the Litz indicated will be better than the best solid wire coil of the same size.

For stranded wire, the formula for the coil factor is

$$P^2 = \sigma + \frac{n^2S^2L}{D^3}$$

in which n is the number of strands, and σ is a number depending only on the number of strands, as follows :

No. of Strands	=	1	3	9	27	large
σ	=	0	0.9	3.3	10.4	$0.4n$

The shape factor S is the same as for the solid wire coils, so that, apart from the new formula for calculating P, the procedure is exactly as for solid wire coils. The optimum diameter d when found is the diameter of wire to use for each strand.

Example.—200-microhenry coil intended for use at 300 metres; allowable size 4in. by 2in.; we are prepared to use Litz of 27 strands, and we require the correct gauge of each strand. LS^2/D^3 is, as in the previous example, 0.044, so that with 27 strands

$$P^2 = 10.4 + (27)^2 \times 0.044 = 42.4 \text{ and } P = 6.5.$$

Designing Low-loss Receiving Coils.—

Since $f = 10^6$, $f/P^2 = 2.36 \times 10^4$. We must use curve A of chart which gives $P.d = 0.697$, so that $d = 0.107$ mm. From the wire tables we find that No. 42 S.W.G. is suitable. The recommended wire is therefore 27/42. In order to know whether the wire may be accommodated we must have some knowledge of the overall diameter of various types of stranded wire. Information on this point is rather scanty, but the writer has found the following table fairly reliable.

Overall Diameters of Stranded Wire.

Each strand S.S.C. overall D.S.C. Overall diameters in mms.

No. of strands :— S.W.G.	9	27	81
45	0.41	0.73	1.41
44	0.45	0.77	1.49
42	0.52	0.91	1.69
40	0.61	1.06	1.96
38	0.73	1.27	2.54
36	0.88	1.49	2.82

These diameters have been found by winding coils of various types, and finding the number of turns possible in unit length. The whole of the gauges given in the table have not been actually tested in this way, but the various numbers have been obtained by drawing smooth curves through measured values.

It is seen from the table that it is possible to get 28 turns per inch with 27/42 wire, and as only 22 turns per inch are required the wire can readily be accommodated. It might even be possible to accommodate 27/42 wire with each strand D.S.C., and this type of wire should theoretically give slightly better results than when each strand is S.S.C. This type of wire is not, however, at present on the market.

As regards the increased efficiency to be expected by using the above wire instead of solid wire, a coil of this type had a measured magnification of 465 at 300 metres, while the corresponding solid wire coil may be expected to have a magnification of between 300 and 350. The cost of the wire in the solid wire coil is practically negligible, while the necessary Litz would cost about 4s.

Optimum Diameter for Multi-layer Coils.

The procedure is exactly the same as for single-layer coils, except that the shape factor is different. There is now no simple formula for S, but for coils having a length less than the radius of the coil the following table holds.

SHAPE FACTOR S FOR MULTI-LAYER COILS.

D=Overall diameter, b=Winding length, t=Winding depth.

b/D :—	0.000	0.125	0.250	0.375	0.500
t/D					
0	—	1.80	1.03	0.77	0.63
0.1	2.32	1.20	0.88	0.72	0.63
0.2	1.48	1.00	0.83	0.72	0.64
0.3	1.30	1.01	0.86	0.76	0.70
0.4	1.29	1.07	0.92	0.85	0.78
0.5	1.37	1.15	1.01	0.91	0.83

It will be noticed that the table contains values of S both for the cases of no winding length and no winding depth. It is, of course, impossible to realise these conditions in practice, and the values are merely inserted in order to be able to estimate the proper value of S when the winding depth is less than 0.1 or the winding length is less than 0.125. Also the figures refer to *many* layered and not to *single* layered coils in the cases where $b/D = 0$ or $t/D = 0$. For single layered coils with $t/D = 0$, we must use the formula already given for S, and for single layered flat coils ($b/D = 0$) we have the following values :—

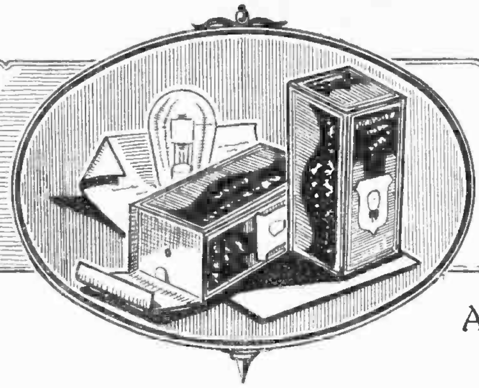
t/D =	0.1	0.2	0.3	0.4	0.5
S =	1.67	1.12	1.02	1.06	1.16

In this connection it must be noted that the simplest type of pancake coil wound basket fashion is a two-layer and not a single-layer flat coil, so that the values of S to choose in designing this type of coil are something between the values of S in the main table and those in the single-layer table. The element of doubt is not serious, as if we do not quite get to the optimum diameter a slight variation will cause an inappreciable change in the final resistance owing to the flatness of the resistance curve in the neighbourhood of the minimum resistance.

As an example of a multi-layer coil we may take the coil illustrated in Fig. 1, viz.: 150 microhenries at $f = 10^6$, D = 10 cm., $t/D = 0.2$, $b/D = 0.125$. From the "S" table, S = 1.00, so that $P^2 = 0.150$ and $P = 0.388$, $f/P^2 = 6.67 \times 10^6$, and from the B curve of Fig. 2 $P.d = 0.19$. This gives $d = 0.49$ mm., which agrees with the curve of total resistance in Fig. 1.

A few calculations of optimum wire diameter for multi-layer coils and single-layer coils of the same overall diameter and the same winding length will show that, owing to the larger values of the shape factor S for the multi-layer coils, the optimum wire diameter of the multi-layer coils is in general less than that for the corresponding single-layer coil. This is important as it shows that we cannot take advantage of the increased winding space afforded by the use of a multi-layer coil. Any reduction of the D.C. resistance of the coil obtained by the use of thicker wire is more than counterbalanced by the enhanced resistance contributed by the alternations of the general magnetic field of the coil.

(*To be concluded.*)



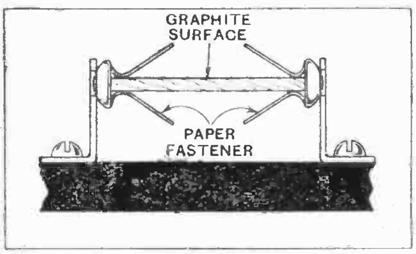
NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

TEMPORARY GRID LEAK.

In the event of a grid leak failing at a time when wireless shops are closed, reception may be continued by inserting a temporary resistance of the type shown in the diagram.

An ordinary match-stick is cut off to the required length, and the ends of one of the faces are coated with graphite from a lead pencil. The match-stick is then clipped between two paper-fasteners and inserted in the grid leak holder. With the receiver switched on, the intervening surface between the graphite covered ends of the match-stick is lightly rubbed with a pencil point until the required resistance value is obtained. At first when the resistance is too high a buzzing noise will be heard in the telephones or



Grid leak substitute.

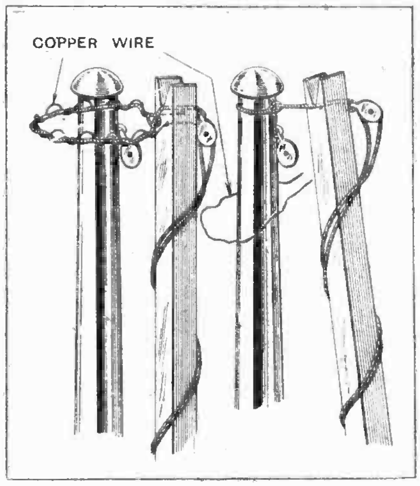
loud-speaker which will gradually increase in pitch as the resistance is lowered. Finally this note will cease, when it may be assumed that the correct value of resistance has been obtained.—G. A. C.

○ ○ ○ ○

REPLACING AERIAL ROPE.

When an aerial rope breaks it is necessary in most cases to lower the mast so that a new rope may be fitted. However, with the simple method shown in the diagram a new endless rope can be fitted in a few minutes without interfering with the mast in any way. The only expense is a new rope pulley.

Screw or lash together two or three clothes props, according to the height of the mast, then drill two small holes below the V in the top



Replacing broken halyard or pulley.

prop. Next bend a length of hard-drawn copper wire and fix this wire in the two holes, then prepare the rope and noose and fix pulley rope in V of prop.

Everything is now ready, and all that is necessary is to lift the prop and lower the noose over the mast top and give one or two sharp tugs at the prop. The noose will then run tight and the wire will fall to the ground. —A. R. B.

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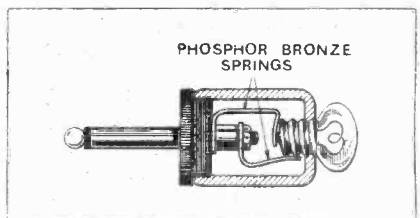
PANEL LIGHT.

The diagram shows a neat method of mounting a flash lamp bulb so that it may be plugged into the front of a receiver to illuminate the panel and tuning dials at night time.

An ordinary telephone jack is fitted to the front panel and the two contacts are connected to the filament supply circuit. The lamp itself is mounted in the ebonite cap of the telephone plug, the hole through which the telephone leads normally pass being enlarged for the purpose. Contact springs for making connection to the lamp are fitted to the terminals of the jack.

If a standard flash-lamp bulb rated at 3.5 volts is utilised, a small resistance depending upon the voltage of the L.T. battery must be connected in series with one of the leads to the telephone jack on the receiver



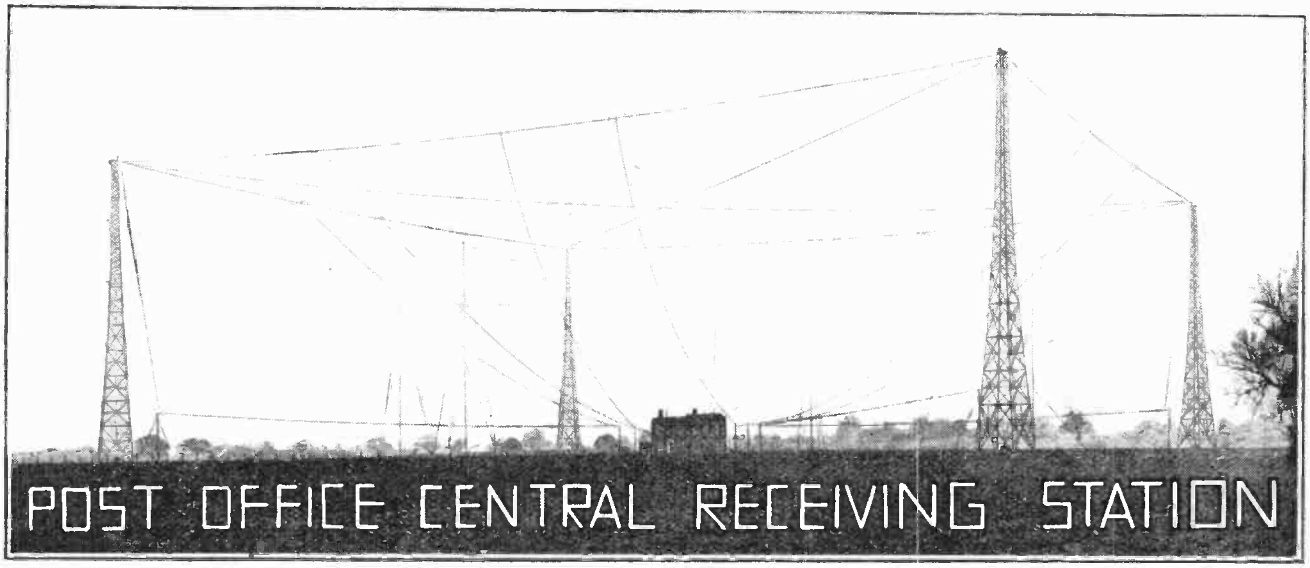
Plug-in lampholder for panel illumination.

panel. In the case of a 4-volt filament supply the resistance should have a value of 2 ohms and for a 6-volt supply 10 ohms will be required. Using No. 34 S.W.G. Eureka resistance wire, the 2-ohm resistance will be supplied by a length of 7in. and one yard will be required for the 10-ohm resistance.—W. P.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A dull emitter receiving valve will be despatched to every reader whose idea is accepted for publicaton.

Letters should be addressed to the Editor, "Wireless World and Radio Review," Dorset House, Tudor St., London, E.C.4, and marked "Ideas."



Aerials and Receiving Apparatus at the New St. Albans Station.

By L. J. JONES, A.M.I.E.E.

MODERN practice in commercial wireless telegraphic communication tends increasingly to localise manipulation services in populous centres where exist easy facilities for the collection and distribution of messages and to govern by remote control over telegraph land lines wireless transmitting and receiving points which may be some distance outside the town and situated far apart. This practice has long been followed by Marconi's Wireless Telegraph Co., Ltd., with its central manipulative station in Wilson Street in the heart of the city of London, whence are governed the several transmitters at Ongar, Essex, and to which point are carried the received signals from the wireless station at Brentwood.

The British Post Office also has for some years centralised the control of its wireless point-to-point service at the Central Telegraph Office, London, whence are governed the transmitting stations at Stonehaven, Northolt, Leafield, and recently Rugby. The corresponding reception has up till recently been carried out in a room situated on the roof of G.P.O. West, and the network of aerials radiating from that point must have frequently attracted the attention of the many passers-by in the street below.

Interference at the G.P.O.

Various reasons led to the transfer of the receiving services from G.P.O. West to a new station erected near St. Albans, Hertfordshire. One was the growth of services which, starting with one in 1921, has grown rapidly and promises even more rapid advancement. The main reason for the transfer, however, was the unsuitability of the site for carrying on an efficient radio receiving service. Those who have experienced the effects of screening and disturbances from electric light, etc., on their broadcast receivers will easily realise the difficulties of wireless reception in a building situated on top of the largest telegraph office in the world and screened in all directions by other high buildings. Only comparatively strong signals could be received, and high-speed recording could not be undertaken to the same extent as would be possible under more ideal conditions. Moreover, no advantage could be taken of modern methods of directional reception, which, as is well known, afford valuable assistance in the elimination of unwanted signals and to some extent atmospherics.

The choice of the site at St. Albans was governed by a number of considerations. The station had to be within a reasonable distance of London, as remote as possible from the wireless transmitting stations at Northolt, Ongar, and Kidbrook, and in a direction well served by telephone routes. The site finally chosen is an admirable one. It is situated about half a mile north of the main road between Hatfield and St. Albans, and is approximately three miles from the latter city. It stands slightly above the level of the surrounding country, which is moderately flat, and the site is an open one clear of trees.

The Aerial System.

A general view of the site is given in the title illustration. The shape is a square of 1,000ft. side. It will be seen that the main building occupies the centre of the site. The ground floor of the building is devoted chiefly to the power plant and batteries; the receiving apparatus occupies a room 40ft. long and 20ft. broad on the first floor. Around the building are grouped eight masts. The masts are arranged in two sets, each consisting of four masts occupying the corners of two concentric squares. The outer square is composed of four 200ft. high steel lattice self-supporting towers and the inner square of four 120ft. stayed steel tubular masts. The former were built by Messrs. Armstrong Construction Co., Ltd., and the latter by the Post Office Engineering Department. An excellent view of the lower part of one of the self-supporting towers is given in

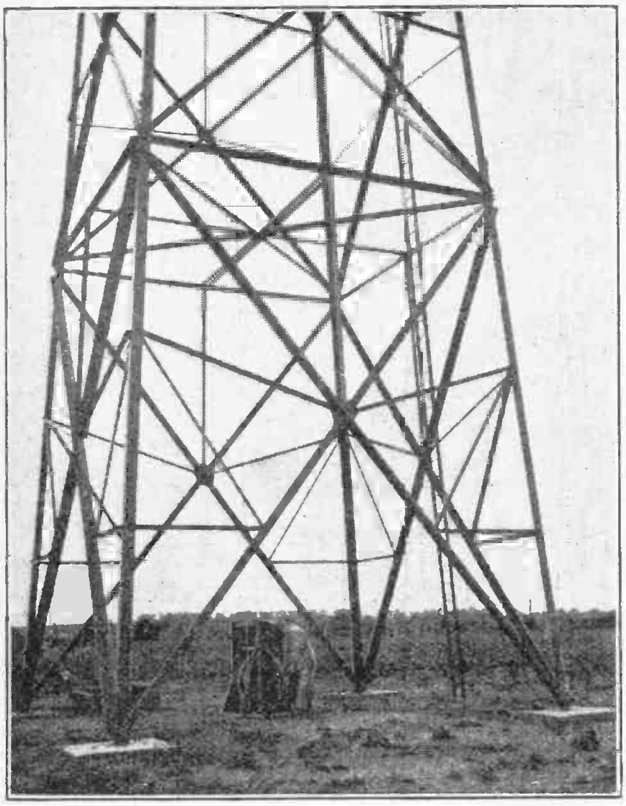


Fig. 1.—Base of 200ft. self-supporting mast, showing halyard winch.

Fig. 1. The construction is steel angle legs braced together by single- and double-angle bracings. The mast is 24ft. square at the base, and tapers to 4ft. square at the top. A platform at the top carries a cast-iron sheave over which passes the steel halyard for supporting one corner of the Bellini Tosi system.

Altogether twelve open aerials are led into the station in addition to the Bellini Tosi aerial system. Eight open aerials and the Bellini Tosi are carried by the 200ft. masts, and four open aerials by the 120ft. masts. They are all led into the receiving room *via* insulators fitted in ¾in. thick glass panels.

Every endeavour has been made to ensure a low-resistance wireless earth system insulated as far as possible to the point where the feeders actually enter the ground. Seventeen galvanised iron corrugated sheet plates 6ft. by 2ft. are buried vertically in the ground on the circumference of a circle of approximately 60ft. radius with the building as centre. The plates are connected by heavy stranded copper wire laid underground to solid copper strips 1½in. by ¼in., running up the outside walls of the building on three sides and entering the floor chases of the receiving room through porcelain tubes. The three leading-in earth strips are connected together in the floor chases by similar size strips to which are sweated all earth connections from the wireless sets. All the power feed and other cables in the chases are lead-covered, having all the lead sheaths connected together and sweated to the wireless earth.

In addition to the above there is an entirely separate land line telegraph earth; there is also a miscellaneous earth to which are connected the frames of all machines, electric light conduits, etc.

Power Plant.

Electric power for the charging of the low-tension and high-tension batteries is taken from the mains of the North Metropolitan Electric Power Supply Company, and enters the station in the form of three-phase alternating current at a pressure of 415 volts. Two filament batteries of 8 volts, each consisting of four 2,000 ampere-hour accumulators and two high-tension batteries of 200 volts each, tapped at 50, 100, and 150 volts, and consisting of 100 accumulators of 24 ampere-hour capacity, are provided. In addition, there are provided two 100-volt batteries, each of 24 ampere-hour capacity for land line purposes. The charging plant consists of two motor generators, each capable of delivering 300 amperes direct current at 8 to 12 volts for charging the filament batteries,

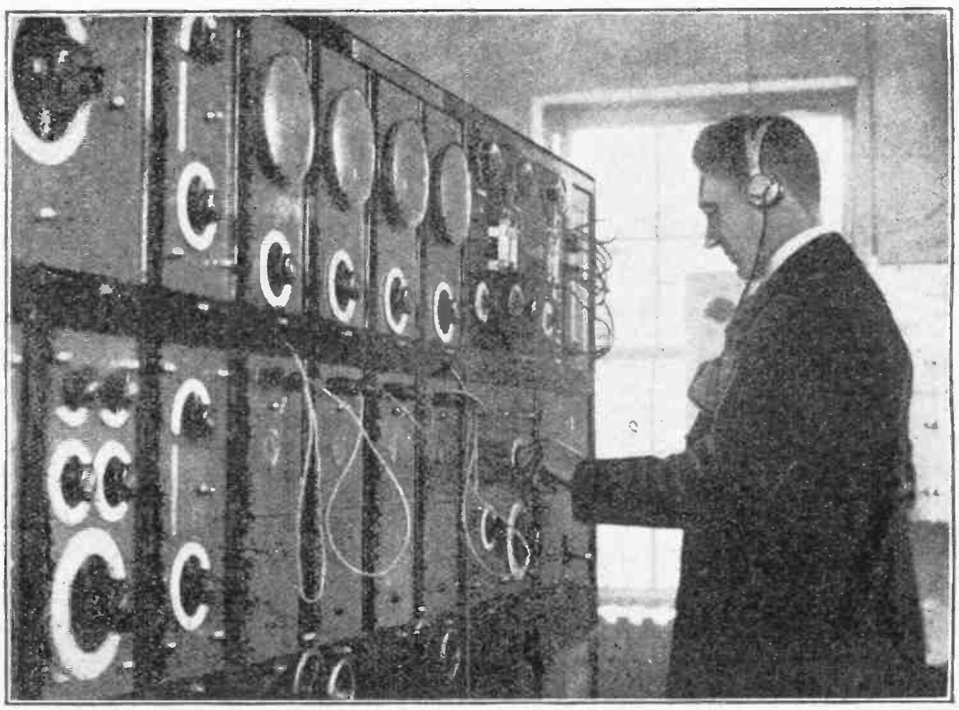


Fig. 2.—View of one of the low-range Marconi receivers.

Post Office Central Receiving Station.—

and two motor generators, each delivering 5 amperes at 100 to 140 volts for charging the H.T. and land line batteries, which are, of course, divided into 100-volt units for charging purposes. In addition to the above plant there is a motor-driven pump for raising water from a well to tanks on the roof of the building. A main switchboard in the power room on the ground floor controls all machines and the charging current to the batteries. Two auxiliary switchboards and distribution cabinets in the receiving room control the power supply to the receivers, etc.

The Receivers.

Twelve wireless receiving sets are at present installed in the station. Eight of these were supplied by the Marconi Company, and are of their usual commercial type, five for a wavelength range of 2,500 to 10,000 metres and three having a range of 6,000 to 30,000 metres. An open aerial is led to each set, but the Bellini Tosi aerial system is common to the eight sets. By means of suitable switching, reception can be carried out by open aerial alone (non-directional), Bellini Tosi system (figure-of-eight diagram) or a combination of open and frame aerials (cardioid reception). A view of one of the lower range sets is shown in Fig. 2. It will be seen that the set is built in units, each unit being carefully screened from its neighbours. On the left of the photograph are seen the aerial tuning units. Then follow :—

Two stages H.F. filter (no valves).

Three stages H.F. tuned and neutrodyned amplification.

One stage rectification (anode bend).

Four stages L.F. filter (tuned grids).

Three stages L.F. amplification.

One heterodyne unit.

One power panel controlling all L.T. and H.T. feeds and grid bias on the various valves.

Switching arrangements, of course, exist, by means of which one or more of the various filtering or amplifying stages can be used. The two handwheels shown in the lower part of the photograph control the selectivity of the low-frequency filter—in the one case by varying simultaneously all the valve couplings, and in the other case by simultaneously adding resistance to all the grid circuits.

The higher range Marconi sets only differ from the above in that two extra stages of H.F. filter are provided.

The overall dimensions of the lower range receivers are 8ft. 8in. by 2ft. 2½in. by 6ft. high, and the higher range 14ft. 3in. long by 2ft. 2½in. wide by 6ft. high.

Fig. 3 shows a view of one of the Post Office type receivers. These sets were built at the Dollis Hill Experimental station, and are not adapted for directional reception. They comprise the usual tuned aerial and tuned secondary circuits coupled together electrostatically. The tuning coils, however, are specially constructed to have an extremely low decrement, and are mounted external to the sets and screened one from the other in iron tanks of ample dimensions to prevent damping losses. These tanks are situated on the roof of the building immediately over their respective receivers. This type of set is constructed also in separately screened units of somewhat

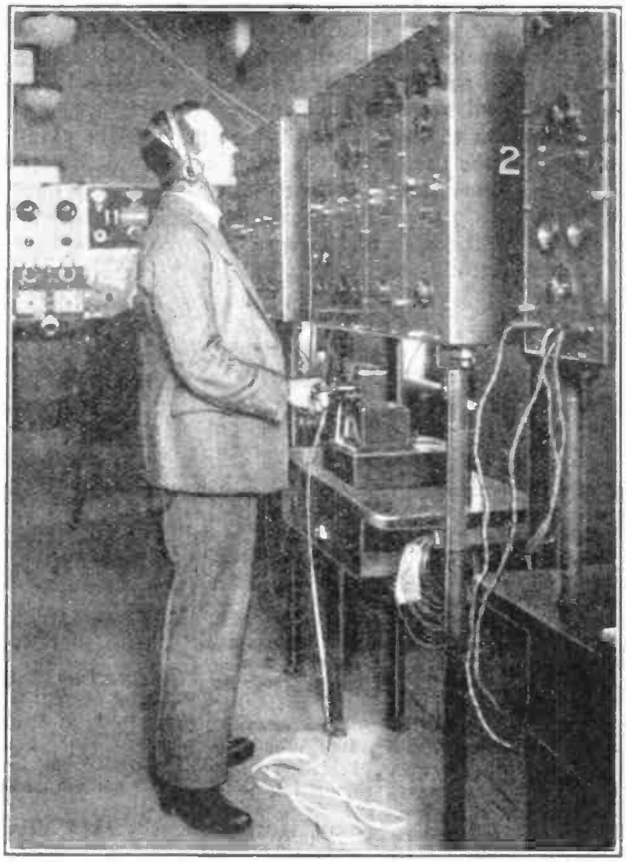


Fig. 3.—Post Office type receivers at St. Albans. The tuning coils are situated on the roof immediately above each receiver.

novel design, and comprise the following units in addition to the aerial tuning and coupling units :—

One detector stage (anode bend).

One low-frequency filter (tuned iron-cored inductance).

Two stages L.F. amplification.

One heterodyne unit (Negatron valve).

One extra stage L.F. amplification for Creed relay recording.

One control panel.

Facilities for re[illegible]ing wireless signals are provided on both the Marconi and Post Office sets. The former use the Marconi type Q.C.4 bridges, by means of which the signals are first amplified and then converted into double-current signals for working telegraph relays, while the latter employ Creed relays in the anode circuit of the final valve, and are worked by single-current impulses. Each of the Post Office sets has a Wheatstone receiver in leak, by means of which the recorded signals passing to line can be observed. The six Marconi type bridges are mounted together on a separate table; any Marconi receiver can be connected to any bridge, and any bridge can be connected to any land line by suitable switching arrangements.

Fourteen telephone loop circuits are provided between St. Albans Radio Station and the Central Telegraph Office, London. The aural signals are passed forward on

Post Office Central Receiving Station.—the loops in a manner similar to that employed for ordinary telephone conversations, and the recorded signals are superimposed across the loops, each leg of which is carefully balanced to avoid interference. In this system the current passes through both wires of the loop in parallel and returns *via* the earth. In addition, one loop is used with a telephone, and a common battery telegraph circuit superimposed to provide communication between St. Albans and the Central Telegraph Office for purposes of traffic control.

It might be thought that in a radio station of this nature, comprising a number of extremely sensitive wireless receivers concentrated comparatively closely together and delivering both aural and recorded signals, there would exist considerable risk of mutual interference. As a matter of fact, the services are remarkably clear, interference between the sets and between bridges, relays, etc., and the sets being practically negligible.

The station has been in operation since the middle of October, is giving excellent service, and has removed all the difficulties hitherto experienced at the G.P.O.

TRANSMITTERS' NOTES AND QUERIES

General Notes.

Mr. E. G. Ingram (G 6IZ), 8, Victoria Road, Aberdeen, is carrying out transmission tests on a wavelength of 23 metres and wishes to get into touch with some other amateur who will co-operate with him in these tests. He will also welcome reports of his transmissions from any listeners.

o o o o

Mr. S. Ridley (G 5NN), 106, Woodside Green, South Norwood, S.E.25, states that in addition to communicating with 15 American stations in two days, using a Burndept L525 valve and 4.8 watts to the anode, he has been heard in Winnipeg, Canada, at 7.50 a.m. (local time) on November 7th, on an indoor aerial at strength R4. This is stated to be the first British station heard in that town.

o o o o

Mr. F. Walker (G 5AX), Crowmarsh, Wallingford, Berks, tells us that on Saturday, November 20th, at 0045 G.M.T. he was in two-way communication with U 1AAO, Mr. H. H. Cooley, Newton Centre, Mass., using 1.5 watts input to a DE5 valve with Hertz antenna and a wavelength of 45 metres. U 1AAO reported his signals as R3 and suggested a reduction in power, so G 5AX dropped to 0.5 watt when his signals were reported as "readable in parts." Mr. Walker believes this to be the lowest power yet employed in two-way working over that distance. Later in the early morning C 3HE at Kingston, Ontario, reported his signals as R6.

o o o o

A correspondent in Thornton Heath, successfully received the Argentine station BG4 on one valve on September 3rd, at 2303 G.M.T. R BG4 was transmitting with an input of 8 watts and his signal strength at Thornton Heath was R3.

o o o o

Mr. M. S. Woodhams, 90, Railway Terrace, Rugby, states that he will be pleased to send reports to any transmitters who require them, of tests at any time during the day up to 2230 G.M.T. He also says that on Sunday, November 21st, he received the following stations on wavelengths between 35 and 45 metres:—23 American, 2 Canadian, and 1 Burmudan, at strengths between R5 and R6 on on O-v-1 receiver. The DX conditions seemed to him to be exceptionally favourable on that day and he asks if other readers concur.

o o o o

Mr. G. P. Ilardi (I 1DO), Via Savoia 84, Rome, Italy, whose experiments on low power we have noted in previous issues, tells us that during a few days in November he has been in touch with the following European amateurs, using only 2½ watts input D.C. (dry batteries):—G 6AI, L 1JW, B CH5, G 2SO, B S5, B 08, I 1CE, B V8, G 2OF, G 5W9, G 2RQ, B 1AJA, F 8CP, G 69H, GW 11Z. The wavelength used was 45-50 metres.

Mr. Ilardi, in his low power work, uses Hartley-Direct circuit with an Osram DE4 all-purpose receiving valve; H.T. supply 150 volts (dry batteries). His aerial is 30 metres long, twin wires, and 20 metres high above the street, but among buildings.

On the 45-metre band he has been reported R7 in Sussex, steady and easy to read. On 33 metres he was R6 at Glasgow, morning and evening, on *1 valve Reinartz receiver*, "clear, steady note, easy to read."

Mr. Ilardi is on the air every night at 2100 G.M.T. on 45 metres, 6 watts input A.C., and will be very glad to get in touch with British amateurs. Reports on his transmissions will be welcomed.

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Reception of American Broadcasting Stations.

A correspondent at Slough reports having received the following stations on an "Everyman's Four" receiver on Sunday, November 21st, between 1.0 a.m. and 4.30 a.m.:—WPG Atlantic City, WOK Homewood, Ill., WBBM Chicago, Ill., WIOD Miami, Florida, WORD Chicago, Ill., WMAK Lockport, N.Y., WSWS Wooddale, Ill., KDKA East Pittsburgh, Pa. (messages for the North), WGY Schenectady, WLS Crete, Ill. The reception was very satisfactory on a loudspeaker.

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Another correspondent at Hammersmith, on the same date, heard U 2XAF on 32.79 metres on a 2-valve short wave receiver. Speech was clear and easily readable.

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A third correspondent in Aberdeen heard U 2XG testing at 1130 G.M.T. Telephony was received well at R7 to R8 on 2 valves, the wavelength being 22.5 metres.

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Military Experimental Stations in Finland.

We are indebted to Major B. Petrelius, the Chief of the Radio Laboratory at Helsingfors, for the following list of military experimental stations:—

SPM	Radiolaboratorio, Albertink 40, Helsingfors.
SPMA	Radiolaboratorio, Albertink 40, Helsingfors.
SPMB	Radiolaboratorio, Albertink 40, Helsingfors.
SPMC	Radiolaboratorio, Albertink 40, Helsingfors.
SPR	Radiopataljoona, Santahamina, Helsingfors.
SPJ	Ilmailuvoimat, Santahamina, Helsingfors.
PL	Laivaston Esikunta, Katajanokka, Helsingfors.
SPS	Suojelusk, Yliesikunta, Fabianink 25, Helsingfors.
SPSA	Suojelusk, Yliesikunta, Fabianink 25, Helsingfors.
SPSB	Suojelusk, Yliesikunta, Fabianink 25, Helsingfors.
SPSC	Suojelusk, Yliesikunta, Fabianink 25, Helsingfors.

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New Call-signs Allotted and Stations Identified.

G 5JA	J. Porter, 61, Brudenell Road, Hyde Park, Leeds. (Transmits on 90 metres).
G 5DP	Whitgift School Scientific Society, Whitgift School, North End, Croydon. (Transmits on 45 metres and will welcome reports).
G 6FD	F. E. Dominey, 19, Shooters Hill, Cowes, I. of W. (This call-sign was formerly held by Mr. F. T. Carter at Streatham, S.W.16).
G 2ASK	(Ex 6AI.) H. Andrews, Ystradgynlais, Swansea.
G 2BBJ	Caulfield & Stewart, East Putney, S.W.15.
F 8LA	A. Wigniolle, 27, rue Jean Gony, Douai (Nord).
F 8LC	J. Scalabre, 37, rue des Carliers, Tourcoing (Nord).

QRA'S WANTED.

G 5OH G 6LH, FFQ, KELLA, UF 3DD, UF 2AU.

A Section Devoted to the Practical Assistance of the Beginner.

MODIFYING THE "EVERYMAN THREE."

The "Everyman Three" receiver, and others using a similar circuit, may be "loaded" for the reception of Daventry in the same way as the "Two Range Everyman's Four." The alterations are simple, merely involving the fitting of a coil at the low-potential end of the H.F. transformer secondary; the aerial is transferred to the grid end of this extra inductance. For work on the normal broadcast waveband, for which the set is primarily designed, the aerial is connected in its usual position, and the loading coil is short-circuited by means of a switch. The circuit diagram is given in Fig. 1.

It should be realised that the H.F. amplifying valve is completely eliminated on the long-wave adjustment, and, moreover, that reaction is only obtainable, at the expense of considerable complication. In the case of the three-valve set, therefore, the loud-speaker range from Daventry will be restricted, and, except under exceptionally favourable conditions, is unlikely to exceed 70 or 80 miles.

It will be obvious that, with the long-wave connection, the circuit becomes practically a direct-coupled one (the aerial-earth circuit is actually connected across the greater part of the total inductance), so a high degree of selectivity must not be expected. Should interference be experienced from a local transmitter on the broadcast waveband, the set may be improved in this respect by inserting a small fixed condenser of 0.0002 or 0.0003 mfd. in series with the aerial.

If a standard type of plug-in coil is used for loading purposes, one of 150 or 200 turns will be necessary, the actual size depending on the constants of the aerial. The larger size will always be required when a series condenser is inserted.

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CHARGING AN H.T. ACCUMULATOR.

When arranging to charge an H.T. battery from D.C. mains, allowance should be made for the "back voltage" of the battery itself, which is acting in opposition to the source of charging pressure. Taking the case of a 120-volt battery which is to be charged at 0.25 amp. from a 240-volt supply, it is necessary, in order to find the voltage available for driving current through the cells and the resistance which will be required, to subtract the voltage of the battery from that of the mains. This leaves 120 volts, and the value of the resistance (in ohms) is then ascertained by dividing this voltage by the charging current (in amperes), the actual figures here being

$$120 \div 0.25 = 480 \text{ ohms.}$$

The internal resistance of the cells has been ignored, as has the fact that the back-voltage may be considerably less than 120 volts at the commencement of a charge, and considerably more towards the end of it. In practice, however, there is generally little need to take these complications into account, although, if desired, a resistance with a slightly higher maximum value, and a few tappings may be constructed. This may be wound with No. 30 S.W.G. Eureka wire, which has a resistance of 5.5 ohms per yard, and will carry a quarter of an ampere without an undue rise in temperature.

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FIXING PANEL COMPONENTS.

Terminals mounted on ebonite have a tendency to work loose after a time unless particular care is taken in fitting them. The trouble may be largely overcome by tapping the holes in which they are to be inserted, but many amateurs lack the necessary equipment for carrying out this operation, and will find the alternative suggested in Fig. 2 (B) equally or more effective.

The drawing is almost self-explanatory; three or four projections are raised around the part of the terminals which normally bears on the panel by means of a small cold chisel

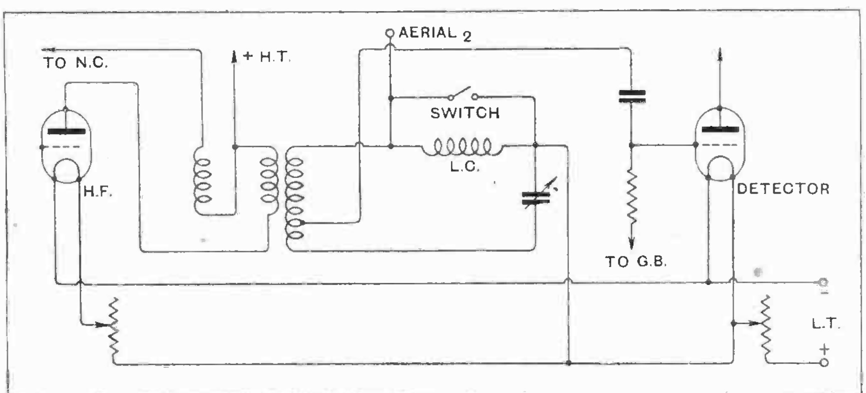


Fig. 1.—Connections of a long-wave loading coil.

or similar tool, which is held at an angle of about 45 degrees. It will be found that quite a small projection is sufficient to engage firmly with the comparatively soft material of the panel, so there is no need to spoil the appearance of the terminal by making deep cuts.

Such components as brass clips for mounting grid leaks, crystal detectors, and interchangeable condensers, will also work loose if their seating on the panel is perfectly flat, and it is recommended that their tips should be turned down as shown in Fig. 2 (A). The points thus formed will, of course, penetrate into the ebonite, and the clip will be firmly secured in position. Thin metal may be bent with a pair of pliers, or the corners may be laid on the edge of a

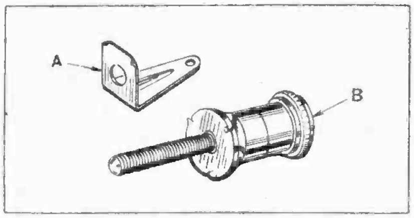


Fig. 2—Preparing clips and terminals for panel mounting.

small anvil and tapped into shape with a hammer.

"Pits" with raised sharp edges which will engage with ebonite can be made in fittings of heavier metal by using a centre punch, held slightly away from the vertical when it is struck with the hammer.

ACCUMULATOR ACID.

Those who are unused to handling accumulators may not be aware of the fact that dilute sulphuric acid will seriously damage any fabric, either woollen or cotton, with which it may come into contact. When there is any risk of spilling the electrolyte, it is as well to have ready a small quantity of some strong alkaline solution, such as ammonia, which, if applied in time, will prevent any harm being done.

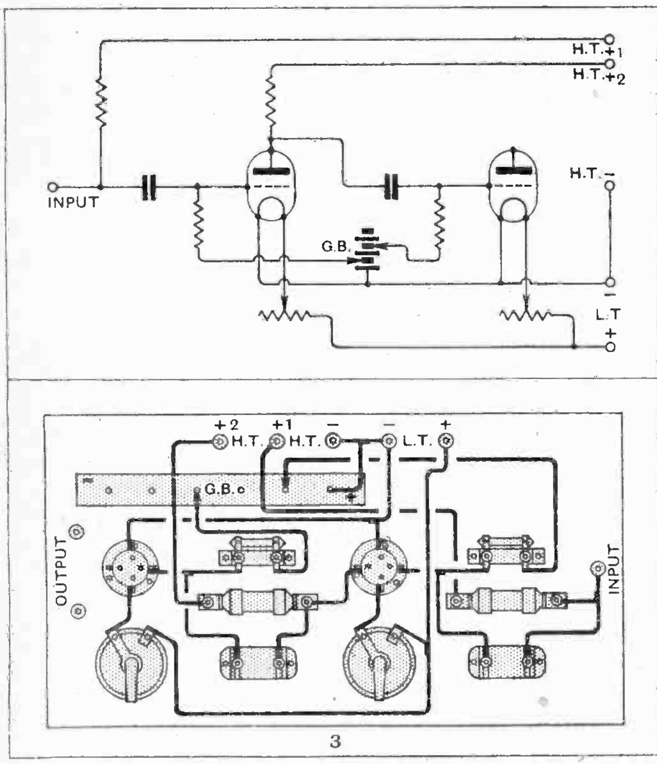
DISSECTED DIAGRAMS.

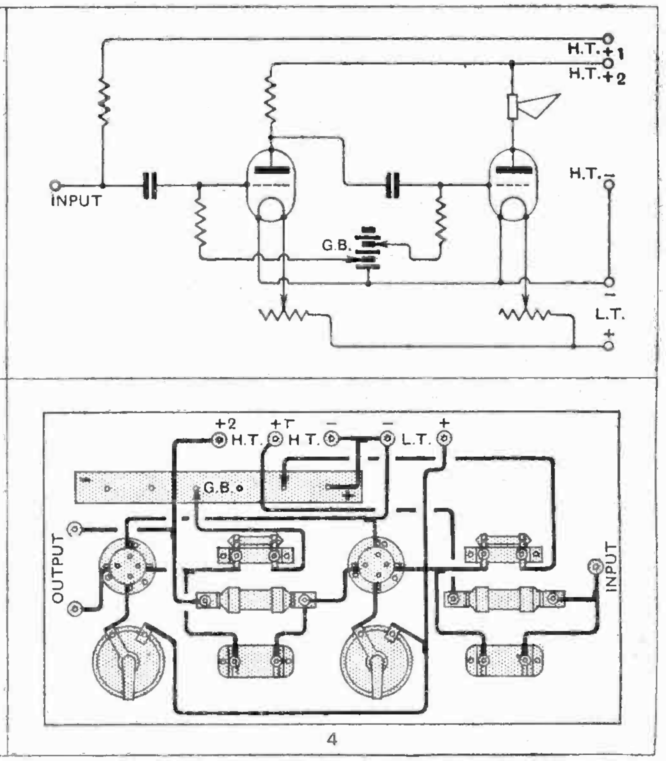
Step-by-step Wiring in Theory and Practice.

No. 50 (b).—A Two-valve Resistance-coupled Amplifier.

(Concluded from last week's issue.)

In this series of diagrams it is hoped to make clear the steps to be taken in converting theory into practice in the construction of various typical wireless instruments. The amplifier shown below is suitable for adding to a valve detector, with or without H.F. amplification; the plate of this detector is joined to the input terminal. Unless common batteries are used for receiver and amplifier, an extra connection will be necessary between the negative L.T. terminals of each.





The anode circuit of the first L.F. valve is completed through a resistance and the H.T. battery. Voltages set up across this resistance are passed to the grid of the second valve through a condenser. Negative bias is applied to its grid through the leak resistance.

The loud-speaker is inserted in series with the anode of the output valve, thus completing the amplifier. The values of the coupling components will depend on the characteristics of the valves. Such refinements as H.T. by-pass condensers are omitted, to avoid complicating the drawings.

MORE CHRISTMAS NOVELTIES.

Further Applications of the Revolving Disc Illusion, and some Additional Experiments.

By A. P. CASTELLAIN, B.Sc., A.C.G.I., D.I.C.

IN this short article the writer proposes to put forward a few suggestions for Christmas decoration, and also a further stunt and a more elaborate form of one of those described last week.

Dealing with the last-mentioned item first, the one referred to is that entitled "Seeing is Believing." General instructions as to the type of double contact cam required were given last week, but it cannot be too strongly emphasised that on the correct shaping of this cam depends the complete success of the double illumination stunts, such as "putting the canary in the cage," as described last week.

The ideal to be aimed at in these experiments is to obtain illumination of the rotating disc for a very small fraction of time indeed, so that the disc has not moved appreciably during the time it is illuminated. If the disc *does* move appreciably when illuminated, any picture on the disc will appear blurred, so that the contact closing the circuit of the neon lamps in the magic box must operate for a very small fraction of time twice for each revolution of the disc.

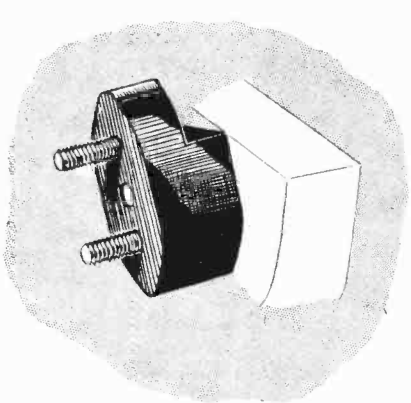


Fig. 1.—Double contact cam giving best results with the revolving disc illusion.

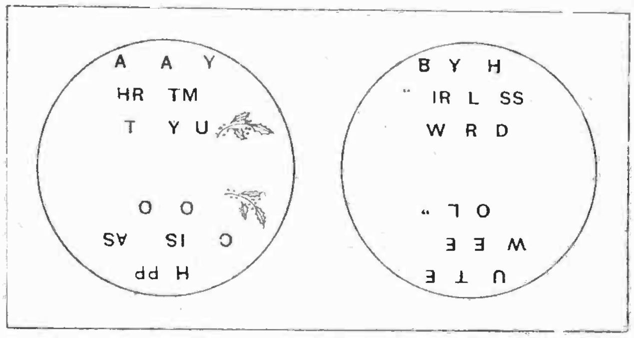
If only single contacts are used, as suggested in the previous article, the cam must be made of conducting material, such as brass, but if double contacts are used, then the cam may be made of some such material as ebonite.

Constructing the Cam.

Although there is no absolute necessity to use the double contacts some readers may find it interesting to experiment with both methods. The shape of the ebonite cam for the double contact method is shown in Fig. 1, and the main point to notice is that the ends of the double contact cam are exactly similar and "sharp." By mounting two 6BA screws as shown, hte cams may be made to take the disc, which is then held in position by means of two 6BA nuts.

Besides the canary and the cage disc many others with broken up sentences may be made—the sentence only becoming intelligible when the disc is illuminated twice per revolution, and not being intelligible when stationary.

When making these sentences on the disc care should be taken in marking out the letters so that when the two halves of the disc are superimposed (which is the effect given by the double illumination per revolution) the letters appear uniformly spaced in the words. A disc which will give the words "A Happy Xmas to You" is shown in Fig. 2 (*a*). A few sketches of holly leaves or other decorations scattered about on the disc will help to bewilder anyone who tries to decipher the meaning of the mystic signs on the disc when it is stationary. A further suggestion for a disc is given in Fig. 2 (*b*).



(a) (b)

Fig. 2.—Suggested arrangement of lettering for the revolving disc illusion.

This is an amusing stunt, as it is not until the rotating disc is illuminated by the *Magic Light* that any sense can be made out of it at all. One word of advice—make the letters nice and thick and black, and do not try to make the diameter of the disc too large, or the outside edge will probably have moved during the contact period. About six inches diameter is quite sufficient for most purposes—and do not forget to illuminate the top half of the disc only.

Christmas Lighting Decorations.

For those who like pretty effects in lighting for festive occasions, the following suggestions may perhaps be useful. When a 200-220 volt house supply is available, neon lamps—or Osglim lamps as they are called commercially, made by the General Electric Co.—offer quite an unusual decoration, since they may be obtained with electrodes in the form of letters, bee-hives, or stars, and since the current consumed is so very small they are economical to run. Fig. 3 (*a*) shows the connections.

Another form of decoration is given by Geissler tubes run from a small sparking coil such as many readers no doubt possess. These tubes contain two electrodes and

More Christmas Novelties.—
are filled with rarified gas which glows when suitable voltages are applied to the electrodes, the colour of the glow depending on the gas. Sometimes these tubes are double, the outside being filled with some liquid which fluoresces when the gas glows, and really beautiful effects may be achieved. These tubes are obtainable from the

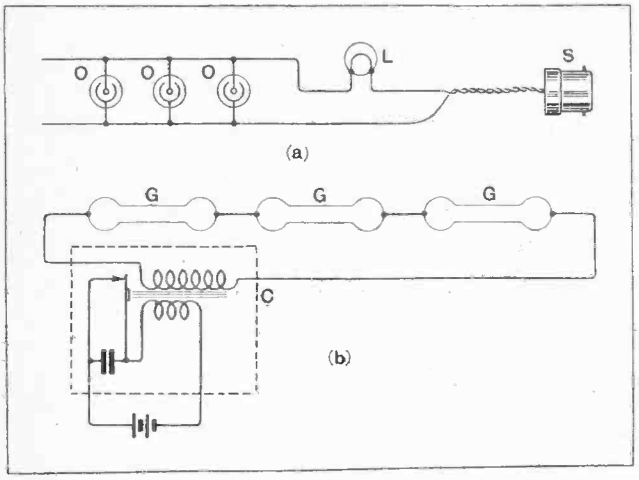


Fig. 3.—Suggested connections for decorative neon lamps and Geissler tubes. In circuit (a), O=Osglim lamp, L=safety lamp, S=lamp socket; in circuit (b), G=Geissler tube, C=spark coil.

Economic Electric Co., Euston Road, London, or from any large store or electrical dealer, and are quite moderate in price. The connections for these tubes are shown in Fig. 3 (*b*). The bigger the coil the more tubes may be run in series, but the writer strongly advises hanging the tubes well out of reach to prevent any trouble due to shocks. A ¼in. spark coil will light as many tubes as is usually required.

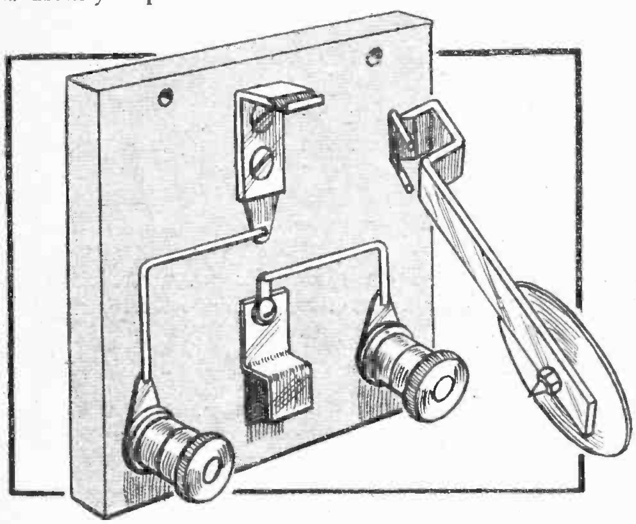


Fig. 4.—Construction of the "dancing contact."

The Dancing Contact.

This stunt has many applications, most of which will be left to the reader. The piece of apparatus to be described will open or close an electrical circuit *once* when shouted at, or even when somebody walks near it, and

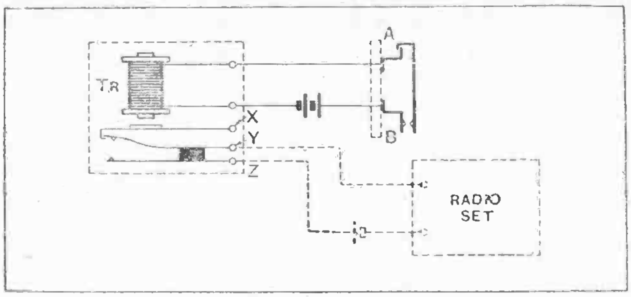


Fig. 5.—Connections of the "dancing contact" and relay.

the method of operation is as follows: A piece of brass is suspended on a knife edge as shown in Fig. 4, and a disc attached to it. Being freely suspended, the piece of brass will swing backwards and forwards when spoken to from quite near or shouted at from a little distance. Just behind the bottom of this piece of brass is another springy piece of brass to form a contact, and this contact is mounted so as to be as close as possible to the brass strip carrying the disc.

Thus if the disc is spoken to sufficiently loudly, contact will be made between the pieces of brass, thus com-

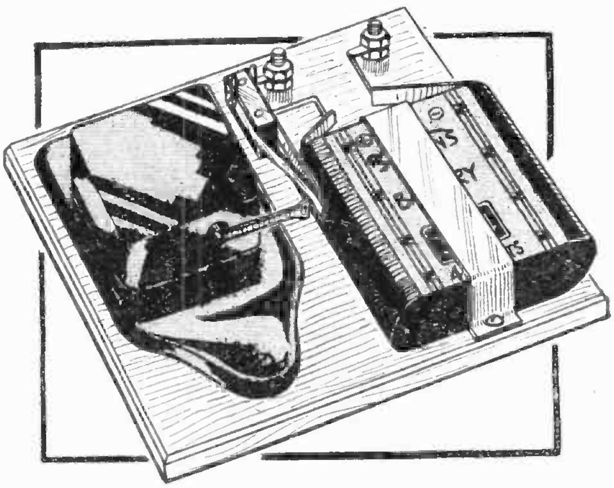


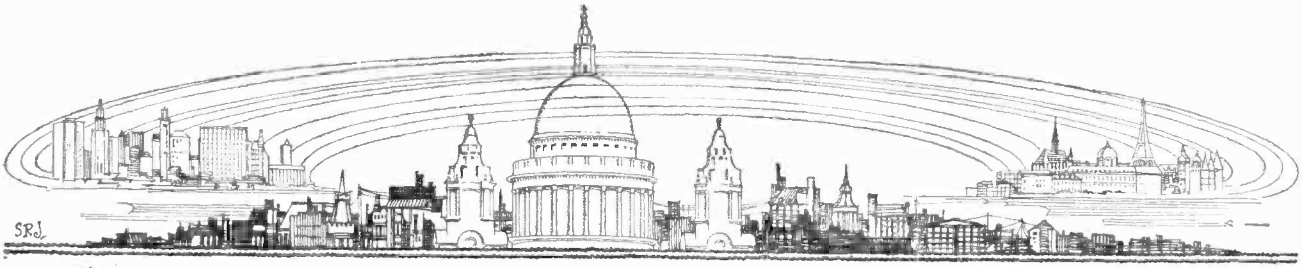
Fig. 6.—Bell movement fitted with special contacts for use as relay.

pleting the circuit between the terminals. Terminals A and B are connected as shown in Fig. 5 to a battery and trip relay made from an electric bell, so that when the disc is spoken to the trip relay is operated, the circuit between X and Y broken, and the circuit between Y and Z completed.

Automatic Switch for a Set.

A suggested application of the dancing contact and trip relay is shown in Fig. 5, namely, the automatic switching on of a radio set at the word of command. Other applications—for example, the control of lights—will be left to the reader.

Constructional details of the trip relay are given in Fig. 6, from which all information may be obtained. The trip relay must, of course, be reset each time it has operated, so that in the case illustrated the radio set will stay on until this is done.



CURRENT TOPICS

Events of the Week in Brief Review.

ALPINE WIRELESS.

Mountaineering huts in the Bavarian Alps are to be provided with wireless for meteorological and rescue purposes.

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MARCONI AT THE VATICAN.

In a private audience granted to him by the Pope, Senatore Marconi has been presented with a gold medal in token of his achievements.

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AMPLIFIERS FOR DEAF CHURCHGOERS.

For the benefit of deaf members of the congregation, the Ablewell Wesley Church, Walsall, has been equipped with a pulpit microphone and amplifiers. The front pews are equipped with earphones.

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LICENCE FOR A LEPER.

A member of the "leper" colony on an island near New Bedford, Massachusetts, has been granted an amateur transmitting licence by the U.S. Naval Wireless Department. His name is Archibald Thomas. The radio inspector conducted the necessary examination over the ordinary wire telephone.

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PHOTOTELEGRAPHY DESCRIBED.

A public lecture and demonstration of the Thorne Baker system of wireless phototelegraphy will be given by the inventor, Mr. T. Thorne Baker, F.Inst.P., F.R.P.S., at the Albert Hall, Leeds, on Friday, December 17th, at 7.30 p.m. Seats may be reserved on application to the Wireless Editor, "Yorkshire Evening News," Leeds. All seats are free.

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WIRELESS AMPLIFIERS FOR RECORDING.

With the aid of wireless amplifiers, a performance by the artists of Charlot's Revue in the Prince of Wales's Theatre was recently recorded by the Columbia Company at Petty France, Westminster. By arrangement with the Post Office, a land line was run from a microphone on the stage to the company's recording station. Ten seconds after the completion of the singing the record was played back from the wax master, two miles away, through a loud-speaker in the theatre.

OUR IMAGINATIVE CONTEMPORARIES.

"On November 30th . . . Aberdeen will send Daventry pipe music."—Provincial Paper.

The transmission must have stirred up memories of the dear old Daventry haggis.

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LICENCES IN AUSTRALIA.

During September 19,530 broadcast receiving licences were issued in Australia, bringing the total to 165,436. New South Wales and Victoria accounted for 44,962 and 83,077 respectively.

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BROADCASTING FROM A PRISON.

The broadcasting station of Cork is to be installed in a disused gaol. The use of this building will foster a cheerful spirit among listeners, who will enjoy the comforting reflection that they are outside it.

WIRELESS IN JEWISH HOSPITAL.

The Jews' Hospital and Home for Incurables at Tottenham has been equipped with wireless under *The Daily News* Fund.

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"WIRELESS WORLD" LECTURE IN GLASGOW.

Readers in the Glasgow district will be interested in the announcement on the next page regarding a lecture, under the auspices of *The Wireless World*, to be delivered by Dr. N. W. McLachlan, M.I.E.E., on Saturday next, December 11th, at the McLellan Galleries. Dr. McLachlan, whose contributions on various aspects of wireless have been a feature of *The Wireless World* for many years, will lecture on and demonstrate "Quality in Broadcast Reception." The lecture discusses the causes of bad quality and explains how to obtain the best results. The demonstration is an example of wireless reproduction at its best.

WIRELESS IN NORTHERN SNOWS. A seasonable photograph, taken in the Rondane Valley of Northern Norway, where many humble dwellings are now equipped with broadcast receivers. The district is practically isolated for many months of the year and wireless has come as a boon to the inhabitants.

whilst the disastrous effect which results from errors in the selection of valves, unsuitable voltages and so forth is practically illustrated.

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RADIO AND RUM.

In the new rum blockade instituted by the U.S. Customs, every liquor-laden vessel leaving a Canadian or Mexican harbour is reported by wireless to coastguard officials, who can thus restrict their range of search to the vessels which are suspect.

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AMERICA'S WIRELESS FUTURE.

A problem confronting the U.S. Senate this winter is that of deciding who shall control and regulate wireless—the Department of Commerce, or a new federal radio commission. The "White Bill" is in favour of the former, while the latter is championed by the "Dill Bill." Political opinion is fairly evenly divided on the matter.

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AN IMPORTANT LICENCE QUESTION.

From remarks made by the Assistant Postmaster-General, Viscount Wolmer, in the House of Commons, on Thursday, November 18th, a widespread impression was created that persons having more than one receiving set were expected to take out a licence for each. In view of a contradictory statement made by Viscount Wolmer in the House of Commons in July last, *The Wireless World* immediately communicated with the General Post Office, and on November 28th received a reply from the Secretary's Department, the following being an extract :—

"A wireless receiving licence entitles the licensee to use wireless receiving apparatus in the premises occupied by him—the address of which is given on the face of the licence—but any part of the same house or premises sublet to other occupiers is not covered by that licence.

"One licence will cover any number of sets installed in the same premises for the use of the licensee, his family, or his servants."

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NORWEGIAN PICTURE TRANSMISSION.

It is claimed that the problem of broadcasting pictures has been solved in practice by Mr. Hermod Petersen, chief engineer of the Norwegian Telegraph Department. Successful experiments, says an Oslo message, were carried out last week, when listeners supplied with specially prepared paper were able to receive scenes transmitted from the local station. The inventor claims that his picture-receiving device can be attached to crystal sets.

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BEAM RUMOUR CONTRADICTED.

The rumour which received publicity last week to the effect that all the Marconi transmitting stations in Britain are to be converted to the beam system is denied by the Marconi Company. In an interview with an official of the company, a *Wireless World* representative was informed that a transmitting station such as Ongar serves a more useful purpose by communicating to different points than could a beam station, the output of which is limited to one direction.

The Marconi Company is proceeding with the erection of its own beam stations at Dorchester and Somerton for communication with North and South America. When the New York beam station is erected, it is possible that the Carnarvon station will be converted to the beam system.

"WIRELESS WORLD" LECTURE IN GLASGOW.

Under the auspices of *The Wireless World* a Lecture will be delivered by Dr. N W. McLachlan, M.I.E.E., on

"Quality in Broadcast Reception"

(with Demonstrations), at The McLellan Galleries, Sauchiehall Street, Glasgow, on Saturday, Dec. 11th, 1926, at 8 p.m.

Chairman : Prof. G. W. O. Howe, D.Sc., M.I.E.E.,

Professor of Electrical Engineering, Glasgow University.

(Admission Free by Ticket. Doors open at 7.30.)

Tickets are obtainable from the Hon. Secretary, Glasgow and District Radio Society, 620, Eglington Street, Glasgow, and 27, Moray Avenue, Scotstoun; also from the following Wireless Dealers in Glasgow :—

Siemens Bros. & Co., Ltd., 144, St. Vincent St.
Forbes Bros. Ltd., 50, Sauchiehall Street.
Brown & Co., 116-118, West Nile Street.
Robert Ballantine, 103½, St. Vincent Street.
James R. Hunter, 73, West Nile Street.
Jones & Stewart, 247A, St. Vincent Street.
Clydesdale Supply Co., 2, Bridge Street.
Youngs (Glasgow) Ltd., 40, Stockwell Street.
Burndept Dept., 93, Holm Street.
Robb Bros., Radio House, 69A, West Nile St.
William Harper & Co., 132, Bothwell Street.
Houghtons Ltd., 70-78, York Street.
The Silvertown Co., 15, Royal Exchange Sq.
Marconi Marine Communication Co. 29, St. Vincent Place.
E. A. Wood, 77, Gallowgate.
Exide Battery Service, 40, Tureen Street, Gallowgate.
W. & A. Smith (Glasgow) Ltd., 236, Argyle St.
F. Austin Biggs, 16, Renfrew Court, C.2.
The Radio Mart, 11, Bath Street.
E Pollock Argyle Street.

PARLIAMENTARY CHESS BY WIRELESS

A chess match by wireless between members of the British and Australian Parliaments has been arranged for next May. The match is to celebrate the opening of Canberra as the capital of the Dominion. Two consecutive days will probably be occupied, giving twelve hours at the board, or 52½ moves per player. The Postmaster-General is sympathetic towards the project.

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A QUESTION OF IDENTITY.

By an unfortunate error, the portraits of Messrs. R. J. Venner and S. G. Archer appearing on p. 36 of the December "Listener" were reversed.

CABLE V. BEAM.

Controversy is raging in Sydney over the speeds attainable by the new duplicated Pacific cable as compared with the beam system. Mr. J. A. J. Hunter, of the House of Representatives, stated the cable was capable of 1,000 letters per minute, contrasting this with the 500 letters by the beam radio from London to Montreal. Mr. E. T. Fisk, of the Amalgamated Wireless (Australasia), Ltd., retorts that the guaranteed capacity of the beam service is double Mr. Hunter's figure, and that in actual practice an average working speed of 1,200 letters a day has been accomplished.

Meanwhile, the public hope that the contending interests will show the same spirit of rivalry in reducing telegram costs!

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GOVERNMENT DISPOSES OF EGYPTIAN STATION.

The Abu Zabal wireless station, near Cairo, which was originally built by the British Government as one of the links in the Imperial Wireless Chain, has been taken over by the newly formed Marconi Radiotelegraph Company of Egypt. The Abu Zabal station was the link between the Leafield station and Karachi, but the erection of the Rugby station and the changes in the Imperial scheme have rendered it of less importance to British wireless development.

BOOKS RECEIVED.

"Aide - Mémoire - Formulaire de la T.S.F." Edition 1926. Comprising useful articles, notes and data on wireless subjects, including the theory and practice of transmitters, receivers, radiotelephony, etc., with a chapter on testing, descriptions of typical transmitting stations, and articles on time-signals, weather reports, wireless control of distant mechanism, and a summary of the wireless regulations at present in force in France. Compiled by E. Pacoret and published by Albert Blanchard, Paris, price 32 fcs.

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"International List of Radiotelegraphic Stations." Published by the International Office of the Telegraph Union, Berne, 11th edition, dated July, 1926. The well-known "Berne List," giving the name, geographical position, call-sign, normal range, system, wavelengths, nature of service, hours of service and coast charges of all commercial and Government land stations in the world and similar particulars of ship stations of every nationality, with table of inland rates, limitropic rates, etc. pp. 449+4. Price (including monthly supplements up to the end of October, 1927), 13 francs (Swiss), post free.

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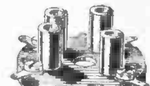
"La Radiotranmissione Delle Immagini," by Ugo Guerra. A general description of various systems of transmission of photographs, etc., by wireless, pp. 239 with 107 illustrations and diagrams. Published by Chierchia e Magiorotti, Rome, price 16.50 lire.

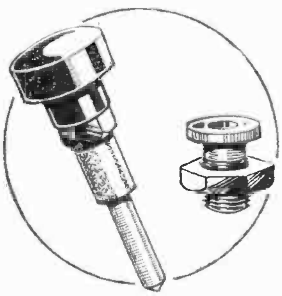
MANUFACTURERS' NEW APPARATUS



A Review of the Latest Products of the Manufacturers.

AN INEXPENSIVE VERNIER ADJUSTMENT.

One of the simplest and yet quite reliable methods for obtaining critical adjustment of an instrument dial is by means of a small rubber-faced spindle engaging on the edge of the dial. The reduction ratio thus obtained is not excessive, and yet is sufficient to permit of critical control.



The M.A.P. Verni-Nob for providing critical dial control. It consists of a rubber faced spindle which can be withdrawn from its bush so as to disengage the instrument dial.

A very simple device of this type, and one which sells for only a few pence, can be obtained from the M.A.P. Company, 246, Great Lister Street, Birmingham. It is easy to fit, a ¼in. hole only being necessary to accommodate a brass bush.

o o o o

500,000 OHM RESISTANCES.

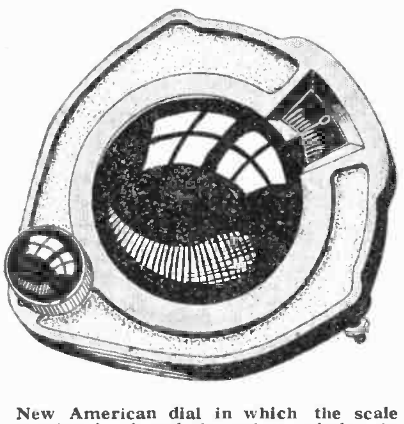
In reply to a query in a recent issue of this journal in which a reader enquired as to why two 1 megohm resistances were connected in parallel in the anode circuit of the "Everyman-Four" receiver to produce a resistance of 500,000 ohms, it was explained that this was deemed expedient in the absence of a wire-wound resistance to ensure the avoidance of noises being developed owing to inadequate current-carrying capacity.

Many readers will be interested to learn, therefore, that a Varley wire-wound anode resistance having a value of 500,000 ohms is now available and can be obtained from Oliver Pell Control, Ltd., Granville House, Arundel Street, London, W.C.2.

THE KURZ KASCH GEARED DIAL.

The trend is to simplify the construction of geared dials rather than to aim at obtaining improved operation by complicating the design. Some of the best dials are assembled from surprisingly few component parts, and the new Kurz Kasch dial, obtainable in this country from the Rothermel Radio Corporation of Great Britain, Ltd., 24-26, Maddox Street, Regent Street, London, W.1, is remarkable for its simplicity of construction.

A condenser dial normally rotates through 180 degrees, although in this instance two 0 to 100 scales are set out, each occupying half the circumference, though increasing numerically in opposite directions. By this means the dial is suitable



New American dial in which the scale reading is viewed through a window in a cleanly moulded Bakelite cover.

for use with condensers where the capacity increase is brought about by either clockwise or anti-clockwise rotation. Used with a straight line frequency condenser, moreover, the scale rotation can be arranged to decrease as the capacity is increased, so as to serve as an indication of frequency.

The circular dial is securely attached to the condenser spindle by means of an expanding collet, and is locked in position by tightening a single nut, a form of fixing which can be relied upon when the condenser is to be calibrated, and where any slip between shaft and dial would render the scale inaccurate. The dial rotates under a cover which is attached to the panel by means of two small bolts, and although the bearing for the operating knob is supported by the cover plate, a smooth movement will be obtained in spite of any minor error in the setting out of the positions for the fixing holes. The drive is through a single grooved wheel pressed hard in position by means of a bronze spring giving a positive movement without backlash.

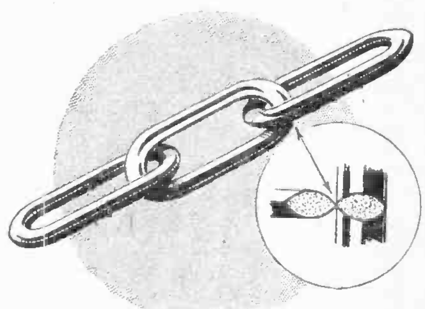
The mouldings are of Bakelite, and possess a good bright finish, the scale being clearly marked with a sharpness equal to that of engraving.

o o o o

LOW LEAKAGE AERIAL INSULATOR.

A novel form of construction has been adopted in the new Link Insulator, a product of Mouldensite, Ltd., Darley Dale, Derbyshire.

By using three insulating links surface leakage is practically eliminated, owing to the very small area of contact between the links. Movement of the links one upon the other, moreover, has the effect



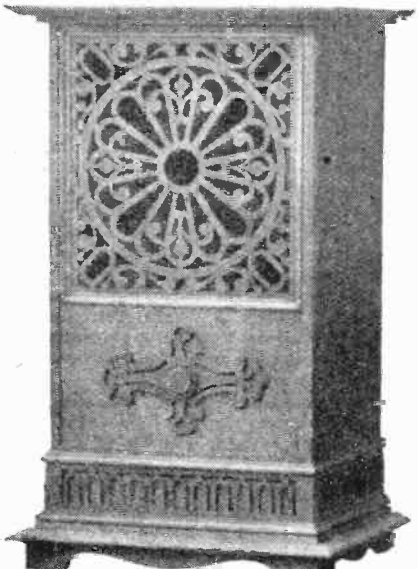
Mouldensite link insulator. Good insulation is maintained by providing only small surface contact between the links.

of keeping the contact surfaces clean. Overall the insulator is some 7½in. in length, which, combined with its open construction, gives rise to negligible dielectric loss, and presents an exceedingly low capacity between the end of the aerial wire and the halyard.

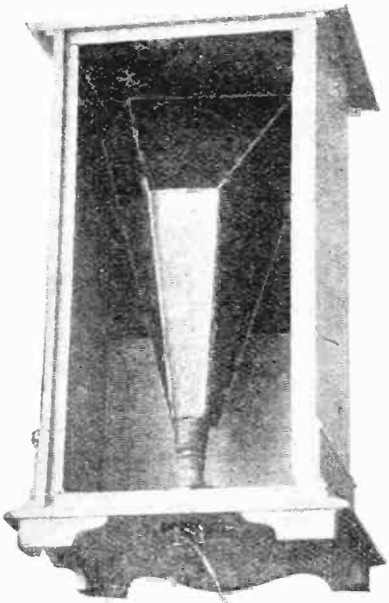
The links are of Mouldensite, which possesses considerable mechanical strength, while the surface is unaffected by the weather, and retains its good insulating properties in spite of prolonged exposure.

FRETWORK LOUD-SPEAKER CABINET.

The Lissenola loud-speaker unit of Lissen, Ltd., Lissenium Works, Friars Lane, Richmond, Surrey, has already found many applications, and amateurs have welcomed the introduction of this loud-speaker action by which they can construct at a moderate cost efficient loud-speakers to suit their particular requirements.



An inexpensive loud-speaker designed by Hobbies Ltd., and for which all the necessary wood is supplied for home construction.

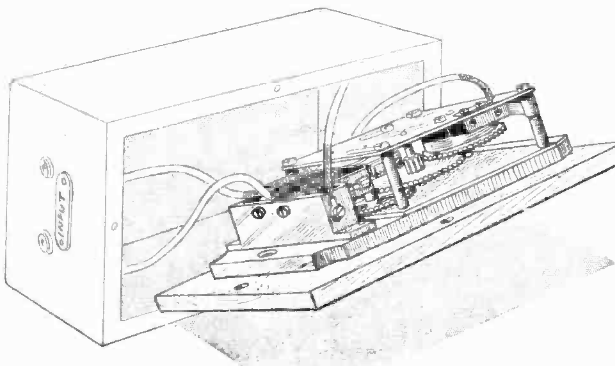


Interior of the fretwork loud-speaker showing the cardboard flare and Lissenola loud-speaker unit.

The idea of constructing in fretwork a loud-speaker cabinet will make a wide appeal, and an attractive design has been developed by Hobbies Ltd., of Dereham, Norfolk, in which the Lissen movement is incorporated. The horn is easily constructed from cardboard, and stands behind the perforated fretwork grating. A parcel containing the pieces of wood cut to the correct size for making up the cabinet is supplied by Hobbies Ltd., and a very attractive instrument can be constructed for an expenditure of less than 25s.

CLOCKWORK REMOTE CONTROL SWITCH.

It is generally considered desirable to install an additional pair of leads to those used for operating the loud-speaker when arranging to control the receiving set from a distant point. Unless the controlling point is to be within a few yards of the receiving set it is essential to use some form of relay to make and break the filament circuit, and it is not good practice to pass the constant current which operates the relay through the leads which feed the speech currents to the loud-speaker. Whatever the circuit system adopted for remote control a difficulty which arises is that with the ordinary type of relay the operating electromagnet must be energised by a steady current during the whole time that the filament circuit is completed. The need for passing a constant current through the windings of the relay is avoided in the Electradix remote control switch, a recent product of Electradix Radios, 218, Upper Thames Street, London, E.C.4.



The Electradix remote control switch, which by means of a clockwork motor is arranged to switch the receiver in and out of circuit without the need for a constant current passing on the switch leads.

The clockwork mechanism is controlled by means of an electromagnet which when energised attracts an armature which in turn releases a catch, setting the pinions in motion. As soon as released the catch swings round, alternately making and breaking the circuit, a positive contact being obtained by the drive action of the clockwork. In use, therefore, it is only necessary to pass a momentary current through the windings of the electromagnet, and if operated by a press-button the set will be switched on and off in turn each time the push is depressed.

The clockwork, together with the electromagnet, is mounted on a fibre base and enclosed in an oak box measuring 3in. × 6in. × 2½in. One winding of the clockwork motor is sufficient to switch the receiver in and out of circuit several hundreds of times.

CATALOGUES RECEIVED.

Radiarc Electrical Co., Ltd., Bennett St., London, W.4. Catalogue of wireless specialities including sets and accessories.

Bretwood Ltd., 12-18, London Mews, Maple St., London, W.1. Leaflet describing the Bretwood low-loss slow-motion S.L.F. condenser.

Arthur Preen & Co., Ltd., Crown Works, Cricklewood Lane, London, N.W.2. Catalogue of Formo products, including transformers, condensers, couplers, plugs, jacks, etc.

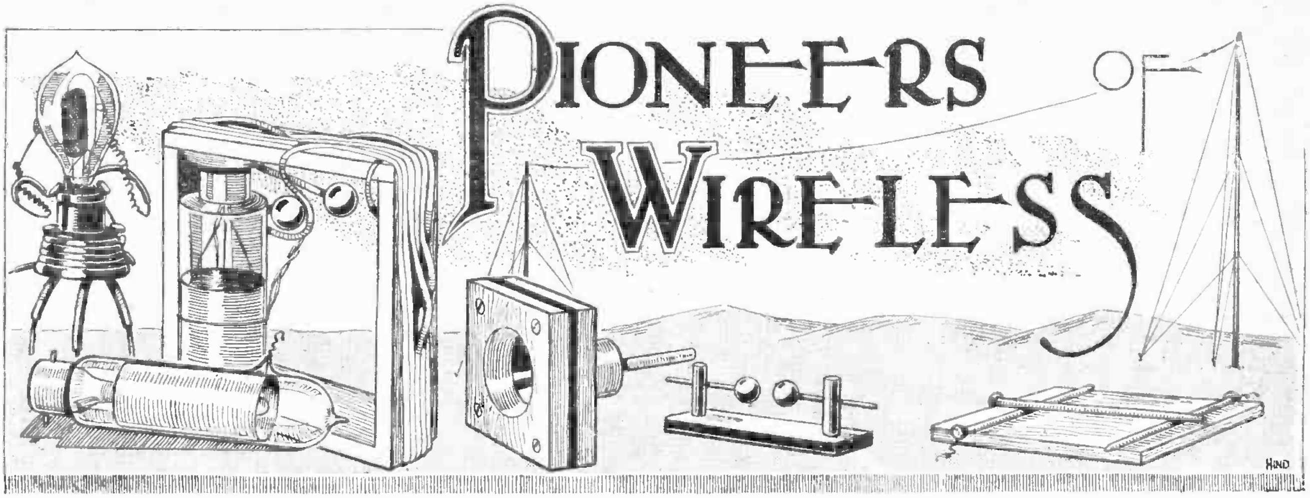
Elektrizitats-Aktiengesellschaft Hydrawerk, Windscherdstrasse 18, Charlottenburg 5, Berlin. Catalogue No. 141E, dealing with fixed condensers for all kinds of electrical engineering.

Watmel Wireless Co., Ltd., 332a, Goswell Road, London, E.C.1. Watmel components catalogue, describing L.F. auto-choke, fixed condensers, grid leaks, etc.

Crawford & Co., Derby Road, West Green, London, N.15. Descriptive brochure of Crawford wireless jacks and switches.

H. M. Pearce & Co., 89, Fore St., Edmonton, London, N.18. Retail list of valve and crystal sets.

A. F. Bulgin & Co., 9-10-11, Cursitor St., Chancery Lane, E.C.4. Season 1926-1927 price list of Deckorem radio products including slow-motion controls, panel brackets, transformers, neutralising condensers, etc.



38.—J. A. Fleming, Pioneer of the Thermionic Valve.

By ELLISON HAWKS, F.R.A.S.

IN our last instalment we described how the blackening of the inside of electric lamps led Edison to investigate the cause, and to make the discovery of what is to-day known as the "Edison effect."

Shortly after Edison's discovery, J. A. Fleming in London took up the question among other problems connected with electric lamps, and in 1883 he published the result of his researches in a paper on "Molecular Radiation in Incandescent Lamps," followed by another paper "On Molecular Shadows" in 1885.

Fleming Investigates the Edison Effect.

In October, 1884, Sir William Preece, having obtained from Edison some of his electric lamps with metal plates sealed inside them, also turned his attention to an investigation of the phenomena of the Edison effect. This he decided was connected with the projection of carbon molecules from the filament in straight lines. There Sir William Preece let the matter rest, just as Edison had done, neither satisfactorily explaining the phenomenon, nor seeking to apply it in any way. For the time being, the Edison effect remained as a peculiar property of the incandescent lamp, and nothing more.

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

In 1888 Fleming had some special lamps made at the Edison and Swan lamp works. Some were strangely shaped, with long glass tubes springing from the sides: others had tubes shaped like the letter "L." The filaments were of carbon, bent in the shape of a horseshoe, and metal plates were fixed within the bulbs or in the side tubes. With these lamps Fleming conducted many tests of a highly technical nature, which were fully described in various scientific papers to the Royal Society and Physical Society. He confirmed Sir William Preece's observations that the molecules discharged from the incandescent filament could not pass round a right-angle bend, and doubly confirmed the original discovery that the molecules travelled in straight lines.

The First Valve Detector.

Fleming next enclosed the negative leg of the carbon filament in a glass tube, and found that the bombardment of electrified particles was completely stopped. By altering the position of the metal plates, he learned that he could vary the intensity of the bombardment. At length he tried placing a metal cylinder around the negative leg of the filament, without touching it. The mirror galvanometer that was being used to detect the currents indicated a strong current, from which it was plain that the metal cylinder enclosing the negative filament received electric particles discharged from the heated carbon filament.

Fleming next experimented with electric arcs in the open air, and he found that the same phenomenon existed. He published the result of these experiments in a paper in 1889 "On Electrical Discharge between Electrodes at Different Temperatures in Air and High Vacua."

In 1889 Fleming was appointed electrical adviser to Marconi's Wireless Telegraph Company. In this capacity he assisted in solving the technical problem of equip-

Pioneers of Wireless.—

ping the first transatlantic wireless station at Poldhu with electrical apparatus to transmit across the Atlantic. Until that time a wireless signal had not been sent over a greater distance than about 100 miles, and, as we have already seen, it was realised that to send a signal for 2,000 miles required high power and a more sensitive receiving apparatus. Marconi had improved on the coherer as a receiver by inventing the magnetic detector, and Fleming realised that if the alternating current could be rectified or converted into direct current, it would be possible to use the mirror galvanometer of Kelvin to register oscillations too weak for known receivers to detect.

With this object before him he experimented with many of the rectifiers then in use, including a rectifier made of plates of aluminium and graphite, immersed in a solution of certain salts. Although this rectifier acted well enough for certain purposes when the frequency of the currents was low, it was found to be useless for practical purposes.

Finding that chemical rectifiers were not suitable for use with high-frequency currents, Fleming sought something that would operate more rapidly as a rectifier. He was pondering on the difficulties of the problem when his thoughts recurred to his experiments in connection with the Edison effect. He determined to see if this would serve the purpose.

"I went to a cabinet and brought out the same lamps that I had used in my previous investigations," he tells us. "My assistant helped me to construct an oscillatory circuit with two Leyden jars, a wired wooded frame, and an induction coil. We then made another circuit, in which was inserted one of the lamps and a galvanometer, afterwards tuning it to the same frequency as the first circuit.

"It was about five o'clock in the evening when the apparatus was completed; I was, of course, most anxious to try the experiment without further loss of time. We set the two circuits some distance apart in the laboratory, and I started the oscillations in the primary circuit.

"To my delight I saw that the needle of the galvanometer indicated a steady direct current passing through and found that we had in this peculiar kind of electric lamp a solution of the problem of rectifying high-frequency wireless currents. The missing link in wireless was found—and it was an electric lamp.

Fleming's Early Valves.

"I saw at once that the metal plate should be replaced by a metal cylinder enclosing the whole filament, so as to collect all the electrons projecting from it. I accordingly had many carbon filament lamps made with such metal cylinders, and used them for rectifying the high-frequency currents of wireless telegraphy.

"This instrument I named an 'oscillation valve,' and it was at once found to be of value in wireless telegraphy. The mirror galvanometer that I used was replaced by an ordinary telephone—a replacement that could be made with advantage in those days, when the spark system of wireless telegraphy was employed. In this form my valve was somewhat extensively used by Marconi's Telegraph Company as a detector of wireless waves."

Fleming applied for a patent in Great Britain on November 16th, 1904, and this patent was subsequently acquired by the Marconi Company, as was Edison's earlier patent covering the use of the "Edison effect."

NEXT INSTALMENT.
De Forest Introduces the Third Electrode.

Calls Heard.

Extracts from Readers' Logs.

Moscow.

(September 22nd to 26th.)

Great Britain :—G 5BV, 5NJ. 5BH, 6JP, 6CL, 6ZE. U.S.A. :—U 1ZE, 6S, 6DEM, 1CMB, 7MBT, WIZ, WIR. France : — F 8RO, 8JL. FF 7PW, FF 9MD, FF 7DS, FW, F8, FM. Argentine :—R BA1. Brazil :—BZ 1AO, 1BD, 1AR, 1AW. Miscellaneous : — BN, PCRR, RDA, K ODO, K J2, TP AI, L 8KD, LQY, TU IR, PCLL, I 1DE, K 1AR, A 4S, L P1, ER1, 5YK, M 5H, S 8DJ, B7; O FP, A 1ZS, Ö KE, D 7MF, FAUS, K W9, O 99, J 2CU, CA1, NL, AR2.

(0-v-1) below 70 metres.

W. N. Paramonow.

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Haslemere.

(October 9th to 31st.)

U.S.A. :—U 1AAO, 1CMP, 1CH, 1RD, 1BZ, 1MV, 1RF, 1BI, 1VZ, 1BEZ, 1AG, 1AFW, 1DV, 1BJK, 1CMF, 1PM, 1AME, 1ADS, 1AMD, 1XJ, 1TZ, 1CMX, 1KK, 1WL, 1AGA, 2CZR, 2ASE, 2AQK, 2CRB, 2LM, 2AMH, 2API, 2EV, 2UF, 2FJ, 2APU, 2ANM, 2CTN, 2AVR, 2AES, 2NZ, 2AST, 3LD, 3AHA, 3GP, 3PS, 3TF, 3TR, 4BN, 4RM, 8DON, 8BEN, 8AGO. Australia :—A 2SH, 2CM, 2YI, 2DY, 3NC. New Zealand :—Z 3AR, 1AX, 2AC, 3AI. Canada :—C 1AR, 2BE, 3XI, 1AC, 2FO. Brazil :—BZ 1AW, SQ4, 2AH, 2AB, 1AM, 1BF, 6QA, 2AG, 1AP, 1BI, SNI, 1AC, 2XA. Argentine :—R BA1, DB2. Morocco :—OCRB, ICW. Egypt :—SUC2. Java :—AND. Uruguay :—1BU. Mexico :—M ITZ. Miscellaneous :—WIZ, WIK, NKF, RCRL, NAI, SKA, OCNB, OCNU, LPI, BXY, OHK, OXU.

(0-v-2 Grebe) on 20-50 metres.

H. Misselbrook.

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Rugby.

(October 9th and 21st.)

France :—F 8DI, 8JF, 8GL, 8GI, 8BVY, 8JN, 8APO, 4BM, 8BW, 8BP, 8MB, 8SR, 8FFR, 8BA, 8TIS, 8ZB, 8RV, 8RVR, 8TOM, 8YNB, 8JO. Germany :—K 4MCA, 4MCL, 4MFL, 4YA, 4YAE, 4CMA. Belgium :—B O8, J6, 4QQ, 3AA, CH2, K44. Sweden :—SMUS, SMTN, SMXV, SMZV. Norway :—S 2CO, OTN, L 1A. Denmark :—D 7KO, 7XU, 7ZG. Holland :—N 0PM, 0AZ, AUC, 0UC, 0TH, PCLL, PCMM, PCPP, PCRR, PCT. Spain :—EAR17, EAR10. Brazil :—BZ 1AA, 1AB, 1AK, 1AW, 1BD, 1BI, 2AK, 2AB. South Africa :—O A6N, A5Z. U.S.A. :—U 1WL, 9ML, KDKA, WIZ, WGY, 2XSA. Egypt :—SUC. French Morocco :—OCRB, OCRU, FM 8MA, 8MB. Philippine Islands :—PI 1AU. Argentine :—R B1. Indo China :—HVA, 8XX. Japan :—J 1PP, JRC. Others :—SKU, EA 4VU, RCRL, B 82, F2, AND, SG 4JW, FU 1RD, A 1AU, OCDJ, H 9XD, NTT, PKX, AGB, AGC.

(0-v-1 Reinartz) no earth.

M. S. Woodhams.

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Wiesbaden.

(October 17th.)

G 2CS, 2MS, 2NM, 2VS, 2XV, 5BU, 5JW, 5KU, 5KZ, 5TZ, 5ZG, 6BT, 6HJ, 6HZ, 6IA, 6NF, 6TD, W 14C.

(0-v-2 Reinartz.)

E. J. H. Moppett.

THE R.K. LOUD-SPEAKER.

A New Product of the British Thomson=Houston Company.

OF the many sound-reproducing devices available to the wireless engineer none gives quite the same results as the small coil-driven cone used in conjunction with a baffle. The cone is generally mounted on the "free edge" principle, i.e., the outer edge, instead of being rigidly supported, is suspended on a flexible flange of rubber or other resilient material. As a consequence the cone moves as a whole with a piston action, and is not subject to distortion due to surface waves travelling over the material of the cone. A baffle is used to prevent the flow of air between the front and back surfaces of the cone, which would otherwise short-circuit the air displacements due to the low tones.

Credit for the development of loud-speakers of this type on a commercial basis is due to Messrs. Chester Rice and Edward Kellogg, of the General Electric Company of America. The original instrument as sold in America was described in an article by Dr. N. W. McLachlan in the issue of *The Wireless World* for November 4th, 1925. The British Thomson-Houston Co., Ltd., have acquired the manufacturing rights for this country, and have produced a combined amplifier and loud-speaker which are mounted together in an attractive cabinet (Fig. 1).

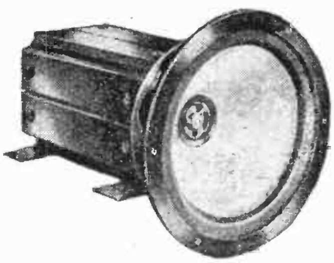

Fig. 3.—The loud-speaker movement.

Naturally the inclusion of a special amplifier has enhanced the price of the instrument, but undoubtedly the B.T.H. engineers are justified in insisting that the loud-speaker shall be used with a suitable input. A separate receiving set is, however, necessary, and the amplifier has been designed to take the output from any receiver of good design incorporating one stage of L.F. amplification.

The loud-speaker amplifier is a single stage of two B11 power valves in parallel, coupled through a transformer to the output of the receiving set. No additional H.T. or L.T. batteries are required for this amplifier, as it is designed to work off the electric light mains. Two types are available, one for use with D.C. mains (Fig. 4), and the other for A.C. mains (Fig. 5). In the latter type two additional valves are incorporated for rectification.

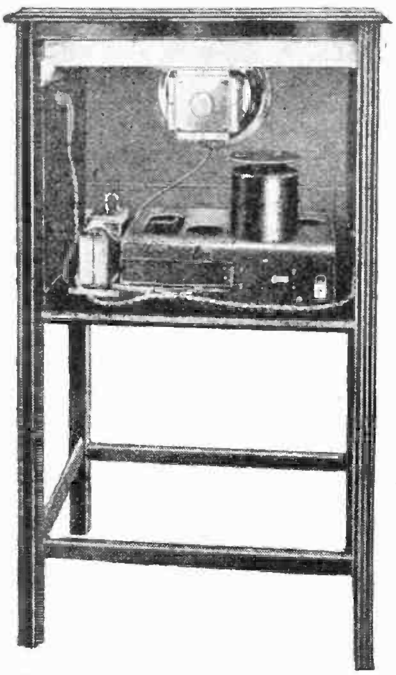

Fig. 2.—Rear view with cover removed.

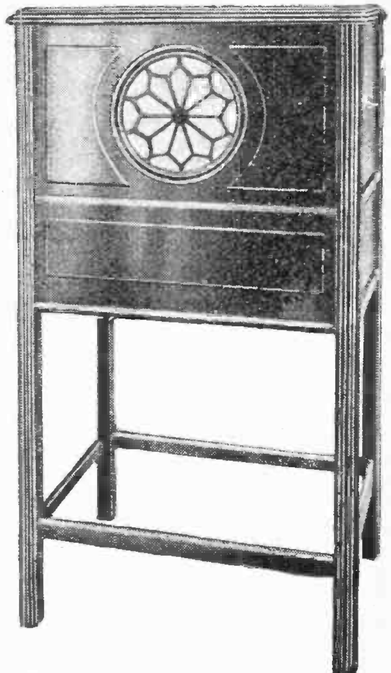

Fig. 1.—Complete loud-speaker and amplifier.

The loud-speaker movement is illustrated in Fig. 3. The principle feature of interest is the magnet system supplying the permanent field surrounding the moving coil. Instead of the usual pot electro-magnet, an arrangement of eight flat bar permanent magnets has been adopted, thus saving the current taken by field coils, and making the movement equally applicable for use with A.C. or D.C. mains.

The front of the cabinet in which the loud-speaker is incorporated constitutes the baffle which prevents short-circuiting of the low tones.

Visitors to the National Radio Exhibition had an opportunity of judging the excellent quality of the R.K. loud-speakers, four of which were installed near the B.B.C. studio in the gallery.

It is interesting to note that the R.K. equipment has been adopted by the Brunswick Company in the gramophone reproducing instrument known as the "Panotrope," to which reference was made in "Broadcast Brevities" in the issue of October 13th, 1926.

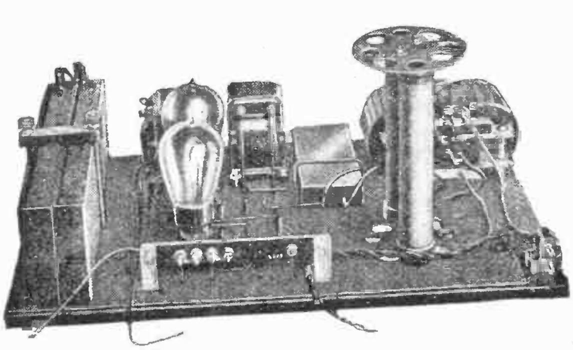

Fig. 4.—Amplifier for D.C. mains.

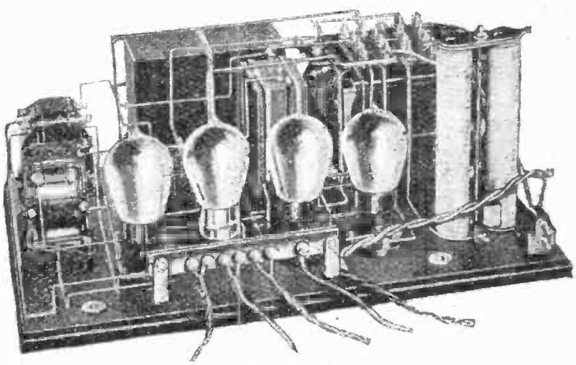

Fig. 5.—Rectifier and amplifier for A.C. mains.

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

B.B.C.'s Receiving Developments.

Mr. H. S. Walker, of the B.B.C., lectured on "Recent Developments in Broadcast Receiving Apparatus," before a large and appreciative audience at a meeting of the Kensington Radio Society, on November 11th. Special interest was taken in the B.B.C.'s own receiver, which Mr. Walker described in detail, and the discussion, in which Mr. Maurice Child, Mr. Perham, and Major Peebles took part, showed, by its pertinent and friendly criticism, how closely the lecturer had been followed.

A feature of the meeting was the presentation to Mr. J. H. Reeves of a silver inkstand in token of the Society's esteem and affection. Major Peebles, who proposed that Mr. Reeves should be made an honorary life member, thanked him for all that he had done for the Society in the past. In acknowledging the presentation, Mr. Reeves said how much he appreciated it, and remarked that anything he had done for the Society had given him the greatest pleasure.

Hon. secretary: Mr. G. T. Hoyes, 29, Upper Phillimore Place, Kensington, W.8.

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Loud-speaker Distribution.

The Auto-Broadcast System of headphone and loud-speaker distribution for institutions, hospitals, and other large buildings was explained and demonstrated in a fascinating manner by Mr. Madden Gaskell at the last meeting of the Taunton and District Radio Society. Mr. Gaskell had gone to great trouble in wiring the hall to different points with three-way lead-covered cable. Loud-speakers and telephones could be plugged in at these points without the least disturbance or diminution in volume.

A control loud-speaker was operated close to the distribution board irrespective of the line speakers, but a pilot light continued to glow as long as anyone was listening on the distribution lines.

The entire system was demonstrated on a seven-valve superheterodyne, a considerable number of stations being heard both on loud-speakers and 'phones.

Hon. secretary: Mr. E. Scott Setterington, 61, Addison Grove, Taunton.

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Valve Manufacture Explained.

A lecture on "Shortpath" valves by Mr. T. Franklin provided an interesting evening at the Muswell Hill and District Radio Society's meeting on November 17th. The speaker gave much valuable information concerning the manufacture of these valves, and provided helpful explanations of such terms as amplification factor and anode impedance. An interesting discussion followed the lecturer's description of the means adopted for obtaining the high amplification given by the "Blue Spot" valves of the series.

The Society is already planning as far ahead as March, 1927, and many extremely attractive features have been arranged. Full particulars of membership can be obtained from the hon. secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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Drilling Glass Panels.

Many visitors to the recent Wireless Exhibition organised by the Tottenham Wireless Society admired the highly efficient receiving set mounted on a plate glass panel and housed in a handsome cabinet. The maker of this set, Mr. D. C. Brown, gave a lecture demonstration, at the society's last meeting, on "Drilling Holes in Glass." He first gave advice as to the most suitable kind of glass to use and then described how to make the necessary drilling tools quite cheaply. Several small holes suitable for terminals, screws, etc., were quickly and cleanly drilled in a piece of plate glass, and the lecturer then gave a full description of the copper bit method of drilling large holes such as those necessary for condenser and rheostat bushes. He then surprised the audience by drilling a perfectly clean ⅜in. hole in about two minutes!

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Morse Classes in Croydon.

Wireless amateurs in the Croydon district may be interested to learn that the Croydon Wireless and Physical Society has regular Morse classes on Monday evenings. Visitors are welcomed, and full particulars of membership are available from the hon. secretary, Mr. H. T. P. Gee, Staple House, 51 and 52, Chancery Lane, W.C.2.

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Institute of Wireless Technology.

At a meeting of the Institute of Wireless Technology, to be held this evening (December 8th), at the Engineers' Club, Coventry Street, W., at 7 o'clock, Mr. W. A. Chambers will read a paper entitled, "A New Rectifier-Amplifier for Broadcast Reception of High Quality."

Information respecting forthcoming Institute meetings may be obtained from the hon. asst. secretary, 71, Kingsway, London, W.C.2.

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All About Valves.

Mr. N. P. Hinton, chief wireless engineer of Messrs. Metrovick Supplies, Ltd., gave an exceedingly comprehensive lecture on the subject of valves and their history at the last meeting of the Bristol and District Radio Society.

The lecturer first spoke of the "Edison effect," the application of this phenomenon by Fleming to the detection of radio signals, and the subsequent addition by de Forest of the third electrode. Mr. Hinton then dealt with the many ramifications of valve research, touching upon the tuned anode circuit, the balancing of valve capacity, and the use of amplification formulæ. Not content with giving an exhaustive account of valve phenomena, the lecturer then discussed variable condensers and various methods of coupling, providing a mass of useful information.

Hon. secretary: Mr. S. J. Hurley, 46, Cotswold Road, Bedminster, Bristol.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 8th.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "Radio and Broadcast," by Mr. D. S. Richards.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Demonstration on transmitter.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. "One Valve and Crystal," by Mr. J. Taylor.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Lantern lecture: "Developments in Broadcasting," by Mr. J. H. A. Whitehouse (of the B.B.C.).

FRIDAY, DECEMBER 10th.

Radio Experimental Society of Manchester.—At the Athenæum. Lecture by Messrs. Dubilier, Ltd.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Supersonic Heterodyne Demonstration, by representative of Igranic Electric Co., Ltd.

Sheffield and District Wireless Society.—The Month's Wireless News. Conducted by Mr. W. Burnet.

Bristol and District Radio Society.—Annual General Meeting.

SATURDAY, DECEMBER 11th.

"Wireless World" Lecture in Glasgow.—At 8 p.m. At the McLellan Galleries, Sauchiehall Street. Lecture (with Demonstrations): "Quality in Broadcast Reception," by Dr. N. W. McLachlan, M.I.E.E. In the chair: Prof. G. W. O. Howe, D.Sc., M.I.E.E. (See page 770.)

MONDAY, DECEMBER 13th.

Croydon Wireless and Physical Society.—At 7.15 p.m. At Phœnix House, 128a, George Street. Annual General Meeting. At 8 p.m., Talk on "One or Two Fundamental Laws Governing Wireless," by Mr. A. C. Dale.

Institution of Electrical Engineers (Mersey and North Wales Centre).—At 7 p.m. At the Laboratories of Applied Electricity, The University, Liverpool. Lecture: "The Making of a Radio Valve," by Messrs. H. W. Edmundson and G. B. Robertson.

Southport and District Radio Society.—At St. Andrew's Hall, Park Street. Review of "The Wireless World."

SUPERSONIC TRANSFORMERS.

PART IV.

Circuits Using Iron-cored Supersonic Transformers.

By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

THE various modes of arranging superheterodyne circuits have been treated so frequently in the pages of this journal that any comments now would be superfluous. So far as circuits are concerned, the chief point with iron-cored supersonic transformers is to get selectivity and large magnification without oscillation. The first can be obtained (*a*) by suitable design of the transformer so that, for any given optimum wavelength, the inductance L_1 and the ratio $\frac{r_e}{L_1}$ are small [C large]. In this case a valve of fairly low internal resistance can be used without flattening the amplification curve too much; (*b*) by using a valve of high internal resistance, the effect being as shown in preceding parts. Here one must guard against oscillation when several transformers are connected in cascade. In this case, where the "*m*" value of the valve will be relatively large, it might be preferable to reduce the turns ratio so that the magnification per stage is brought down to a normal figure. The reduction in wavelength due to reduced secondary turns can be corrected by the addition of a condenser to the primary.

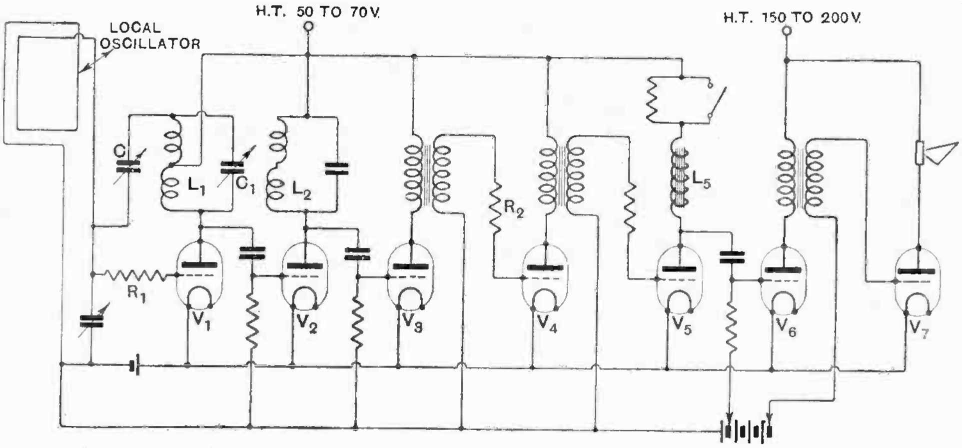


Fig. 19.—Circuit diagram of superheterodyne receiver using iron-cored transformers for supersonic amplification. Transformer connections are as follow: O.P. to anode, I.P to +H.T., O.S to grid, I.S. to filament via grid bias battery. In practice a choke-condenser combination would be used to avoid D.C. in the loud-speaker.

So far as the prevention of oscillation is concerned, there is no reason why the neutrodyne principle should not be adopted. The design of the windings would have to be carefully considered. In this respect it is sometimes useful to incorporate a damping resistance next to the grid, as shown at R_2 valve V_4 of Fig. 19. This damps out local oscillations in circuits where the valve capacity is active, but should not be used unless absolutely necessary.[1] Another precaution is desirable inasmuch that the iron-cored transformers should be screened efficiently.

A straight circuit is shown in Fig. 19, which gives good magnification and good quality when using two supersonic 4 : 1 transformers. Selectivity is secured chiefly by the low-resistance frame, and the two tuned anode circuits which follow. The data pertaining to Fig. 19 are set forth in detail in Table X. Taking the product of the amplication per stage given in the table, and assuming the power valve to be a D.E.5, the total voltage magnification from the grid of V_1 to the anode of V_7 is nearly 35 million[2] Greater magnification and selectivity could be secured by using D.E.5B valves from V_1 to V_6, but difficulty might be experienced in holding the set down, *i.e.*, in avoiding oscillation, unless special precautions were taken. For best quality V_5 and V_6 would be resistance coupled, V_6 would be a D.E.5 and V_7 a D.E.5A. The magnification would then be about 4 million.

By the addition of a detector and a second local oscillator to precede valve V_1 of Fig. 19, the set can be employed for the reception of short waves below 100 metres. An open aerial is used prior to the detector, which latter is coupled to the grid of V_1 by any suitable means. Probably one or more suitably placed switches will serve to convert the set from short wave to broadcast wave. If the signal strength is too great, no trouble will be experienced in effecting a reduction.

There is no reason, of course, why reflexing should not be incorporated at supersonic frequency. Some enthu-

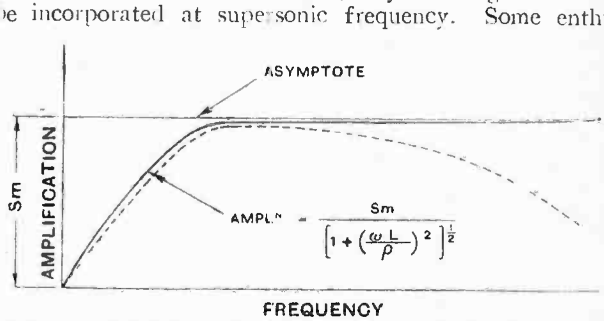


Fig. 20.—Curve (full line) for transformer devoid of capacity resistance and leakage. The dotted line shows the effect of increasing resistance and decreasing inductance due to eddy currents in the core plates.

[1] It is better to stop the oscillation by reduced magnification per stage.

[2] Allowing for a modulation coefficient of 0.2 at the detector, the net magnification is 7×10^6. The effect of valve capacities will modify these figures. In some cases adjustment of the transformer wavelengths may be necessary.

Supersonic Transformers, Part IV.—
siast might like to make a double reflex circuit in which one valve amplifies at three different frequencies.

Summary.

(1) Thin iron can be used with success in the design of intervalve transformers for the magnification of currents of supersonic frequency.

(2) At any given optimum wavelength the breadth of the top of the amplification-frequency curve is greater the lower the internal resistance of the valve.

(3) With any given valve and primary winding the breadth of the top measured in cycles per second increases with decrease in the optimum wavelength (increase in optimum frequency due to reduction in secondary turns or in C_s).

(4) The step of a transformer at its optimum wavelength is $\frac{S}{1+\frac{\rho C_s r_e}{L_1}}$. Thus, in order that the step shall approach the turns ratio s, it is imperative that the quantity $\frac{\rho C_s r_e}{L_1}$ shall be small compared with unity. The factor $\frac{C_s r_e}{L_1}$ which pertains to the transformer alone, can be regarded as a measure of its qualities. For high magnification it should be as small as possible.

(5) At any given optimum the breadth of the top depends upon the value of C_s and $\frac{r_e}{L_1}$. For any given ratio $\frac{r_e}{L_1}$ the smaller C_s the wider is the top. This amounts to saying that L_1 should be large. For any given value of C_s, the greater $\frac{r_e}{L_1}$ the flatter is the top. In practice the limit is set by C_s. Its value is kept down by (*a*) constructional methods, (*b*) reduced turns ratio, (*c*) high quality magnetic material. $\frac{r_e}{L_1}$ is increased by reducing the optimum wavelength. Thus the design is a question of balancing out the various factors to arrive as nearly as possible—with the materials at our disposal—at any required result.

(6) The value of $\frac{r_e}{L_1}$ depends upon the magnetic properties of the magnetic material. It increases with the frequency, *i.e.*, at shorter wavelengths. The thinner the magnetic material and the higher its resistivity, without sacrificing its differential permeability, the smaller the value of $\frac{r_e}{L_1}$ at any definite frequency, and the greater the inductance for a given volume of magnetic material.[3] For any given optimum wavelength and turns ratio this is accompanied by a reduction in the effective primary capacity, and results in greater amplification.

(7) The optimum wavelength depends upon the conditions of reception, and no rigid rule will be laid down on this score. In general, however, the turns ratio will require reduction as the wavelength decreases, so that the value of $\frac{C_s r_e}{L_1}$ does not become excessive. For any desired performance the higher the quality of the iron or other magnetic material employed the shorter can be the optimum wavelength.

(8) The influence of a small amount of leakage, say 10 per cent., is of minor importance, although it detracts somewhat from the efficacy of the transformer. With large leakage of the order of 50 per cent., and a valve of moderate internal resistance, the result is to reduce the step and to flatten the amplification curve (provided the effective capacity is much smaller than for a transformer of equal optimum wavelength with zero leakage). With a valve of very low internal resistance there is leakage resonance resulting in a relatively decided peak to the curve.

(9) It can be deduced that the performance of a transformer of zero leakage, capacity, and resistance would be of the form portrayed in Fig. 20. The cut-off point would depend upon the primary inductance and the internal resistance of the valve. The smaller $\frac{\rho}{L_1}$ the lower the cut-off frequency. If coil resistance be assumed and the ratio $\frac{r_e}{L_1}$ increased sufficiently rapidly with the frequency, the curve of Fig. 20 would droop, as shown by the dotted line.

TABLE X.—DATA FOR FIG. 19.

V_1 (D.E.3).	Anode Rectifier. V_2 (D.E.3B).	V_3 (D.E.3).	V_4 (D.E.3).	Anode Rectifier. V_5 (D.E.3B).	V_6 (D.E.5B).
C = Neutrodyne condenser. R_1 = Damping res. = 300 ohms. L_1 = Coil in two halves, wound right and left-handed to be astatic. Inductance = 220μH. C_1 = 0.0005 mfd. Coupling condenser to V_2 = 0.004 mfd. mica.	Grid leak = 0.25 MΩ. C_2L_2 adjusted to λ=9000 metres. C_2 = 0.0003 to 0.001. C_2 may be increased and L_2 decreased to reduce any tendency to oscillate (reduces mag.). L_2 is an astatic pair of flat coils of low resistance. Coupling condenser = 0.004 mfd. mica.	Grid leak = 0.25 MΩ Transformer No. 2 = 4 : 1 ratio with λ = 9,000 M.	Transformer No. 2.	L_5 = iron-cored choke of 200 to 600 henries. Coupling condenser to V_6 = 0.1 mfd. mica. If desired, the choke can be replaced by a resistance of 0.1 to 0.2 MΩ	Grid leak 1 to 2 MΩ. Transformer 2.7 : 1 Ideal.
Approximate Amplification 4	8	17	17	12	50

[3] There is a lower limit to the reduction in thickness owing to the increasing proportion of insulation in the cross-section of the core.

VALVES WE HAVE TESTED

SOME "SIX-SIXTY" AND COSMOS VALVES.

VALVES of the type having a box-shaped anode and an "M" filament appear to be rapidly increasing in popularity, for the reason, no doubt, tnat the peculiar construction and arrangement of the electrodes enable a really first-class valve to be turned out at a popular price. It would appear that it is no longer necessary to use a valve taking a filament current of more than 0.1 ampere in any but the output stage of a receiver, and the remarkable thing is that the valves to which we are referring have several excellent characteristics.

Specimens of the valves sold by the Electron Co., Ltd., known as "Six-Sixty" valves, were obtained for test, and the results are given in the tables. These valves resemble the Mullard PM valves in construction and performance. The SS2a H.F., for instance, is a 2-volt valve taking a heating current of 0.1 ampere, its average A.C. resistance being 27,000 ohms and its amplification factor 15. Type SS10 is a 2-volt power valve and can be used in the output stage of a receiver with an anode voltage of

Type SS2a H.F.

Filament voltage 1.8. Filament current 0.1 ampere.
Anode voltage 50–100. Total emission 8 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
50	0.79	0	32,300	15.4
75	1.11	−1.0	27,100	14.2
100	1.73	−1.5	25,600	15.8

Type SS9.

Filament voltage 5.5–6.0. Filament current 0.1 ampere.
Anode voltage 50–125. Total emission 25 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
50	1.07	0	28,600	12.5
75	1.5	−1	27,200	13.1
100	1.9	−2	26,300	14.8
125	2.16	−3	23,600	13.2

100 and a grid bias of negative 9. When used under these conditions the A.C. resistance of the valve tested was found to be 11,500 ohms, and its amplification factor 6.

Six-volt Valves.

In the 6-volt range are two valves, the SS9 and SS11. Type SS9 is suitable for use in H.F. transformer coupled stages, as a detector, and in all low frequency stages except the output stage. Here a valve of the SS11 type is fairly suitable, although it would be better to employ a valve having a characteristic such that with an anode voltage of, say, 120, a grid bias of at least negative 9 is required. Full details of the four "Six-Sixty" valves tested appear in the tables, but before leaving them we would refer to the method of identifying the valves. Type SS11, for instance, conveys very little; would it not be better, and just as easy, to call the valve an SS610 (six volts, 0.10 ampere), or by some other name connecting the valve with its filament characteristics?

The "Cosmos SP55" Valves.

The SP55 Blue Spot valve was, we believe, designed for resistance-capacity coupled amplification, and on test was found to be very suitable for the purpose. As shown in the table, the valve tested had an A.C. resistance of 77,000

Type SS10.

Filament voltage 1.4–1.8. Filament current 0.15 ampere.
Anode voltage 50–100. Total emission 20 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
50	1.83	−3	12,000	6.25
75	2.5	−6	11,700	6.0
100	2.96	−9	11,500	6.0

Type SS11.

Filament voltage 5.5–6.0. Filament current 0.1 ampere.
Anode voltage 50–100. Total emission 30 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
50	2.15	−1	13,000	9.1
80	3.4	−2	9,950	9.1
100	4.61	−3	9,650	9.25

ohms and an amplification factor of 34, when the anode voltage was 90, a usual value. Such a valve is suitable for anode or grid circuit rectification, and may be used with choke coupling provided the choke has an inductance of well over 100 henries.

The SP55 Red Spot valve is a low impedance valve suitable for use in the output stage of a set. When testing specimen valves it was found that it was advisable not to exceed the rated anode voltage of 120. Both types of valve, the Blue and Red spot, do not give grid current until the grid is made about 1.4 volts positive.

Type SP55 Red Spot.

Filament voltage 5.5. Filament current 0.25 ampere.
Anode voltage 30–120. Total emission over 50 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
48	3.1	−1.5	5,550	4.86
60	3.7	−3	5,550	5.2
90	6.1	−6	5,260	5.61
120	9.0	−9	4,600	5.1

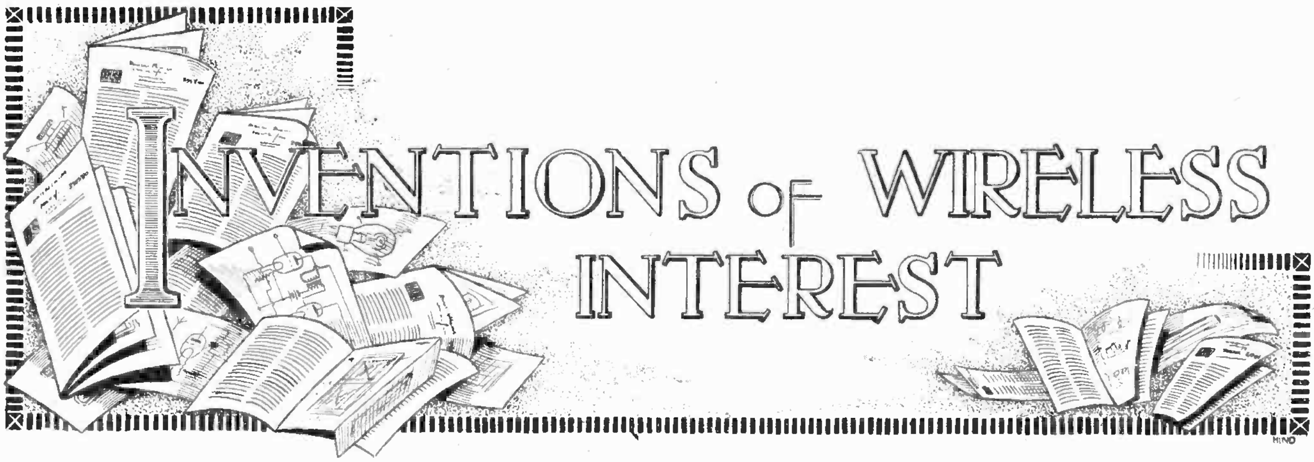
Grid current starts at +1.4 volts grid bias.

Type SP55 Blue Spot.

Filament voltage 5.5. Filament current 0.09 ampere.
Anode voltage 60–120. Total emission over 20 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
60	0.17	0	125,000	31.2
90	0.45	0	77,000	33.7
120	0.9	0	43,500	32.2

Grid current starts at +1.4 volts grid bias.



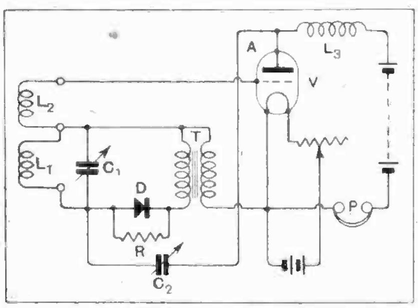
INVENTIONS OF WIRELESS INTEREST

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

A Dual Amplification Scheme. (No. 258,927.)

Application date, June 25th, 1925.

A rather peculiar form of dual amplification circuit is claimed by J. Sieger in the above British Patent. The circuit appears to be of the type in which incoming oscillations are rectified by a crystal, the low-frequency potentials being passed on by a transformer to the grid circuit of a valve which further amplifies them, the valve also being used to introduce a reaction effect into the tuned circuit, which is also connected to



Valve-crystal reflex circuit. (No. 258,927.)

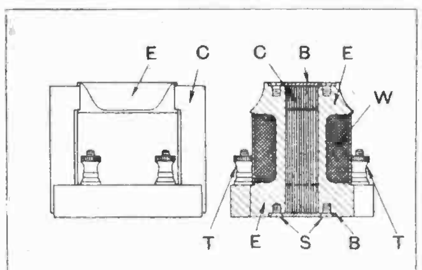
the grid circuit of the valve. Thus, the invention should be quite clear from the accompanying illustration. Here it will be seen that an inductance L_1, such as a frame aerial, is tuned by a condenser C_1. Potentials across this tuned circuit are rectified by the crystal detector D, the rectified potentials being passed on by a low-frequency transformer T to the grid circuit of the valve V, through another inductance L_2, which is coupled to the frame aerial or inductance L_1. The anode circuit of the valve contains a high-frequency choke L_3 and the usual anode battery and telephones P. A reaction condenser C_2 is included between the anode A and one side of the inductance L_1. If the circuit is carefully followed out it will be seen that the two inductances are respectively connected in the grid and anode circuits of the valve, capacity reaction being obtained by means of the condenser C_2. A further feature of the invention is the inclusion of a resistance R, which is connected across the detector D. The object of this resistance is to stabilise the set and prevent it breaking into oscillation too readily when the crystal contact is altered or affected by vibration.

oooo

"Lissen" Transformer. (No. 258,710.)

Application Date, July 28th, 1925.

The construction of the "Lissen" transformer is described in the above British patent by Lissen, Limited, and R. P. Richardson. The invention consists essentially in the use of a special type of moulded bobbin, which is provided with slots for the purpose of holding the laminated core in position. The general nature of the transformer can be gathered by reference to the accompanying illustration, in which it will be seen that a bobbin of ebonite or other moulded material E is provided with the usual winding space containing the two coils W. The flanges of the bobbin are more solid than those normally employed, the



L.F. transformer construction. (No. 258,710.)

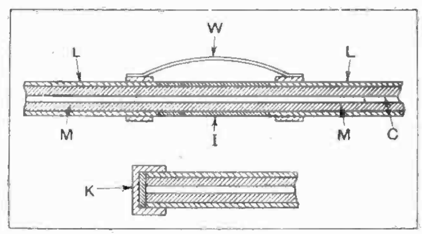
lower flange constituting the base of the transformer on which the terminals T are mounted. The core C is composed of "U" shaped and "T" shaped stampings, which are assembled in the normal way, and the two flanges are provided with longitudinal slots through which the core stampings can pass, sufficient stampings being used to fill the slots entirely. The stampings are then kept in position by means of two plates of brass or similar material B, which are secured by means of screws S.

oooo

An Underground Aerial. (No. 256,837.)

Application Date, Dec. 2nd, 1925.

J. D. Gibson and J. R. Gibson describe in the above British patent the construction of an underground aerial. Underground aerials, of course, have been employed for some time, and the novelty of the invention lies in the construction



Underground arial system. (No. 256,837.)

of the particular aerial, the nature of which can be gathered by referring to the accompanying illustration. It will be seen that the aerial comprises a conductor C, insulated by means of suitable insulating material M from a lead or similar sheath L. This sheath is not continuous, but is divided into two portions. Where a break in the sheath occurs the gap is filled with other insulating material I. A further feature of the invention is the electrical connection of the two portions of the sheath by a copper strip or wire W. The imbedded end of the aerial is covered with a lead cap K. The other end of the aerial is taken up through the surface of the ground, and led to the receiving set. In another modification of the invention the aerial may terminate at the surface of the ground, and be connected to the set with an ordinary wire.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

Relay Stations to Go?—The Regional Scheme—Faulty Organ Transmissions—For the Woman Listener—Daventry Concerts in Prague—The Uses of Advertisement.

Back to the Melting Pot?

At the moment of writing, the Geneva scheme appears to have reached an unexpectedly parlous state. Deliberations have been resumed at Geneva, whither Capt. Eckersley and other lights of the European ether have suddenly repaired with all speed. The Union at Geneva is, of course, concerned with the European position as a whole, whereas most of us in Britain are chiefly anxious to set our own house in order.

oooo

Relay Stations in Trouble.

One fact emerges crystal clear from the welter of the past two or three weeks, viz., that the British relay stations show a decided "incompatibility of temperament" when working on the common wave of 288.5 metres. This is hardly surprising, in view of the preliminary test, which was reported in *The Wireless World* of October 20th. Several correspondents were appalled at the confusion which was then evident, and one writer described the attempt as "pandemonium."

oooo

Another Change-over.

On Sunday last another wavelength revision took place, certain of the British stations, including the relays, being involved.

The revised wavelengths are as follow:

	Revised.	Present.
Aberdeen	500	481.8
Birmingham	491.8	481.8
Bournemouth	326.1	306.1
Belfast	306.1	288.5
Edinburgh	294.1	288.5
Liverpool	297	288.5
Bradford	254.2	294.1
Leeds	277.8	297
Nottingham	275.2	288.5
Sheffield	272.7	288.5
Plymouth	400	288.5

If the British wavelengths require revision at such an early stage, what must be happening on the Continent?

oooo

The Knell of the Relay?

An idea seems to be gaining currency that the days of the relay stations are numbered. I understand that it is not unlikely that the Corporation may press forward the regional scheme with greater promptitude than was originally expected, in which case some, at any rate, of the relay stations would disappear next year.

Tell It Not in Gath!

Talking about the regional scheme, which we have heard discussed off and on for nearly a year, one question that has been kept very dark is that of cost. What would be the cost of such a scheme as Capt. Eckersley had in mind when he was discussing the subject in the autumn of 1925? Broadly, he hinted at ten main regional stations, including Daventry, to serve England, Scotland, and Wales; five stations of low power; and one station for linking up the Dominions and other countries.

A very delightful project, no doubt, but I should not be surprised if the cost of a little venture of this sort were rather staggering. It would probably be of such dimensions that even the approximate figure dare not be whispered in the precincts of St. Martins-le-Grand!

oooo

Scrapping Apparatus.

Existing apparatus would probably have to be scrapped, because something even more formidable than the ancient problem of trying to get a quart into a pint pot would face the engineer who tried to get 10 kilowatts from a 1½-kW. transmitter.

oooo

Tantalising 10 Kilowatts.

Ten kilowatts is becoming a favourite power for the larger stations on the Continent, such as Berlin (Königswusterhausen), Frankfurt, and Hamburg, and it is probable that stations of this calibre will comprise the British regional chain.

BROADCASTING AN ANCIENT CEREMONY. To-morrow evening (Thursday), listeners will hear the sounds accompanying the ceremony of "handing over the keys" at the Tower of London, which has been carried out nightly for very many years. The above photograph, taken a few nights ago, shows the Warden locking the gates.

This would undoubtedly be a step towards Capt. Eckersley's *millennium*, wherein every listener could pick up at least one programme by means of a damp clothes peg and a piece of cheese!

oooo

Mild Speculation.

A little mild speculation is a pardonable indulgence. Therefore, let us speculate. This week we may as well turn our attention to the money which the Post Office still holds in respect of wireless licences taken out during the present year. It amounts to many thousands of pounds. Will the accession of the Corporation into power secure some of this money for the betterment of programmes? I gather that there is a shade of probability in the idea.

And there we must leave our speculations for another week.

oooo

Faulty Organ Transmission.

To one listener, at least, the broadcast recital on the new organ at Liverpool Cathedral on Sunday, November 28th, was disappointing. The poor land line connection from Liverpool may have been partly responsible for the lack of clarity, but that would not account for the lack of balance.

The dimensions of the Liverpool organ are so vast that a single microphone suspended anywhere near will certainly give undue prominence to pipes in the immediate neighbourhood. This is what happened last week. In the case of recitals on large organs, why not distribute several microphones at different parts of the instrument?

oooo

For the Woman Listener.

A revival, in a modified form, of the "Women's Hour" is to take place in the first week of January. Every Monday, from 5 to 5.15 p.m., crisp little items will be broadcast of special interest to women. The items will include everything that has to do with the household, from interior decoration to cooking recipes and hints on labour saving in the home.

oooo

Hints for Harassed Husbands.

That a deputation of harassed husbands has petitioned the organiser of the "Women's Hour" to supply hints on money-saving in the home, together with bright homilies on the demoralising influence of new hats, is untrue.

oooo

The Greenwich Time Signal.

Objections have been raised by listeners to the occasional omission of the 10 o'clock time signal. It was formerly the custom to superimpose the six "pips" on the programme item, whether it was music or talk, but complaints were received that, in the case of music particularly, the effect was inartistic and frequently incongruous. In deference to objectors the 10 o'clock time signal is no longer superimposed, but is only given when the programme arrangements permit.

Next Week's National Concert.

Herr Otto Klemperer will be unable to conduct the B.B.C. National Concert at the Royal Albert Hall on December 16, as originally arranged. His place will be taken by Herr Brecher, principal conductor and musical director of the Leipzig Opera House. The artist will be Fraulein Frida Leider, soprano, who is one of the leading exponents of Wagnerian songs in Europe.

FUTURE FEATURES.

Sunday, December 12th.

LONDON. — Military Band Programme.

BIRMINGHAM.—Re-Opening Service from the Parish Church, Yardley.

BELFAST.—Chamber Concert.

Monday, December 13th.

LONDON.—"From Arms to Armistice."

DAVENTRY. — Welsh Programme S.B. from Birmingham.

NEWCASTLE.—"A Sharp Attack," by Herbert C. Sargent.

Tuesday, December 14th.

NEWCASTLE. — "A Hymn of "Praise," by F. Mendelssohn-Bartholdy.

BELFAST.—"Mrs. Bates' Saturday Night," by A. McClure Warnock.

Wednesday, December 15th.

LONDON.—"Act 2, Scene 2. of "Parsifal," by B.N.O.C.

ABERDEEN.—"What Is It?"

Thursday, December 16th.

LONDON.—Fifth National Concert relayed from Royal Albert Hall.

Friday, December 17th.

MANCHESTER.—A Beethoven Concert in Commemoration of the Composer's Birth.

ABERDEEN.—"Fire." by A. J. Alan.

Saturday, December 18th.

BIRMINGHAM.—Pantomime "Cinderella."

BELFAST.—Concert by Belfast Philharmonic Society.

Paddy in the Studio.

A studio performance of "Paddy the Next Best Thing" will be given from 2LO on December 14th. Miss Peggy O'Neill will play her original part.

oooo

Daventry Enjoyed in Bohemia.

A correspondent in Prague tells me that the Czech postal authorities, who control radio in that city, have hitherto been content to broadcast local concerts and operas. Experiments were made some days ago in the direction of re-broadcasting foreign programmes. Daventry was relayed quite successfully, and it is hoped that this new venture will be made a permanent feature of broadcasting in Bohemia.

The Uses of Advertisement.

The habit among American business houses of sponsoring broadcast programmes as a means of indirect advertisement leads to some ambiguous programme titles. WGY, for instance, offers a selection by the Remington Typewriter Band, a combination which, to the unsophisticated listener, suggests a somewhat restricted musical scale. One frequently comes across Somebody's Tinned Tomato Hour of Music and some day we shall probably stumble on Poetry Pickings from the Pork Packers' studio.

Corporation, or no Corporation, I think I prefer the British system.

RADIO DRAMA.

ANYONE who has misgivings in regard to the future of the broadcast play as a serious development in dramatic art should read Mr. Gordon Lea's hopeful little book on "Radio Drama," * to which an introduction is furnished by Mr. R. E. Jeffrey, Production Director of the B.B.C.

Mr. Lea is not blind to the obstacles and limitations which may, or may not, be overcome, but he sounds a trumpet note of optimism. Indeed, he garnishes his theme with such ingenious arguments as to persuade one, almost, that the radio play is a medium of expression richer in its possibilities than any medium hitherto known! Whether we can subscribe to this opinion, or not, few readers will disagree with the author's contention that radio drama, in which scenes are skilfully built up in the mind's eye of the listener, opens up vistas of imagination and suggestion unapproachable within the three walls of the "legitimate" stage. "The best stage scene (he says) is a second-hand affair—whereas the radio-scene is beyond art—it is reality itself, not an isolated expression of imagination, but imagination itself."

In his later chapters Mr. Lea adduces reasons for supposing that the radio drama of to-day—amounting to an adaptation of stage methods—will develop into something entirely fresh, with a technique all its own. The present practice of "helping along" a stage play at the microphone by the aid of descriptive announcements is labelled as the Narrator Method. The new form, says the author, will employ only the Self-Contained Method, wherein the play is everything in itself. No narrator, no programme, not even the announcement of a mind-picture will be needed; dialogue and sound effects will supply all that is required.

But the consummation of all art lies in the fullness of the response which it evokes. If and when radio drama arrives at the imaginative pinnacle on which Mr. Lea would place it, will the listener respond? E.C.T.

* "Radio Drama, and How to Write It," by Gordon Lea. With a foreword by R. E. Jeffrey (London: George Allen and Unwin, Ltd., 40, Museum St., W.C.1. pp. 91. Price (paper) 2s. net, (cloth) 3s. net).

BUYERS' GUIDE TO SETS.

We give below the particulars of various Receiving Sets which were received too late for inclusion in the "Buyers' Guide" published in our issue of November 10th.

CRYSTAL SETS.

Manufacturer.	Name of Set.	Type of Cabinet.	Price.	Description and Remarks.
			£ s. d.	
Automobile Accessories (Bristol), Ltd., 93/95, Victoria Street, Bristol.	P.D. Mark O.	Oak box, with lid	2 2 0	Receiver only.
	"	" "	3 9 6	Complete with headphones and aerial supplies.
Lissen, Ltd., Friars Lane, Richmond, Surrey	Lissen Crystal	—	10 0	With coil for local station. (Revised price.)
Radio Telegraph Engineering Co., 37, High Street, Uckfield, Sussex	Collier	Oak cabinet	2 2 0	Complete with headphones, coils and aerial supplies.

1-VALVE SETS.

Manufacturer.	Name of Set.	Type of Cabinet.	Price.	Description and Remarks.
			£ s. d.	
Automobile Accessories (Bristol), Ltd., 93/95, Victoria Street, Bristol.	P.D. Mark X.	Oak, box type	3 17 6	Receiver only.
	"	" "	7 10 6	Complete with valve, batteries, headphones and aerial supplies.
J. & P. Manufacturing Co., 50, King Street, Cambridge.	J. & P.	Mahogany or walnut, box type	1 15 0	Receiver only. Without coils.
" " " "	"	" "	2 4 0	" " With coils.
Nottingham Radio Supplies, 33, Mansfield Road, Nottingham.	Chanticleer	Polished oak, American type.	4 7 6	Receiver only.
" " " "	"	" "	6 8 9	Complete with valve, batteries and 4 coils.

2-VALVE SETS.

Manufacturer.	Name of Set.	Type of Cabinet.	Valves. H.F.	Valves. Det.	Valves. L.F.	Price.	Description and Remarks.
						£ s. d.	
Automobile Accessories (Bristol), Ltd., 93/95, Victoria Street, Bristol.	P.D. Mark I.	Oak, box type	—	1	1	6 5 0	Receiver only.
	"	" "	—	1	1	11 10 0	Complete with valves, batteries, headphones and aerial supplies. 300/500 metres.
" " "	P.D. Mark II.	" "	—	1	1	7 5 0	Receiver only.
" " "	"	" "	—	1	1	17 6 0	Complete with valves, batteries, headphones, loud-speaker and aerial supplies. 300/500 and 1,500/1,800 metres.
" " "	P.D. Mark XII	Oak	—	1	1	4 15 0	Receiver only.
" " "	"	"	—	1	1	14 16 6	Complete with valves, batteries, headphones and loud-speaker. 300/500 metres. American type cabinet, 21s. extra.
" " "	P.D. Mark XV.	Box type	—	1	1	3 3 0	Receiver only.
" " "	"	"	—	1	1	12 13 0	Complete with valves, batteries and loud-speaker.
Brandes, Ltd., 296, Regent Street, London, W.1.	Brandeset II.	Walnut	—	1	1	6 10 0	Receiver only.
Nottingham Radio Supplies, 63, Mansfield Road, Nottingham.	Chanticleer	American type	—	1	1	7 0 0	Receiver only.
	"	" "	—	1	1	10 17 9	Complete with valves, batteries and tuning coils.
Radio Telegraph Engineering Co., 37, High Street, Uckfield, Sussex.	Collier	Oak	—	1	1	10 10 0	Complete with valves, batteries, loud-speaker and aerial supplies.

3-VALVE SETS.

Manufacturer.	Name of Set.	Type of Cabinet.	Valves. H.F.	Valves. Det.	Valves. L.F.	Price.	Description and Remarks.
						£ s. d.	
Automobile Accessories (Bristol), Ltd., 93/95, Victoria Street, Bristol.	P.D. Mark V.	Oak, with doors and compartment for batteries.	1	1	1	13 0 0	Receiver, with coils and grid-leak battery.
" " "	"	" "	1	1	1	20 1 6	Complete with valves, batteries, headphones and aerial supplies. Loud-speaker, £4 5s. extra.
" " "	P.D. Mark VIII.	Roll-top cabinet	—	1	2	11 0 0	Receiver only.
" " "	"	" "	—	1	2	18 9 0	Complete with valves, batteries, headphones and aerial supplies. Loud-speaker, £4 5s. extra.
" " "	P.D. Mark XIV.	Box type	—	1	2	5 15 0	Receiver only.
" " "	"	" "	—	1	2	17 5 0	Complete with valves, batteries and loud-speaker. American type cabinet, 21s. extra.
" " "	P.D. Mark XI.	"	—	1	2	6 12 6	Receiver only.
" " "	"	"	—	1	2	16 5 0	Complete with valves, batteries, headphones and loud-speaker.
Brandes, Ltd., 296, Regent Street, London, W.1.	Brandeset III.	Walnut	—	1	2	8 10 0	Receiver only.
Nottingham Radio Supplies, 33, Mansfield Road, Nottingham.	Chanticleer	American type	—	1	2	10 7 6	Receiver only.
	"	" "	—	1	2	14 19 3	Complete with valves, batteries and tuning coils.
Radolian Co., Market Chambers, Watford.	Radolian Music Model, Type 31.	Mahogany or oak	—	1	2	32 0 0	Complete with valves, batteries and loud-speaker. Single control.
" " "	Do., Type 32	" "	—	1	2	35 0 0	" " " " (Local and Daventry stations.)

Buyers' Guide to Sets.—

4 OR MORE VALVES.

Manufacturer.	Name of Set.	Type of Cabinet.	Valves. H.F.	Det.	L.F.	Price.	Description and Remarks.
Automobile Accessories (Bristol), Ltd., 93/95, Victoria Street, Bristol.	P.D. Mark VI.	Oak, with doors and compartment for batteries.	1	1	2	£ s. d. 16 0 0	Receiver only.
" " "	"	" "	1	1	2	24 2 0	Complete with valves, batteries, headphones and aerial supplies. Loud-speaker, £4 5s. extra.
" " "	P.D. Mark VII.	Pedestal type, with enclosed loud-speaker.	2	1	2	77 10 0	Complete with valves, batteries, headphones, loud-speaker and aerial supplies. 300/4,000 metres.
" " "	P.D. Mark IX.	Oak, with doors.	—	1	3	21 10 0	Receiver only.
" " "	"	" "	—	1	3	30 11 0	Complete with valves and batteries, 1 valve transformer coupled, 2 valves res.-cap. coupled. Loud-speaker, £4 5s. extra.
Nottingham Radio Supplies, 33, Mansfield Road, Nottingham.	Chanticleer	American type	—	1	3	13 0 0	Receiver only.
	"	" "	—	1	3	18 8 3	Complete with valves, batteries and tuning coils.
Radio Telegraph Engineering Co., 37, High Street, Uckfield, Sussex.	Collier	Oak	—	1	3	16 16 0	Complete with valves, batteries, loud-speaker and aerial supplies.
Radolian Co., Market Chambers, Watford.	Radolian Music Model, Type 41.	Mahogany or oak	1	1	2	40 0 0	Complete with valves, batteries and loud-speaker. Single control. (Local and Daventry stations.)
" " "	Do., Type 42	" "	1	1	2	45 0 0	" " " "
" " "	Radolian Continental Model.	" "	1	1	2	50 0 0	Complete with valves, batteries and loud-speaker, calibrated tuning control and interchangeable H.F. circuits.

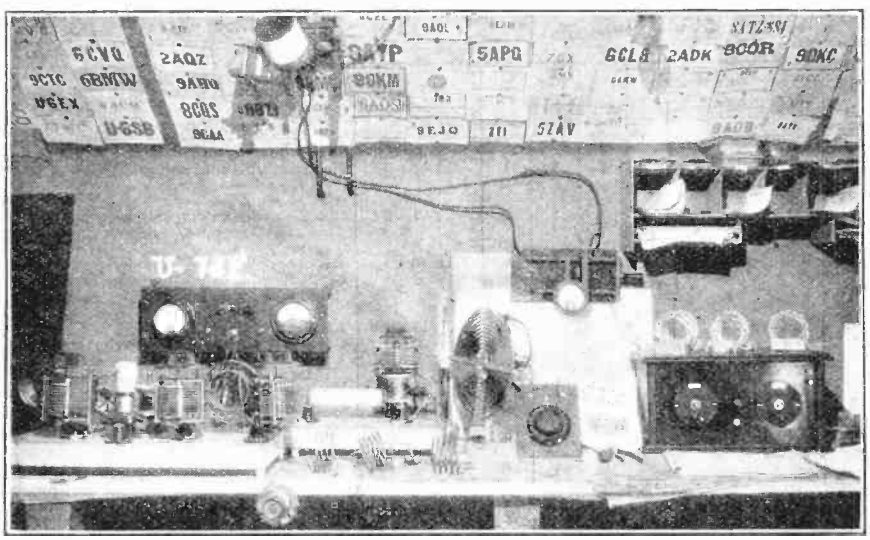
AMPLIFIERS.

Manufacturer.	Name of Set.	Type of Cabinet.	Valves. H.F.	L.F.	Price.	Description and Remarks.
Automobile Accessories (Bristol), Ltd., 93/95, Victoria Street, Bristol.	P.D. Mark III.	Oak	—	2	£ s. d. 6 15 0	Amplifier only.
	" Mark IV.	"	—	2	8 10 0	" "
Radio Telegraph Engineering Co., 37, High Street, Uckfield, Sussex.	Collier	Oak	—	1	2 2 0	Amplifier only.
" "	"	"	—	2	4 4 0	" "
" "	"	"	—	3	6 6 0	" "
" "	"	"	—	4	8 8 0	" "

OVERSEAS AMATEUR TRANSMITTERS.

Amateur Transmitters in Finland.

Through the courtesy of the secretary of the Finnish Radio-Amateur League we are able to supplement and correct the list of transmitters published on pages 87 to 89 of the "Wireless Annual for Amateurs and Experimenters," 1926.



The amateur station U 7JF owned and operated by Mr. Clyde C. Anderson, at 509, South Washington Street, Moscow, Idaho, U.S.A.

ADDITIONAL STATIONS.

S 2NA Helsingin Radiokerho, Kluuvink 7 D, Helsinki.
S 2NB B. A. Petrelius, Malmi.
S 2NE Björn-Erik Björkbom, Villia Solbacka, Grankulla.
S 2NI S. R. Peacock, Estnäsg 7 C, Helsinki.
S 2NJ A. Valmari, Siltasaarenk 8–10, Helsinki.
S 2NK S. R. Manner, Flinkin huvilla, Leppävaara.
S 2NL F. F. Andersin, Konstanting 9 A 11, Helsinki.
S 2NO U. A. Aittola, Santahamina, II.m. V., Helsinki.
S 2NP R. K. W. Lundqvist, Korkeavuorenk 30, Helsinki.
S 2NQ A. A. Häkkonen, Pietarink 12 C114, Helsinki.
S 2NT G. R. Nordfors, Brändö, Pilviksvägen 7, Helsinki.
S 2NU A. U. S. Schroeder, Ahlqvistink 9 A4., Helsinki.
S 2NV T I. Leiviskä, Linnak 5 D24, Helsinki.
S 2NW K. E. Brummer, Katajanokank 4 D, Helsinki.
S 2NX H. B. Jalander, Nylandsg. 3–5, Helsinki.
S 2NY E. Heino, Runeberginkk 29 A16, Helsinki.
S 3NL E. E. Kolehmainen, Lasitehtaan kansakoulu, Riihimäki.
S 3NM O. A. Alho, Otavallank 5 C I, Tampere.
S 6NK K. E. Heinonen, Taulumäki, Jyväskylä.
S 7NF J. S. L. Jääskeläinen, Kuninkaank 35, Kuopio.
S 7NO K. Finne, Suok 30, Kuopio.

CHANGES OF ADDRESS.

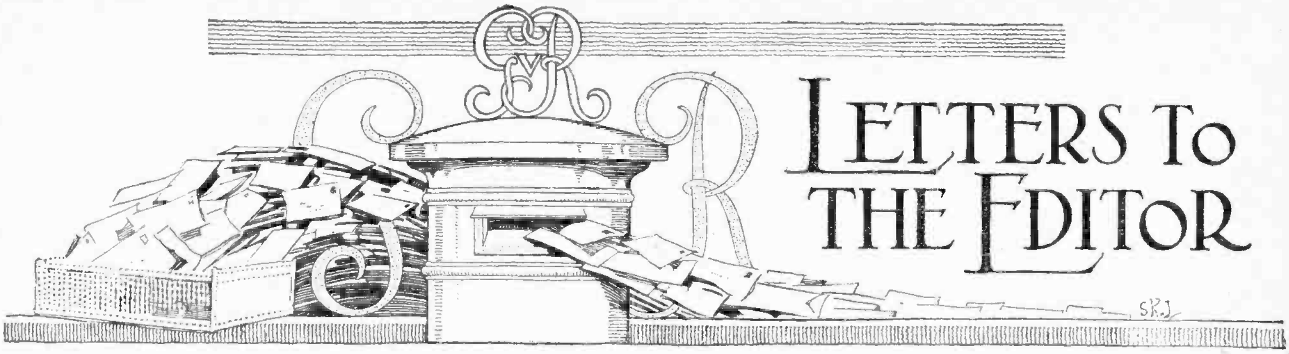
S 1NU Rauman Radiokerho, Ent. Kirkkokoulu, Rauma.
S 2NF L. A. Nyström, Hangon vaihde, Hanko.
S 8NF K. O. Kaattari, Kirkkok 40, Oulu.
S 8NH V. A. Kiiskilä, Kajaanink 21, Oulu.

○○○○

Amateur Transmitters In Japan.

We are indebted to our contemporary, *Radio In Australia and New Zealand*, for the following QRA's of Japanese amateurs :—

J 3AA Kochi Kasahara, 605, Chome Yamamotodori, Kobe.
J 3AZ Kenichi Kajii, 100, Torishima Konohanaku, Osaka.
J 3BB Futoshi Ibuka, c/o "Kamai," 4, Chome Yamamotodori, Kobe.
J 3KK(1KK) Kankichi Kusama, 1581, Hirano Mikagecho, near Kobe.
J 3WW Yuzuru Tangiawa, 132, 4 Chome, Yamamotodori, Kobe.
J 3QQ Keikichi Yamaguchi, 18–1, 4, Chome, Nakayamatodori, Kobe.



The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

BRITISH-MADE COMPONENTS.

Sir,—We note in the November 17th issue of *The Wireless World* that your correspondent G. O. Kerr refers to the absolutely extortionate prices of wireless apparatus. This is entirely untrue, as most wireless components in this country are extremely cheap when one considers the excellent quality one gets for the money. If your correspondent were to look at the high cost of wireless parts in the U.S.A. he would not perhaps run down British manufacturers so much.

In the latter part of his letter he refers to mass-production as applied to the motor industry. This is all right as far as cars are concerned, but when applied to the wireless industry quite a different situation arises. A loss of one-twentieth horse-power in a motor car does not make much difference, whereas in radio we have far less than this in the aerial of which we can make use, and you will therefore appreciate that wireless components must be made separately by hand by skilled engineers and not thrown together.

Perhaps your correspondent can now see why British manufacturers sell such excellent quality apparatus at so low a price and why the Press advocate the public taking up radio as a very necessary and inexpensive addition to any home.

RADIO TELEGRAPH ENGINEERING CO.
G. D. COLLIER, General Manager.
Uckfield, Sussex, November 17th, 1926.

H.T. FROM A.C. MAINS.

Sir,—As one who has experimented with H.T. rectifiers for even longer than Mr. E. C. Richardson, I should like to endorse all he says and add that rectification by a valve is even better than by tantalum cells. I have recently replaced my battery of such rectifying cells by a D.E.R. valve, with grid and plate connected and lit by a small "bell" transformer, though a 2-volt accumulator is just as good, only more trouble. The H.T. output from the valve is steadier and has the great advantage that control is effected by merely regulating the filament resistance.

My tantalum cells ran from March till October in constant use with no attention whatever, but the tantalum then needed careful cleaning and the lead plates eventually got covered with a hard and badly conducting layer of a mixture of peroxide and sulphate, which had to be removed. Some of the cells also have a habit of "shirking," thus throwing an undue voltage on the others, as can easily be found by running over them, while in use, with a voltmeter.

The single valve arrangement is very simple and cheap. Half-wave rectification is quite satisfactory if an adequate smoothing circuit is provided, and that, as he says, is where the expense comes in.

ARTHUR J. WEBB.
Croydon,
November 18th, 1926.

RELAY STATION WAVELENGTHS

Sir,—While I still keep in mind the requests from the B.B.C. and other sources to bear patiently until the new wavelength scheme gets into proper working order before criticising, I have now come to the conclusion that the relays working on one wavelength will never be a success. Situated as I am about half-way between Edinburgh and Dundee and interested locally in both places, I find it impossible to get either. There is another scheme which would put this right which seems to me quite simple although I have never seen it mentioned anywhere.

Briefly it is this: The main wavelengths to remain as they are, *viz.*, so many to each country, according to population, while the seventeen common ones be free. Each country would be allowed to use them all if it so desired, provided it conformed to certain regulations. The regulations would have to be made by engineers with a full knowledge of broadcasting, but I would suggest the following: That no relay station be built within 50 kilometres of another country's frontier, and that any such station between 50 and 100 kilometres to use 200-watt output. The output could be allowed to be increased in proportion as the 100 kilometres was exceeded. It will therefore be seen that even a small country with one main wavelength would be able to build eighteen stations. This is, of course, too many, so I would further suggest that ten common relays be used, thus releasing seven more as main ones.

Dunfermline,
November 22nd, 1926.
ALEXR. THOMSON.

THE POST OFFICE AND BROADCASTING.

Sir,—In Hansard (vol. 199, p. 1575) the P.M.G. is reported as having said in the House, apropos of development of broadcasting, "I do not know how that may come—whether it will be with a low-wave rotating beam or something of the kind."

Could this be a new scheme for enlivening talks—two words on and six off while the beam revolves, and a prize for the listener who guesses the missing words?

Last night, I see, the P.M.G.'s assistant suggested that the licence is limited to one set. Both of my licences speak of a station.[1]

Is it not time that the Post Office figure-heads found out something about the practical side of a science they are supposed to control?

R. E. TARRANT.
London, E.C.,
November 19th, 1926.

A SCOTTISH "DAVENTRY."

Sir,—In your issue of November 17th you state there has been no demand for a high-power station in Scotland, and this is certainly not going to be considered.

As convener for the Edinburgh trade members of the B.B.C., I would state that the necessity for a high-power station in Scotland has been raised at every one of our meetings, but we have accepted the B.B.C. statement that, owing to the action of the Post Office, they are short of funds, but that the matter would be considered in the New Year.

Capt. Eckersley promised that everyone in Great Britain should be within crystal range of some station, and he has

[1 See note in this week's "Current Topics."—Ed.]

carried out his promise fairly well as far as England is concerned, but how does Scotland stand?

We have one 1½ kW. main station in Glasgow at sea level badly shielded with hills and absolutely useless for the North. The B.B.C. have promised time and again that the power of Glasgow should be raised to 3 kW., but nothing has been done. We have another 1½ kW. station at Aberdeen, also badly shielded from the north and west. The effective range of this station has been reduced, by sharing Birmingham's wavelength, to 30 miles. I quote Capt. Eckersley's own figures.

We have two relay stations, Edinburgh and Dundee; the effective range of both, even on a valve set, has been reduced to six miles by sharing the common wavelength. There are many listeners in Fife with 2-valve sets, detector and L.F., who have previously been getting Edinburgh or Dundee satisfactorily on a loud-speaker. These people can now get nothing, but Capt. Eckersley states that residents in Fife must take Daventry. I have nothing to say against Daventry—it is a wonderful station—but your readers will hardly understand that to get Daventry properly on the headphones in many parts of Scotland necessitates an H.F. and detector, and for proper loud-speaker reception four valves. Two-valve short-range loud-speaker sets are, therefore, almost useless. If separate wavelengths can be found for Leeds and Bradford, why cannot Dundee share one of these wavelengths and be separated from Edinburgh, and why should the whole of the north of Scotland have to depend on Daventry? In the summer atmospherics make reception hardly worth listening to.

We want a high-power station in the centre of Scotland, placed high so as not to be shielded, working on a wavelength clear of Morse. Reception from Aberdeen and Glasgow—where this can be obtained—is almost smothered in Morse in the north. A high-power Scottish station would give an alternative programme to Northern Ireland and would make wireless much more popular in the Highlands.

Our contention is that the Scottish service is quite inadequate. Our stations are too few, are under-staffed and under-paid, and very little of the present inadequate funds are crossing the Border. I speak as an Englishman living in Scotland.

JAMES PLUCKNETT, A.M.I.E.E.,
Chairman of the Edinburgh Branch of the Electric Contractors' Association of Scotland.

November 19th, 1926.

Sir,—Anent the paragraph on "The Silent Hebrides" on page 685 of the November 17th issue, the following extract from a letter written by me to the *Morning Post* in October, 1923, may be of some interest.

"Sir,—In your issue of September 30th, page 6, there is a paragraph on 'English messages inaudible in France.' It may interest your readers to know that all British B.C. stations are received here comfortably loudly under normal conditions on a one-valve set—Flewelling circuit. Under exceptional conditions a three-valve set will work a loud-speaker."

In the Inner Hebrides high mountains may cause complete screening in some places, but in the outer isles, after dark, a good one-valve set, in efficient hands, will tour Europe.

A good five-valve set will give full loud-speaker reception the whole year round, daylight as well as dark, from 5XX, 5SC, 2BD, 2BE, Radiola, and, after about 6 p.m. in summer, from Moscow (weak).

Atmospherics and heterodyning permitting, I could rely on reasonable reception from nearly 70 stations in 1925 (September, 1925, reports on 54 to the B.B.C.).

Several stations could be put on the loud-speaker "off the ground" after dark, and I have regularly received 5XX with neither aerial nor earth. (Pick up? Yes, but the same set here, after slight modification, enables me to get the stations immediately above and below 2LO without a trace of the local.)

Generally speaking, I find conditions in Weybridge nothing like so good for general reception as in the Outer Hebrides.

It may interest you to know that in the St. Peter's Church Hall, Stornoway, dance music was "on tap" for up to 60 couples during the winter and summer of 1924-25. I venture to suggest that in the "Silent Hebrides" the "Savoury Orphans" are as well known as in London.

During the strike news received by W/T was posted regularly. Some people in Stornoway knew that the strike was off before some in London Village.

An acquaintance of mine, an Edinburgh doctor, heard W/T for the first time in Stornoway (in 1924). J.R.P.

Weybridge,
November 18th, 1926.

"SUPERSONIC TRANSFORMERS."

Sir,—We have followed with some considerable interest the two articles on the above subject, by Mr. N. W. McLachlan, D.Sc., M.I.E.E., F.Inst.P.

In Part II comparisons are given between experimental *laboratory* transformers and an American *commercial* article. We are of the opinion that, in fairness to the latter, it should have been pointed out that it is a comparatively easy matter to devise efficient Supersonic Transformers in the laboratory, given quite simple apparatus, but the commercial manufacture in large quantities of "matched" transformers of this type, which are to sell at a reasonable price, is a vastly different matter.

Moreover, in fairness to our firm, who have been advertising *American* supersonic transformers in your columns for nearly one year, we think that the name of the manufacturers of the transformer which was compared with laboratory-made transformers should have been mentioned. It is *not* the one we handle, yet, although your paper has been out in Liverpool only to-day, the signor has already been asked if the adverse comments refer to the American transformers that his firm have been importing for some time.

Finally, we are of the opinion that the particular American Supersonic transformer compared cannot be considered the best of its type emanating from the U.S.A. Had the best procurable been compared, we think the comparison between the laboratory and commercial article would not have disclosed such a wide difference.

We see no value, to the *average* reader, of these articles unless—

(1) The make, price and date of manufacture of the American transformer is cited.

(2) The probable cost, *commercially produced*, of supersonic transformers of the type suggested by these *laboratory* experiments is cited.

(3) *British made, commercially produced* supersonic transformers—particularly the latest produced, such as the products of Messrs. The Marconiphone Co., Ltd., Messrs. Burndept. Ltd., Messrs. McMichaels, Ltd., etc., are also carefully compared, under similar operating conditions, with *both* the inferior (so it would appear) American transformer *and* the laboratory made.

By all means let us have the *names* of the respective transformers against their various curves, etc., otherwise of what assistance is such an article as a guide to those readers who look to you for a guiding hand as regards their purchases?

It is surprising, in view of the great knowledge of this subject displayed by many persons on this side of the Atlantic, that, up to date, in the signors very humble opinion, there has not yet appeared on this market a single British-made supersonic transformer with any claim to especial merit. It is also unquestionably true that the overall efficiency and general standard of workmanship, comparing the British-made with the American-made, shows overwhelmingly in favour of the American article.

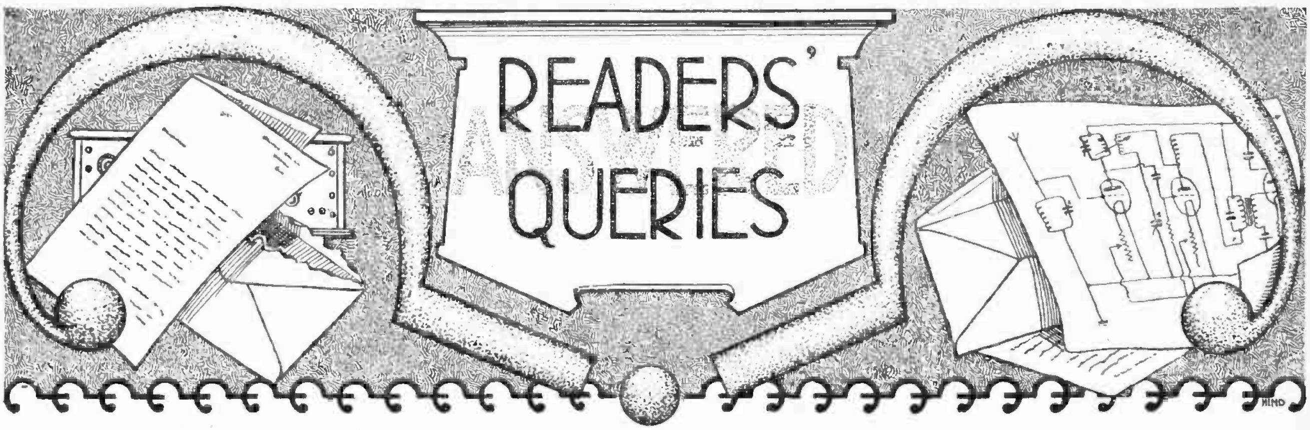
If the articles serve no other highly useful purpose than to direct the attention of British manufacturers to doing something towards perfecting their product, it will, we suppose, have done good work.

We shall feel obliged if you will kindly publish this letter in your correspondence columns at as early a date as is possible.

CLAUDE LYONS.

Liverpool.
November 17th, 1926.

[We cannot agree with our correspondent that it is necessary or even desirable to mention the make of a particular component when it is used merely for the purpose of example in a theoretical article. Further, we feel it is necessary to remind our readers that the Editorial policy of *The Wireless World* is not influenced by the contents of the advertisement pages of the Journal.—ED.]



"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Another Polarity Problem.

In the "Readers' Problems" section for October 20th you gave me full instructions for ascertaining the polarity of my mains for the purpose of accumulator charging. I now desire to take H.T. direct from my mains. I understand that if my positive main is earthed I must put a 1 mfd. fixed condenser in my earth lead, but that if the negative main is earthed this need not be done. A friend informs me that, in order to know which main is earthed, I must find out whether I am on the positive or negative side of the three-wire system. Can you help me out of my difficulties? P. K. T.

In the first place, let us say that if your positive main is earthed and no condenser is included in the earth lead your mains will be short-circuited and fuses blown. This is obvious because the earth terminal of any set (certain special receivers excepted) connects through to the H.T. – terminal, and, since the negative main will be connected to H.T.–, therefore, the negative main will become earthed, and, since the positive main is already earthed, the natural result is a short-circuit. This would be cured by the connection of a fixed condenser in the earth lead. The condenser should be of large capacity in order not to upset the tuning of the receiver, whilst at the same time, in the interests of safety, it must be capable of withstanding at least twice the mains voltage without breaking down. If the negative main is earthed this precaution need not be taken, but at the same time, it is advisable, in our opinion, to take the precaution of using the earthing condenser whenever mains of any type are used in conjunction with a wireless receiver.

With regard to your friend's statement that whether your positive main is earthed or not depends upon whether you are on the positive or the negative side of the system, this is, of course, correct. In this system the neutral wire is earthed, and obviously, therefore, one wire will be positive with respect to it and the other negative. If, therefore, the negative and the neutral wires are led into your house, it follows that your earthed main will be positive with respect to the other main, or, in other words, your positive main will be earthed. If, on the contrary, the positive and neutral are led into your house, the reverse will be the case. It will be impossible to give a full explanation of the three-wire system in the space at our disposal, and

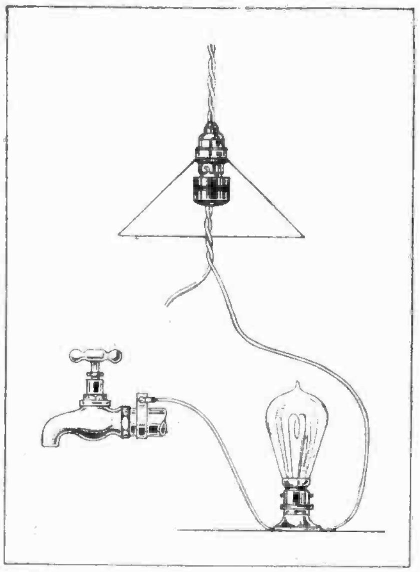


Fig. 1.—Test to discover which side of mains is earthed.

we think that the best method for you to adopt would be to make a test as in Fig. 1. Here we show one of the mains earthed *via* a series lamp, which should be of the same voltage as the mains. The water tap merely forms a convenient connection to the earth. If the lamp lights brilliantly, then the main you are testing is *not* earthed, but if it does not light at all or gives a faint glow, then the main you are testing *is* earthed. Testing the other main will, of course, give an opposite effect, *i.e.*, if one main gives a brilliant light, showing that it is *not* earthed, then the other main will give an indication showing that it *is* earthed.

In any case, however, we advise you to use a fixed condenser in series with your earth lead.

○○○○

Inductance or Capacity Loading?

Since the wavelength to which a circuit will resonate can be altered by changing the value of the inductance or the capacity in the circuit, why is it that it is always the inductance which is increased when it is desired to "load" a normal B.B.C. wavelength circuit to the Daventry wavelength? Why could not a large fixed condenser be connected in parallel with the variable condenser, thus increasing the capacity in the circuit instead of increasing the inductance by adding a loading coil? A. C. R.

Whilst it would be quite possible by adding a fixed parallel condenser as you suggest, to cause the circuit to tune to the Daventry wavelength, signal strength would be very poor indeed, because of the large amount of capacity in the circuit as compared with the inductance. It should be remembered that the voltage set up across the tuning coil is greatest (or in other words signal strength is greatest) when the ratio of inductance to capacity is large, whilst the reverse is true of the selectivity of the circuit. It is a good rule to remember that on the normal broadcasting band of wavelengths the maximum capacity of any parallel tuning condenser should not exceed 0.0005 mfd. On short wavelengths the maximum value should not exceed 0.0002 mfd. at the outside, 0.0001 mfd. being a better value. On the Daventry and Paris wavelength, of course, there is no objection to the use of a 0.001 mfd. condenser, whilst as is well known, on receivers designed for the reception of long wave C.W. stations, variable condensers having a maximum capacity of 0.01 mfd. are frequently used.

An Old Offender.

I am a novice and have recently acquired possession of a two-valve receiver which receives the London station very loudly. I desire, however, to listen to foreign stations and have been told to tune in the carrier wave of foreign stations and then to "resolve" them. I have tried to do this and have tuned in a large number of whistles. I have practised hard at tuning in these whistles, but cannot "resolve" any of them. Can you tell me where I have gone wrong? C. F. T.

We are afraid that you have been guilty of violating one of the primary conditions of your wireless licence, namely, causing interference to your neighbours by oscillating. The method of receiving foreign stations known as "resolving the carrier wave" can only be described as criminal. It is evident that the receiver you are using is a regenerative one, and if properly designed and operated and used with a reasonably efficient aerial should be capable of receiving several foreign stations without oscillating. We think that your best plan is to refrain from any attempts to receive foreign stations until you can secure the services of an expert friend, who will either instruct you in the proper tuning of the receiver, or advise you that your aerial system is not efficient enough for you to attempt the reception of foreign stations without risk of interfering with your neighbours. Alternatively, we would advise you to construct a modern type of receiver employing one H.F. stage and no reaction control. You could then "search" to your heart's content without causing consternation in your neighbourhood.

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A Simple Frame Aerial Receiver.

I live in a flat about 20 miles from 2LO and wish to obtain good headphone reception from that station. I shall be compelled to make use of a frame aerial or short indoor aerial, as an outdoor aerial is out of the question. Can you suggest a suitable receiver to meet the above conditions which is at the same time easy to construct and operate, economical in initial cost and upkeep, and at the same time productive of good volume and purity? P. H. P.

We would unhesitatingly recommend that you make up a simple single valve receiver and frame aerial, using the circuit given in Fig. 2. This receiver should be productive of excellent volume and quality at the distance you mention, and, moreover, by careful adjustment of the reaction condenser it should be possible for you to tune in a large number of other stations. The frame aerial may consist of 12 turns of a fairly stout gauge of wire, such as No. 20, on a two-foot former spaced $\frac{3}{16}$ths of an inch. Bare wire may be used if desired. The reaction condenser may consist of an ordinary type of neutrodyne condenser, but it should be pointed out that many of these may prove to be of too small a maximum capacity for the purpose, and it is advisable to use one having a maximum of not less than 25 micro-microfarads, such as the Gambrell "Neutrovernia" or any other similar type. The H.F. choke may consist of any of the commercial chokes that are upon the market, or may be constructed at home following the instructions given in the "Hints and Tips" section of this journal for February 24th.

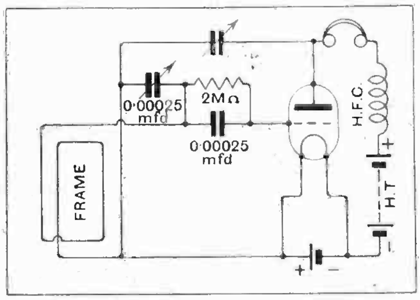

Fig. 2.—Single-valve circuit with frame aerial.

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A Literary Query.

Can you tell me in what manner the various terms of electrical measurement such as volt, ampere, ohm, etc., are derived? They do not appear to me to owe their origin to any of the "dead" languages. G. B. S.

The various units of electrical measurements are named after famous electrical pioneers. From the following list of names of eminent electrical engineers many familiar electrical terms may be deduced: Volta, Ampère, Ohm, Galvani, Henry, Faraday, Watt, Coulomb. An exception to this rule is the "mho," which is the unit of conductance. Since conductance is the opposite to resistance, this term was obtained by merely writing the word "ohm" backwards, the ohm being, of course, the unit of resistance. However, the word "mho" is now giving place to the word "siemens," and so the derivation of the term for unit conductance falls in line with the derivation of the other terms of electrical measurement. Needless to say, compound words like megohm and microhm, meaning 1,000,000 ohms and $\frac{1}{1000000}$th of an ohm respectively, are derived by adding the appropriate Greek prefixes to the word indicating the particular unit of measurement under consideration.

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Correct Neutralising Condenser Capacities.

What is the correct maximum and minimum capacity for a neutralising condenser, and why are some neutralising condensers far more critical in adjustment than others? P. D. R.

The purpose of the neutralising condenser is to balance the inter-electrode capacity of the valve and also the capacity of the associated wiring. Its maximum capacity will therefore have to be fully equal to the capacity it is required to balance. The inter-electrode capacity of the ordinary type of valve may be taken as 10 micro-microfarads, although this is, of course, only an average value. The capacity set up by the valve holder and the associated wiring must also be taken into account, and in most cases it will be found that a maximum value of 18 to 20 micro-microfarads for the neutralising condenser is ample. In many cases, however a neutralising condenser is used as a reaction condenser in a Hartley circuit and on the long waves it is desirable that the maximum capacity be not less than 25 micro-microfarads in order to produce sufficient feed back. The Gambrell "Neutrovernia" which has a maximum capacity of 28 micro-microfarads will be found useful in this case.

With regard to the minimum capacity, it might be thought at first that a value slightly under ten micro-microfarads would be suitable, since the valve capacity alone is not likely to be less than this unless a special low-capacity type of valve like the V24 is used. It sometimes happens, however, that in wiring up a receiver, the capacities formed between the various wires occur in such a manner that they tend to balance out a large amount of the valve capacity instead of adding themselves to it. In this case, it might be only necessary to add a capacity of 3 or 4 micro-microfarads in order to complete the balancing process, and the necessity of a low minimum will therefore be obvious. Usually a minimum of 2 micro-microfarads will be suitable.

The reason why some neutralising condensers are more critical in adjustment than others is because many are arranged to give a capacity variation from minimum to maximum by a 180 degree movement of the adjustment knob. Others of the "many revolution" type such as the Gambrell "Neutrovernia" require a half a dozen complete revolutions of the adjusting knob to pass from maximum to minimum. It will be obvious that the use of the latter type gives the same effect as the use of a vernier dial of 12 to 1 ratio, and consequently adjustment will be very much easier and less critical.

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TESTS ON BROADCAST RECEIVERS.

IN our issue of November 10th we made the announcement that it was our intention to undertake, for the information and guidance of our readers, tests on standard broadcast receivers marketed by the manufacturers. Independent tests of such a character have never previously been made and published, and we hope that this new departure introduced through *The Wireless World* may serve to bring to light the excellent qualities of many of these receivers, whilst at the same time we shall be able to point out little defects, or loopholes, for improvement which may have escaped the notice of the manufacturers themselves, who have not hitherto had the unquestionable advantages of independent technical criticism.

In conducting tests to consider the efficiency of broadcast reception the transmissions may be regarded as a constant factor so that the remaining decisive factors are the aerial receiving system and the receiver itself. No two aerials can be considered identical, especially when we remember the very varying circumstances under which the average aerial for broadcast reception has to be erected. Therefore, it is immediately apparent that some standard equivalent for the aerial must be adopted before comparative tests on different sets can be carried out. The idea of testing receivers exclusively on incoming signals from an aerial has, therefore, been supplemented in our tests by the use of a calibrated oscillator modulated to a known percentage by a 1,000-cycle note similar to the B.B.C. tuning note. A fraction of the output of this oscillator is tapped off by means of a potentiometer and applied to the aerial and earth terminals of the set under test. After amplification by the set, the voltage across the loud-speaker terminals is measured; the ratio of the modulated H.F. input to the L.F. output is then taken as a measure of the sensitivity of the set, and this figure naturally reflects the efficiency not only of the H.F. and L.F. amplifying valves but also of the detector as a frequency converter and the last valve as a power converter. Selectivity tests are carried out with the same apparatus by de-tuning the oscillator by a fixed amount, and observing the ratio of the output from the set with the oscillator at resonance, and de-tuned by this given amount.

We mention the method of test in order that our readers may be assured that no haphazard system is adopted in order to arrive at our results. The actual figures in our tests will not be published, but our reports will be based upon these results taken in comparison with measurements on a standard set with similar stages of amplification.

It will be readily appreciated that the broadcast receivers on the market are altogether too numerous for it to be possible for us to deal with every set even if we did not take into consideration the fact that models are frequently changing as improvements are introduced by the manufacturers. Our endeavour will be as far as possible to test and describe standard types or sets of outstanding interest.

CONTENTS.

An Easily Controlled Loud-speaker Receiver.

By N. P. VINCER-MINTER.

DURING the past few months all the great daily newspapers without exception have been lamenting the enormous increase in the number of people who, either in the form of the dole or otherwise, have been compelled to seek Government assistance in the matter of their daily sustenance. Whilst the writer has been reluctantly compelled to agree that such is indeed a true picture of the lamentable state of affairs extant, he can by no means agree that it is due in its entirety to the depressing effect on industry generally of the recently terminated coal strike, as they all with one accord would have us to believe. True, the coal strike, to a certain extent, accounts for the overcrowding of the workhouse and dole queues by those employed in industries directly dependent on the coal supply, but it scarcely accounts for the unusual number of bankruptcies which as statistics (which, like the camera, cannot lie) tell us have occurred even among members of the learned professions.

It is a curious, but none the less true, fact that the effects of the bite of what the Americans call the "Radio bug" are often more severe amongst those whose pockets are shallow, and the lure of the umpteen valve set may be so strong as to result in the subject who has been bitten acquiring more wireless apparatus than his income will allow, so that he may speedily find himself filing his petition instead of his ebonite.

Distance on Two Valves.

Now it is the purpose of the writer in this article to show those who are still solvent that a gargantuan instrument employing umpteen valves and costing ditto pounds is not necessary in order to enjoy the amenities of broadcasting. He will endeavour to show that in order to receive not only British but also several Continental stations, with excellent quality, some being on the loud-speaker, two valves only are necessary, provided that they are connected up with suitable components in a suitable manner. "Surely, then, a multi-valve set is superfluous and of no practical use," writes "Puzzled, Pimlico." By no means; one would scarcely think of taking the old two-seater on to the track at Brooklands. One only goes on the Brooklands track if one is suitably equipped, and can afford it. Those, therefore, to whom this applies need read no farther.

It is universally acknowledged that under normal and average conditions, it is quite impossible to receive any broadcasting station at comfortable strength and good quality without H.F. amplification. True, it is not impossible to receive distant stations, including even

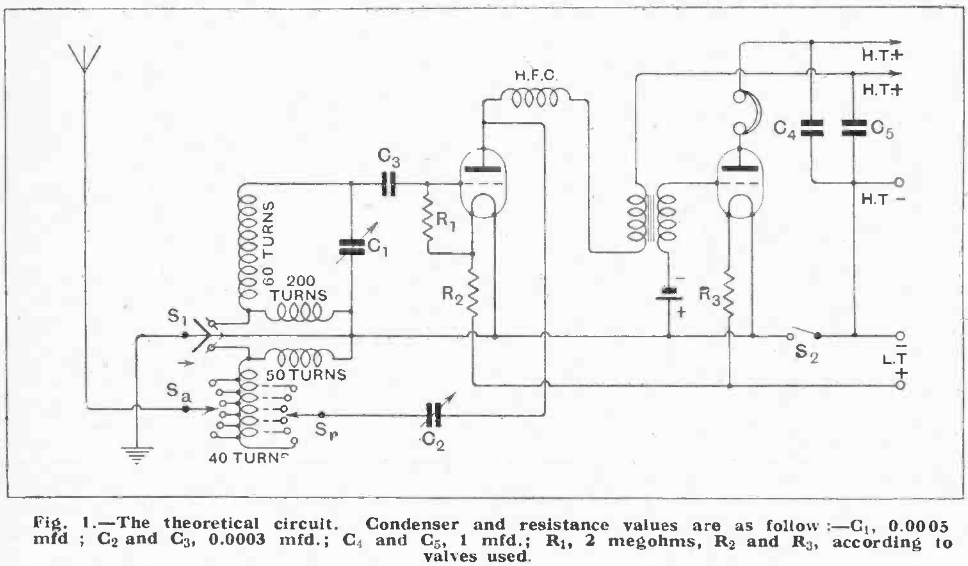
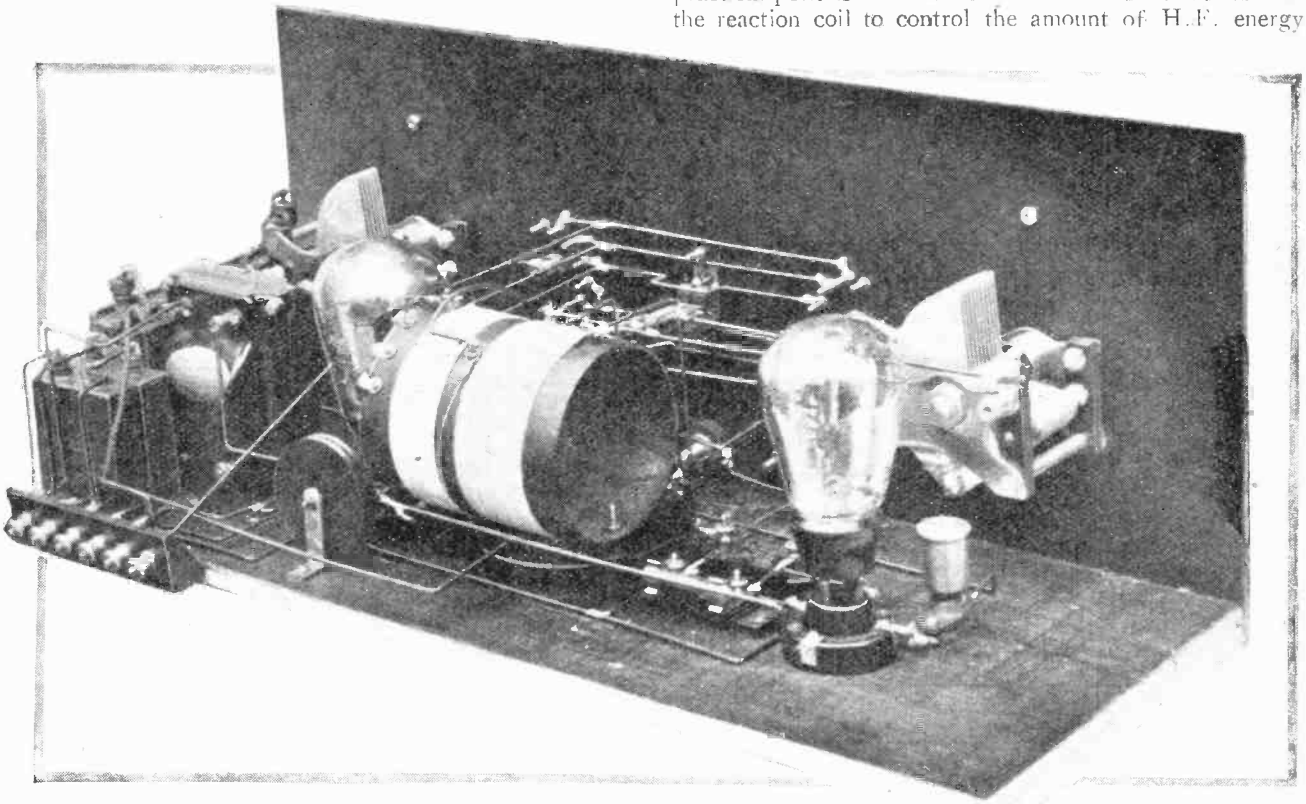


Fig. 1.—The theoretical circuit. Condenser and resistance values are as follow:—C_1, 0.0005 mfd; C_2 and C_3, 0.0003 mfd.; C_4 and C_5, 1 mfd.; R_1, 2 megohms, R_2 and R_3, according to valves used.

Two Range Reinartz.—

American ones, with an unaided crystal receiver, and the writer has himself repeatedly done it by employing a certain type of crystal and catwhisker, the name of which he divulged in a previous article published in this journal. H.F. amplification by means of a separate valve is ruled out in the present case in the interests of economy, and we must, therefore, apply it in the form of reaction. Having decided, therefore, that we are to use reaction, we must next decide upon the best method of applying it.

There are two main methods usually known as "magnetic" reaction and "capacity" reaction. Unfortunately, the general public has come to regard magnetic reaction as being solely that associated with a moving reaction coil, whilst they regard capacity reaction as being synonymous with "Reinartz" reaction. Actually, of course, both the "swinging coil" and the Reinartz systems are merely different methods of controlling the same thing, namely, magnetic reaction. Magnetic reaction, as its name implies, means a feeding back of energy by virtue of the magnetic coupling between two coils. A greater or lesser degree of reaction is brought about simply by varying the number of lines of force inter-linking between the reaction coil and the coil to which it is coupled. In the "swinging coil" method of control we bring about this "inter-linkage" variation not by varying the actual number of lines of force emanating from the reaction coil, but by varying the relative position of the two coils, and so varying the number of lines of force that are common to both. In the "Reinartz" method we do not change the relative positions of the two coils, but vary the actual number of lines of force emanating from the reaction coil. This is done by varying the amount of H.F. energy passing through the coil which, in its turn, is brought about by varying the A.C. resistance or impedance of the circuit. It is obviously impossible to do this by varying the ordinary D.C. resistance, or by varying the inductive or capacitative reactance of the circuit, but for reasons of mechanical simplicity and smoothness of control, an impedance variation by means of varying the capacitative reactance is the only one which falls into the region of practical politics. Thus we use a condenser in series with the reaction coil to control the amount of H.F. energy present in the circuit and a very convenient control it makes, too.



A rear view of the interior. Note the position of the H.F. choke and long wave coils.

Capacity Control of Reaction.

It will be seen, therefore, that the Reinartz circuit is not a "capacity" reaction circuit, for the actual H.F. energy is fed back from plate to grid circuit of the valve magnetically by a coil. The feed back is still magnetic, but is controlled by varying the capacity of a condenser instead of by moving a coil, and the Reinartz circuit, therefore, is one which uses not capacity reaction, but capacity controlled magnetic reaction. We have all heard of Reinartz, Hartley, and such great names as these, and may have been confused by them. It is only necessary to remember that they are all circuits employing capacity-controlled reaction, and only differ in the manner in which that control is applied. A more detailed analysis of the operation of various types of reaction circuit is given in the writer's previous article on this subject.

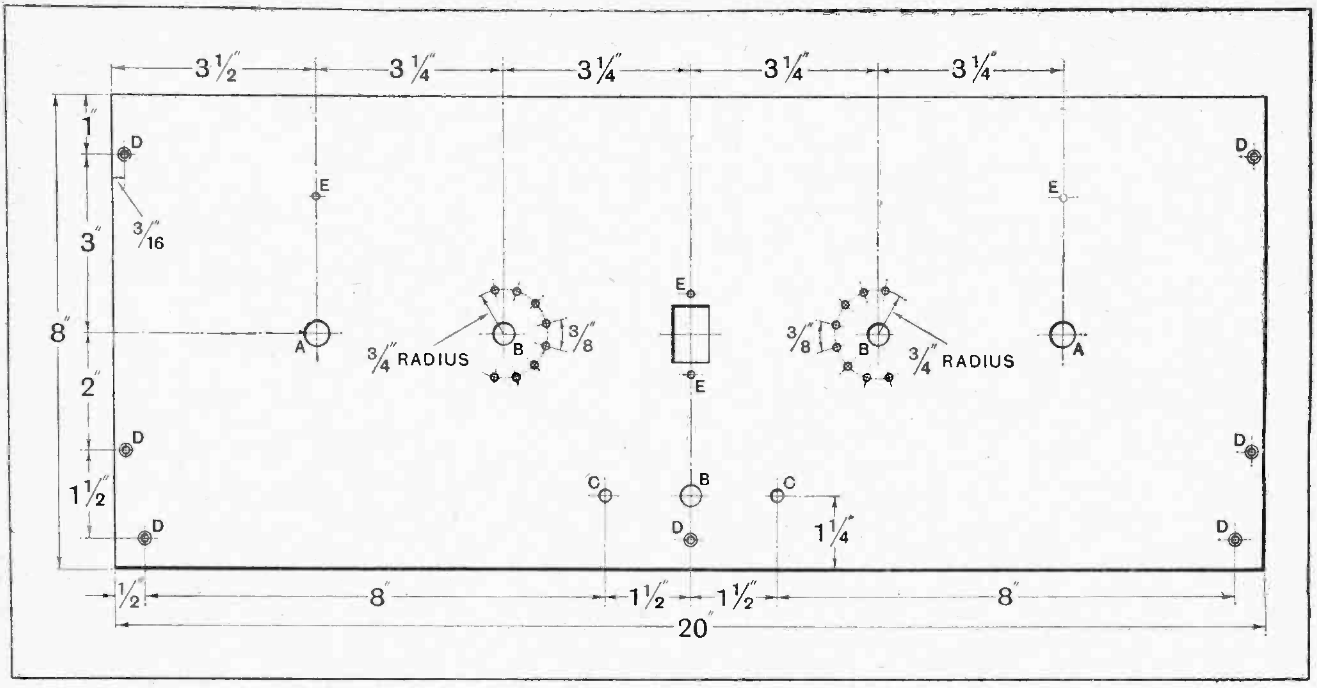


Fig. 2.—Dimensional details of the front panel. Drilling sizes are as follow :—A, $\frac{7}{16}$ in. dia. ; B, $\frac{3}{8}$ in. dia. ; C, $\frac{5}{32}$ in. dia. ; D, $\frac{1}{8}$ in. dia., and countersunk for No. 4 wood screws ; E, $\frac{1}{8}$ in. dia.

In the receiver under discussion, a capacity-controlled reaction circuit (actually the Reinartz) has been chosen as the most suitable. Now, with regard to the remainder of the circuit, we shall need one L.F. stage which will give us ample loud-speaker strength on the nearer stations, and a transformer-coupled stage has been chosen partly because we want the utmost amplification we can get as we are only going to use one stage, and partly because the writer has got to be convinced (by demonstration only, please) that the reproduction obtainable with a good inter-valve transformer and suitable valves is in anyway inferior in quality to resistance coupling of any kind. Those who wish to argue that equal L.F. amplification would be obtained by one of the new high magnification factor high-impedance valves and a suitable resistance coupling unit, must not forget that this receiver is not intended for the local and high power stations only, and we cannot, therefore, forgo the benefits conferred by our reaction system.

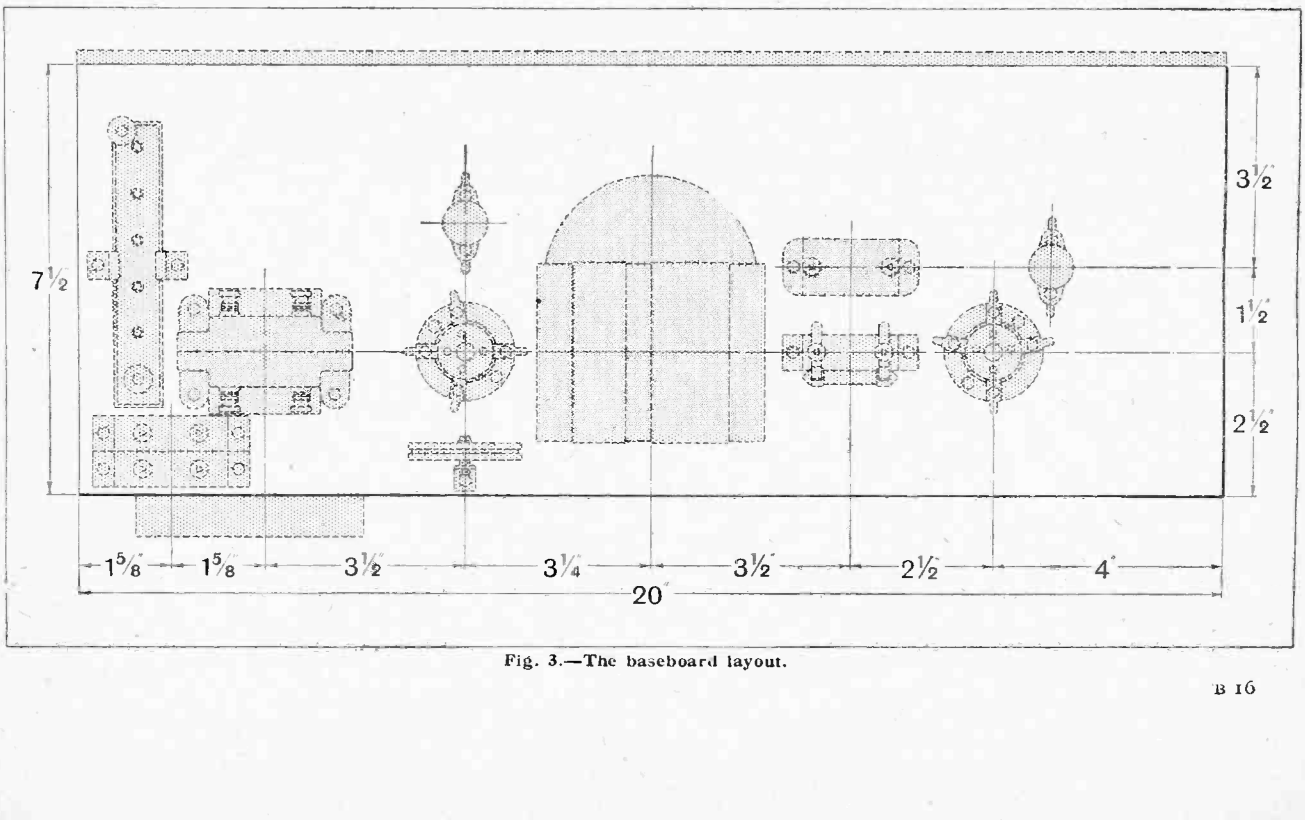


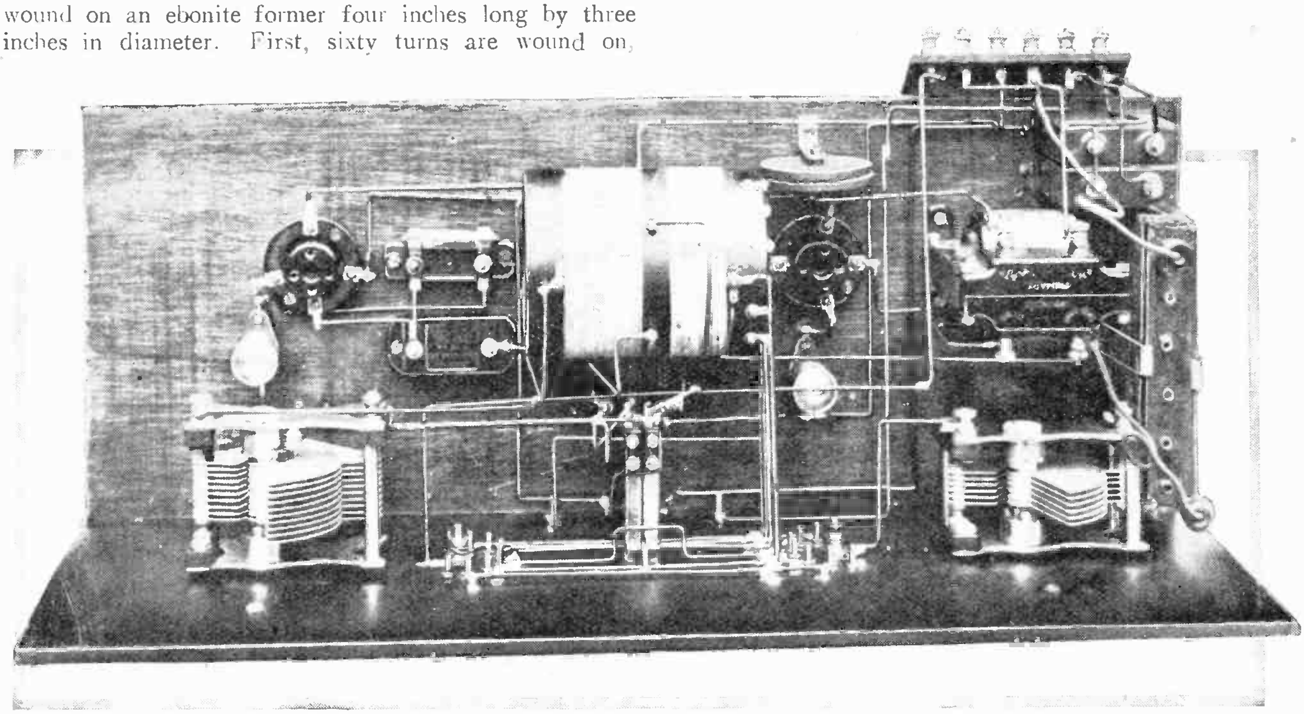
Fig. 3.—The baseboard layout.

LIST OF COMPONENTS.

1 Ebonite panel, 20in. × 8in. × ¼in.
1 Wooden baseboard, 20in. × 7½in. × ½in.
1 Ebonite tube, 4in. × 3in. dia.
3 Ebonite discs, 3¼in. × ⅛in.
2 Ebonite discs, 2¾in. × ⅛in.
1 0.0005 mfd. variable condenser with vernier (Williams & Moffat).
1 0.0003 mfd. variable condenser with vernier (Williams & Moffat).
1 L.F. transformer (Ferranti).
2 Valve holders (Aermonic).
1 0.0003 mfd. grid condenser (Dubilier).
1 2-megohm grid leak (Dubilier).
1 "Dumetohm" grid leak holder (Dubilier).
2 Stud switches (Bowyer Lowe).
1 Dewar type switch (Ericsson).
1 Terminal strip (Edison Bell).
2 Telephone terminals (Belling Lee).
1 Key switch (Lissen).
2 1 mfd. condensers (T.C.C.)
1 9-volt grid battery (Hellesen).
2 Fixed resistor holders (Burndept).
2 Fixed resistors or shorting plugs (Burndept).
2 Dial indicators (Belling Lee).
Quantity of No. 24 and No. 30 D.C.C. wire.

Approximate total cost £5 5s. 0d.

With regard to the constructional details, the only part which should present any difficulty, is the making of the coils used, the remainder of the work being merely straightforward assembly work. The short wave coil consists of a total of 100 turns of No. 24 D.C.C. wound on an ebonite former four inches long by three inches in diameter. First, sixty turns are wound on, commencing half an inch from the beginning of the ebonite former, each end of the winding terminating in a soldering tag held in position by a nut and bolt passing through the wall of the ebonite former. This portion of the coil is for tuning the grid circuit. A space of ⅜in. is then left on the former, this space being merely for the accommodation of the nuts and bolts, and then a further 40 turns of the same wire is wound on in the same direction. This part of the coil is the combined aerial and reaction coil, and as to the ends of its winding it is secured in the same manner as before. This coil, however, must have certain tappings made to it as it is being wound, the actual taps occurring at the 5th, 10th, 15th, 25th, and 35th turns. Each of these tappings is led down directly through a small hole into the interior of the cylindrical former, whence it passes along to the end of the former to the usual nut and bolt fastening. These tapping terminals are clearly seen in the photographs.



A view taken from above showing the connections of the coil tappings.

The long-wave coil is wound on a different type of former, and it is first necessary to construct this former, which consists virtually of a disc with two peripheral slots into which the grid and combined aerial-reaction coils are respectively wound. It is actually made up from five ebonite discs, three having a 3¼in. diameter and two a 2¾in. diameter. These should be cut from $\frac{3}{16}$in. ebonite. In case the ordinary constructor lacks the necessary skill for cutting these out, it should be mentioned that any dealer should be willing to supply them at small cost. The discs are all clamped together by two nuts and bolts, the smaller sandwiched between the larger, and thus two peripheral slots are formed whose deepness and width are determined by the relative diameters of the large and small discs and the thickness of the discs respectively. Into one of these slots is wound 200 turns of No. 30 D.C.C. for the long-wave grid coil, the two ends of

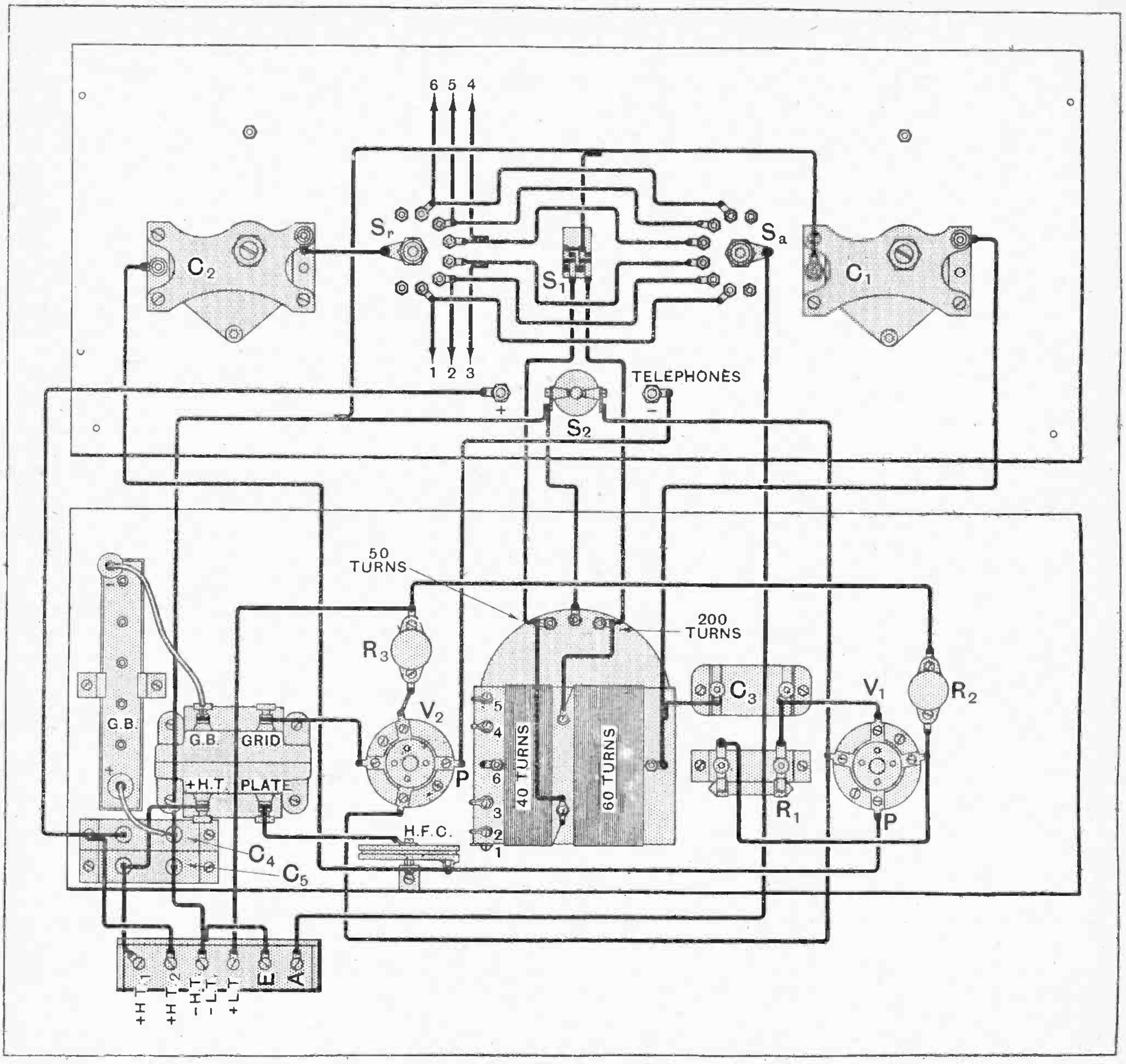


Fig. 4.—The practical wiring diagram.

the winding being taken to the same type of "anchorages" as before, situated on the outer disc of this particular winding. The winding having at the 200th turn been taken up to the terminal just mentioned is then continued into the other slot, where fifty turns are wound for the aerial-reaction coil, the end of the winding being taken to a fastening situated side by side with the other two. This long-wave coil is then screwed down to the baseboard, grid winding uppermost, by means of an ordinary wood screw passed through its centre. The short-wave coil is then straddled over the long-wave coil (the two magnetic fields being at right angles), and is supported on two cylindrical pieces of ebonite tubing one inch long. The Dewar type switch is so connected that when put in an upward direction it short-circuits both sections of this loading coil, the horizontal position letting these extra inductances into the two circuits for long-wave reception. With regard to the H.F. choke any of the commercial instruments at present on the market will suffice, although actually the writer has made use of the home-made choke, of which full constructional details were given in the "Hints and Tips" section of this journal for February 24th.

Final Adjustments.

With regard to operating details, it may be said at once that success or otherwise depends upon an intelligent use of the reaction controls. For smooth working, the writer has found that the best results are obtained by using a valve of from 20,000 to 30,000 ohms impedance

Two Range Reinartz.—

with about 40 volts H.T. as detector. The output valve should, in the interests of good quality, be one of about 7,000 ohms impedance with an H.T. voltage of 120 and appropriate grid bias. If one bears these facts in mind it matters little whether the valves are of the 2-, 4-, or 6-volt type. Reaction should first be adjusted coarsely by means of the stud switch, using the smallest number of turns with which it is possible to secure oscillation.

Increasing Selectivity.

With regard to the aerial tap, it will be found that for loudest signals more turns will be required in the aerial coil when working on the upper part of the 200 to 600 wavelength band than when working on the lower part. To a certain extent the actual tapping for best results on any given wavelength depends on the characteristics of the particular aerial used, and so no definite figures can be given. Selectivity can always be secured at the expense of signal strength by cutting down the number of turns in the aerial circuit. Thus with only five turns in the aerial circuit selectivity is good, but signal strength on distant stations naturally suffers.

In conclusion, the writer would like to add that those who require loud-speaker operation of stations which are already received on the telephones may accomplish their desires by adding an extra L.F. stage, without a great deal of trouble, but on no account is the adding of H.F. advised. In the long run it will be found a more economical matter to purchase a racing car complete than to dump a high-powered engine in the old family covered wagon.

Calls Heard.

Extracts from Readers' Logs.

Thornton Heath.

(October and November.)

Great Britain :—('Phone) G 2JB, 2RG, 5DC, 5GQ. 5KU, 5QV. 5TZ. 5US, 5UW, 6GF, 6OH, 6QO, 6UZ. Northern Ireland :—GI, 5NJ, 6MU ('phone). Australia :—A 3BD. Tasmania :—A 7AA, 7CS. Argentine :—R AD1, AF1, BA1, BG4. Brazil :—BZ 1AD. 1AK. 1AN, 1AO, 1AP, 1AV, 1BD, 1BI, 1QA, 2AB, 2AD, 2AG, 5AB. 5AD, 6QB. Canada :—C 1AR, 2AL, 2AN. Hong-Kong :—BXY. Java :—AND. New Zealand :—Z 2BG, 3AI, 4AA. Philippines :—PI 1BD. Porto Rico :—PR 4SA. South Africa :—O A6N. U.S.A. :—U 1AHV, 1AIR, 1AMD, 1AXA, 1BJR, 1BQT, 1BZP, 1CMF, 1CNZ, 1DM, 1KL, 1LJ. 1RD, 1VF, 2AES. 2AD, 2BQS. 2CTF, 2FJ, 2KVS, 2RS. 2ZV, 3AFW, 3CDV. 3CJN, 3GP. 3QW, 4FT. 4IS, 4TV. 8ADG, 8BF, 8BTH, 8ES, NBA. Others :—TPAI, UM-CYY.

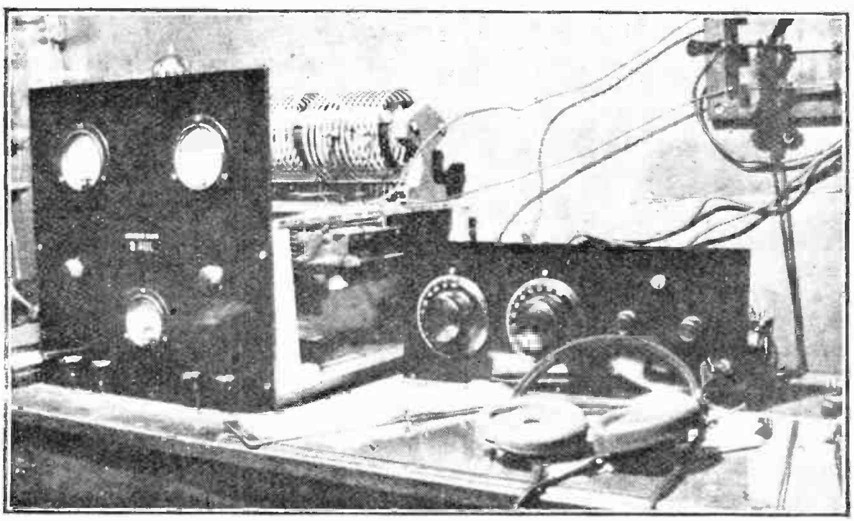
(0-v-0 and 0-v-1.)

M. E. Coaffee.

Dublin.

New Zealand :—Z 1AV, 1AX, 1FE, 2AB, 2AC, 2AE, 2GC, 2XA, 3AI, 3AR, 4AA, 4AC, 4AM, 4AV. Australia :—A 2CM, 2CS. 2IJ, 2YI, 3BD, 3BQ, 3EF, 3LS, 4CM. 5KN, 7CS, 7LA, 7CW. Argentine :—R FF9, AF1. Philippine Islands :—PI 1AU, 1BD, WUAJ. Japan :—JKZB, JOC. China :—C FUP, BXY, 9AA. Brazil :—BZ 1AO, 1AK. 1AW. 1BC, 1BI, 1QA, 2AB, 2AF, 5AB. 5AD, 5AE, 6QB. South Africa :—O A3B. A4Z, A5X, A6N. Canada :—C 1AC, 1AR, 1DD, 2FO, 3KP, VOQ. Borneo :—BN SK2. Uruguay :—Y 2AK. Chile :—CH 2LD. Porto Rico :—PR 4JA, 4JE. U.S.A. :—U 1AAO, 1ADM, 1AGA, 1ALR, 1ASA, 1AXA, 1AXX, 1BIG, 1BMM, 1BTF, 1BXH, 1BZP, 1CH, 1CIB, 1CJC, 1CKP, 1CMX, 1CRI, 1CWC, 1GA, 1KC, 1KK, 1KL, 1NQ, 1MY, 1QI, 1RD, 1SW, 1UW, 1ZK, 2ABA, 2AMJ, 2ANX, 2APD, 2ARM, 2BAD, 2BRB, 2BW, 2BXJ, 2CC, 2CVJ, 2FO, 2UO, 3ACL, 3AFQ, 3FJS, 3MV, 3ZO, 4CV, 4LK, 4LL, 4NI, 4PR, 4QB, 5AQY, 5KC, 6EW, 6OI, 7IT, 7WU. 8ADG, 8AHC, 8ALY, 8BTH, 8DDN, 8EQ, 8XE, 9BBF, 9BWW, 9DWO. 9ECC, 9EEV, 9XI, WIY, AA7, AB1.

D. F. and D. M. O'Dwyer (GW 18B).



AN AMERICAN AMATEUR STATION. U 8AUL owned and operated by Mr. R. D. Craig, at 4414, Water Street, Wheeling, West Virginia. This station uses 240 watts input with "S Tube" rectification, and the aerial is 88 ft. long and 40 ft. high. Mr. Craig will welcome reports on his 20 metre transmission.

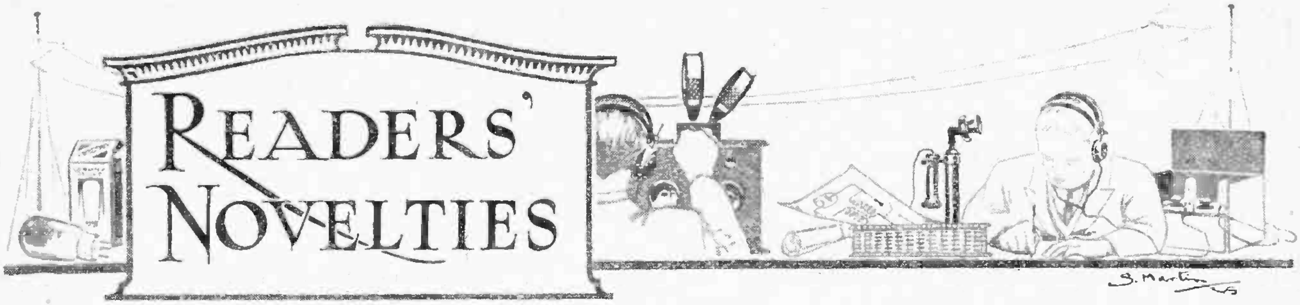
Howden, E. Yorks.

(October 20th to November 20th.)

U.S.A. :—U 1AIB. 1AFG, 1AG, 1AGA, 1AK, 1AMD. 1ANX. 1AQK, 1ASU, 1AWR, 1AXX, 1AZR. 1AZT. 1BBX, 1BCH. 1BHM. 1BJK. 1BKE. 1BL. 1BMI, 1BZP. 1CI. 1CIB. 1CJH. 1CJS. 1CMP, 1CMX, 1CX, 1DA. 1DI, 1GA. 1KC. 1KF, 1QC, 1RD. 1SW. 1TN, 1VZ. 1XAM. 1XV, 1ZD. 2ABP. 2AFG, 2AFO, 2AHK, 2AKZ, 2ALM, 2AMJ, 2ANP, 2ANX. 2ARM, 2AVK, 2AYJ. 2BAA. 2BG. 2BGZ, 2BKR. 2BL, 2BWA. 2CBG, 2CFT, 2CJB, 2EM. 2FA. 2MA, 2MM, 3AKW, 3AP, 3AW. 3AY, 3BLC. 3BWT. 3CAB, 3DN, 3EF, 3GP, 3HG, 3JN. 3JO, 3LD, 4BX, 4CB. 4IZ. 5AAV. 8ADG. 8AGO. 8BA, 8BEN. 8BOU. 8CQZ. 8CFH. 8CLS. 8KC, 8MC. 8XE. 9ADG. 9BHI, 9BMM, 9EJI, 9SJ. 9TF. Brazil :—BZ 1AA, 1AD, 1AI, 1AK, 1AL. 1AN. 1AO. 1AW, 1AX. 1BI, 2AF, 2AQ. 5AA. 6QA. SNI. SQIX. Canada :—C 1AR. 2BG, 2FO, 3AA, 3MP. Argentine :—R BG8. CB8. DB2. Uruguay :—X 137. 331, Y 1CD. Chile :—CH 2AS. 2 LD. Madeira :—P 3FZ. Porto Rico :—PR 3AB. 3JA. New Zealand :—Z 1AO, 2AC, 3BA. Australia :—A 5BG. Japan :—J 2PZ.

(0-v-1 Reinartz.)

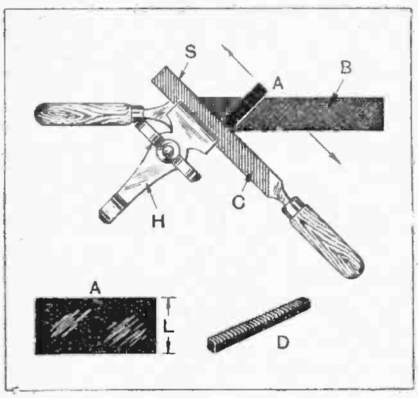
D. E. Scarr.



A Section Devoted to New Ideas and Practical Devices.

SPACING STRIPS.

In transformer and other solenoid coils where another winding is supported by ebonite strips placed symmetrically between the two windings, it is a great advantage if grooves at the desired distance apart can be made



Cutting grooves in spacing strips.

in the strips. The workshop method of doing this is, of course, to chase a thread of the desired pitch upon a piece of ebonite tube and subsequently cut the strips out of this, but all constructors have not a lathe at their disposal.

An alternative method is as follows :—

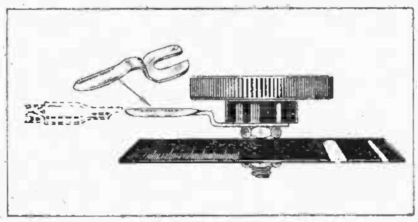
Take a new file, the teeth of which are the desired width apart (bastard or coarse cut is generally suitable) and with a hand vice clamp another file or a strip of fairly thick metal so that its edge "S" (safe edge if a file) is parallel with the cuts on the first file. Now cut a piece of short ebonite (A) of a thickness corresponding with the width desired for the spacing strips and of a width equal to the length the strips should be (L). This should then be placed upon the file with its left edge close to the guide and at right angles to it. Now rub it to and fro upon the teeth of the file until the grooves the teeth will cut are deep enough. Then saw the strip off, when it will have the appearance of D. As many strips as are needed can be made in this way, and each sawn-off when the grooves are filed. If rather wide spacing of the wire is needed on the transformer alternate grooves only need be used to wind the wire upon. —W. F. C.

oooo

EXTENSION HANDLE.

Where several tuning dials have to be adjusted in a receiver suffering from hand capacity effects, a single extension handle which can be applied successively to each dial is an advantage.

An ordinary penholder may be used for this purpose, if a modified "pen



Penholder extension handle.

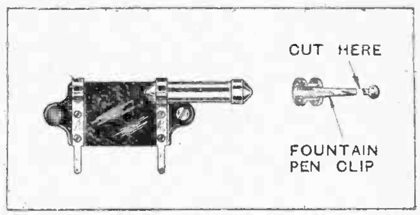
nib" is fitted underneath the knob of each dial. A large spade terminal would probably suffice, if the end is bent to the shape of the curved portion of a pen nib. It is then an easy matter to fix the penholder to the adaptor on each dial for tuning purposes.—G. D.

oooo

GRID LEAK CONNECTIONS.

When converting grid condenser and leak units in order that the grid leak may be connected between grid and filament instead of in parallel with the grid condenser, it is generally necessary to remove the grid leak and remount it in a special holder. This is unnecessary if the scheme shown in the diagram is followed.

One of the original clips is utilised to hold one end of the leak, and the connection to the other end is made



Grid leak clip.

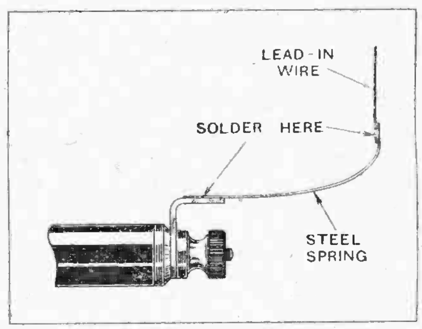
through the medium of a fountain pen clip of the type shown in the diagram. The end of the clip is cut off, leaving part of the spring to serve as a soldering tag.—E. J. T.

oooo

LEAD-IN JOINT.

Through swaying of the aerial in the wind the lead-in frequently breaks at the point where it is attached to the terminal of the lead-in tube.

This trouble may be overcome by making the connection to the lead-in



Improved lead-in joint.

terminal through the medium of a length of clock spring soldered at one end to the down-lead and at the other end to a stiff brass bracket clamped beneath the terminal nut.—C. P. S.

Broadcast Receivers.

THE POLAR-THREE RECEIVER.

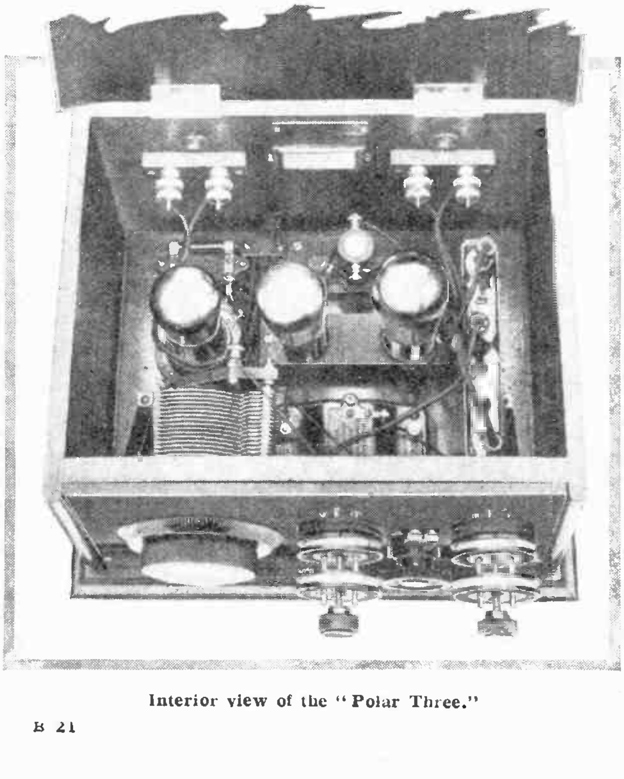
A Compact Set for Loud-speaker Reception from the Local Station and Daventry.

Three-valve receivers, incorporating a detector valve and two low-frequency amplifiers, are exceedingly popular with listeners primarily interested in loud-speaker reception from the local station and Daventry. Accordingly, we are commencing this series of receiver tests with simple three-valve sets of this type for the guidance of readers requiring broadcast reception with the minimum complication and cost.

IN a descriptive leaflet issued by the makers of the Polar-Three Receiver it is specifically stated that no attempt has been made to achieve record-breaking results, but that an endeavour has been made to provide loud-speaker reception of at least one broadcast programme in any part of the country.

In general, two programmes will be available, one from the local main station and the other from Daventry. Such a receiver meets the requirements of the majority of listeners who require clear reproduction of the broadcast programmes of adequate volume with as little complication as possible.

The Radio Communication Co., Ltd., have set themselves out to meet this demand and have succeeded in producing a neat and compact receiver containing all the essentials of broadcast reception without "frills."



Interior view of the "Polar Three."

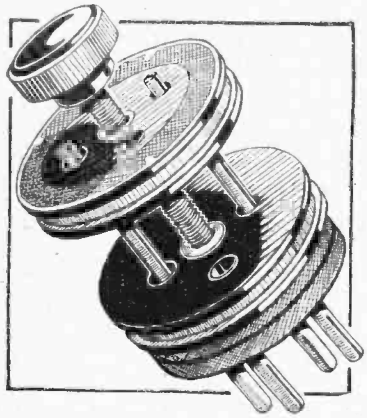
Simple Tuning Controls.

The controls represent the irreducible minimum for a receiver of this type and are perfectly simple to operate. The control which will be used most is the valve switch immediately below the tuning dial. This switch interrupts the filament current to the valves, and, the set having been once tuned in, it may be switched on and off in the same way as an electric light. Second in importance is the double-pole change-over switch below the two coil units, by means of which the receiver may be switched over from the local station to Daventry. Retuning by means of the third control (the tuning condenser dial) is generally necessary when changing over from one wavelength range to the other. An additional tuning control would be necessary to render the change-over automatic, and the manufacturers evidently regard this complication as unjustified, having regard to the general simplicity of the set. The fourth control in order of importance is the reaction coupling between pairs of coils in the tuning units. The distance between the coils is varied by a quick-motion thread; this adjustment is made when the set is first installed, and requires no further attention so long as the wavelengths of the stations being received remain unchanged. It is to be regretted that the makers have not taken advantage of this fact to house the coil units inside the set immediately below the hinged lid. There they would be safe from mischievous or accidental interference which might set the receiver oscillating during the absence

Broadcast Receivers.—

of a responsible person, thus causing considerable annoyance to neighbours.

Instead of the usual terminal panel for battery connections, a set of battery leads are supplied with the receiver and are permanently connected into the circuit. The leads are clearly marked with braided covering of different colours, and there can be no possible excuse for making a wrong connection. The leads pass through an ebonite bush in the back of the receiver cabinet, a particularly neat method which is also applied to the aerial, earth, and loud-speaker leads. Separate ebonite bushes are provided for the latter groups of leads, and a small terminal block is mounted inside the cabinet beneath each bush, as shown in the sketch. The provision of a single bush for the aerial and earth leads must not be made an excuse for using twin flex for the lead-in and earth connections.



The "Polar" reaction unit.

The receiver was tested with the valves and battery voltages specified by the makers. For the detector valve a P.M.1 H.F. was used, for the first L.F. a P.M.1 L.F., and for the power valve a P.M.2. These valves require a two-volt battery for the filament current supply and H.T. batteries totalling 132 volts. Anode voltages up to 90 are recommended for the detector.

The actual tests of the receiver were carried out with 86 volts on the detector and 136 on the two L.F. valves. The grid bias was adjusted to – 4.5 volts for the P.M.1 L.F. valve and – 9 volts for the P.M.2.

Performance.

On a standard P.M.G. aerial the wavelength ranges of the two sets of coils supplied with the receiver were as follow: 270 to 480 metres on the short-wave coils and 1,100 to 2,200 on the long-wave coils.

The receiver was tested for sensitivity and selectivity both on broadcasting and by means of a special modulated oscillator. Results under both these heads were normal having regard to the type of circuit adopted, and indicated that the range of the receiver on a standard 100ft. aerial would be 30 miles on a main B.B.C. station and 150 miles on Daventry.

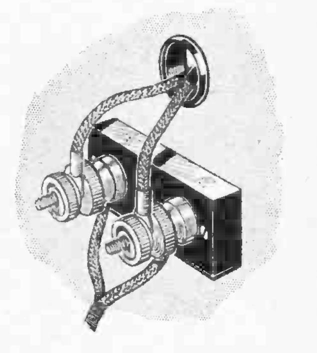
While selectivity on each range taken separately was poor, the "selectivity" between the two ranges was good. When only one station is to be received on each wavelength range selectivity is unimportant, but it is essential that there should be no interference from the local main station when receiving Daventry. This requirement was fulfilled at a distance of four miles from 2LO, Daventry being received without noticeable interference from the former station. This result can be considered good.

The quality of reproduction was satisfactory provided that the receiver was not "pushed." No attempt should be made with this receiver to obtain realistic volume on orchestral items, but excellent results may be expected from solo performers, chamber music, and talks.

The current consumption of the receiver is comparatively low. The valve filaments draw a total of 0.35 ampere from the 2-volt accumulator. A 30-ampere hour cell is recommended by the makers, and this should give 100 hours' service on each charge. The total current drawn from the H.T. battery is 6 milliamperes, quite a low figure for a three-valve set, and the small type H.T. batteries recommended by the makers should give satisfactory service under these conditions. Assuming that the set is used three or four hours a day, the batteries will require renewal on an average every six months, the cost of renewal being 25s.

The circuit is conventional and follows well-tried principles. The reacting detector valve is followed by two low-frequency amplifying valves. The first amplifier is coupled to the detector by means of an iron-cored transformer, and resistance-capacity coupling is employed between the first amplifier and the power valve. The loud-speaker is connected directly in the anode circuit of the power valve. Separate tappings for each of the L.F. valves are available on the grid bias battery, which is mounted inside the cabinet.

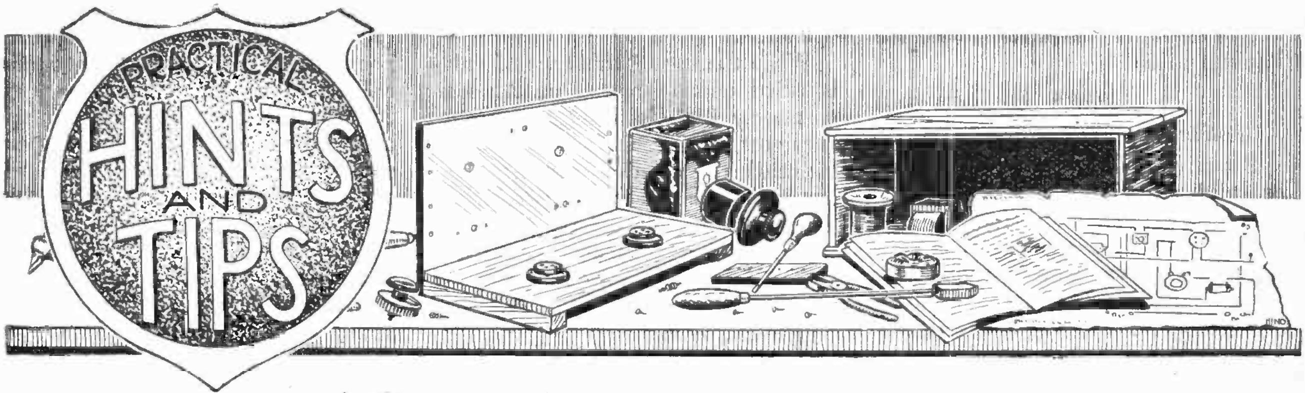
There are one or two unique constructional details. For instance, the condenser is controlled by the well-known Polar cam-vernier movement, which gives both coarse and fine adjustment by means of one knob only. The coupling resistances and condenser between the two L.F. valves are mounted in the form of a compact unit, the condenser forming the base and the grid leak being mounted inside the wire-wound anode resistance. This is standard practice in all Polar sets making use of resistance-capacity coupling, and the units are available as separate components.



Neat terminal panels and ebonite bushes are provided at the back of the set for aerial, earth and loud-speaker leads.

The two L.F. valves are mounted on a platform carrying two rigid valve-holders, and are sufficiently protected from vibration by the rubber feet on the base of the cabinet. A separate rubber sponge mounting is provided for the detector.

The Polar-Three Receiver can be recommended for the reception of the British Broadcasting Company's programmes from one or two stations at moderate loud-speaker strength. The price of the receiver, including grid bias battery and leads, is £10. To this must be added Marconi royalty of £1 17s. 6d. The cost of a complete installation, inclusive of royalty and all accessories recommended by the makers, is £19 12s. 9d. The manufacturers are The Radio Communication Co., Ltd., Barnes, London, S.W.13.



A Section Mainly for the New Reader.

A WIRING HINT.

Porcelain-insulated connectors, such as those sold by many electrical dealers at a few pence each, have several applications for wireless purposes, particularly when joining up a temporary telephone or loud-speaker extension lead. They are obtainable in several patterns—those with one, two, or three brass insets are referred to respectively as "one-way," "two-way," and "three-way" connectors, and are illustrated in Fig. 1.

In the majority of these fittings

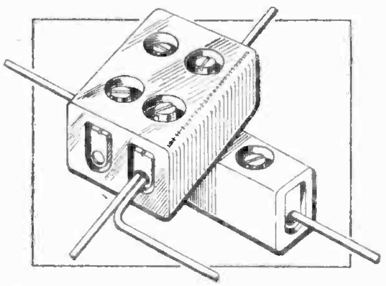


Fig. 1.—Connectors with porcelain insulation.

both screw-heads and insets are sunk well below the surface of the porcelain, so there is little fear of an accidental short-circuit. The connectors will often be found useful when making an experimental alteration in the wiring of a receiver. For instance, it may be necessary to insert temporarily an extra resistance in one of the filament circuits of a multi-valve set; this operation is easily carried out by cutting the appropriate wire and inserting the ends in the opposite sides of a two-way connector to which flexible leads are attached for joining to the extra resistance.

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CHOOSING POWER VALVES.

An examination of the characteristic curves of some of the newer power valves, which are primarily designed for large inputs, shows that they are capable of handling greater amplitudes with only 80 or 90 volts of high tension than are the ordinary type with 120 volts.

These valves will, therefore, commend themselves to the notice of the amateur who is desirous of obtaining the best possible reproduction combined with economy in outlay, because the extra cost of the valve may be offset by a less expensive H.T. battery. It must not be forgotten, however, that the anode current will still be considerable, even with the large grid bias voltage which may be used.

The low impedance of these "high-power" valves is of assistance in bringing out the low tones which are so often lacking in loud-speaker reproduction.

o o o o

HIGH-AMPLIFICATION VALVES.

When valves having an amplification factor of 30 or more are used as anode detectors or L.F. amplifiers, it is usual to insert a very high resistance of 0.5 megohm, or even more, in their anode circuits. It may be useful to know that, working under these conditions, the valves rated at from 5 to 6 volts give an ample emission with 4 volts, or even less, applied to their filaments. It will often be found convenient to operate one or more of these valves in conjunction with those rated at 4 volts, the filaments of the latter being, of course, heated in the normal manner.

When the "high-amplification" valves are worked in any other way (*e.g.*, as grid detectors or tuned anode H.F. amplifiers) the full filament emission will be required, and the rated voltage must be applied.

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TUNING THE "UNTUNED" AERIAL CIRCUIT.

It will sometimes be found that both sensitivity and selectivity are improved by tuning a so-called "aperiodic" aerial circuit. A marked improvement as far as the former is concerned is most likely to

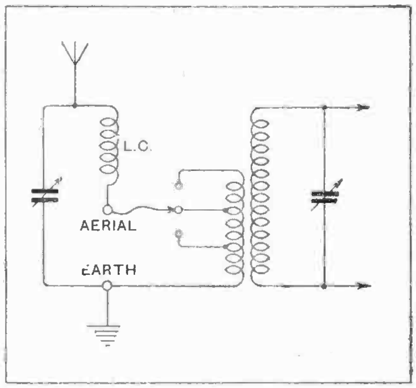

Fig. 2.—Adding a tuned aerial circuit.

be noticed when the aerial is exceptionally short.

An existing receiver may easily be modified by connecting an external loading coil and variable condenser to the aerial and earth terminals, as shown in Fig. 2. For the broadcast waveband, the coil will have from twenty-five to fifty turns (it may be of the plug-in variety), while the maximum capacity of the condenser should be from 0.0003 to 0.0005 mfd.

The degree of coupling between aerial and closed circuits may be controlled by varying the primary inductance of the "aperiodic" coupler; this is already provided for in the majority of more recent designs. It is assumed that the loading coil will not be in inductive relation with the internal coils.

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SENSITIVE LOUD-SPEAKERS.

Sensitivity is seldom put forward as a desirable quality in a loud-speaker, although it should be realised that the use of an instrument giving considerable volume with a small input will enable us to effect a considerable economy in the receiving apparatus, and at the same time to obtain a signal of sufficient loudness.

It is, unfortunately, a fact that the majority of modern loud-speakers, particularly those of the "cone" type, give appreciably weaker signals on a given input than those fitted with a horn; indeed, it may be said that many of the former require a "super-power" valve in the last stage of the amplifier for really satisfactory operation.

When the use of this type of valve is ruled out by reason of its comparatively high initial and maintenance cost, it is advisable to pay some attention to sensitivity when choosing a loud-speaker, and to remember that, even if that decided upon is slightly less perfect, considered purely from the point of view of quality, than another less sensitive instrument, it is likely to give infinitely more pleasing results if adequate volume is obtainable without overloading the output valve.

oooo

TESTING WITH DRY BATTERY AND PHONES.

Although it would appear to be a fairly simple matter to test the insulation or continuity of a circuit by means of a battery and phones, there are in practice one or two small difficulties which are likely to puzzle the beginner. The most important of these is connected with the fact that a click will be heard when completing a circuit containing an appreciable capacity, due to the flow of charging current into the condenser. This will possibly give rise to a mistaken idea that insulation is inadequate; to assure himself on this point the reader should listen carefully when *breaking* the circuit, and if no click is heard it may be assumed that everything is in order.

It is always advisable to use insulated electrodes (wander plugs or insulated pin terminals will serve) to avoid leakage through the body of the tester.

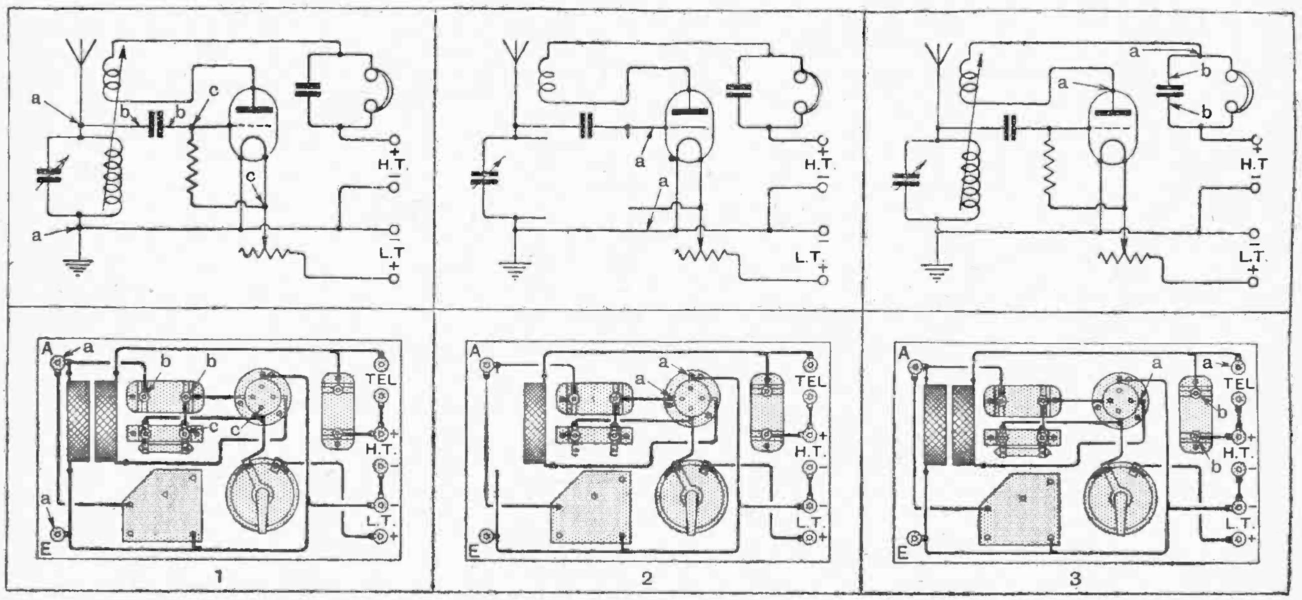
It will also be as well to get an idea of the loudness of the click, which should be heard when a pair of phones and a battery of a given voltage are connected across a resistance (grid leak or anode resistor) of known value.

DISSECTED DIAGRAMS.

Point-to-point Tests in Theory and Practice.

No. 51.—A Single-valve Regenerative Receiver.

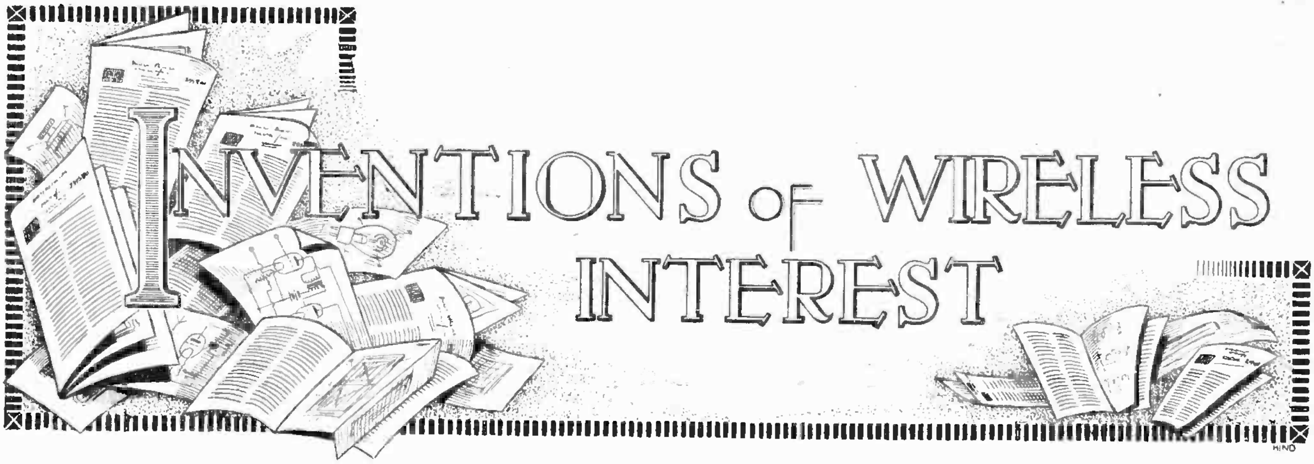
Below is given the first of a short series of diagrams, which are intended to show simple methods of locating faults in typical wireless receivers. Failing a sensitive galvanometer, it is suggested that a pair of telephones with a small dry battery should be used as an indicating device. The tests will show not only actual faults, but will reveal the small leakages which are often responsible for poor reception and flat tuning.



1. A test between the two points marked *a* will indicate continuity through the tuning coil and its connections; between *b* and *b*, insulation of the grid condenser, and between c and c, continuity of the grid leak. The valve should be removed from its socket.

2. With aerial coil and leak removed, and the tuning condenser set at minimum, a test between *a* and *a* will show the insulation of the grid circuit as a whole. This should be of a high order. Also test between −L.T. and aerial terminal.

3. The anode circuit of the valve may be tested between points *a* and *a*, and insulation of the by-pass condenser between *b* and *b*. A further insulation test is recommended between the plate and −L.T. (with H.T. battery disconnected). Several other continuity tests may be applied.



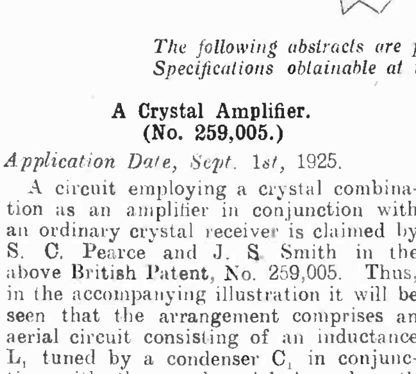
INVENTIONS OF WIRELESS INTEREST

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

A Crystal Amplifier. (No. 259,005.)

Application Date, Sept. 1st, 1925.

A circuit employing a crystal combination as an amplifier in conjunction with an ordinary crystal receiver is claimed by S. C. Pearce and J. S. Smith in the above British Patent, No. 259,005. Thus, in the accompanying illustration it will be seen that the arrangement comprises an aerial circuit consisting of an inductance L_1 tuned by a condenser C_1 in conjunction with the usual aerial A and earth connection E. Another inductance L_2 is coupled to the aerial circuit, and is shunted by the usual detector D and telephones T. The connection between the lower end of the inductance L_1 and the earth is broken by two condensers K between which another crystal combination M is connected. This crystal combination is energised by a battery B in series with a choke L and a resistance R.



Crystal amplifier circuit. (No. 259,005.)

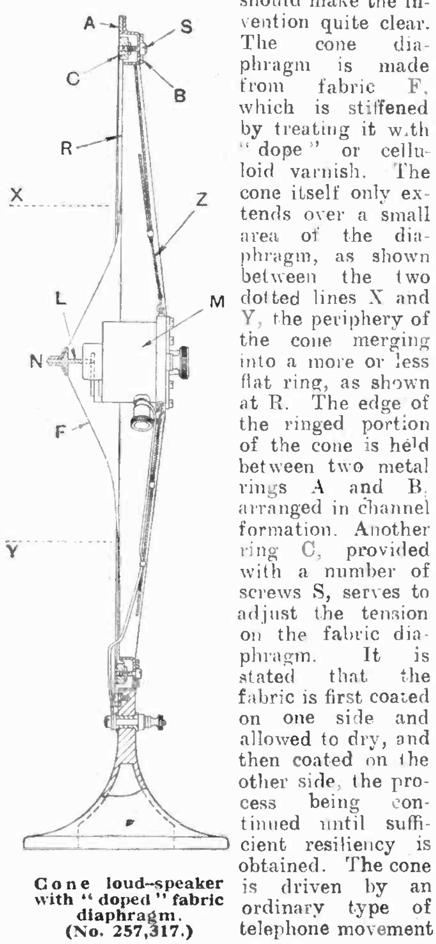
It is stated that the best adjustment of the battery voltage, the resistance, and contact pressure of the crystal combinations can be readily found, and that the circuit presents no difficulty in operation.

The specification gives no indication of the manner in which the circuit functions.

Another Cone-type Speaker. (No. 257,317.)

Application dates, April 30th and June 22nd, 1925.

An interesting form of cone loud-speaker is described by N. W. McLachlan in the above British patent. The accompanying illustration should make the invention quite clear. The cone diaphragm is made from fabric F, which is stiffened by treating it with "dope" or celluloid varnish. The cone itself only extends over a small area of the diaphragm, as shown between the two dotted lines X and Y, the periphery of the cone merging into a more or less flat ring, as shown at R. The edge of the ringed portion of the cone is held between two metal rings A and B, arranged in channel formation. Another ring C, provided with a number of screws S, serves to adjust the tension on the fabric diaphragm. It is stated that the fabric is first coated on one side and allowed to dry, and then coated on the other side, the process being continued until sufficient resiliency is obtained. The cone is driven by an ordinary type of telephone movement M, which is attached to the apex N by a link L. The movement is supported by a number of springs Z, the other ends of which are fixed to the metal framework and rings supporting the diaphragm.



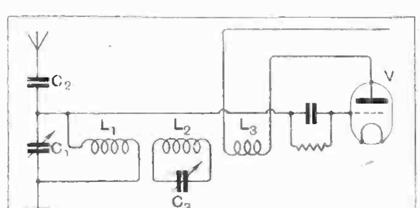
Cone loud-speaker with "doped" fabric diaphragm. (No. 257,317.)

○○○○

Selective Reaction Circuit. (No. 256,689.)

Application Date, May 12th, 1925.

A rather interesting form of selective receiving circuit is described by A. G. Benstead and Rotax (Motor Accessories), Limited. The invention really consists in coupling a tuned filter circuit or wave trap to the aerial inductance and coupling the reaction coil into the wave trap instead of into the normal aerial tuning circuit. Referring to the accompanying illustration, it will be seen that a tuned circuit L_1 C_1, which is connected to an aerial and earth system through a series condenser C_2, forms the input circuit of the valve V. Loosely coupled to the inductance L_1 is another tuned circuit L_2 C_3, which forms the trap circuit. Reaction is obtained by including an inductance L_3 in the anode circuit of the valve, which is then coupled to a trap circuit L_2 C_3. The reaction effect is brought about, of course, by the fact that the circuit L_2 C_3 is coupled to the grid circuit of the valve through the ordinary aerial tuning circuit. It should be noted that the intermediate circuit L_2 C_3 is electrically disconnected from the other components of the circuit.

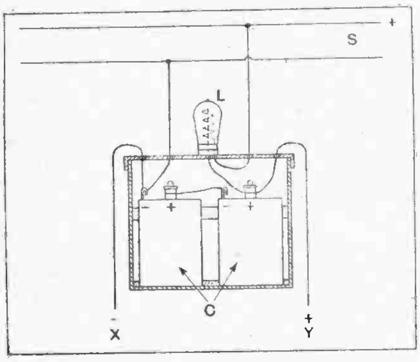


Reaction circuit with tuned intermediate circuit. (No. 256,689.)

Floating Battery Circuit.
(No. 258,739.)

Application Date, Oct. 15th, 1925.

E. Heese describes in the above British Patent Specification a circuit utilising a floating battery for the purpose of running the filaments of receiving valves from the supply mains. The novelty of the invention lies, perhaps, rather in the nature of the apparatus used than in the actual circuit. The accompanying diagram, which illustrates the invention, shows an ordinary battery consisting of two cells C connected through a lamp resistance L to the supply mains S, the supply to the valve set being taken across the two cells, *i.e.*, at X and Y. The specification, although very short, is exceedingly detailed, and provides for many modifications, such as the control of the charging current by switches or automatic cut-outs. It also provides for making the charging current exactly equal to the discharging current, so that the cell does not tend to overcharge. One of the chief features of the invention, however, is the use of lead-copper accumulators, since they are stated to be almost indestructible, and capable of remaining charged for years without deteriorating. Another type of cell which is mentioned is the recharge-



Floating batteries for L.T. supply.
(No. 258,739.)

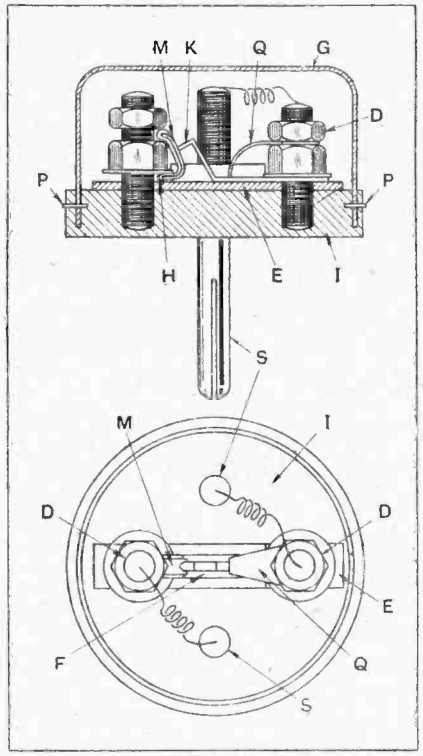
able carbon—manganese dioxide—zinc cell. Another feature of the invention is the use of the same type of cell in conjunction with a rectifier for use with A.C. mains.

o o o o

Molybdenite Detector.
(No. 256,830.)

Application Date, Nov. 13th, 1925.

A form of molybdenite detector is described by S. J. Eintracht and E. J. Dickins in the above British patent. The accompanying illustration should make the invention quite clear. The detector is of the enclosed type, mounted upon a circular insulating base I, provided with an annular groove in which the edge of a cover G can be placed and held in position by pins P. The detector is of the plug-in type, and for this purpose is provided with two split plugs S. Two studs D provided with nuts hold in position an insulating strip E provided with a groove F. One of the studs D and its associated nuts carry a clip H, which holds a strip of molybdenite. A soft strip of copper or similar metal K works in the groove F, and is controlled by a spring Q connected to the other stud. Leads are



Plug-in molybdenite detector.
(No. 256,830.)

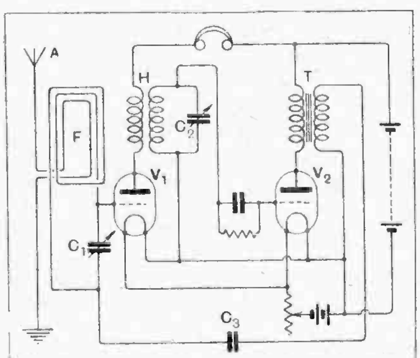
taken from the two studs to the two split plugs S. The detector element, of course, comprises the flat molybdenite surface in contact with the metal strip or point. A detector of this nature is very stable in operation.

o o o o

Frame Aerial Reflex Receiver.
(No. 256,688.)

Application Date, May 12th, 1925.

A familiar type of reflex receiver associated with a particular form of aerial circuit is described in the above British patent by A. G. Benstead and Rotax (Motor Accessories), Limited. The form of the reflex receiver will no doubt be recognised by reference to the accompanying illustration, in which it will be seen that the first valve acts as a high-frequency amplifier, the output being transferred to the detector valve by means of a high-frequency transformer H, the secondary of this being tuned by a condenser C_2. The anode circuit of the second or detector valve contains the primary winding of a low-frequency transformer, the secondary of which is connected to the grid circuit of the first valve. The grid circuit of the first valve V_1 comprises a frame aerial F, tuned by a variable condenser C_1. In addition the frame aerial F is inductively coupled to an ordinary open aerial A. Since the first valve acts as a low-frequency amplifier and as a high-frequency amplifier the telephones T are, of course, included in the anode circuit, as usual.



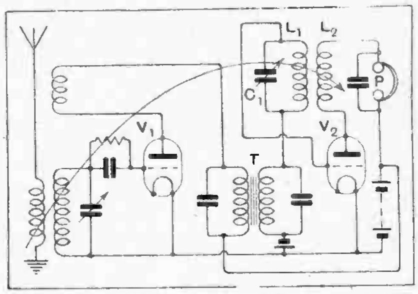
Two-valve reflex frame aerial circuit.
(No 256,688.)

o o o o

Eliminating Undesired Signals.
(No. 258,969.)

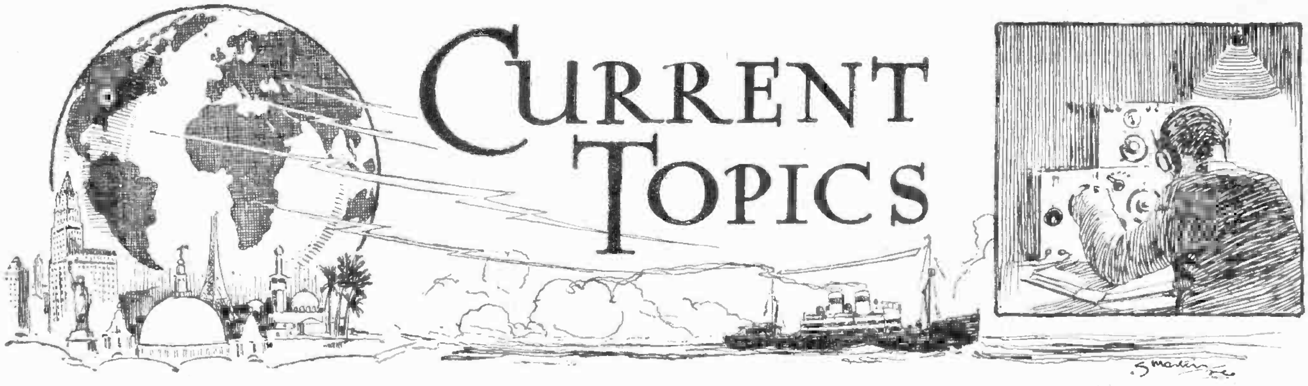
Application Date, July 9th, 1925.

Reaction rejector circuits for the elimination of undesired signals are well known, and a particular form of reaction rejector circuit is described in the above British Patent Specification by Igranic Electric Limited, and P. W. Willans. The novelty of the invention lies in the utilisa-



H.F. rejector in L.F. valve circuit.
(No. 258,969.)

tion of a low-frequency amplifying valve for the reaction rejector. Thus, the accompanying illustration should make the invention quite clear, where it will be seen that a detector valve V_1 is coupled by a low-frequency transformer T to an amplifying valve V_2, the anode circuit of which contains the telephones T. The aerial circuit comprises the usual aerial inductance coupled to a tuned circuit connected between the grid and filament of the first valve V_1, a grid condenser and leak being shown. Instead of connecting the secondary winding of the transformer T directly to the grid of the second valve V_2, a tuned circuit L_1 C_1 is included in the grid lead. Coupled to the inductance L_1 is another inductance L_2, which is in the anode circuit of the second valve. The two inductances are coupled in such a way as to bring about a regenerative or negative resistance effect, thereby materially lowering the effective resistance of the tuned circuit L_1 C_1.



CURRENT TOPICS

Events of the Week in Brief Review.

HACKNEY RADIO WEEK.

A " Radio Week " is being organised by the Hackney and District Radio Society, and will hold sway from January 10th to 15th, 1927.

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NO PRIVILEGE FOR GUARDIANS' STAFF.

The Postmaster-General has decided that separate licences must be taken out by individual members of the Fulham Guardians' staff who install receiving sets in their private apartments.

oooo

HOOTS!

" Gc " has been adopted as the national prefix for Scottish amateur transmitting stations. This will save the Caledonian " hams " the mortification of being mistaken for Englishmen.

oooo

A NOTABLE ANNIVERSARY.

The 25th anniversary occurred on Sunday last of Senatore Marconi's historic achievement in transmitting and receiving wireless signals across the Atlantic for the first time. The first signal was the letter " S," sent from Poldhu, Cornwall, and picked up at St. John's, Newfoundland.

oooo

NEW IRISH BROADCASTING SCHEME.

Mr. Walsh, Minister for Posts and Telegraphs in the Irish Free State, has outlined a broadcasting scheme which includes stations at Athlone and Gaeltacht in addition to those at Dublin and Cork. The Athlone station would operate on high power with a crystal range of 80-100 miles, deriving power from the Shannon water scheme.

oooo

PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION.

The seventeenth annual exhibition of the Physical Society and the Optical Society is to be held on Tuesday, Wednesday, and Thursday, January 4th, 5th and 6th, 1927, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, and will be open in the afternoons (from 3 to 6 p.m.) and in the evenings (from 7 to 10 p.m.). Further particulars will be announced later.

MORE WIRELESS LICENCES.

By the end of October the number of wireless receiving licences issued had dropped slightly, but the former level was reached at the end of November, the total being 2,130,785.

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GREETINGS BY BEAM.

Seasonable greetings can be sent to any town in Canada from any post office in Great Britain, "*via* Empiradio," at 2s. 6d. for 20 words. The new beam stations are employed for the service.

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A DANGEROUS AERIAL.

Eccles Town Council is adopting bylaws regulating the erection of wireless aerials in the borough. It is stated that an aerial which fell recently short-circuited an electric supply cable and caused damage.

RADIO RESEARCH BY AMATEURS.

The Radio Society of Great Britain has formed a Research Section, and it is understood that several ambitious plans are being proceeded with. The chairman of the new section is the well-known amateur transmitter, Mr. G. L. Morrow (6UV).

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STAMBOUL CALLING.

Constantinople will shortly have a broadcasting station with the slogan " Stamboul Calling." Receiving licences will probably cost about one guinea per annum.

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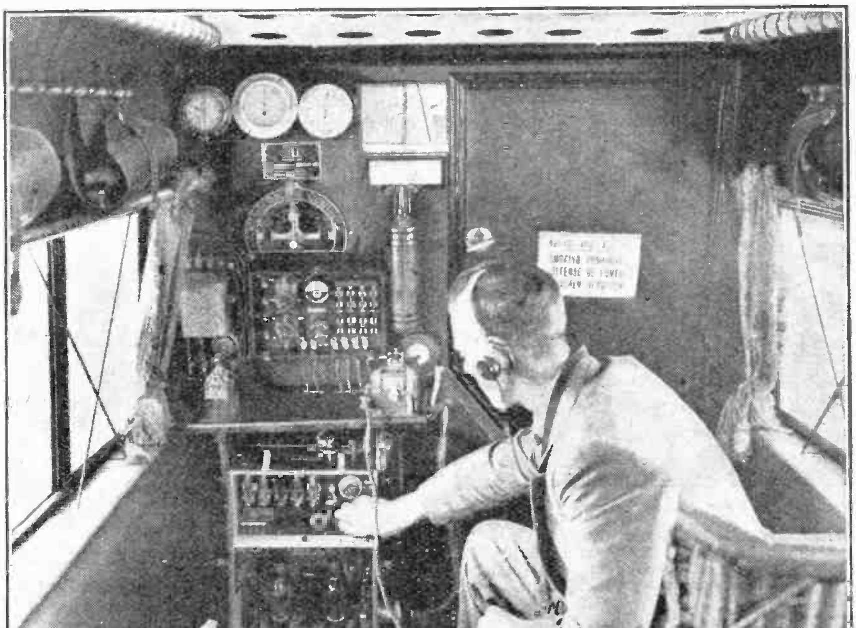
THE LAST STRAW.

With the licensing of five new American broadcasting stations during the past fortnight, the total number of stations now amount to 615, writes our Washing-



NEW AIR LINER'S WIRELESS CABIN. The first of the D.H. " Hercules " Air Liners for the new route to India via Cairo and Karachi is now practically complete. This photograph was taken in the wireless cabin, which is fitted with a Marconi telegraphy and telephony transmitter and receiver. A special operator will be carried, relieving the pilot of any wireless responsibility.

ton correspondent. Mr. Hoover, Secretary of State, remarks that now there is no longer any question but that there is chaos in the air!

oooo

NOVEL WIRELESS CASE.

At Grimsby last week an electrician was summoned for a breach of the Shops Closing Order in selling wireless batteries to a customer on closing day. It was urged on the defendant's behalf that to renew exhausted batteries for wireless sets was only effecting repairs and was a public service. The Bench dismissed the case.

SMALL ADVERTISEMENTS.

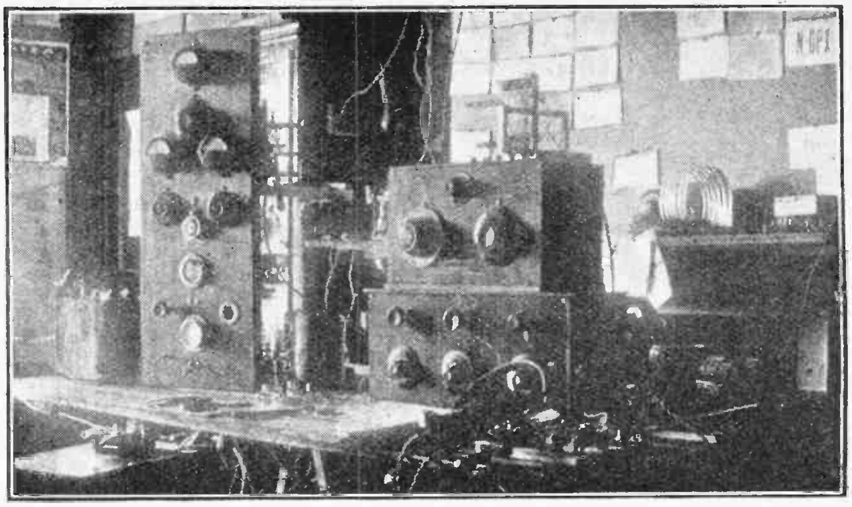
Owing to the Christmas Holidays, the issue of "The Wireless World" for December 29th must be closed for press earlier than usual. MISCELLANEOUS ADVERTISEMENTS for insertion in that issue can be accepted up till NOON on Wednesday, December 22nd.

"YES" BY WIRELESS.

At a radio convention held in Cleveland, Ohio, recently, the operator of an amateur transmitting station installed at the convention headquarters for the purpose of relaying free messages for the delegates was much surprised on glancing over one of the messages to notice that it was a proposal of marriage to a young lady in a neighbouring city. After being assured by the sender that the message was genuine and in good faith, the operator sent it off. Next day a message came from the young lady stating that the proposal was accepted!

Photo.: Lafayette, Dublin.

PROMINENT IN IRISH RADIO. Mr. G. Marshall Harriss, M.A., M.I.E.E., who has just been re-elected President of the Wireless Society of Ireland.



AN AMATEUR IN ANTWERP.—Belgium boasts a large number of transmitting amateurs, one of the best known being M. Louis Era, of Antwerp, whose station BB1 is seen in the photograph.

AUSTRALIAN BEAM TESTS.

All expectations have been fulfilled by the preliminary tests between the new beam stations at Ballan and Rockbank in Australia, and Skegness and Grimsby in this country. The present tests are being conducted by the contractors, the Marconi Company. Subsequent trials will be carried out by the British Post Office and Amalgamated Wireless (Australasia), Ltd. The stations will probably open for traffic early in March.

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PHOTOTELEGRAPHY DESCRIBED.

On Friday next, December 17th, wireless enthusiasts in the Leeds district will have an opportunity of witnessing a demonstration of the Thorne Baker system of wireless phototelegraphy. The inventor himself, Mr. T. Thorne Baker, F.Inst.P., F.R.P.S., will give a public lecture and demonstration on that evening at 7.30 o'clock in the Albert Hall, Leeds. Seats may be reserved on application to the Wireless Editor, *Yorkshire Evening News*, Leeds. All seats are free.

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TELEVISION AT NEWCASTLE.

On Sunday last, December 12th, Mr. J. L. Baird gave a demonstration of his system of television at the Palace Theatre, Newcastle-on-Tyne. This interesting event was arranged by the Northumberland and District Group of Radio Associations, to the hon. secretary of which, Mr. R. E. Fabian, congratulations are due for his work in staging one of the first demonstrations of television outside London.

WIRELESS AT WESTMINSTER.

BY OUR PARLIAMENTARY CORRESPONDENT.

COST OF ISSUING LICENCES.

In the House of Commons last week, Lord Wolmer, in answer to Mr. Day, said that the average cost of issuing wireless licences, including all recording, accounting, and administrative work, and also the work necessary to secure renewal of licences and the prevention of evasion, was estimated to be about 1s. 3d. per licence.

POLICE USE OF BROADCASTING.

Sir Walter de Frece asked whether warnings to the public issued by Scotland Yard in respect of such practices as the luring away by thieves of house occupants deluded by bogus messages over the telephone were broadcast; and, if not, whether the Postmaster-General would arrange for this to be done to protect the public?

Viscount Wolmer said that the police authorities already used the broadcasting service for certain urgent notices, and if they desired that such notices as that mentioned be broadcast, no doubt the necessary arrangements could be made.

OUR INFORMATION DEPARTMENT.

It has been our experience in previous years that with the holidays and the approach of Christmas, the volume of questions sent in to our Information Department increases to an enormous extent, and it is difficult to guarantee that the enquirer will receive a reply before Christmas unless his letter is sent to us in good time. We mention this now in order that readers who particularly require replies early, should assist us by sending in their questions at once. It would also be helpful to us if readers who have enquiries which are not of an urgent nature would withhold them until immediately after the holidays.

PORTABLE SETS AND THE LAW.

Mr. Day asked whether any, and if so, how many, prosecutions had been instituted against persons working but failing to take out a wireless licence for portable wireless sets?

Viscount Wolmer said that it had not yet been necessary to institute a prosecution for the use of a portable wireless set without a licence.

LOUD-SPEAKER CHARACTERISTICS.

A Method of Measurement Developed by Dr. Erwin Meyer.

AT the meeting of the Heinrich Hertz-Gesellschaft, at Düsseldorf, on September 24th, 1926, Dr. Erwin Meyer described a new process for the testing of loud-speakers. In order to make clear the principle underlying this method of measurement there is shown in Fig. 1 a single-valve transmitter containing a variable condenser C_1 in the grid circuit and a condenser C_2 in the anode circuit. The condenser C_3 in parallel with the direct current ammeter I_a and with the anode battery B serves to prevent the high-frequency oscillations of the valve from passing through the battery and measuring instrument.

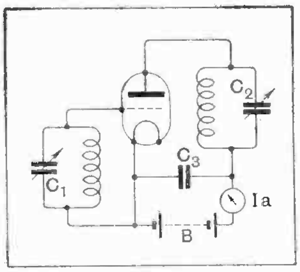

Fig. 1.—Circuit illustrating the principle underlying the method of measurement.

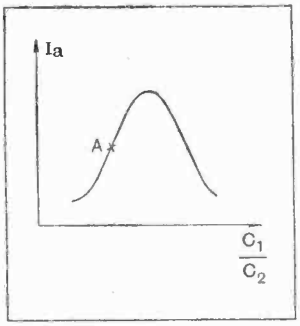

Fig. 2.—Variation of oscillating current with change of the ratio $C_1 : C_2$.

The transmitter oscillations are strongest when the wavelengths of the grid and anode circuits coincide, and the anode direct current I_a is also highest at this point. If, therefore, the anode current I_a is represented as being approximately dependent upon the ratio $C_1 : C_2$, we obtain a curve (Fig. 2) which somewhat resembles a resonance curve. In the method developed by Meyer the condenser C_1 is adjusted in such a way that it is at a point A in the middle of the sloping part of this curve. A small increase of C_2 then causes a certain decrease of the anode current, whilst a corresponding decrease of C_2 increases the anode current by an equal amount, assuming that the curve is straight for a short distance on either side of A.

For the measurement of sound intensity the condenser C_2 takes the form of a condenser microphone. If an audible note is impressed on this microphone, the capacity of the condenser C_2 fluctuates in rhythm with the variations of air pressure and the intensity of the anode current I_a fluctuates accordingly. If a telephone were placed in the anode circuit of the oscillator one would be able to hear a note corresponding in pitch to the sound impressed on the diaphragm of the condenser microphone. Now in order to be able to measure the strength of this note, alternating current of the same frequency, but 180 degrees out of phase, is applied to the condenser and is so adjusted that the movements of the condenser are just neutralised. Exact balance is indicated by the disappearance of the note in the telephone and from the alternating current applied the sound intensity at the microphone can be deduced.

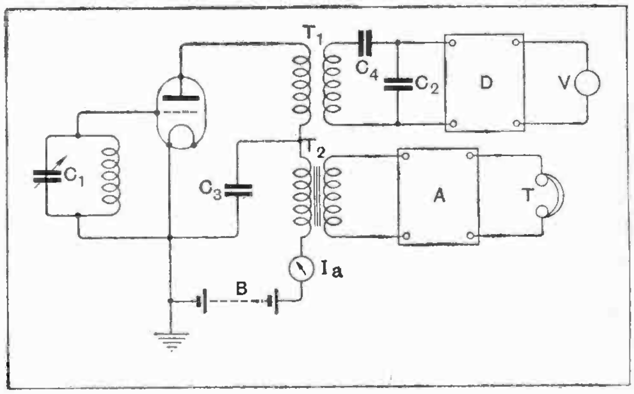

Fig. 3.—Schematic circuit diagram of the apparatus.

In practice, several refinements are necessary. In order first of all to adjust the zero point as sensitively as possible, the telephone is not connected directly in the anode circuit, but is supplied through a transformer T_2 and a low-frequency amplifier A (Fig. 3). Similarly, the

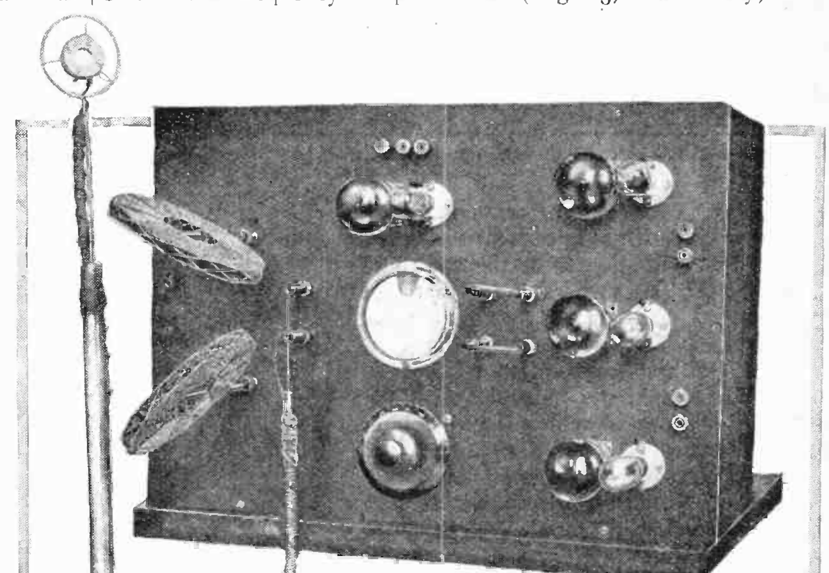

Fig. 4.—Oscillator and amplifier panel. On the left is seen the stand supporting the condenser microphone.

Loud-speaker Characteristics.—

condenser C_2 is not placed directly in the anode circuit, but is connected up by means of a high-frequency transformer T_1. A filter circuit D serves the purpose of separating the variable applied alternating current potential V from the actual valve transmitter, so that no high-frequency oscillations can reach the source of alternating current. A condenser C_4 is also necessary, in order to block the direct current potential which is necessary for the working of the condenser microphone, and which might otherwise be short-circuited through the transformer T_1. The source of current V must, therefore, supply both direct and alternating current, and the alternating current must be of precisely the same frequency as the note with which the loud-speaker is to be tested.

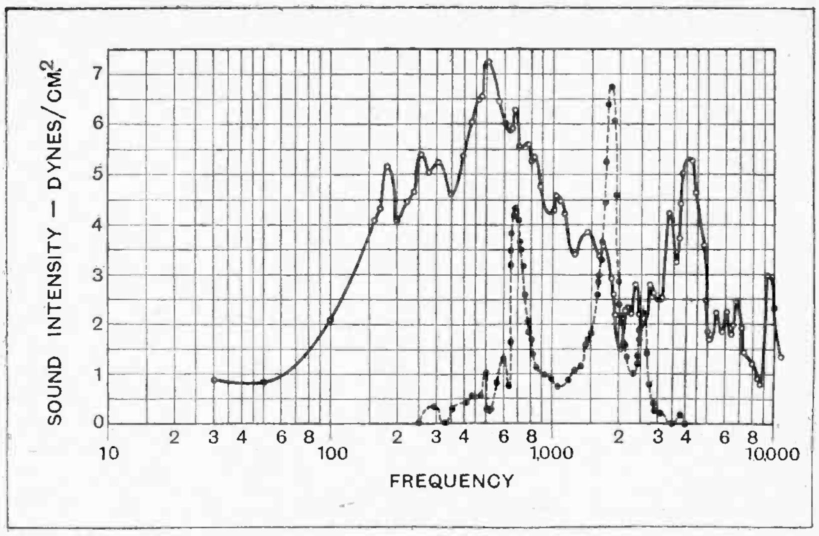

Fig. 5.—Curves of two representative loud-speakers.

The procedure in taking a measurement is as follows: The condenser C_1 is first of all adjusted, without excitation from the loud-speaker or the source of current V, in such a way that the ammeter I_a shows about half the normal deflection. The loud-speaker is then excited with a pure sinusoidal current and the note in the telephone T is observed. By a simple phase displacer and by varying the direct current and alternating current potential of V adjustments are then made so that the note in the telephone disappears. The sound of the loud-speaker is then completely compensated at the microphone, and it only remains to convert into units of pressure the intensity which at first could only be stated in terms of direct and alternating voltage. For this purpose, Meyer screens the condenser microphone and applies to it a given fixed potential, the equivalent pressure of which is to be determined. He then pumps a little air from the microphone, until the effect of the applied potential is again compensated, which is indicated by the return of the ammeter reading to its original value. The change of air pressure equivalent to this applied potential can then be read by means of a manometer, and in this way the fluctuations of voltage at the microphone can be converted into units of pressure.

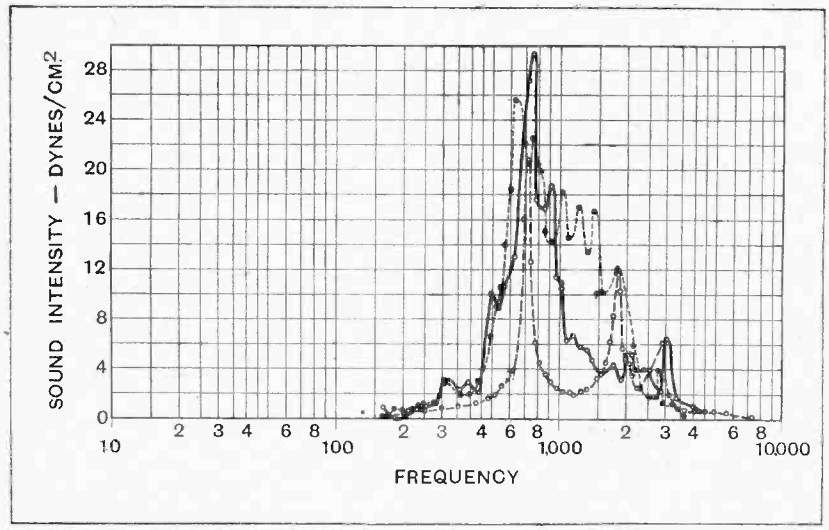

Fig. 6.—Influence of small horn (long dash curve) and large horn (short dot curve) on loud-speaker characteristic. The full-line curve is for the movement without horn.

The complete apparatus is shown in Fig. 4. On the left, supported in a metal ring, can be seen the condenser microphone, the diameter of which is only 33 mm., in order to disturb the wave front as little as possible.

Figs. 5 and 6 give examples of

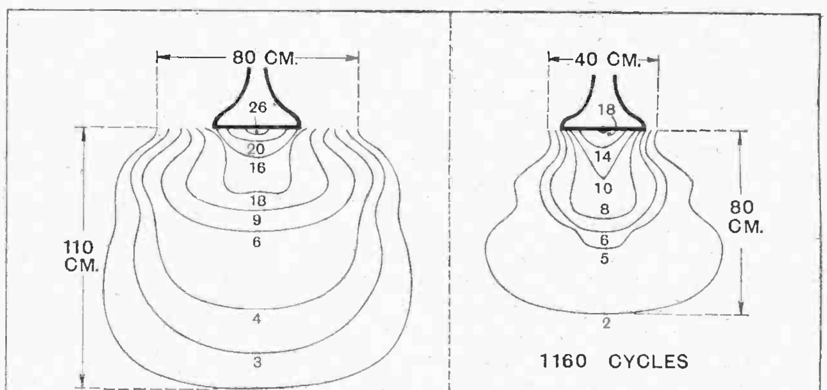

Fig. 7.—Distribution of sound field strength in the vicinity of a horn type loud-speaker for frequencies of 680 and 1,160 cycles respectively.

Loud-speaker Characteristics.—
measurements effected with Meyer's apparatus. Meyer has taken the characteristics of a large number of loud-speakers. In Fig. 5 the full line curve shows a loud-speaker which, although not by any means perfect, does in fact show an essentially continuous pressure curve. On the other hand, the loud-speaker with dotted curve is not able to reproduce audibly oscillations below 250 and above 4,000, and between these limits there are two extraordinarily sharply marked resonance points. Incidentally, the closeness of the points in these resonance curves is indicative of the precision with which the measurements can be carried out.

Fig. 6 shows the influence of the horn on the characteristic of a loud-speaker of inferior quality. The principal effect is to increase the width of the resonance peaks.

The curves in Fig. 7 show yet another use to which this method of measurement may be applied, namely, the plotting of the sound distribution in the vicinity of a loud-speaker. These curves clearly show that at high frequencies the sound is projected in a forward direction from the loud-speaker horn, whereas at low frequencies there is considerable lateral spreading of the waves. Clearly, then, this constitutes a source of distortion to a person listening at the side of the loud-speaker. This is only one line of investigation followed by Dr. Meyer, and the possibilities of the method for purposes of research would seem to be unlimited. H. K.

TRANSMITTERS' NOTES AND QUERIES

General Notes.

The prefix "P," used by Portugal, her colonies and Madeira, is followed by a figure denoting the locality of the transmitting station, thus :—

P1 = Portugal. P2 = The Azores. P3 = Madeira. P4 = Portuguese Guinea. P5 = Cape Verde Islands. P6 = Angola. P7 = Mozambique. P8 = Goa. P9 = Macao. P10 = Timor.

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A correspondent writes that at 12.30 p.m. on 27th November he received on an Armstrong Super (single valve), strong speech, obviously American. Although fading was bad he caught such sentences as "Would you like to hear my wife say good morning?" (She then spoke) "It is rather a novelty for one to speak to London" and many other fragments of conversation. The transmitter appeared to be working on duplex as he did not change over once during the hour in which our correspondent was listening. He tells us he was using an aerial coil of 2 turns, reaction of 3 turns, and no aerial or earth or even a frame aerial, so he thinks the wavelength must have been very low. He asks if any other of our readers have heard or can identify the station.

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Mr. J. Hum (G 2AJI), 17, Eastwood Road, Muswell Hill, N.10, is carrying out experiments on an artificial aerial with zincite-oscillator transmission and will be glad to hear from any reader engaged in a similar branch of experiment who will co-operate with him.

o o o o

The photograph reproduced on this page represents some of the members of the Coventry Transmitters' Association. This active society has recently had many interesting discussions on the subjects of phototelegraphy and crystal control, and, for the benefit of those members who contemplate taking the P.O. test and those who want practice, half an hour of their meetings is allotted to Morse.

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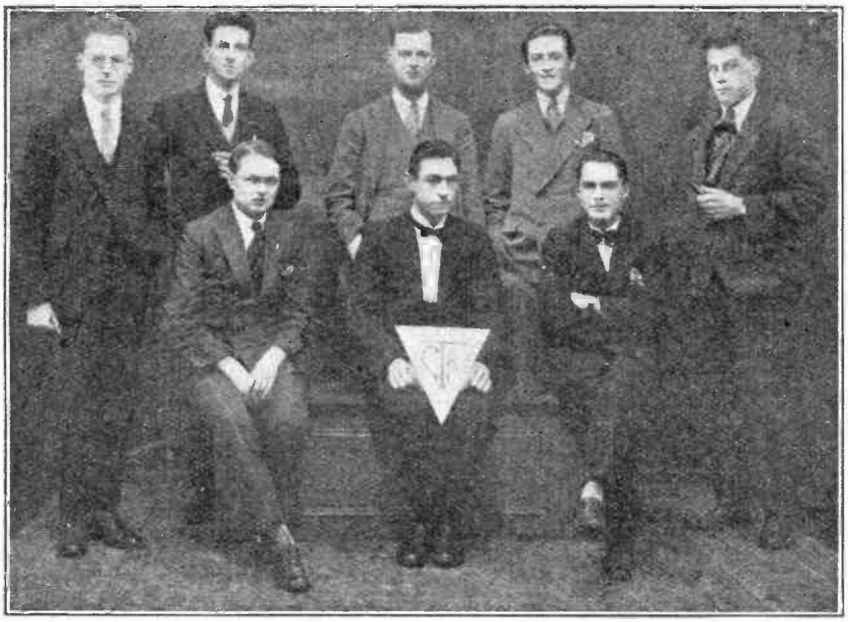


Some members of the Coventry Transmitters' Association. Back, standing (left to right) P. N. Coulston (6JL), J. Hanson (6YU), A. M. Keeling (2BMW), B. W. Warren (6CI), J. C. Martin (2BLM). (Front, sitting) L. W. Gardner (2BPI), H. F. Smith (2AUF), H. Maycock (5SK).

Reception of American Broadcasting Stations.

A correspondent in Borth, Wales, writes that during the last fortnight in November he has received a number of American stations on an 0-v-2 receiver; amongst others were WPG, WIBA, WBBM, CNRA, WGBS, WJZ, WB2, WGY and KDKA. He considers that WPG, Atlantic City, is the most consistently reliable and most free from distortion.

o o o o

New Call-Signs Allotted and Stations Identified.

G 2JO Lancashire County Police, County Offices Preston, Lancs.
G 6NS N. T. Shuttlewood, "Claremont," The Avenue, Gravesend ; transmits on 45, 150–200 and 440 metres. (This call-sign was formerly owned by Mr. J. Frater, Felling-on-Tyne).
GI 2BB E. Beat, 4, Eton Street, Belfast ; transmits on 23–45 metres either as a fixed or portable station.
G 2AJI (Art. A.) J. Hum, 17, Eastwood Road, Muswell Hill, N.10.
G 2AWX (Art. A.) H. L. Humphries, 7, Elmwood Road, Herne Hill, S.E.24.
EAR 41 Juan Golf, Chapa 11 1°, Grao, Valencia.

o o o o

QRA'S Wanted.

G 2BQT, G 2NC, G 2NX, G 2QX, G 6AM, G 6IW, G 6NA, G 6PB, GC 2WL, GXAN, LA 5B, S IC.

BROADCASTING SYSTEM IN A HOSPITAL.

Novel Installation at Clare Hall, South Mimms.

A WIRELESS installation comprising not only a receiver with headphones and loud-speaker but a miniature self-contained broadcasting system was formally handed over to the Clare Hall Hospital for Consumptives at South Mimms, Herts, on Wednesday last, December 8th. The cost of the installation was borne by public subscription, while the practical work of equipping the institution was entrusted to members of the Golders Green and Hendon Radio Society. How thoroughly this task has been carried out was revealed at the presentation ceremony on Wednesday, when a representative of *The Wireless World* was privileged to inspect the arrangements.

The Microphone in Circuit.

The principal novelty of the installation—a microphone circuit—has been introduced so that patients in the outlying bungalows may enjoy concerts and dramatic entertainments given in the recreation hall. The microphone —a Sterling 150-ohm instrument—was put to good use at the opening ceremony, when the presentation speech of Mrs. A. W. Perkin was clearly heard throughout the institution. During the afternoon cheerful band selections were played in the main hall, and an amusing contrast was afforded to "listeners-in" when the orchestra was switched over to a twenty-year-old carbon microphone!

Specially Wound Transformers.

The receiver (0-v-2) is housed in the main building, and was designed and constructed by Mr. Maurice Child. The circuit comprises a detector followed by two transformer-coupled L.F. valves. A portion of the energy delivered by the first valve is by-passed through a step-down transformer to the telephone circuit which includes 250 pairs of telephones in parallel. Uniform volume of sound is maintained irrespective of the number of headphones in use. The second L.F. valve is connected by a somewhat similar transformer, which gives an output suitable for six loud-speakers in parallel.

High-tension supply is derived from the 240-volt 50-cycle mains employing a Henderson two-way T. and T. rectifier giving a maximum of 140 volts on the power valve. Two 6-volt accumulator batteries are used alternately, and are charged by a Zenith Tungar rectifier.

The Aerial System.

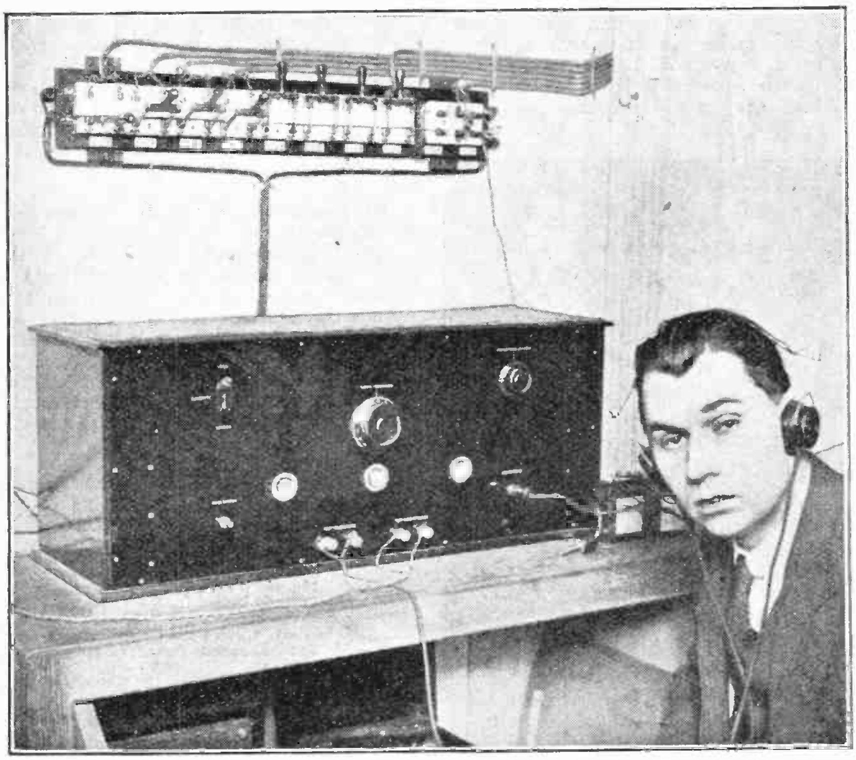
The hospital possesses the advantages of an excellent aerial system, a "mast" being provided by a towering oak tree in the centre of the green. The "earth" consists merely of four 120ft. lengths of 7/22 wire buried a few inches beneath the lawn.

Very careful attention has been paid to the switching arrangements so that any part of the hospital can be linked up or disconnected as desired. Indeed, the formidable array of switches in the matron's room almost suggests the "S.B." board at 2LO!

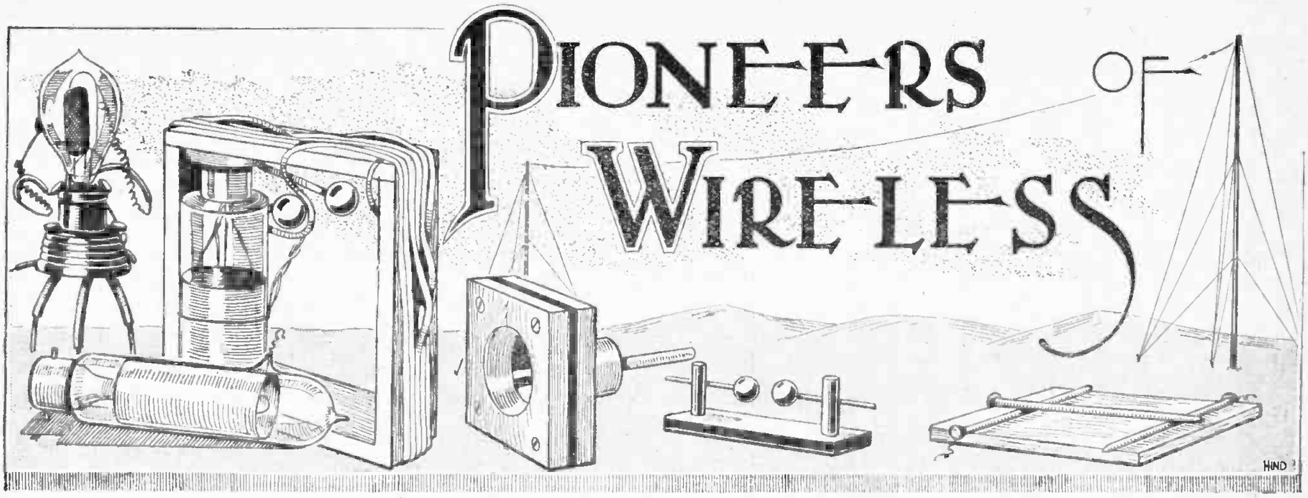
Two switches are provided for the loud-speaker circuits, and provision is made for linking up three further circuits, either for loud-speakers or telephones.

The double pole throw-over switch, seen on the extreme right in the photograph, is for the purpose of incorporating or throwing out the microphone circuit. When the microphone is brought into circuit this switch disconnects the detector valve and couples up the microphone through the second and third valves to the telephones and loud-speakers respectively. Microphone control, when necessary, is effected by a 300 ohm resistance in series.

The hospital is favourably situated as regards broadcast reception, the London and Daventry stations being received at approximately equal strengths.



HOSPITAL SET INSTALLED BY AMATEURS. Members of the Golders Green and Hendon Radio Society installed the wireless equipment which was last week presented to Clare Hall Hospital, South Mimms. The photograph shows the receiver, a three-valve instrument, with its designer and constructor, Mr. Maurice Child. The switch panel links the receiver with the various wards of the hospital, in which there are 250 pairs of headphones in parallel.

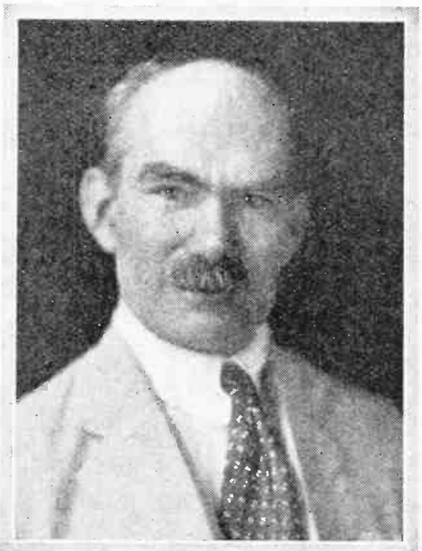


39.—The Thermionic Valve: de Forest Introduces the Third Electrode.

By ELLISON HAWKS, F.R.A.S.

IN our last two instalments we traced the development of the thermionic valve, from the time when Edison carried out the original experiments with discoloured electric lamps to the introduction of the valve in 1904 by Professor J. A. Fleming. The Fleming valve used the "Edison effect" as a detector or rectifier of radio oscillations, and it was much used as a receiver in long-distance wireless telegraphy on account of its great sensitiveness.

The Fleming valve was subsequently greatly improved by Dr. Lee de Forest, who (in 1907) conceived the idea of introducing into it a third element, in addition to the filament and cylindrical plate. The result of de Forest's invention was that it became possible to amplify the signals received to a considerable extent.



Dr. Lee de Forest.

Function of the Grid.

De Forest's third element takes the form of a perforated metal plate, or "grid," supported by a separate connecting wire and fused through the glass of the bulb. As the grid is inserted between the plate and the filament, negative electrons from the filament must first pass through its meshes before reaching the plate. Bearing in mind that "unlikes attract" and "like repels like," it is not difficult to understand that if the grid is negatively charged it will drive back the negative electrons to the filament. On the other hand, if the grid be given a positive charge it will assist matters and add its attraction to that of the positively charged plate.

The oscillations received from the transmitting station by the aerial are composed of alternating currents, half positive and half negative. When they reach the grid, which is connected to the aerial, they affect the degree of strength of the negative charge it carries. Thus, when the negative half of the incoming oscillation reaches the grid it increases the negative charge of the grid and so causes the latter to repel, to a greater extent, the electrons from the filament. When the positive half of the aerial current reaches the grid the flow of electrons to the plate is assisted. In this way the flow of electrons is controlled by the incoming oscillations, which alternately weaken and strengthen the stream from filament to plate.

An Analogy.

A comparison may be made between the three-electrode valve and a machine gun (the filament) that is bombarding a target (the plate) with bullets (the electrons). The grid, acting as a spasmodic shield between machine gun and target, resembles a Venetian blind that has its laths alternately opened and closed by the presence or absence of an impulse from the aerial. When the positive half of the aerial current reaches the grid the laths are opened and the projectiles are allowed free access to the target. When the negative half of the impulse reaches the grid the laths are closed, the plate is screened from the filament, and the stream of negative electrons, and hence the plate current is thus completely cut off.

Every time the grid allows the electrons to pass from the filament to the plate an impulse is produced in the plate circuit, which impulse is converted into sound waves by a telephone earpiece connected in the circuit. These impulses are of very much greater intensity than is the original impulse from the aerial, because of the high voltage maintained in the local circuit. The valve may be said to resemble the trigger of a rifle, which by slight

Pioneers of Wireless.—
pressure of the finger of the marksman is made to release tremendous energy.

To this improved form of three-electrode valve Dr. de Forest gave the name "Audion." Because, in addition to its property as a rectifier, it may also be used for magnifying the current it is sometimes called the "amplifying valve." In America it is known as a vacuum tube.

It is interesting to learn that de Forest, the inventor of the Audion, commenced his scientific experiments in a room at Chicago, for which he paid 10s. per week, and there, as a struggling scientist, he made his great discovery. "In that room," he says, "was born the tiny glass baby that was destined to rule the world of electrical communication—the present transmitter of news and music, and the future bringer of untold happiness. Unfortunately, a great fire completely gutted the Parker Buildings in January, 1908, wiping out of existence my notebooks and many precious samples of the earliest Audion bulbs. These would have to-day shown the history of its evolution in a most interesting way. The memory of that early struggling period still lives—a pleasant memory, no doubt, shared to-day by many who, in one way or another, contributed to the development of the art of radio."

Experiments in 1900.

As was the case when Edison discovered the leaping electrons, de Forest at first thought that his discovery was only a strange phenomenon, and it was not until later that he realised its immense importance. His discovery was made one night in 1900, when he was experimenting with a new detector. In those days radio signals were few and far between, and he had to use a small transmitting set himself in order to be sure of receiving signals. He had installed this transmitting apparatus in the room in which he was working, operating it by means of a string, with the sparking coil in a cupboard about 10ft. away. He was surprised to notice that when the coil sparked there was a decided change in the light given out by the incandescent mantle that illuminated the room. When the coil was sparking the light decreased very materially; as soon as the sparking ceased the light at once resumed its normal brilliance.

De Forest was greatly impressed by this phenomenon, and his interest was so aroused by the peculiar set of facts described that he commenced a series of experiments with the incandescent burner. As a result, he came to the conclusion that "heated gas molecules are sensitive to high-frequency electrical oscillations." Having investigated the matter so far, he shelved it for the time being, and engaged in other experimental work. Three years later, however, he returned to the subject, and commenced a series of extensive experiments, using various types of Bunsen burners. As a result of these experiments, he discovered that a flame can be used to detect electric waves, and a flame detector was subsequently used successfully for receiving wireless signals from ships in New York Harbour. This type of detector required a large supply of gas, however, and there were many other difficulties in the way of making its use commercially possible.

In his next experiment, de Forest tells us, he employed heated gas, using an incandescent filament enclosed in a glass bulb, and this was the foundation of his vacuum tube. He first used a plate consisting of a simple band of tinfoil wrapped around the outside of the bulb. "Then I experimented with two plates—the anode and the control—one on each side of the filament. Finally, I tried with the third electrode in the form of a grid, or a perforated plate located between the filament and anode." De Forest took out his first patent in June, 1906.

The introduction of the third electrode to the valve marks a very definite stage in the development of radio communication, and from that point onwards interest in the subject of wireless became so widespread that workers of distinction came into the field all over the world, and have since contributed to bring about the amazing development which has taken place. It would not, of course, be correct to suggest that the list of pioneers ends with the work of De Forest, yet it would be equally difficult to come to a decision as to which of the contemporaries of Edison, Fleming, and De Forest, are entitled to rank as pioneers. Without taking some such definite stage in radio development as the introduction of the three-electrode valve to bring our series of "Pioneers of Wireless" to a close, we should, in justice to contemporary workers, feel obliged to classify all as pioneers in some branch or other of the science. Having, therefore, in our series reached a very definite stage of progress, we think it fitting to conclude the series here, remembering, however, that we have not exhausted the list of those who, if judged on the merit of their work and contributions to the science, might well have been included in the series.

TRADE NOTES.

The Osram Bulletin.

The current number of this bright little publication contains several features of interest to the wireless amateur, including an article on the dull emitter valve and its operation, together with striking testimonies to the longevity of Osram valves.

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The Brandes Family.

A refreshing picture of family bliss is revealed in the pages of a lively booklet produced by Messrs. Brandes, Ltd., in which we read of the wireless adventures of Brandes *père*, Amaryllis, young Bill and Baby. The story provides sufficient evidence of the rejuvenating properties of the Brandes range of receivers, examples of which are described in the latter half of the booklet.

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An Amplion Change.

Many readers will be interested to learn that the old-established business of Alfred Graham & Company has now been divided into two limited companies, *viz.*, Alfred Graham & Co., Ltd., and Graham Amplion Limited. The latter company undertakes the manufacture and sale of wireless loud-speakers and other radio products, while the former continues to operate the naval telephone side of the business. The associated companies in various parts of the world fall under the control of Graham Amplion Limited.

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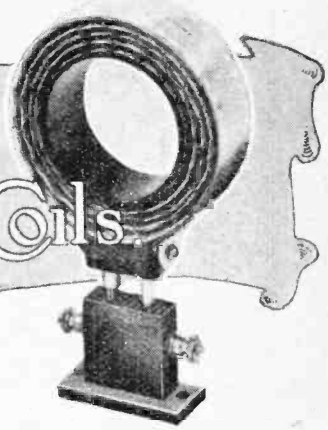
"Lewcos" Price Reductions.

Price reductions amounting to between 15 and 20 per cent. are announced by the London Electric Wire Co., and Smith's, Ltd., manufacturers of "Lewcos" inductance coils.

Designing Low-Loss Receiving Coils.



Multi-layer Coils.

By S. BUTTERWORTH.

(Continued from page 759 of the December 8th issue.)

ASSUMING that the optimum diameter is practically realisable for both types of coil, the following table gives the relative resistances of the two types of coil. The table is also intended to show the relative advantages of various shapes, and for this purpose the coils compared have been taken to have equal surface areas, that is, the cylindrical surface area plus the two flat ends is the same in all cases. Thus the flat coils have larger diameters than the coils of finite length in order to satisfy this condition. The coils may be described as "equally bulky." Equal volume is not suitable for such comparisons as this would lead to an infinitely large flat coil of zero length as the "best" coil. The table shows that the best coil on this basis is a single-layer coil having a winding length equal to its radius. The dimensions of the 4in. × 2in. coils in the above examples have been decided upon for this reason. Of flat coils the best winding depth is 0.3 times the diameter, but its resistance is 13 per cent. greater than that of the best single-layer solenoid. The best multi-layer coil has the shape of the coil of Fig. 1, viz.: b/D 0.125, t/D 0.2, but its minimum resistance is more than 40 per cent. worse than that of the best single-layer solenoid.

RELATIVE RESISTANCES OF COILS WOUND WITH WIRE OF OPTIMUM DIAMETER.

b/D	0.000		0.125	0.250	0.375	0.500	0.625	0.750	0.875
t/D	One layer		1.81	1.32	1.18	1.12	1.12	1.12	1.14
	Two layers		2.36	1.68	1.49	1.40	1.39	1.38	1.39
0.0	Three layers		2.44	1.74	1.54	1.44	1.43	1.42	1.43
	Multi-layer		2.51	1.79	1.59	1.49	1.47	1.45	1.46
	S.L.	M.L.							
0.1	1.95	2.70	1.82	1.60	1.54	1.55	—	—	—
0.2	1.43	1.90	1.59	1.59	1.61	1.64	—	—	—
0.3	1.26	1.76	1.70	1.72	1.78	1.86	—	—	—
0.4	1.50	1.82	1.88	1.93	2.06	2.17	—	—	—
0.5	1.68	1.98	2.06	2.16	2.27	2.37	—	—	—

The table refers only to very high frequencies, but a comparison at lower frequencies shows that the coils are still arranged in the same order, although the single-layer coil has not such a marked advantage.

It has been shown, however, that as the inductance and wavelength are increased, a stage is reached at which it is impossible to realise the optimum diameter for the single-layer coil. The multi-layer coils still require to be spaced for quite low frequencies, and quite considerable inductances. Since the advantage of the optimum diameter is lost first for the single-layer coil, it is important to know how far the single-layer coil still retains the superiority. No general rule has yet been formulated, but we may study the case of coils of overall diameter 3in. and winding length $1\frac{1}{8}$in. These dimensions approximate to the sizes employed for commercial plug-in coils. Let us suppose that each coil is intended to resonate with a condenser of 200 micro-microfarads capacity, so that for each specified inductance the frequency is fixed. We first calculate for a number of inductances the optimum diameter of wire to use in a single-layer coil having dimensions 3in. by $1\frac{1}{8}$in. Allowing 0.9 as the maximum space factor, we find that the optimum diameter is practically realisable up to inductances of 315 microhenries. For larger inductances the coils must be tightly wound.

When to use Multi-layer Coils.

In order to see where it is advisable to abandon single-layer coils we have calculated the actual resistances of tightly wound single-layer coils and plotted the results in curve A of Fig. 3 against inductance. Next in curve B the resistances of corresponding multi-layer coils have been plotted. This curve refers to multi-layer coils for which the overall diameter is 3in., the winding length is $1\frac{1}{8}$in. and the winding depth is 0.3in. This winding depth has been chosen as being the most efficient winding depth for coils of length-diameter ratio 0.375. (See table of relative resistances.) For curve B the optimum diameter of wire is used in all cases.

It is seen that the two resistance curves cross each other at an inductance of 1,360 microhenries. Hence for this type of coil, single-layer coils are the most efficient up to this inductance. For higher inductances multi-layer coils should be used. The result only holds for coils wound with solid wire. For stranded wire coils the limit for single-layer coils of this size is reached much earlier. In order to obtain the above inductance (1,360 microhenries) in the requisite winding length, we will need 122 turns, and it is seen that we can proceed to wire of gauge No. 35 before abandoning single-layer coils. This is totally at variance with general commercial practice, while, in addition, when multi-layer coils are resorted to

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the wire usually employed is much too thick. In illustration we may take the following table of values, which refers to a very popular type of commercial coil.

Inductance. μH.	Wavelength. Metres.	H.F. Resistance. Ohms.	Magnification.
S.L.120	360	5.5	114
S.L.180	440	6.5	118
S.L.275	540	8.3	115
M.L.580	790	40	35
M.L.1,150	1,120	63	31
M.L.2,300	1,600	107	26
M.L.5,000	2,400	147	27

S.L.=Single-layer coil; M.L.=Multi-layer coil.

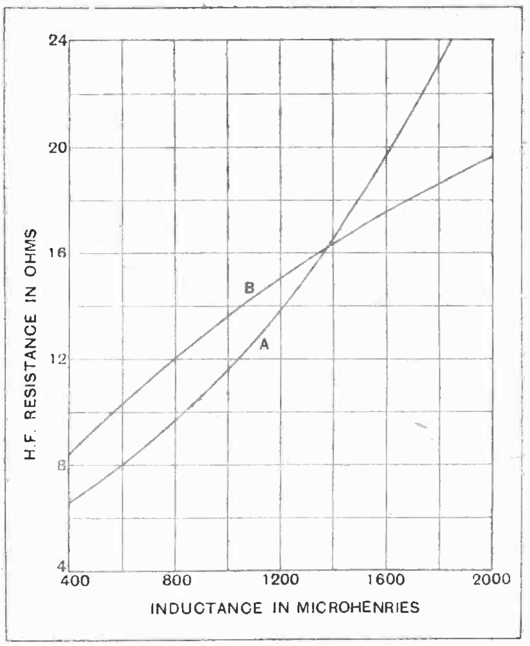


Fig. 3.—Comparison of H.F. resistance of single layer and multi-layer coils of equal inductance. Curve A: Single layer coils, $\frac{\text{Wire diameter}}{\text{Pitch of turns}}=0.9$; coil diameter, 3in.; winding length, 1⅛in. Curve B: Multilayer coils; wire diameter, optimum; coil diameter, 3in.; winding length, 1⅛in.; winding depth, 0.3in. Resistances are for that frequency which gives resonance with a capacity of 200 micro-microfarads.

The interesting point about the table is the enormous drop in magnification as soon as the single-layer coils have been abandoned. This is mainly due to the thick wire employed in the multi-layer coils. Unfortunately, the type of multi-layer winding adopted in this series of coils does not lend itself to the use of the much thinner wire which theory demands. In the case of another commercial series of coils the writer recommended the replacement of No. 24 wire by No. 30 wire in a 2,000 microhenry coil, and the magnification was increased by this simple change from 34 to 107.

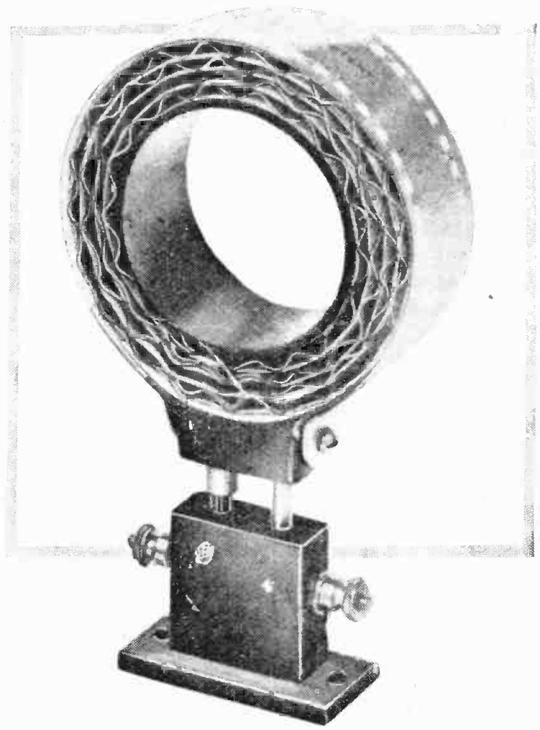
Mode of Winding Multi-layer Coils.

Having decided the optimum diameter of wire by the methods already given, and having fixed the number of turns from the inductance required, it is necessary to decide how to distribute and support the winding so as to secure the necessary insulation space. So far as the theoretical copper losses are concerned it is practically immaterial whether we wind closely in layers and space between layers or wind in close banks and space between banks so that the coil resembles a set of flat coils in series. Double spacing also scarcely affects the copper losses. The considerations determining the type of winding must therefore depend upon other factors. The most important of these is self-capacity. For a coil of perfect insulation there is a correction on the resistance due to self-capacity. If C is the total resonating capacity, and c the self-capacity of the coil, while R_c is the calculated resistance apart from self-capacity, the resistance when corrected for self-capacity is given by

$$R_c . C^2/(C-c)^2.$$

If we intend to use the coil with very small resonating capacities it is clearly important to keep the self-capacity down. Now the writer knows of no theoretical formula for finding the self-capacities of multi-layer coils, but it is generally known that the self-capacity of coils in which the layers are short and many is less than when the layers are long and few. This immediately gives us the following rules.

If the winding length is greater than the winding depth, wind in banks and space between banks. If the winding depth is greater than the winding length, wind in layers and space between layers. The former type of winding is equivalent to a series of flat coils with suitable spacings between them and the latter to a series of concentric solenoids. Coil manufacturers have recently paid considerable attention to this question of low self-capacity, but it certainly is secondary in importance to that of optimum wire diameter.



The "Lewcos" plug-in coil: a multi-layer coil wound with stranded wire.

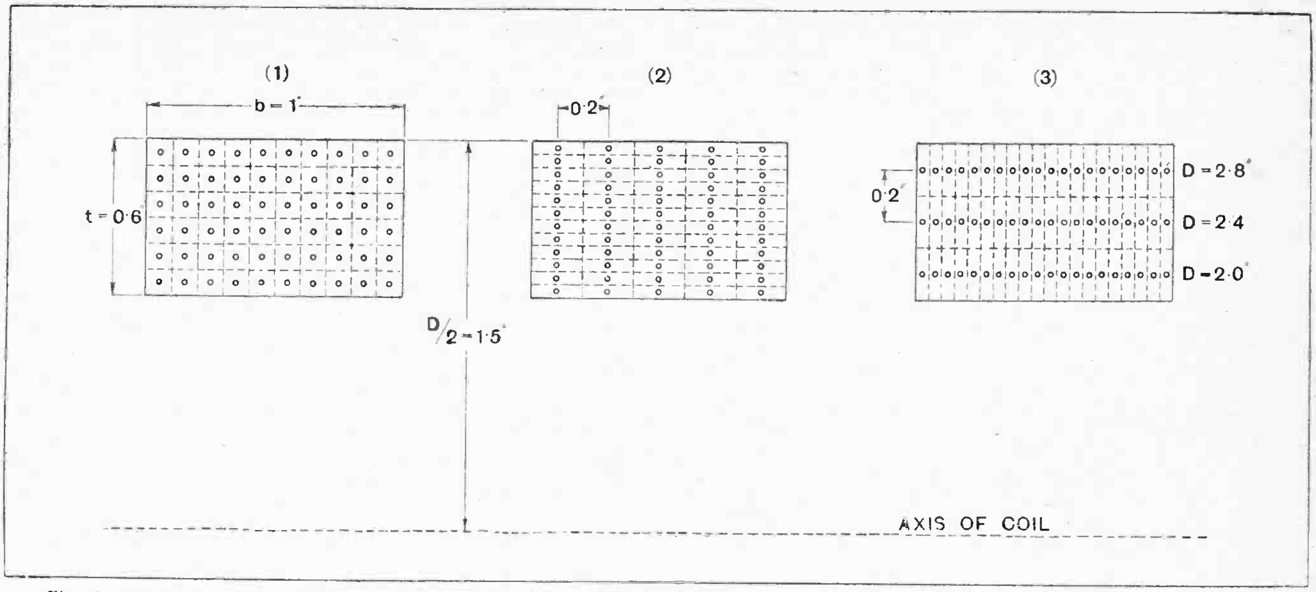


Fig. 4.—Three modes of distributing 60 turns throughout the winding section of a coil of overall diameter 3in., winding length 1in., winding depth 0.6in. In case (1) double spacing is employed and there are 6 layers each of 10 turns. In realising this distribution the coil would probably be wound in layers and spacers introduced between layers. The self-capacity would probably be less if it were possible to wind in banks. In case (2) there are 5 banks with 12 turns per bank. This winding is realised by the use of radial combs as in Fig. 5. In case (3) there are three layers each of 20 turns. The self-capacity of this type of winding is greater than that in case (2). All the coils have practically the same inductance and the same copper losses, but case (2) is recommended on account of its lower self-capacity. If the winding depth had been greater than the winding length, case (3) would have been the better winding. In calculating resistances and inductances of these types of coils, we must always take the dimensions as those corresponding to the bounding rectangle as illustrated. Thus in case (3) the overall diameter is 3in. and not 2.8in. the diameter of the outer layer, while in case (2) the winding length is 1in. and not 0.8in. the distance between the two outer banks.

At this stage it is of interest to state what is meant by the winding length and winding depth in the case of spaced coils. The winding length to use in the formulæ is the number of turns per axial layer multiplied by the distance between the axial turns. Similarly the winding depth is the number of layers multiplied by the distance between centres of successive layers.

Generally for symmetrically disposed wires we may suppose each wire to command a rectangular space, and the sum of these rectangular spaces represents the whole winding section. (See Fig. 4.)

In the multi-layer coils considered in the preceding section the correct mode of winding is in banks. The number of banks and turns per bank is fixed as follows :—Knowing the overall diameter of the wire and the winding depth, the number of turns per bank is clearly the ratio of winding depth to overall wire diameter. The inductance required fixes the total turns so the number of banks follows immediately. Thus for a coil of 2,000 microhenries, for which $D = 3$in., $b = 1\frac{1}{8}$in., $t = 0.3$in., the number of turns necessary is 170, and the optimum diameter is 0.278in. mm., indicating No. 32 wire. With this wire we can get 20 turns in 0.3in., assuming D.S.C. We thus require 9 banks, and these should be $\frac{1}{8}$in. apart to secure the required winding length. The supporting frame is conveniently made by having eight radially projecting ebonite combs carried by a central cylinder, as in Fig. 5. The mouths of the 9 slots in each of these combs should be made V-shaped so that the wire will readily slip into its proper slot when winding. This form of coil can readily be fitted into the usual type of dust-proof cover carrying the coil plug.

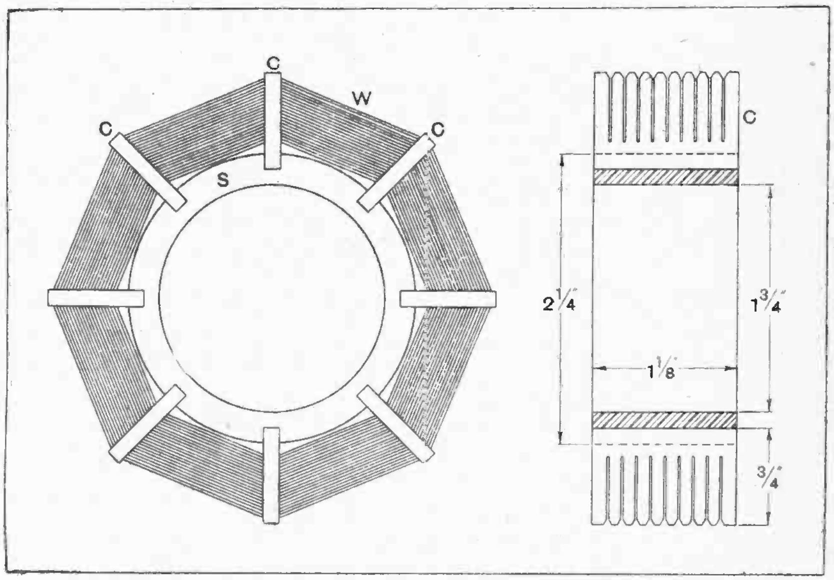


Fig. 5.—Example of a bank wound coil. S is a supporting cylinder carrying 8 ebonite combs C. For winding an efficient coil of approximately 2,000 microhenries with solid wire each comb should have 9 slots and the winding W consists of 9 single layer banks each of 20 turns of No. 32 wire. The V-shaped openings shown at the mouth of each slot are for easy entry of the wire when winding. If 9/40 Litz is employed a still better coil can be obtained. In this case it is convenient to use 10 slots each carrying 18 turns. The coil magnification with solid wire should be greater than 100, and that with Litz greater than 200. The gauges given above are essential to obtain efficient coils.

Designing Low-loss Receiving Coils.

Details for Series of Class A Coils.

The following series of coils have been designed with a view to securing a magnification of at least 200 in all cases when the coils are resonating with 300 micro-microfarads. The diameters of all the coils are 3in. over-all and the winding lengths $1\frac{1}{8}$in. For the multi-layer coils the winding depths are 0.3in. For coils greater than 100 microhenries the necessary magnification cannot be secured with solid wire so that 9-stranded wire has been employed. The optimum diameter gives 9/40 S.W.G. wire in all cases, and this should be S.S.C. for each strand and D.S.C. overall.

Coil No.	Type.	Wire.	Turns.	Inductance.	Slots filled.
1	S.L.	No. 18	15	20 μH.	—
2	S.L.	No. 22	23	50	—
3	S.L.	9/40	33	100	—
4	S.L.	9/40	47	200	—
5	Comb 10,	9/40	15 × 6	485	1, 3, 5, 6, 8, 10
6	narrow	9/40	15 × 8	865	1, 2, 4, 5, 6, 7, 9, 10
7	slots	9/40	15 × 10	1,350	All
8	Comb 10,	9/40	30 × 6	1,940	1, 3, 5, 6, 8, 10
9	wider	9/40	30 × 8	3,460	1, 2, 4, 5, 6, 7, 9, 10
10	slots	9/40	30 × 10	5,400	All

It will be noticed that coils 5, 6 and 7 each have the same type of comb which has 10 slots 0.112in. apart, the slot widths being such as to give an easy fit to 9/40 wire. Coil 5 consists of 6 banks with a single-layer winding of 15 turns in each, the slots 2, 4, 7 and 9 being left unfilled. Coil 6 has 8 single-layer banks each of 15 turns, slots 3 and 8 being unfilled. Coils 8, 9 and 10 have 10 wider slots in each comb so as to give a two-layer bank of 30 turns in each slot.

This method necessitates only two types of combs and gives a symmetrical distribution of wire.

It need hardly be said that the coil plugs should be embedded in satisfactory insulating material. If possible such plugs should be tested at radio frequencies by putting them across the condenser of a resonating wave-meter circuit and measuring the resulting increase in H.F. resistance.

Formula for Calculating Number of Turns.

The number of turns required to obtain a specified inductance is readily obtained from the formula

$$N = \sqrt{1{,}000\ L/L_0 D},$$

in which N is the required number of turns, L the inductance of the coil in microhenries, D the overall diameter of the coil in centimetres, and L_0 is a shape factor read off from the following table.

The formula can equally well be used for estimating the inductance of an existing coil, for then we have

$$L = L_0 N^2 D/1{,}000.$$

In using the formula for this purpose care must be taken to use the right dimensions for the coil. The mode of arriving at the correct dimensions is sufficiently illustrated in Fig. 4.

Values of Shape Factor L_0.

b = Winding length. t = Winding depth.

b/D :—	0.000	0.125	0.250	0.375	0.500
t/D					
0.0	Inf.	18.68	14.43	12.02	10.37
0.1	17.46	12.92	10.52	8.93	7.78
0.2	11.51	9.10	7.58	6.49	5.68
0.3	7.82	6.33	5.31	4.57	4.00
0.4	5.26	4.27	3.59	3.08	2.69
0.5	3.48	2.82	2.37	2.03	1.78

Formulæ for Calculating H.F. Resistances of Coils.

The theoretical resistances given in the preceding work have all been calculated from the following formulæ :—

Solid wire coils :

$$R_c = R\left\{1 + F + \left(\frac{KNd}{2D}\right)^2 G\right\}.$$

Stranded wire coils :

$$R_c = R\{1 + F + (k/d_0^2 + \tfrac{1}{4}K^2N^2/D^2)\, n^2 d^2 G\}.$$

In these formulæ the symbols have the following interpretation :—

R_c = H.F. resistance. d = Diameter of one strand.
R = D.C. resistance. d_0 = Overall diameter of stranded wire.
N = No. of turns.
n = No. of strands. D = Overall diameter of coil.

The units of measurement of the resistances and the various diameters do not matter, as if R is in ohms, R_c is also in ohms, while since the diameters enter as ratios (d/D and d/d_0) we can express the diameters as all in inches or all in millimetres indifferently. The remaining factors k, K, F and G all require tabulation. The factor k, entering only in the stranded wire formula, depends on the number of strands and has the following values.

n	1	3	9	27	large
k	0	1.55	1.84	1.92	2

The factor K is a shape factor and also depends upon whether the coil is single-layer or multi-layer. Its value is read off from the following table :—

VALUES OF THE FACTOR K.

b/D :—	0.000	0.125	0.250	0.375	0.500
t/D					
0.0	Inf.	41.7	21.2	14.4	11.0
0.1	52.4	23.3	15.4	11.6	9.5
0.2	27.4	16.2	12.4	9.9	8.2
0.3	19.6	13.7	10.7	8.8	7.5
0.4	16.0	12.0	9.5	8.0	6.9
0.5	13.8	10.4	8.4	7.0	6.0

NOTE.—The column $b/D = 0$ refers to *many* layered disc coils, and the row $t/D = 0$ to *many* layered solenoids. When the layers are few the following values hold for K.

SOLENOID WITH m LAYERS.

b/D :—	0.000	0.125	0.250	0.375	0.500
m					
1	—	30.1	15.6	10.7	8.3
2	—	39.2	20.0	13.6	10.4
3	—	40.6	20.7	14.0	10.7
Inf.	—	41.7	21.2	14.4	11.0

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DISC COIL WITH *m* LAYERS.

t/D.—	0.1	0.2	0.3	0.4	0.5
m					
1	37.8	20.6	15.4	13.2	11.7
2	45.0	25.9	18.6	15.3	13.3
3	51.0	26.8	19.2	15.7	13.6
Inf.	52.4	27.4	19.6	16.0	13.8

The functions F and G depend upon the frequency (f) and on the diameter (d) of a single strand. We first calculate a quantity z from the formula

$$z=d\sqrt{f}/92.8,$$

d in this formula being in mms. and the frequency in cycles per second, and then simply read off F and G from the appropriate table.

Examples.

(1) *Coil of Fig. 1 using solid wire 0.5 mm. diameter. Required inductance, and H.F. Resistance at frequency of a million.*—For this coil D=10 cm., $b=1.25$ cm., $t=2.0$ cm., N=40. Hence $b/D=0.125$, $t/D=0.20$, so that from L_0 Table, $L_0=9.10$, and from K Table, K=16.2.

The inductance follows immediately as

$$L=L_0N^2D/1{,}000=9.10(40)^2\times 10/1{,}000=146$$

microhenries.

As regards resistance, $KNd/2D=(16.2\times 40\times 0.5)/200=1.62$.

The resistance formula for all frequencies is therefore

$$R_c=R(1+F+2.62G).$$

For a frequency 10^6, $z=0.5\times 1{,}000/92\ 8=5.50$.

The F and G Table then gives $1+F=2.22$, $G=0.843$. Hence $R_c=4.43R$.

It remains only to calculate the D.C. resistance R. The length of wire is $40\times 3.14\times 8$ cm. since the mean diameter of the coil $(D-t)$ is 8 cm. Expressing the wire length in yards, we obtain 10.95 yards of wire, and from the wire tables the resistance of 1,000 yards of 0.5 mm. wire is 79 ohms. Thus R=0.864 ohm and $R_c=3.82$ ohm.

If we desired greater refinement we should also take into account the leads to and from the coil. The formula for these is got by putting N=0 in the resistance formulæ.

(2) *Single-layer coil of 200 microhenries wound with 27/42 wire. Coil diameter 4in. Coil length 2in. Required, number of turns and resistance at frequency of a million.*

Since $b/D=0.5$ and $t/D=0$, $L_0=10.37$, and since coil is S.L. K=8.3.

Number of turns $=\sqrt{200{,}000/(10.37\times 4\times 2.54)}=44$.

In the resistance formula the following values hold: $k=1.92$, $d_0=0.91$ mm. Therefore $k/d_0^2=2.32$, K=8.3, D=101.6 mm., N=44, and $(KN/2D)^2=3\ 24$, $n=27=d$ 0.102 mm., $(nd)^2=7.6$.

The resistance formula becomes $R_c=R(1+F+43G)$. At $f=10^6$, $z=1.10$, and from Table $1+F=1.008$, $G=0.0220$. Hence $R_c=1.95R$.

From the wire tables 27/42 wire has a resistance of 71 ohms per 1,000 yards (neglecting twist), while the length of wire is 15.3 yards. Hence R=1.09 ohms, and therefore $R_c=2.13$ ohms.

The value previously given for this coil at 300 metres was 2.05 ohms, and was obtained by assuming a slightly larger value for d_0. This shows that some slight improvement may be expected if we could increase the internal spacing of the stranded wire. The improvement is not, however, so marked as to warrant a change in the strand covering, say, from S.S.C to D.S.C.

VALUES OF THE FUNCTIONS F AND G.

z	1 + F	G	z	1 + F	G
0.1	1.000		5.2	2.114	0.7902
0.2	1.000	$z^4/64$	5.4	2.184	0.8255
0.3	1.000		5.6	2.254	0.8609
0.4	1.000		5.8	2.324	0.8962
0.5	1.000	0.00097	6.0	2.394	0.9316
0.6	1.001	0.00202	6.2	2.463	0.9671
0.7	1.001	0.00373	6.4	2.533	1.003
0.8	1.002	0.00632	6.6	2.603	1.038
0.9	1.003	0.01006	6.8	2.673	1.073
1.0	1.005	0.01519	7.0	2.743	1.109
1.1	1.008	0.0220	7.2	2.813	1.144
1.2	1.011	0.0306	7.4	2.884	1.180
1.3	1.015	0.0413	7.6	2.954	1.216
1.4	1.020	0.0541	7.8	3.024	1.251
1.5	1.026	0.0691	8.0	3.094	1.287
1.6	1.033	0.0863	8.2	3.165	1.322
1.7	1.042	0.1055	8.4	3.235	1.357
1.8	1.052	0.1265	8.6	3.306	1.393
1.9	1.064	0.1489	8.8	3.376	1.428
2.0	1.078	0.1724	9.0	3.446	1.464
2.1	1.094	0.1967	9.2	3.517	1.499
2.2	1.111	0.2214	9.4	3.587	1.534
2.3	1.131	0.2462	9.6	3.658	1.570
2.4	1.152	0.2708	9.8	3.728	1.605
2.5	1.175	0.2949	10.0	3.799	1.641
2.6	1.201	0.3184	11.0	4.151	1.818
2.7	1.228	0.3412	12.0	4.504	1.995
2.8	1.256	0.3632	13.0	4.856	2.171
2.9	1.286	0.3844	14.0	5.209	2.348
3.0	1.318	0.4049	15.0	5.562	2.525
3.1	1.351	0.4247	16.0	5.915	2.702
3.2	1.385	0.4439	17.0	6.268	2.879
3.3	1.420	0.4626	18.0	6.621	3.056
3.4	1.456	0.4807	19.0	6.974	3.232
3.5	1.492	0.4987	20.0	7.328	3.409
3.6	1.529	0.5160	21.0	7.681	3.586
3.7	1.566	0.5333	22.0	8.034	3.763
3.8	1.603	0.5503	23.0	8.388	3.940
3.9	1.640	0.5673	24.0	8.741	4.117
4.0	1.678	0.5842	25.0	9.094	4.294
4.1	1.715	0.6010	30.0	10.86	5.177
4.2	1.752	0.6179	40.0	14.40	6.946
4.3	1.789	0.6348	50.0	17.93	8.713
4.4	1.826	0.6517	60.0	21.46	10.48
4.5	1.863	0.6687	70.0	25.00	12.25
4.6	1.899	0.6858	80.0	28.54	14.02
4.7	1.935	0.7030	90.0	32.07	15.78
4.8	1.971	0.7203	100.0	35.61	17.55
4.9	2.007	0.7376	—	—	—
5.0	2.043	0.7550	—	—	—

NEWS FROM THE CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Current from A.C. Mains.

The popularity enjoyed at the present moment by apparatus for obtaining current from the house mains for the purpose of operating wireless receivers resulted in a good attendance at the last meeting of the Croydon and District Wireless Society, at which Mr. Arthur J. Webb, M.A., B.Sc., gave a comprehensive lecture on the subject of rectification of alternating current, a question which confronts so many would-be users of the electric light mains.

The society welcomes visitors at any of its meetings, which are held at 128, George Street, Croydon. Full particulars of membership can be obtained from the Hon. Secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2.

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H.F. Amplification Tendencies.

The headquarters of the Tottenham Wireless Society were well filled at the Society's last meeting, when Mr. J. H. Reynor, B.Sc., lectured on "Modern Tendencies in High-frequency Amplification." After dealing with the question of good quality reception Mr. Reynor discussed the efficient control of energy in a receiver. Dual condensers, he said, had passed out of fashion years ago, but the gang control system was coming into favour for four reasons. First, there was an all-round increase in the efficiency of tuning arrangements. Second, owing to the screening and capacity to earth being the same in all parts of the receiver, the apparatus was completely under control. Third, the use of a tight or autocoupled aerial coil had overcome tuning difficulties, and fourthly, the use of Reinartz capacity reaction had secured absolute reaction control and the maintenance of a high state of sensitivity.

The lecturer caused some amusement by remarking that compromise was necessary in conducting wireless experiments, because when progress was made in one direction, one invariably encountered the well-known electrical law of "Pure Cussedness"!

oooo

Valve Development.

Large broadcasting valves, including those of the water-cooled variety, were demonstrated by Mr. F. E. Henderson, M.I.E.E., in his lecture before the Muswell Hill and District Radio Society on Nov. 24th. The lecturer's remarks dealt principally with developments in valves for broadcasting. Considerable interest was aroused by a demonstration on a good three-year-old receiver equipped with "R" valves, followed by a further demonstration on the same set slightly modified and with the correct modern equivalent of "R" valves, a comparison which showed a striking development.

Hon. Secretary: Mr. G. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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The Panatrope Demonstrated.

A Brunswick Panatrope Reproducer for gramophone records and wireless receivers was demonstrated by Mr. R. P. H. Collings (of the B.B.C. Research Dept.) at the Ilford and District Radio Society's meeting on November 24th.

The Panatrope employs the Rice-Kellog loud-speaker, which is of the moving coil cone type and works directly off the lighting mains. It contains three amplifying valves (B.T.H.). The aerial used for the wireless reception (2LO) was a length of 7/22 wire suspended on string across the hall. The receiver circuit consisted of a detector and three stages of resistance capacity coupled with L.S.5 valves.

The results on both gramophone and wireless reception came as a revelation to everyone present, all frequencies appearing to receive equal amplification.

Mr. Collings gave a careful description of the reproducer, and to judge from opinions given in the discussion the members shared the view that in the Panatrope reproducer the desideratum was reached in mechanical reproduction.

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Condensers and How They are Made.

The story of the condenser, especially in regard to its manufacture, was told by Mr. Hayward, of the Dubilier Co., at the last meeting of the Sheffield and District Wireless Society. Mr. Hayward described the various processes necessary for the production of reliable condensers, how the mica is obtained in India, how it is graded, and eventually takes its place in the fixed condenser to be found in every broadcast receiver. The manufacture and testing of the largest condensers in existence received attention, and the speaker had some interesting things to say regarding condensers in the transmitting and filtering circuits of the new station at Rugby. Many types of condensers were exhibited, and it was interesting to note that the capacity of even the cheapest type is guaranteed to be accurate within 15 per cent.

Hon. Secretary: Mr. T. A. W. Blower, 129, Ringinglow Road, Sheffield.

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Tone and Power.

Those popular personages Mr. Tone and Mr. Power were seen in the flesh in the persons of Mr. E. H. Murgatroyd and Mr. R. S. Gough at the last meeting of the Bristol and District Radio Society, when an illuminating lecture was given on the products of the General Electric Co. Mr. Murgatroyd dealt with the Osram range of valves, while Mr. Gough gave a fascinating description of the "Gecophone" range of receivers.

At each meeting of the society a valve is balloted for among the members present, the winner last week being Mr. A. E. Pope.

Hon. Secretary: Mr. S. J. Hurley, 46, Cotswold Road, Bedminster, Bristol.

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A Lecture on Coupling.

The theoretical principles of resistance-coupled and transformer-coupled L.F. amplification were described by the aid of lantern slides by Mr. J. Ridgway, of the Metropolitan-Vickers Electrical Co., Ltd., at a recent meeting of the Barnsley and District Wireless Society. The speaker added interest to his remarks by demonstrating with two types of resistance amplification sets, both of which revealed remarkable clarity.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 15th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture and Demonstration: "Running Sets from the D.C. Mains," by Mr. Leonard Hirschfield, B.Sc.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Discussion: "Aircraft Wireless."

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Lecture: "A Simple Wave-meter," by Mr. G. W. Wigglesworth.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "The Acoustics of a room and their effects on a Loud-speaker," by Mr. J. F. Stanley, B.Sc., A.C.G.I.

THURSDAY, DECEMBER 16th.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street, Leeds. Question Night. Subject: "Reaction."

Sheffield and District Wireless Society.—At the Department of Applied Science, St. George's Square. Lecture: "The Maintenance of a Receiver from A.C. Mains," by Mr. C. H. Handford.

Bristol and District Radio Society.—Lecture and Demonstration by Messrs. Ferranti, Ltd.

Savoy Hill Topicalities: By Our Special Correspondent.

Wavelength Revisions—The Spanish Master Mind—Daventry's Record—Drama in France—A Microphonic Newspaper—Christmas Programmes.

Unsolicited Correspondence.

Despite the wistful appeal of the B.B.C. for a little more time in which to explore for themselves the results of the Geneva scheme, more than 2,000 letters from listeners have been received at Savoy Hill during the last week or two. A striking feature of these "unsolicited testimonials" is their general agreement with the findings of the expert "watchers," to whom I referred a fortnight ago.

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Hopscotch in Europe.

As predicted in these columns last week, many wavelength revisions are already taking place on the Continent. In theory the Geneva scheme was well-nigh perfect, but in practice . . . the experts are learning lessons every day. The scheme shows evidence of developing into an etherial hopscotch.

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The Spanish Master Mind.

Many questions have been asked regarding the unaccountable behaviour of the Spanish stations in refusing to budge from their original wavelengths. What has astonished many people is their surprising unanimity in the matter. But is it surprising? The offenders all belong to the *Union Radio* Group, which is rapidly embracing all the Spanish stations. The obvious deduction is that some master mind has decided to flaunt the rulings of Geneva. What can Geneva do about it?

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Powerless.

The Union Internationale de Radiophonie is completely powerless in the face of this kind of opposition. What a pity it is that Mr. A. R. Burrows, the secretary-general, cannot install a gun of the "Big Bertha" class which could be trained on the aerial of any defaulter!

oooo

Relays Happier.

The British relay stations seem to be in a decidedly happier position than they were ten days ago, before the further revision of their wavelength. Prior to the change, when they shared the common wavelength of 288.5 metres, clear reception was problematical at anything over a mile or two from each. This was particularly noticeable in the areas served by the Dundee and Edinburgh stations. Indeed, if the B.B.C. engineers had not moved quickly, the bonnets of bonny Dundee might very soon have been waving in revolt! Since the change reliable reception is pretty well assured up to five miles from each relay station.

"ON THE AIR."—A typical American broadcasting station, WOW, at Omaha, Nebraska. New equipment with a power of 2½ kilowatts has been installed. The main studio is built on a stage with a glass front and the "auditorium" has a seating capacity of 500.

Rocks Ahead for Plymouth.

Devonians are noting a decided improvement in Plymouth's transmissions, but I have reason to suspect that their joy will be short-lived if 5PY remains on the new 400-metre wavelength. For this is the provisional wavelength chosen for the Cork station, which will open early in the New Year. Cork will probably relay Dublin, though with a power in excess of that of the British relays; so before long there may be some lively exchanges between Patrick and the "Dogs of Devon"!

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Daventry's Record.

The Daventry station completed last week 5,000 hours' actual programme transmission time. The high-power station was opened on July 27th, 1925.

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Christmas Dances.

A talk on Christmas dances, with musical illustrations by Leon Van Straten's band, will be relayed to 2LO from the Riviera Club on December 23rd. The talk is by Mrs. I. C. Humphreys.

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The "Grand Lama" at Bournemouth.

Bournemouth station is to broadcast on December 23rd a performance of "The Grand Lama," an extravaganza by Wyllie O'Kay, with music by Guy Liddell, whose waltz, "We Two," was a favourite with regimental bands in the 'nineties.

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New Rules for Listeners.

One of the American broadcasting stations has an announcer who possesses original ideas. This in itself should not occasion undue alarm: but I sincerely hope that he remains in America.

He conducts a "Children's Hour," and woe betide the luckless child who falls into his clutches! Children who wish to listen, he intimates, must have clean hands and faces and well-brushed hair, and he asks parents to inform him of any of his little charges who neglect this rule. In the case of defaulters a public reprimand will be administered over the microphone!

The Burden of Urbanity.

In fairness to the children the same code of cleanliness and order should be demanded of adult listeners. The time has come, it seems, when no self-respecting listener should tune in to Grand Opera without first slipping into his boiled shirt. Gone are the days when a degenerate man in his shirt-sleeves dared to abase himself still further by tuning-in to the sanctity of the Savoy Ballroom, or when a foolish listener switched on for the weather forecast without first putting up his umbrella. Nowadays we should all of us listen like ladies and gentlemen, and not place all the burden of urbanity on the shoulders of those charming people in the loud-speaker advertisements.

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"Shockheaded Peter."

A microphone version of "Shockheaded Peter," by Mr. Nigel Playfair and Mr. Philip Carr, with music by Mr. Walter Rubens, will be broadcast between 6 and 7 p.m. on December 22nd.

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Christmas Carols.

Christmas carols by the Tonbridge School Choir, conducted by Mr. R. H. Kay, musical director, will be relayed from the Chapel of St. Augustine, Tonbridge School, on December 19th.

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A Detective Sketch.

"P. Pip, Detective," is the title of a sketch which Bert Coote will broadcast on December 20th. The author is Horace Kenney.

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A Drama of Southern France.

All the ingredients of a first-class melodrama, except a heroine, are revealed in a surprising situation which has developed at Toulouse. The question is, who is the villain?

To comprehend the present turn of events, which have involved the juxtaposition of rival microphones in a cathedral, the installation of an illicit (?) transmitter in the cathedral cloister, and a police caution for an arch-priest, it is necessary to look back.

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The Plot Develops.

Since the month of May, 1925, it appears that for an unexplained reason Radio Toulouse has been prevented by the postal authorities from making use of land lines for the purpose of re-transmissions from places of interest. The station engineers have, therefore, had to rely upon their portable short-wave transmitter, which they install in the theatre or concert hall in which the performance is taking place. The short-wave transmissions are picked up on a super-heterodyne and re-broadcast from Radio Toulouse. In October last it was decided to broadcast the services and sermons in the cathedral of St. Étienne, in Toulouse, and, permission having been obtained from the arch-priest, the transmitter and microphone were duly installed, an aerial being rigged up in the cathedral precincts.

All would have been well; but on November 5th the postal authorities came down like a wolf on the fold.

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The Arch-priest's Dilemma.

The postal authorities began by declaring that Radio Toulouse had no legal right to broadcast sermons from a State-owned edifice. To this the arch-priest retorted that Radio Toulouse had already transmitted, with public approval, the operas in the State-owned Capitol and that, having signed an agreement with the broadcasting company, he could hardly withdraw from the contract. The Post Office replied by installing land line, microphone, and amplifiers in the cathedral for the purpose of broadcasting the services through P.T.T. Toulouse.

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Rival Microphones.

The arch-priest remonstrated without avail, and the two microphones were placed side by side. Simultaneously the Post Office approached the Procureur of the Republic, invoking an Act of 1851 and a decree of November, 1923, to show that the arch-priest had violated the law by installing a clandestine transmitter. Radio Toulouse then stepped forward and accepted the responsibility for this heinous offence, but asked why, if such a transmitter were against the law, the P.T.T. station had more than once availed itself of transmissions from the same instrument on occasions when the two stations broadcast the identical programme!

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Post Office Criticised.

This appears to be the present "impossible" situation, and it has produced an unpleasant impression among listeners in the South of France. The Post Office is severely criticised for adopting such an attitude at a time when other countries are exploiting the possibilities of broadcasting in every direction.

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Education.

In taking over the direction of the New York broadcasting station WEAF, the American National Broadcasting Company intimates that no education will be "crammed down the throats of people who do not want it." In other words, I suppose, those who can't swallow it can switch off. How very fair!

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A Microphonic Newspaper.

Something a little more ambitious than the ordinary news bulletin has been launched by "Radio Belgique." It is called a "Journale Parlé," and takes the form of a wireless newspaper. Listeners are kept in touch with current events and the "Journale" specialises in interviews and commentaries on daily affairs, Parliamentary reports, the stage, and kindred subjects. The "Journale Parlé" is given daily between 8 and 8.30 p.m. M. Theo Fleischman acts as "Editor."

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The Unaccompanied Violin.

In the week beginning December 19, the classical feature will take the form of an unaccompanied violin recital and will be given at 7.25 p.m., and not at the time at which the pianoforte recitals are at present given, *i.e.*, 9.45 p.m.

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Father Christmas in the Studio.

The B.B.C. promises that one of the most interesting in the series of broadcasts, under the title of "My Programme," will be that by "Father Christmas" on Dec. 25th.

FEATURES FOR CHRISTMAS WEEK.

Sunday, December 19th.

LONDON.—Symphony Concert.
BIRMINGHAM.—Popular Christmas Music.
BOURNEMOUTH.—"Bethlehem," a Choral Drama.
CARDIFF.—"The Light of Life," short oratorio by Elgar.
ABERDEEN.—Christmas Service relayed from the Cowdray Hall.

Monday, December 20th.

LONDON.—Chamber Music.
GLASGOW.—"The Long Lost Uncle."
BELFAST.—"The Blue Penguin."

Tuesday, December 21st.

LONDON.—"Hansel and Gretel."
CARDIFF.—Short Classical Programme.

Wednesday, December 22nd.

LONDON.—Nativity Play, "Bethlehem."
CARDIFF.—Christmas in Song.
MANCHESTER.—Songs of Christmas.
ABERDEEN.—"Roun' Oor Ain Lum."

Thursday, December 23rd.

LONDON.—"A Pickwick Party."
BOURNEMOUTH.—"A Lass of Lhasa."
BELFAST.—Christmas—Past—Present—and To Come.

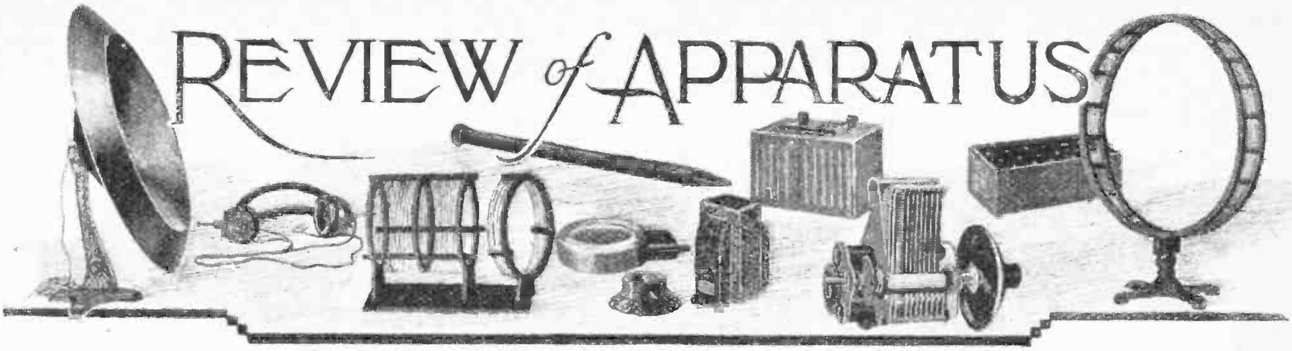
Friday, December 24th.

LONDON.—Xmas Party.
BIRMINGHAM.—"Echoes," a ghost story by John Overton.
CARDIFF.—A Dickens Recital by Richard Barron.
MANCHESTER.—James Bernard presents "A Christmas Carol."
ABERDEEN.—Marquis of Aberdeen reading from "A Christmas Carol."

Saturday, December 25th.

LONDON.—Christmas Concert.
MANCHESTER.—Christmas Programme.

REVIEW of APPARATUS



Some Recent Products of the Manufacturers.

AUTOMATIC PROGRAMME SELECTOR.

There has always been a demand for a time switch that will automatically switch the broadcast receiver in and out of circuit according to the times of transmission, and the items to which it is desired to listen.

A time switch for automatically bringing the receiver into operation at predetermined intervals. Certain items from a programme can therefore be selected and the receiver is automatically brought into operation as required.

The Electone time switch, a product of Fredk. J. Gordon & Co., Ltd., 92, Charlotte Street, London, W.1, is a welcome introduction, and is probably the first automatic time controlled switch to make its appearance on the market.

The automatic switch is operated by a clock movement, and by the insertion of plugs in holes arranged round the dial the filament circuit of the receiving set is closed over any period of time. The receiver is switched both in and out of circuit, and the insertion of a plug in any one hole gives reception for a period of half an hour, and at a time corresponding to its position around the face of the clock. Thus for two hours' reception, say, between the hours of 8 and 10, four plugs will be inserted corresponding in position with the two hours on the dial. Contact is made behind the dial by a brush sweeping over 24 studs, and the insertion of the plugs completes the circuit to a metal plate on the front of the clock.

The instrument is attractively finished in a polished mahogany case, has a bronze front plate, and the clock has a 24-hour movement.

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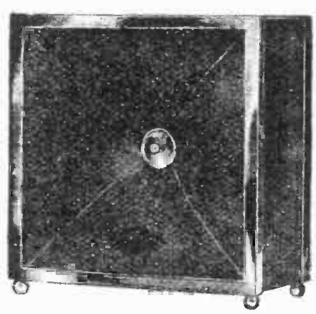
"MUSICALPHA" LOUD-SPEAKER.

Several loud-speakers of excellent performance are now available on the market, though in many instances they are of unattractive design, and have a somewhat unsightly appearance in association with the furnishing of a room.

A loud-speaker, if conspicuous, must be attractive, and should be built in a durable form to stand rough usage. These points have been borne in mind in the design of the "Musicalpha" loud-speaker, obtainable from E. Joublin and A. R. Kingsley, 317, High Holborn, London, W.C.1.

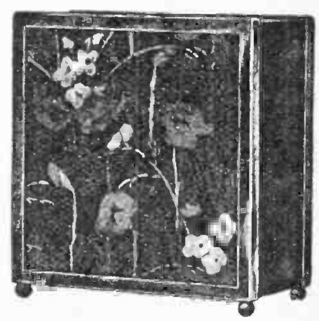
The movement is enclosed in a well-finished mahogany case 8in. × 8in. × 4in. deep, the front and back edges being



The new "Musicalpha" loud-speaker makes use of a tightly stretched silk diaphragm.

substantially bound with nickel plated angle brass. The diaphragm, which is stretched tight, is of silk, treated with a form of protective varnish. The diaphragm is driven from the centre, and an adjusting screw exerts an appreciable pull on the diaphragm. It is probably the only commercial loud-speaker in which the diaphragm is used in this way in a state of tension.

The loud-speaker is attractively finished both at the back and the front, and sound is emitted in equal volume from both sides. The reproduction of this loud-speaker possesses an exceedingly pleasant tone, and is, perhaps, somewhat low pitched, a property usually much appreciated. The absence of distortion calls for attention in the design of the amplifier from which the loud-speaker is



The reverse side of the "Musicalpha" loud-speaker has a fabric covering and sound is equally emitted from either side of the instrument.

operated. It will give particularly good performance when operated from a carefully designed set.

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Catalogues Received.

Metro - Vick Supplies, Ltd., 115, Charing Cross Road, London, W.C.2. Cosmos radio catalogue (section R), 48 pages, giving particulars of Cosmos receivers, components and accessories.

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Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, W.C.2. Leaflet No. 1057 (supplementary to pamphlet No. 234), describing the Marconi 50-75-watt portable and semi-portable station, type A.D.5g.

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Carrington Manufacturing Co., Ltd., 18-20, Normans Buildings, Central St., London, E.C.1. Illustrated catalogue of Camco wireless cabinets of all types.

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Radio Instruments Ltd., 12, Hyde St., New Oxford St., London, W.C.1. Catalogue of "R.I." components for every constructor, including retroactive tuner, permanent mineral detector, multi-ratio transformer, etc.

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

PIONEERS OF WIRELESS.

Sir,—I have read the article in the Dec. 1st issue of *The Wireless World* by Mr. Ellison Hawks entitled "Pioneers of Wireless," in which the author deals with Edison's work. I do not think that Mr. Hawks can have read the judgment given unanimously by three judges in the United States Court of Appeals in 1917. It is not quite correct to say that Edison paved the way for the valve. Edison made no useful application whatever of the so-called Edison effect. The Court of Appeals said it remained a sterile fact until I applied it. I enclose extracts to this effect from the United States Court of Appeals judgment, and I shall ask you to be so good as to bring these quotations (which are not my private opinions) to the notice of your readers. There has been far too much effort already in the United States to represent Edison as the pioneer discoverer in relation to the thermionic valve. He was nothing of the kind.

Sidmouth, J. A. FLEMING.

December 1st, 1926.

Extracts from the unanimous judgment of the United States Circuit Court of Appeals for the Second Circuit, given 1917.

The Court said concerning Edison's patent :—

"Edison's patent stated a fact and suggested a tantalising mystery, because he did not pretend to state or assert that he knew why his 'effect' took place. His disclosure remained (so far as we can discover from this record) a laboratory problem until Fleming applied it (whether with a wrong theory or a right one is immaterial) to a new and very practical field of usefulness."

"Utilisation of the Edison effect does not mean that the use of Edison's apparatus or any modification thereof was simple or easy."

"Fleming was the first to disclose an apparatus for this purpose."

"We have no doubt that Fleming's patent displays invention and of a very meritorious device."

"Fleming's invention consisted in producing a detector which Edison did not do."

IDENTIFYING BROADCAST TRANSMISSIONS.

Sir,—I have read with some interest the various letters appearing in recent issues referring to the vexed question of station identification.

It would, of course, be quite a "plum" for the Esperantists could they secure the world-wide recognition which would follow the adoption of their language for call signs, and naturally they cannot be blamed for exerting all possible pressure. It is probably also quite true that use of the Morse system would fail because of the aversion to learning something new, such aversion being by no means confined to the people of this country.

I think the germ of the right idea can be found in Mr. Schaschke's letter in the issue of December 1st, but I suggest to you that the desired result might be achieved even more simply than he suggests without the aid of Esperanto or any other language and without either the Morse code or musical knowledge.

I think it will be agreed that every listener, of any nationality whatever, must be able to distinguish between a short sound and a long one, and also between two sounds separated by, say, a full tone. This must be, else they could hardly be listeners at all. Granted this, then by a combination of such sounds, varied by length and pitch, each station could be given an absolutely distinct sign consisting of four consecutive sounds, which on reference to any list of stations could be immediately identified. Assuming the length of the sounds formed, say, by an oscillator valve, to be—short, one-quarter second; long, three-quarters of a second, and the pitches to be C and D, with, say, one second intervals between each repetition of the signal, which would be automatically imposed on the carrier during the whole of any interval so long as radiation was taking place, then if transmission of such signals were at a station's normal strength, no one once in possession of a list of stations could fail to solve the riddle, "What was that station?"

Seven Kings. CHAS. BOWLES.

December 1st, 1926.

MANUFACTURERS AND THE RADIO SOCIETIES.

Sir,—Referring to Mr. Field's letter in your issue of December 1st. I would like to say that he has apparently misread my original letter. We are a radio society formed solely for the purpose of acquiring knowledge and helping one another in all radio matters. As a society we have never tried to obtain trade terms for our members, neither are our members entitled to ask in the name of the society for such terms, and we do not issue cards. We can show many letters from firms who have been good enough to give demonstrations and lectures who express their pleasure in visiting us and offer to come again.

We would like to agree with Mr. Field, however, that radio societies are not a benefit to manufacturers of inferior goods, as by extending the knowledge of radio their members and friends are enabled to discriminate between good and bad components. There is one thing which is expected free of charge from all manufacturers but on which the people my first letter referred to do not even offer trade terms, and that is courtesy. In answer to Mr. Cookson, hon. secretary of the Preston and District Research Society, all we have to say is that our claim is based on an average attendance of members for fifty-two weekly meetings of the year and not on one public meeting. He has evidently been more fortunate than ourselves in his dealings with manufacturers. A. H. BANWELL,

Hon. Sec., Thornton Heath Radio Society.

WEATHER REPORTS ON QSL CARDS.

Sir,—With reference to Mr. Clarricoats' letter in the "Transmitters' Notes and Queries" section of your issue of November 24th regarding weather reports on QSL cards, I might mention that I have for some considerable time past put the abbreviation "WX" on all my cards as well as the barometer reading. The weather, in my opinion, has a very considerable effect on short-wave signals, and this fact is amply borne out by a number of observations I have made on DX stations, commercial and otherwise, under various climatic conditions. With a high or rising barometer, the long distance stations can very often be received at surprising strength, but when the barometer is low it is quite a job to find any DX stations at all. In fact, if you do get hold of signals fading appears to be very bad, and difficulty is experienced in reading them. This subject seems worthy of more attention than is at present bestowed upon it, and it would be interesting to hear the views of some other of your readers.

Weybridge R. C. NISBET.

November 25th, 1926.

READERS PROBLEMS

"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Winding a Resistance Non-inductively.

I am constructing a wire-wound anode resistance, and am taking every care to make the instrument as non-inductive as possible. Will it matter very much if there is a certain amount of inductance in the instrument?

L. B. D.

It would, of course, be almost impossible to construct a wire-wound resistance that was absolutely non-inductive, but by exercising proper care in the construction the inductance can be reduced to a minimum. In any case, the inductance of the resistance will be so relatively small that the frequency to which it will resonate when tuned by its own self-capacity will be far above audibility. Probably the best method of construction to adopt is that given on page 480 of our March 31st issue.

○○○○

Improving the Sensitive Two-valve Receiver.

In connection with the sensitive two-valve circuit given in your issues of March 17th and October 20th, would it be possible to arrange for this circuit to be changed to a Reinartz receiver by incorporating a suitable switch?

P. J. O.

It is quite possible, as you suggest, to incorporate a switch in this circuit to enable a change over to the Reinartz circuit to be made in a rapid manner when desired. We give the necessary circuit diagram in Fig. 1. By placing the switch in the upward position the circuit becomes a plain Reinartz. Moving it to the downward position restores the circuit to its original form.

○○○○

Saturation or Satisfaction.

I intend to construct an output choke for use in conjunction with a Mullard P.M. 254 valve. I am going to use the core of an old intervalve transformer of Continental manufacture. Can you tell me the number of turns, gauge of wire, etc., which I shall require? I understand that a high inductance will be necessary, and wish to aim at a value of 100 henries.

N. C. P.

Since the impedance of your valve is very low there is no necessity whatever for you to wind your choke to an inductance value of 100 henries, and in any case we doubt whether you could get enough turns on the core of the average Continental inter-valve transformer to produce this high inductance value without undue self-capacity effects. In a "super" power valve of the Mullard P.M. 254 type the impedance is so low that a value of 20 henries for any choke connected in its anode circuit is ample. The plate current will, however, be considerable, and whilst little fear need be entertained of introducing distortion owing to low inductance value, great care will have to be exercised to prevent distortion due to magnetic saturation of the iron core of the choke. Now, in order to avoid magnetic saturation it is necessary that the iron core be suitably designed, and it would almost certainly be found that the ordinary "inter-valve" coupling type of choke would be quite unsuitable, because its core is designed with a view to high inductance and not with a view to avoidance of magnetic saturation. The reason is that this type of choke is designed to follow a medium or high impedance valve where the plate current will be small, and risk of saturation therefore remote.

The same remark applies to intervalve transformers, and more especially those of Continental manufacture. We realise, of course, that the number of turns required on the transformer core would be considerably less than when it was used for its original purpose, and that, therefore, from this point of view the risk of saturation would be lessened. But the very heavy plate current must not be forgotten, and our opinion is that any attempt to construct a suitable choke on this core would result in considerable loss of volume and quality. We think that in the long run you would find it cheaper and more satisfactory to obtain a suitable choke of commercial manufacture, as a really good output choke suitable for following a valve of this type is by no means easy to construct.

○○○○

A Dielectric Dilemma.

Some little time ago I read that the resistance of a 1 mfd. condenser was found on test to be a little over six ohms. Can you explain this as I understood that the dielectric of a condenser was made of high-grade insulating material which one would assume would have a very high resistance?

D. P. H.

The 1 mfd. condenser which you read about may have been a faulty specimen in which an almost complete short circuit was present in the dielectric, but we are more inclined to think that reference was being made to the A.C. resistance of the condenser at a frequency corresponding to a wavelength of 300 metres, since this would work out at a little over 6 ohms. Naturally the dielectric of the condenser is of high-grade insulating material, whilst the D.C. resistance which theoretically should be infinite would probably work out at several hundred million ohms.

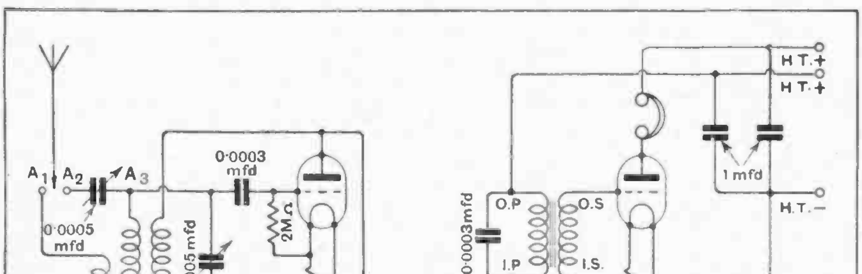

Fig. 1.—Improving the "Sensitive Two."

A High-efficiency Four-valve Receiver.

I wish to construct a four-valve receiver of the highest possible efficiency which will bring in distant stations loudly and clearly on the loud-speaker. Needless to say, the receiver must be selective and it must also be capable of responding to both the normal B.B.C. band of wavelengths and the Daventry and Paris wavelength band without necessitating the interchanging of coils.
R. V. W.

We give in Fig. 2 a suitable circuit which should admirably suit your requirements. The aerial-grid coil should be constructed as follows: On a Paxolin former 3½in. long by 3in. diameter should be wound 70 turns of No. 24 D.C.C. This will be the secondary. At the "filament" or low-potential end of this coil should be wound 15 turns of No. 30 D.S.C. wound on spacers in the manner described in full on page 502 of our October 13th issue, a tapping being made at the seventh turn. The intervalve transformer should be constructed in a similar manner, except that the primary and neutralising windings should be wound with No. 40 D.S.C. and consist of 15 turns each. There is, however, one very important point of difference, and that is, that a longer former must be used for the purpose of the reaction winding R.C.1. This winding consists of 30 turns of No. 24 D.C.C. commencing close up against the secondary winding, and wound in the same direction. It will be noticed that the Reinartz system of reaction control is used.

In order to receive on the long waves, it is arranged that a loading coil (L.C.) be let into the grid circuit of the detector valve, this loading coil consisting of an ordinary No. 200 plug-in coil with the plug-in coil (R.C.2) placed in fixed relationship with it for reaction purposes, the actual degree of reaction being controlled by the condenser as before. The long-wave loading coil being connected at the low-potential end of the secondary circuit will introduce no losses whatever on the normal broadcasting band of wavelengths. The switch S merely serves to short-circuit this loading coil on the lower wavelengths, there being no need to short-circuit the extra reaction coil. It should be pointed out that it will be far better to use some such device as a "Polar" tuning unit instead of two plug-in coils in this position, since not only would it take up less space, but there would be less risk of interaction with other portions of the circuit owing to the greatly reduced magnetic field. Another advantage is that a finer initial setting of reaction can be had than is obtainable by adjusting the size of the plug-in coil used for reaction. It will be noticed that the aerial coil is connected in such a manner that no alteration need be made to the aerial connection when changing over from short waves to long waves, or *vice versâ*. The rheostat controlling the H.F. valve should be of 30 ohms resistance or more, irrespective of what type of valve is used, as it is intended for use as a volume control. The H.F. choke can consist of any of the commercial products that are upon the market. With regard to valves, it is required that a valve of 20,000 to 30,000 ohms impedance be used in the H.F. position, since the transformer is designed for it. Naturally the valve having the highest possible amplification factor in respect of this impedance will be chosen. A D.E.5B will, therefore, be a highly suitable valve, and would be chosen in preference to the D.E.R., which for the same impedance gives only half the amplification factor of the D.E.5B. With regard to the general layout, it is highly important that plenty of room be allowed for the H.F. side of this receiver, and it is strongly advised that the general layout of the receiver described on page 500 of the October 13th issue be followed, more especially in regard to the use of a single straightforward screen for cutting off all electrostatic effects between the two H.F. transformers and their condensers. Needless to say, closely screened coils with their attendant inefficiencies should not be used.

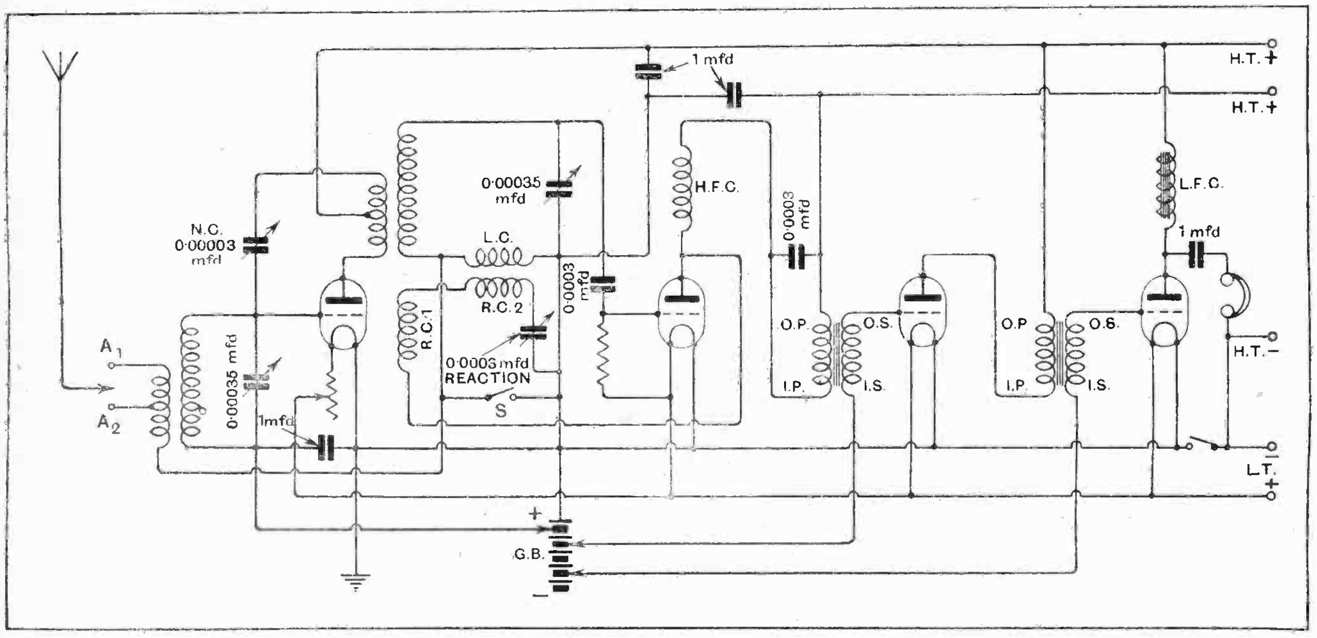

Fig. 2.—Circuit for long-distance loud-speaker work.

Complicating the "Everyman's Four."

I have built the "Everyman's Four-Valve Receiver," and have obtained excellent results with same. I now wish to make arrangements for the rapid insertion of a milliammeter into the plate circuit of each valve to obtain a reading of the plate current. Are there any special precautions necessary?
J. H. B.

You do not state definitely the manner in which you propose to arrange for the rapid insertion of the milliameter into the plate circuits of the various valves as necessary, but we would suggest that the use of double circuit jacks, with their two centre contacts joined together would offer the best solution of the problem. It is of little use attempting to place the milliameter in the plate circuit of the detector valve since the current flowing in that circuit is only a few microamperes, or, in other words, a very small fraction of a milliampere.

Since your milliameter jacks will be inserted in leads which are definitely at earth potential with respect to both H.F. and L.F. currents, no complications will be introduced provided the jacks are not placed in proximity to any high potential wiring.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

"1927 CALLING."

We take this, our latest opportunity before Christmas, of wishing to all our readers greetings of the Season and good wishes for the New Year.

From a wireless point of view we cannot contemplate the approach of 1927 without realising that there is every indication that 1927 is to be an extremely eventful year in so far as broadcasting is concerned. The New Year will see the organisation hitherto conducted as the British Broadcasting Company under new control with wider powers than were granted to the old executive.

We are left almost in complete ignorance regarding the extent to which the new authority will be likely to make its influence felt, and, although the general opinion is certainly that the present direction of the activities of the Broadcasting Service will be interfered with very little, yet it is quite impossible to foresee to what extent the mere presence, perhaps of the newly appointed authority may tend to influence the general policy.

It is quite evident that amongst the public there is general apprehension lest 1927 should see a tendency to develop the programmes too strongly on the educational side. We are ourselves in agreement with those who regard broadcasting as an invaluable medium for education, but we consider that it is imperative that the proportion of educational matter broadcast should be very strictly limited and carefully selected. When once those on the broadcasting organisation who are staunch supporters of microphone education realise what a powerful weapon is at their disposal, there is great risk that their enthusiasm may so carry them away as to make them forget that by too much "uplift" and educational broadcasts they run the very serious risk of driving their audiences away. Unfortunately, the immediate effect of what is broadcast is not apparent to us as it would be in the case of a lecture to a visible audience, but the effect of unpopular programmes on listeners is none the less disastrous to the interests of broadcasting. The first concern of the Broadcasting service must always be to capture the interests of the public, and this can only be done by making the programmes really popular with the majority. There is, in our view, no doubt that to-day the more serious broadcasts make a much wider appeal than they did in the early days of broadcasting, and the public is gradually acquiring and cultivating a taste even for the talks; but let us hope that the Programme Editors will be extremely careful to see that they do not undo the good work already achieved, by incautious enthusiasm. In educational matter the aim should be always to supply just a little more than is demanded.

We shall watch with the deepest concern the progress of the programme policy which 1927 will evolve, but with at least equal attention we expect to observe developments on the technical side which have been promised. If 1927 will guarantee us alternative programmes, that alone will be a momentous advance, but we anticipate that, in addition, other very marked improvements will take place.

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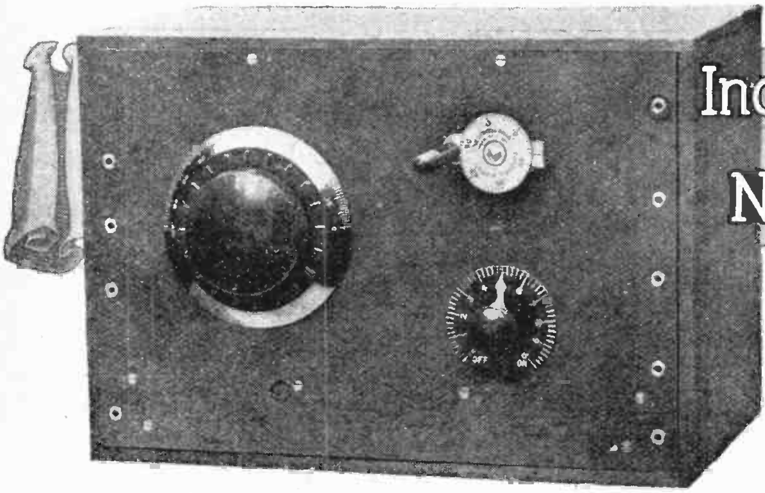


Increasing the Range of the Nucleus Receiver

An H.F. Unit for the Broadcast Waveband.

By H. F. SMITH.

THE unit to be described in this article is primarily intended to operate in conjunction with the "Nucleus Receiver"[1] recently described in this journal by the present writer. There is no reason, however, why it should not be used with any suitable detector valve, preferably functioning on the anode bend principle, and with or without L.F. amplification. It has a wavelength range of from about 200 metres to slightly under 600 metres.

The design chosen is that of the "Everyman Four"; in fact, the essential H.F. circuit of that popular receiver has been taken in its entirety, except for one or two minor modifications made necessary by the fact that the unit is self-contained. Its effectiveness depends almost completely on the use of highly efficient aerial-grid and intervalve transformers with low resistance secondaries, and a minimum capacity between the windings. It may be recalled that an amplification of nearly 40 is obtained over the greater part of the tuning range; this without taking into account the by no means inconsiderable gain possible by the application of reaction. For further information on this subject, the reader is referred to an article by W. James describing the original receiver, which appeared in the issue of this journal dated July 28th, 1926.

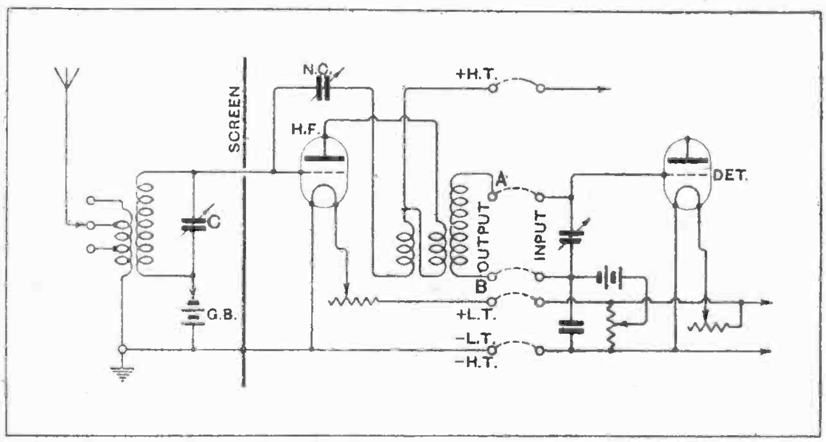


Fig. 1.—The circuit diagram, showing connections to the external detector valve. C=0.0003 mfd.

It may be considered that the coils are not easy to make, and that the materials used in their construction are somewhat expensive. It is admitted that a certain amount of patience is necessary, although, apart from the fact that the operation is tedious, there is no real difficulty, and the writer would submit that results obtained will amply repay the constructor for his outlay both of time and money. In any case, the total cost of the unit is by no means high. It is noticed that a number of firms are now supplying ready-made Litz coils, wound to specifications which have appeared in *The Wireless World*.

Choice of Valves.

The instrument is intended to be used with a valve having a plate impedance of, very roughly, 25,000 ohms, and an amplification factor of 20—or as high as

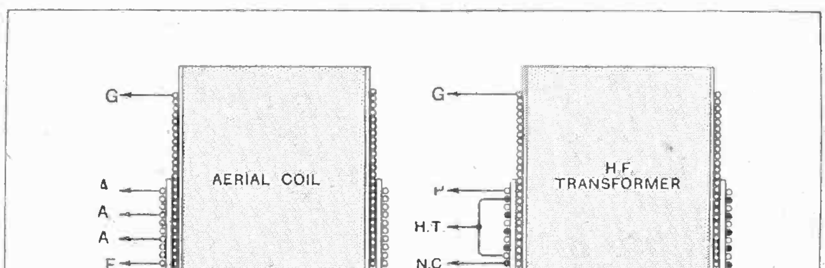


Fig. 2.—The windings of the transformers. In this sectional sketch, the primary winding of the H.F. transformer is shown by circles, and the neutralising winding by black dots. The lettering indicates the ultimate connections of the various ends, and corresponds with that in Fig. 6.

[1] *The Wireless World*, Dec. 1st, 1926.

Increasing the Range of the Nucleus Receiver.—

possible. It should be realised that, speaking generally, with different valves of a given impedance, the actual H.F. magnification obtainable will be in direct proportion to the valve amplification factor.

The Aerial-grid Transformer.

The circuit of the unit is given in Fig. 1, which also shows the method of connecting it to the detector valve. The tuned secondary winding of the conventional type of aerial-grid transformer, with a tapped "untuned" primary, is connected between grid and filament, a bias battery being interposed. The negative potential thus applied helps to reduce the drain on the H.T. battery, to lengthen the life of the valve, and also to sharpen up tuning by preventing the flow of grid currents.

The primary of the H.F. transformer is wound over the low-potential or filament end of the secondary, and to it is tightly coupled another parallel winding, potentials developed across which are fed back to the grid through the neutralising condenser for stabilising the circuit. The ends of the secondary are connected to the output sockets, which are in turn joined to the input of the "Nucleus Receiver." The variable condenser of this latter unit, which normally tunes the aerial circuit when it is used by itself, is now tuning the H.F. transformer.

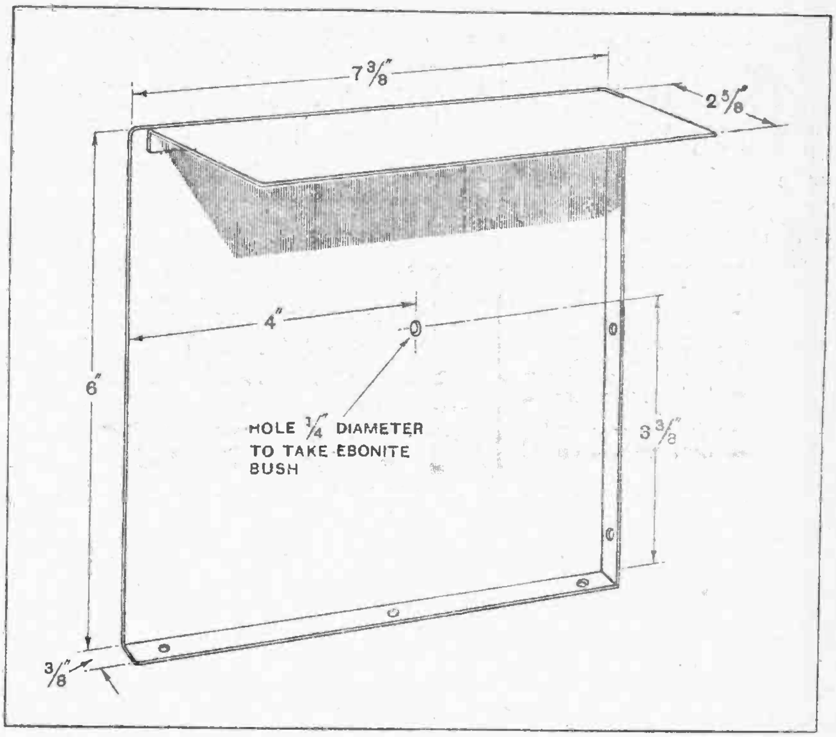
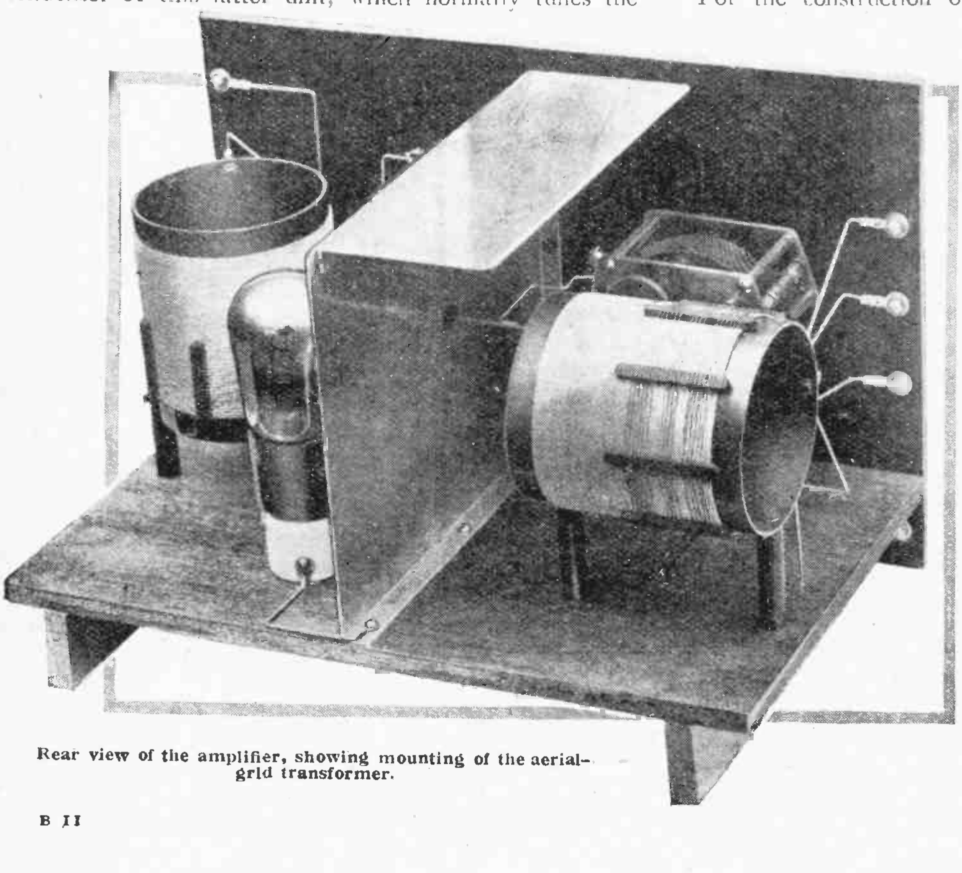


Fig. 3.—Detail of the screen. The horizontal part is attached with three No. 6BA screws and nuts.

For the construction of the aerial-grid transformer, which is shown in Fig. 2, we require, in addition to the Paxolin former (3in. diameter and 3½in. long) and wire, a total of eight spacers, made of ebonite, measuring ¼in. wide by ⅛in. thick and 1⅝in. in length. One of these carries four No. 8BA screws, with their heads deeply countersunk, which act as junction points for the windings. That for the earth connection (E) is mounted 3/16in. from the end, while the first aerial tapping is separated from it by ⅓in. There is a spacing of 7/16in. between the first and second aerial tapping points, and ½in. between the second and third.

The secondary winding consists of 68 turns of Litz wire, having a total of 27 strands of No. 42 S.S.C. wire, with a double silk covering over all. The ends are soldered to small double-ended tags, secured to the



Rear view of the amplifier, showing mounting of the aerial-grid transformer.

Increasing the Range of the Nucleus Receiver.—

cylinder with No. 6BA nuts and screws.

Contrary to the usually expressed opinion, this wire is not really difficult to handle; the ends may be bared by unwrapping the outer covering for a length of about $\frac{3}{4}$in., unlaying the strands, and then scraping them gently with a knife, which should not be too sharp. Care should be taken not to break even a single strand, and to see that all are bared properly.

The spacers are now arranged equally around the circumference of one end of the secondary, and temporarily secured in position by means of a stout rubber band. The primary, with a total of 15 turns, tapped at the sixth and tenth turns from the "earth" end, is now wound on, in the same direction as the secondary, and is soldered to each of the connecting screws, which should be "tinned" before commencing this operation.

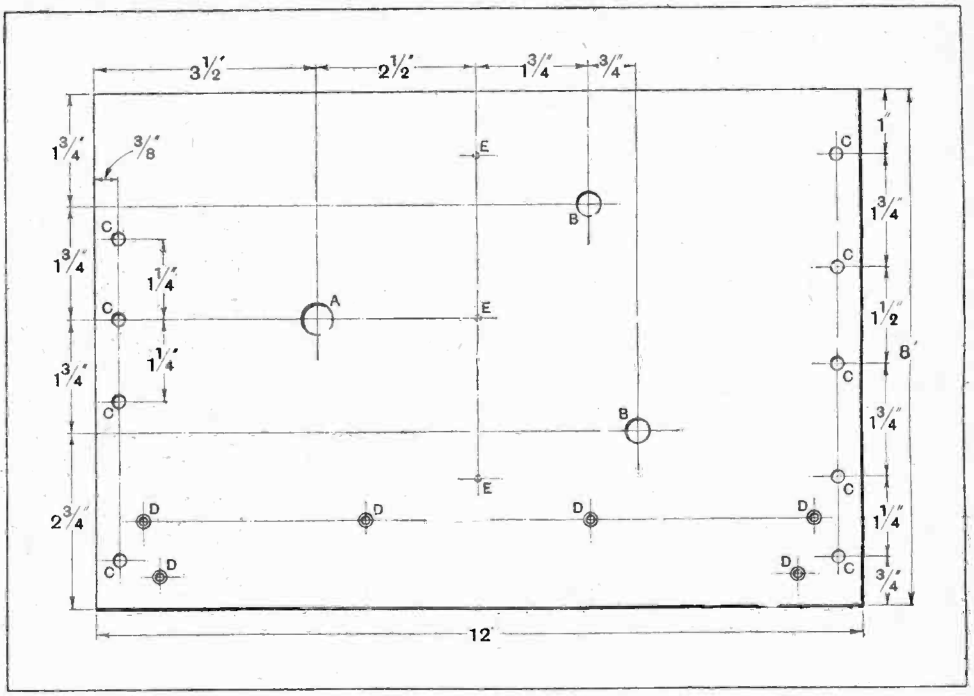


Fig. 4.—Drilling details of the panel. A, $\frac{1}{2}$in. dia.; B, $\frac{3}{8}$in. dia.; C, $\frac{3}{16}$in. dia., tapped No. 1BA; E, blind holes, tapped No. 6BA.

The H.F. transformer is constructed in a similar manner; its secondary winding is identical. The spacers are of the same width and thickness, but are $1\frac{1}{2}$in. in length. One of them carries a terminal screw at each end, and two others have a single screw. The approximate relative positions of these spacing strips will be clear if Figs. 2 and 6 are considered in conjunction; they are arranged in such a way that the external wiring is as short as possible. For ease in winding, it is almost essential that the spacers should have a shallow thread cut on their surfaces; they are best made from a short length of ebonite tube, so that the thread (32 to the inch) may be turned in a lathe.

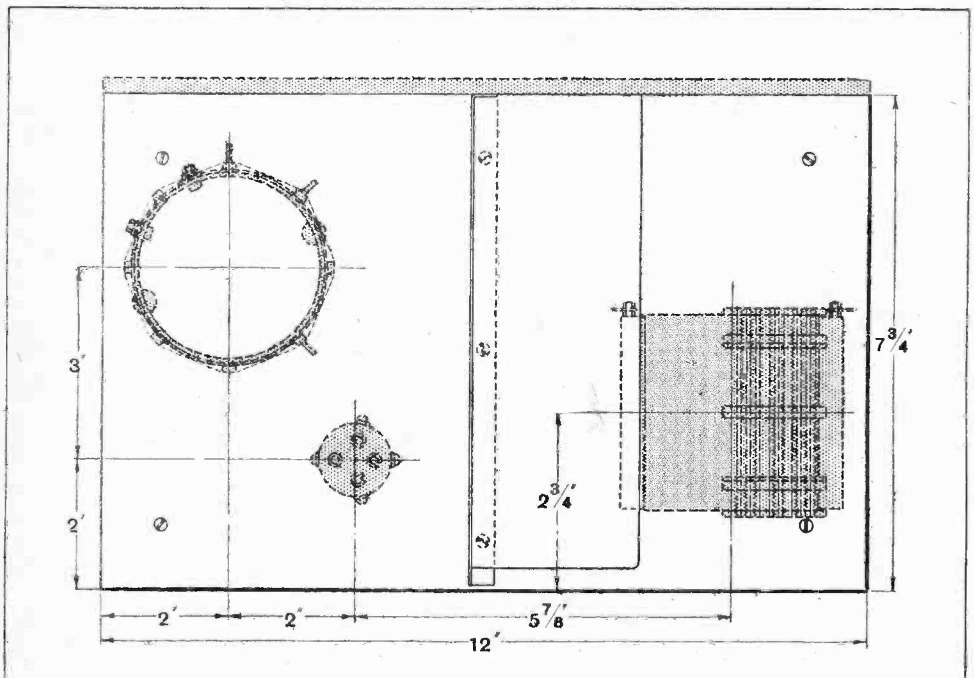


Fig. 5.—Layout of the components on the baseboard. The horizontal screen is not shown in this diagram or in Fig. 6.

The H.F. Transformer.

The primary section is wound in alternate grooves, and thus has a spacing of $\frac{1}{16}$in. between adjacent turns; the neutralising section is wound in the space between these turns. No. 40 D.S.C. wire is used, and there is a total of 15 turns in each section. All coils (primary, secondary, and neutralising) are wound in the same direction. It will be clear from Fig. 2 that *opposite* ends of the primary and neutralising windings are joined together for connection to H.T. +. Both transformers are fitted with

Increasing the Range of the Nucleus Receiver.—

feet, cut from $\frac{1}{2}$in. ebonite tube, for mounting on the baseboard, as shown in the illustrations. The aerial and H.F. transformers are raised, respectively, $1\frac{1}{2}$in. and $1\frac{1}{8}$in. above the baseboard.

It is well worth while taking pains with the construction of these coils; provided that they are properly made, the instrument can hardly fail to function properly. Each winding should be thoroughly insulated from the others; one or two cases of failure have been traced to a short-circuit between primary or neutralising sections and the terminal screws.

Screening.

The construction of the screen, which is made of aluminium sheet approximately $\frac{1}{32}$in. thick (copper will do equally well), is shown in Fig. 3. It was realised that, on account of the different lay-out of the components, as compared with other standard receivers using the same circuit, a certain amount of extra screening would be necessary to prevent interaction, so the horizontal portion was constructed in such a way that it could be easily removed for experimental alterations. There is no reason, however, why the whole screen should not now be made from a single piece of metal. It will be noticed that it is connected electrically to the negative L.T. terminal, and therefore to earth. A hole is drilled to pass a connection to the grid of the valve, and is bushed with a short length of ebonite tube, with internal and external diameters of respectively $\frac{1}{8}$in. and $\frac{1}{4}$in. The wire is actually "air-insulated," as it does not touch the bush.

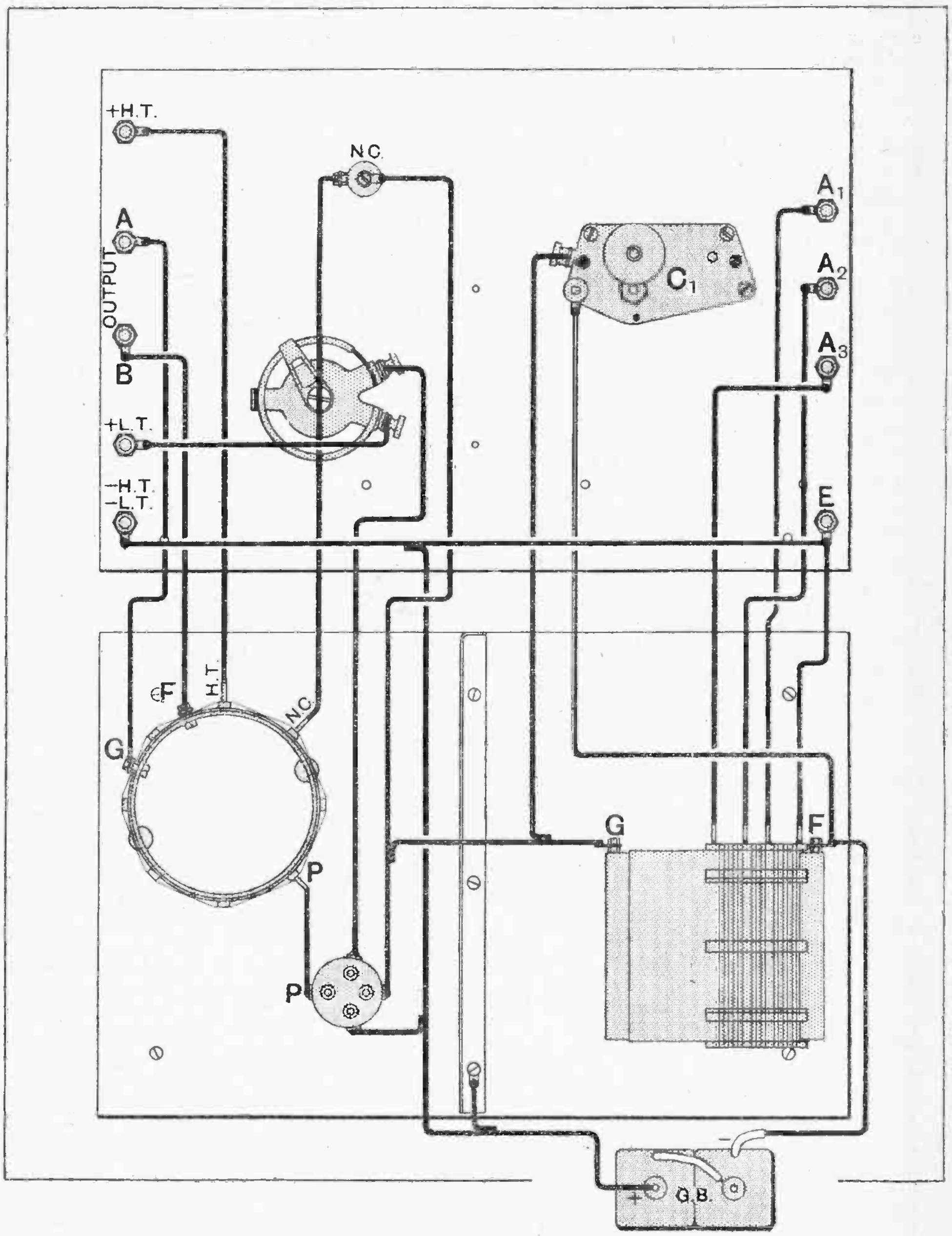


Fig. 6.—The practical wiring plan. The lettering of the transformers corresponds with that in Fig. 2.

The mounting of the components does not call for any comment, as all details are well shown in Figs. 5 and 6 and in the photographs. As in the case of the "Nucleus" set, the baseboard is raised on two battens, $1\frac{1}{4}$in. in depth, to give space below it for the grid battery, made up of two small dry cells. The use of a separate grid battery for this unit is possibly a luxury, as that necessary for the main unit could serve equally well. It is, however, very convenient to be able to change units without having to trouble with an extra connection.

The wiring of a simple unit of this description is naturally a fairly easy matter, and is clearly shown in Fig. 6. No. 18 tinned copper wire was used throughout, except for a flexible lead from the negative side of the filament to the positive terminal of the grid bias battery.

The cabinet is of exactly the same size as that which accommodates the main unit, and was illustrated on page 729 of *The Wireless World* for December 1st, 1926; a further description is therefore unnecessary.

The H.F. unit is connected to the "Nucleus Receiver" by means of five short connectors, made of rubber-

LIST OF PARTS.

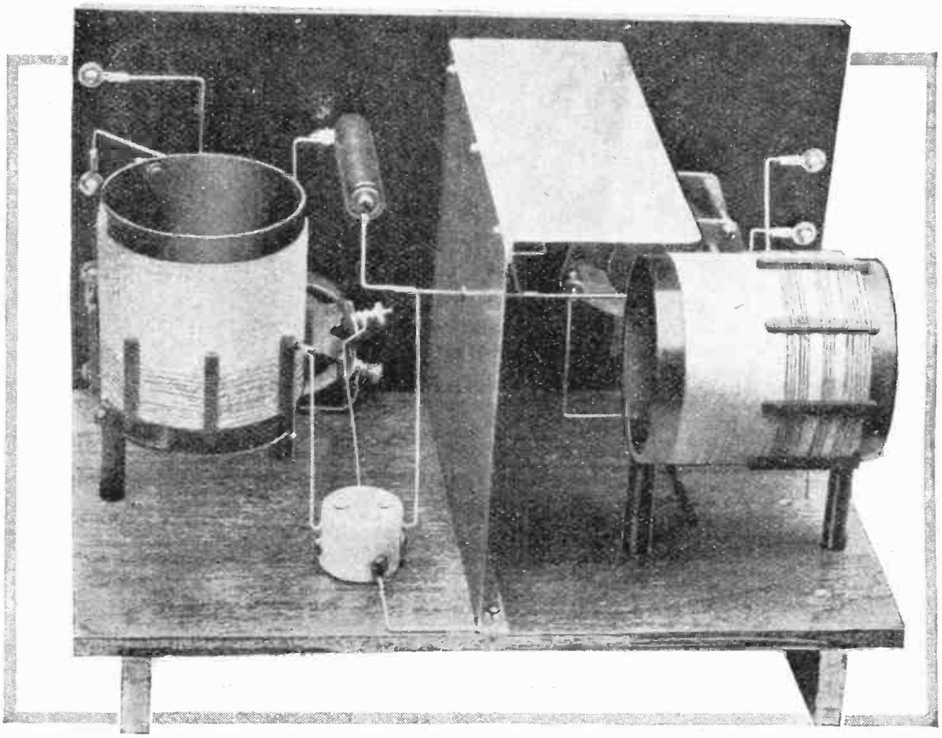
1 Ebonite panel, 12in. × 8in. × ¼in.
1 Variable condenser, 0·0003 mfd. (Brandes).
1 Balancing condenser, with dial (Gambrell).
1 Rheostat, 15 ohms (Ormond).
1 Valve holder (Athol).
9 Plug sockets (Lisenin).
10 Plugs (Lisenin).
2 Paxolin tubes, 3in diameter, 3½in. long (Micanite & Insulators Co., Ltd.).
50 yards Litz wire, 27/42 (Ormiston).
2 Dry cells, T size (Siemens).
Wood for cabinet.
Aluminium sheet, screws, wire, ebonite rod, &c.

Cost approximately - £3 0 0

insulated flexible wire fitted with plugs. There is little risk of error, as inter-connecting sockets are immediately opposite one another. The H.T. and L.T. battery connections are automatically made by inserting these connectors, it being assumed that common voltages will be used on all valves.

Operating Notes.

As already stated, a valve of about 25,000 ohms impedance and the highest possible amplification factor should be used. In the 6-volt class we have quite a wide choice; the D.E.5b, P.M.5, S.T.61, and several others will give excellent results. Among suitable 4-volt valves are the P.M.3 and S.T.41; while in the 2-volt range we have the P.M.1 H.F., S.T.21, and Cosmos "Green Spot," etc. On the assumption that about 120 volts of high tension will be applied, a grid bias of 1½ volts will generally give best results, and it is suggested that this value be tried for initial tests, although the use of 3 volts will effect a further economy in H.T. consumption.



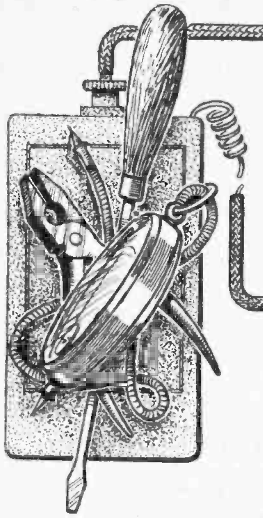
Another rear view of the unit.

Provided that everything is in order, oscillation will normally be produced as the two circuits are brought into tune; the neutralising condenser should now be turned until a state of stability is reached, after which it is advisable to re-tune, and make a further balancing adjustment until the set is perfectly stable over the whole tuning range. The neutralising condenser can now be regarded as a form of reaction control; if it is moved slightly away from the position giving a perfect balance, the strength of the signals will be increased enormously—as will, unfortunately, the risk of causing interference by oscillation! It is, however, one of the great advantages of this circuit, using the particular coils described, that the condenser may be set slightly "off balance" without actually causing oscillation, but, at the same time, giving a good measure of reaction over a large part of the tuning scale.

It is convenient to reduce the volume of signals which are sufficiently strong to overload the L.F. amplifier by "dimming" the filament of the H.F. amplifier. If a valve with a consumption of considerably less than 0.25 ampere is used, the resistance of 15 ohms which has been suggested will not be sufficient, and one of 30 ohms, or even more, should be substituted, particularly when this valve takes a very small current of, say, 0.1 ampere.

The complete set as described up to the present, consisting of an H.F. amplifier with a detector and one stage of L.F. magnification, will not give great volume on very distant transmissions, except under very favourable conditions. For loud-speaker work at extreme ranges an extra L.F. amplifier will of course be necessary, although it may be pointed out that, with a moderately good aerial and earth system, a number of stations should be heard in this way at night time with the three-valve receiver.

The writer hopes to describe, at a very early date, the construction of a special short-wave unit, intended for the reception of American broadcasting, and to follow this by articles dealing with a long-wave H.F. amplifier and an L.F. amplifier.



PRACTICAL HINTS & TIPS

A Section Mainly for the New Reader.

AN EFFICIENT CRYSTAL SET.

When a good measure of selectivity, combined with high sensitivity, is required from a crystal receiver, the circuit shown in Fig. 1 can be recommended. It makes use of a tuned aerial circuit, which is inductively coupled (with provision for adjusting the degree of coupling) to a tuned secondary circuit.

The crystal detector and telephones are not connected across the whole of the secondary inductance, but are in shunt with only a part of the coil. The best position for this tapping can only be found by trial, and will depend on the resistance of the particular type of crystal which is used. Unless a very high degree of selectivity is required, however, it will generally be found satisfactory to make this connection to the centre point of the coil. It thus becomes possible to use commercial plug-in coils, with a centre tapping; this is one of the advantages of the arrangement.

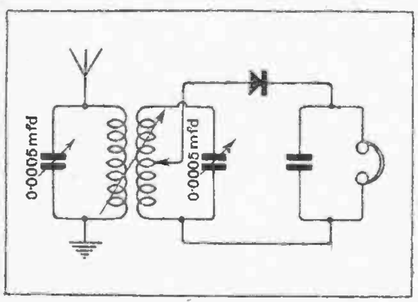


Fig. 1.—A selective crystal circuit.

When a number of coils are available different inductance values should be tried experimentally, as the damping of the circuit as a whole will be reduced when the ratio of capacity to inductance is large. There is no real reason why the secondary tuning condenser should not be considerably larger than that shown; one of 0.001 mfd. will give good results, particularly with a treated galena crystal, which usually has a low resistance.

○○○○

ADAPTING A RECEIVER FOR THE SHORT WAVES.

Although it is almost impossible to modify a set with a stage of H.F. amplification for reception of the ultra-short waves (below 100 metres) there is no reason why the average detector-L.F. combination should not be altered with a fair chance of success. The East Pittsburgh station, K.D.K.A., as well as the relays of Schenectady (W.G.Y.) on still shorter wavelengths, are being received at good strength in this country during the present winter; indeed, signals are often so strong that a receiver of extreme efficiency is not necessary.

A very simple method of adapting the conventional direct-coupled detector circuit with magnetic reaction is shown in Fig. 2 (*a*). The grid coil should be replaced by one having some seven or eight turns (these are now fairly easily obtainable commercially). A similar inductance will generally be suitable for insertion into the reaction coil socket, although one with fewer turns may give better results.

The aerial is connected to its usual terminal through a very small variable capacity (C in the diagram), which need not have a maximum capacity greater than about 0.00005 mfd. A vernier or neutralising condenser will generally be found suitable; its capacity should be adjusted for best results, and it should be regarded rather as a variable coupling than as a tuning control. The grid circuit is brought into resonance in the usual manner by rotation of the parallel condenser.

The arrangement shown in Fig. 2 (*b*) is also capable of giving good results, and will be found useful when a coil wound with bare wire is used in the grid circuit. This should have some eight turns, the aerial being connected to a point about three turns above the earthed end: this connection should be varied experimentally till signal strength is at maximum.

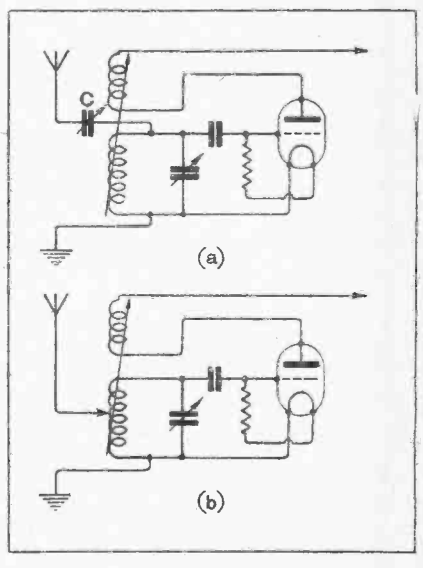


Fig. 2.—Short-wave reception with an ordinary receiver.

The effects of hand capacity are always noticeable when receiving the short wavelengths, and it will often be necessary to fit temporary extension handles to both the tuning condenser and reaction control. Unless the condenser is fitted with a good slow-motion gear its adjustment will be found to be extremely difficult, and in any case it is a good plan to reduce its capacity by connecting a small fixed condenser of, say, 0.0002 mfd. in series.

oooo

THE STANDARD AERIAL.

Readers may have been puzzled by published statements regarding receivers said to be designed for use with "an aerial of standard dimensions," or by expressed opinions that certain results should be obtained with an "average aerial."

Although there is no authoritative pronouncement on what constitutes a "standard aerial"—indeed, there is really no such thing—it can be assumed with safety that the designer of a receiver always has in mind the idea that it will be used with an aerial probably consisting of a single wire with a total length of 100ft. (the maximum allowed by the Post Office authorities), and a height of not less than 30ft. The horizontal span will therefore be about 70ft. long, with a 30ft. down-lead. Such an aerial will generally have a capacity of slightly over 0.0002 mfd.

oooo

REDUCING VALVE IMPEDANCE.

The point has often been stressed that an ordinary low-frequency transformer is unsuitable for connection in the anode circuit of a valve with an exceptionally high impedance. While there can be no question that we run a grave risk of introducing serious distortion by disregarding advice on this point, it is not generally realised that the actual impedance of the valve may be forced down to a considerably lower figure than that given by the manufacturers. Their published data on this subject generally refer to the conditions obtainable when the grid is maintained at a zero or negative potential; the impedance is reduced considerably when a positive bias is applied.

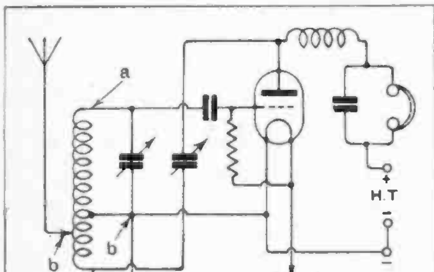
A valve operating as a grid rectifier always requires a certain amount of positive voltage on the grid, and this, combined with a large value of high-tension voltage, will effect a considerable reduction in its internal impedance. On page 593 of *The Wireless World* for November 3rd, 1926, it is shown that a normal resistance of 50,000 ohms may be reduced to 30,000 ohms by this method.

DISSECTED DIAGRAMS.

Point-to-point Tests in Theory and Practice.

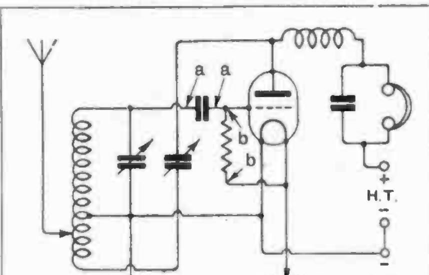
No. 52.—A Single-coil "Reinartz" Receiver.

The present series of diagrams is intended to show simple methods of locating faults in typical wireless receivers. Failing a sensitive galvanometer, it is suggested that a pair of telephones with a small dry battery should be used as an indicating device. These tests will show not only actual faults, but will reveal the small leakages which are so often responsible for poor reception and flat tuning. Batteries should be disconnected before testing.



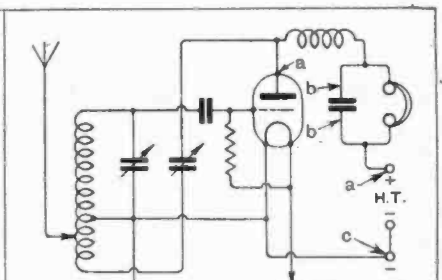
1

The continuity of the coil winding as a whole may be tested between the points marked *a* and *a*. Another test between *b* and *b* will show if the aerial and earth tappings are in order.



2

Application of the testing device between *a* and *a* will show if the insulation of the grid condenser is adequate, while a test between *b* and *b* will indicate continuity in the leak. The variable condensers should also be tested.



3

Continuity of the anode circuit as a whole is tested between *a* and *a* (with telephones in position or their terminals "shorted"). Insulation of the by-pass condenser is shown between *b* and *b*, and of the anode circuit as a whole between *a* and *c*.

TRANSATLANTIC WIRELESS.

Twenty-fifth Anniversary of Senatore Marconi's First Success.

In this article Senatore Marconi gives a detailed account of the first wireless transmission across the Atlantic, on December 12th, 1901, when, with the simplest possible apparatus, he succeeded in hearing in Newfoundland the "S" signals sent out from Poldhu, Cornwall.

The twenty-fifth anniversary of this achievement has followed closely on the opening of the Canadian Beam Service, which operates over practically the same route. It is interesting to compare the apparatus and methods of the first experiments with the modern beam installation described in the issues of November 3rd and 24th, 1926.

IN 1895 and 1896 I had proved the possibility of transmitting signals to considerable distances by means of the raised antenna and earth connection; in 1899 I had proved that the curvature of the earth did not interfere with the propagation of ether waves over short distances; and in 1900 I felt that the time had come to venture further afield. Very naturally I realised that my first endeavour must be directed to prove that an electric wave could be sent out across the Atlantic and detected on the other side.

It was obvious to me from the very first that if my purpose was to succeed it would be necessary to employ more power than had ever been used before, and, above all, it was imperative that the production of wireless waves with this power should not cripple or render useless the already established maritime wireless communication which was proving its enormous value to ships and increasingly so every day. After examining many likely sites I fixed my choice upon a particularly suitable spot on the Cornish coast, quite close to Mullion, and in August, 1900, the Marconi Company leased the site I had chosen, which is known as Poldhu.

Erection of the Poldhu Transmitter.

The buildings at Poldhu were begun in October, 1900, and at the same time the nature of the aerial that it was proposed to employ was decided. This aerial was to be supported by a ring of twenty masts, each about 200ft. high, arranged in a circle 200ft. in diameter and covering an area of about an acre. By December, 1900, the building work was sufficiently advanced for arrangements to be made for the electric plant in the station. When this had been delivered and installed, experiments were carried out at Poldhu in January, 1901, for the purpose of ascertaining how far it would be efficient for the end in view.

At Easter, 1901, by means of a short temporary aerial, experiments were conducted between Poldhu and a wireless station at the Lizard about six miles distant, and these experiments proved that the work was being conducted on the right lines.

A recent photograph of Senatore G. Marconi at his desk at Marconi House.

By the end of August, 1901, the erection of the masts at Poldhu was nearly completed. And then, unfortunately, a terrific gale swept the Channel and the English coast on September 17th, with the result that the whole construction was wrecked. For some days I had visions of my experiment having to be postponed for several months or longer, and then I decided that it might be possible to make a preliminary trial with a simpler aerial. Therefore ten of the masts, each 170ft. high, were re-erected. A triatic stay was stretched between the two end masts, and from this triatic stay were suspended sixty almost vertical bare copper wires, the distance between the wires being about 1 metre at the top. After converging together at the bottom these wires were all connected to the transmitting instrument.

Preliminary Arrangements.

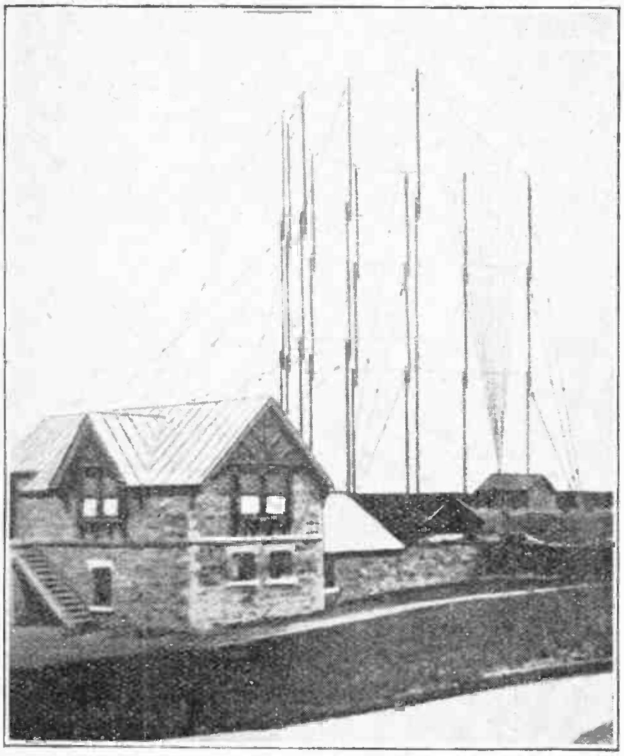
By the middle of November, I was able with this temporary aerial to obtain signals of such great strength at what was then my most distant station—Crookhaven, in the South of Ireland—that I felt sure they would be detectable at a ten times greater distance. I decided that Newfoundland, as almost the nearest part of the Western hemisphere to the English coast, should be the scene of my attempt to bridge the Atlantic.

Now, as the momentous step I was about to take represented such an amazing extension of the existing range of my system, I thought it wiser to keep secret the real object of my mission. If successful, my success would be all the greater from coming upon the world so unexpectedly. I may say that in this I was only following my consistent system not to make announcements until I have obtained actual results.

A legitimate reason existed for my visiting Newfoundland apart from the transatlantic experiment which I wished to try. As I was interested in the possibility of signalling by

Transatlantic Wireless.—

wireless to Cunard liners traversing the ocean beyond the Grand Banks, 400 miles from the coast of Newfoundland, I announced my intention of making these marine experiments, which in themselves formed a sufficiently ambitious object for my trip from the public's point of view, seeing that, if successful, it would represent almost doubling the greatest range I had hitherto attained.



Aerial system at Poldhu, reconstructed after the gale of September 17th, 1901.

Having finally decided to sail at the end of the month, I gave definite instructions regarding the sending of the signals from Poldhu. After my arrival at St. John's, I was to wire to the chief engineer in Cornwall a date, say Tuesday, December 10th, and on each day after the receipt of that wire the letter "S," which in the Morse code is represented by three dots, was to be sent at regular intervals from 3 to 6 p.m. Greenwich time until further instructions. These hours corresponded to about 11.30 a.m. to 2.30 p.m. at St. John's, which I reckoned would be the most convenient time for my work there.

Kite Aerials.

On the 26th of November, then, I sailed from Liverpool on the Allan liner *Sardinian*, accompanied by my two assistants, Messrs. G. S. Kemp and P. W. Paget. As it was clearly impossible, at that time of the year, owing to the inclement weather, and especially in view of the shortness of the time at our disposal, to erect high masts to support the aerial, I had arranged to have the necessary aerial supported in the air by a small captive balloon, and so we took with us two balloons as well as six kites.

We landed at St. John's on Friday, December 6th, and the following day, before beginning operations, I visited the Governor, Sir Cavendish Boyle, who offered me the temporary use of such lands as I might require for the erection of depots at Cape Race, or elsewhere, if I should eventually determine to erect the wireless stations which they understood were then being contemplated.

Choice of a Site.

After taking a look at the various sites which might prove suitable, I considered that the best one was to be found on Signal Hill, a lofty eminence overlooking the port and forming the natural bulwark which protects it from the fury of the Atlantic gales. On the top of this hill there is a small plateau of some two acres in area which I thought very suitable for the manipulation of either the balloons or the kites. On a crag on this plateau rose the new Cabot Memorial Tower which was designed as a signal station, and close to it there was an old military barracks which was then used as a hospital. It was in a room in this building that I set up my apparatus and made preparations for the great experiment.

On Monday, December 9th, barely three days after my arrival, I began work on Signal Hill together with my assistants, and tested the comparative efficacy of balloons and kites as a means of supporting the aerial. I came to the conclusion that perhaps the kites would answer better, and on Thursday morning, December 12th, 1901, in spite of the gale then blowing, we managed to fly a kite to a height of about four hundred feet.

A group taken at Signal Hill, Newfoundland in December 1901. From left to right: Mr. G. S. Kemp, Mr. Marconi and Mr. P. W. Paget.

It was a bluff, raw day; at the base of the cliff, three hundred feet below us, thundered a cold sea. Oceanward, through the mist, I could discern dimly the outlines of Cape Spear, one of the easternmost reaches of North

Wrestling in a high wind with the kite which carried the aerial at Signal Hill, Newfoundland. Mr. Marconi is seen on the extreme left of the picture.

America, while beyond that rolled the unbroken ocean, nearly two thousand miles of which stretched between me and the British coast. Across the harbour the city of St. John's lay on its hillside, wrapped in fog.

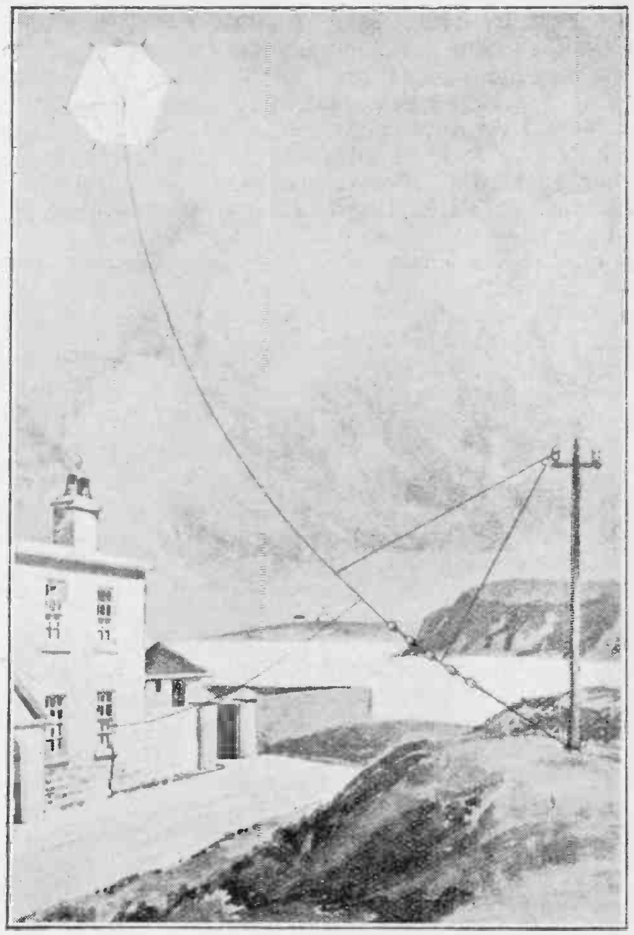
The critical moment had come for which the way had been prepared by six years of hard and unremitting work despite the usual criticisms directed at anything new, and I was about to test the truth of my belief.

Three Faint Clicks.

In view of the importance of all that was at stake I had decided not to trust entirely to the usual arrangement of having the coherer signals recorded automatically through a relay and a Morse instrument on a paper tape, but to use instead a telephone connected to a self-restoring coherer, the human ear being far more sensitive than the recorder. Suddenly, about half-past twelve, unmistakably three faint little clicks in the telephone, corresponding to three dots of the Morse code, sounded several times in my ear as I listened intently; but I would not be satisfied without corroboration.

"Can you hear anything, Mr. Kemp?" I said, handing the telephone to my assistant. Kemp heard the same thing as I, and I knew then that I had been absolutely right in my anticipations. I knew then that the day on which I should be able to send full messages without wires or cables across the Atlantic was not very far distant. The distance had been overcome, and further development of the sending and receiving apparatus was all that was required.

After a short while the signals stopped, evidently owing to changes in the capacity of the aerial wire, which in turn were due to the varying height of the kite. But again at 1.10 and at 2.20 the three sharp little clicks were distinctly and unmistakably heard, about 25 times altogether. On the following day the signals were again heard, though not quite so distinctly. On Saturday a further attempt was made to obtain a repetition of the signals, but owing to difficulties with the kite we had to give up the attempt. However, there was no further doubt possible that the experiment had succeeded, and that afternoon, December 14th, I sent telegrams to the Italian Government and to Major Flood Page, the then managing director of the Marconi Company, informing them that the signals had been received but that the weather made continuous tests extremely difficult. That same night I also gave the news to the Press at St. John's whence it was telegraphed to all parts of the world, and



Method of anchoring the kite aerial at Signal Hill. The total height of the aerial was about 400 ft.

Transatlantic Wireless.—
received, in some quarters, with great enthusiasm as heralding a new era in telegraph communication, and in others with scepticism. Upon these two differing attitudes no comment is necessary to-day when wireless has proved itself a world-wide messenger.

Following the success of my experiment, I was notified on behalf of the Anglo-American Telegraph Company that as they held a charter giving them the exclusive right to construct and operate stations for telegraphic communication between Newfoundland and places outside the Colony, the work upon which I was engaged was a violation of their rights. I was asked to give an immediate undertaking not to proceed with my work and to remove my apparatus, or legal proceedings would be taken. I was absolutely astounded at this communication which, however, at least gave the satisfactory assurance that one of the great telegraph and cable companies not only believed in but also feared the possibility of wireless transatlantic communication.

A few weeks later I sailed from New York for England, where I arrived on January 26th prepared to take up my work again and to answer the criticisms the feat had aroused.

Confirmation of First Success.

On February 22nd, 1902, I sailed for the United States of America again *en route* for Canada, where I was due to sign the final draft of the agreement for the erection of a large wireless station at Glace Bay and to put in hand the construction of that station. I crossed on the *Philadelphia* of the American Line, and before leaving arranged for Poldhu station to send out a programme of signals for me to receive on the ship during the voyage.

On this voyage I was able to receive complete messages up to 1,551 miles and single letters up to 2,099 miles. Thus within three months of receiving single letters at 1,800 miles I was receiving complete messages at 1,500 miles. All the messages were followed by the code signature of Poldhu, and upon every occasion, being mindful of the scepticism with which my Newfoundland results had been received in certain quarters, I made a point of receiving the signals and messages in the presence of independent witnesses and throughout used the ordinary tape receiver for the purpose. The tape records were duly signed and attested in each case by Capt. Mills, his chief officer Capt. Marsden, or others of the ship's officers. It was no longer a question of "faint clicks in a telephone," but very material dots and dashes on a paper tape that all could see and handle.

Past, Present and Future.

Naturally it is very gratifying for me, after a lapse of 25 years, to look back upon those early experiments and to meditate upon the far-reaching effects that followed those early beginnings. It is a pleasing coincidence that almost exactly on the 25th anniversary I have been able to bring to fruition another far-reaching development in long-distance wireless communication in the establishment of short wave beam stations which constitute practically a revolution in wireless communication.

During the next 25 years there will probably be almost as great a development in means of obtaining directional wireless transmission and reception as there has been in other directions during the last 25 years.

As to the application of wireless in the future, as you know I am always averse from entering into the realm of prophecy, but perhaps I might suggest that apart from the ordinary transmission and reception of wireless messages of which I have spoken there is a possibility that the transmission of power over moderate distances may be developed and television will become an actuality. I must leave to your imagination the uses which can be made of these new powers. They will probably be as wonderful as anything we have experienced so far.

LIFE TESTS ON THERMIONIC VALVES.

An Interesting N.P.L. Report on Mullard Valves.

THE National Physical Laboratory, at the request of the Mullard Radio Valve Co., Ltd., have recently completed a series of life tests on six P.M.5 type valves taken at random from stock. These tests clearly indicate the consistent results attainable with modern methods of valve manufacture, and show that 1,000 hours is a conservative estimate of the life of a modern receiving valve. Indeed, the characteristics at the end of 1,000 hours' working are substantially the same as at the beginning.

The conditions under which the life test was carried out, in so far as they affect the voltages used and the measurements made, were specified by the manufacturers, and were as follow :—

Conditions during Life Test.

Filament potential (D.C.), 5.5 volts.
Anode potential, 100.0 volts.
Grid connected to negative end of filament.

Measurements taken at 150-hour Intervals during Life Test.

(1) Filament current with no potential on anode or grid.

(2) Anode current with 100, 75, and 50 volts on anode, measurements for each anode potential being taken with −2, 0, and +2 volts on grid.

(3) Total emission with grid connected to anode and with a combined grid and anode potential of 80 volts.

Measurements of Characteristics.

In addition to the above, measurements of the anode current-grid voltage characteristics between −4 and +4 grid volts with 100, 75, and 50 volts on anode were made at 0, 600, and 1,000 hours in the life test.

Throughout the life test the filament current did not vary from its initial value by more than 1 per cent.

The curves in Fig. 1 show the anode currents obtained with various values of grid bias for an anode potential

Life Tests on Thermionic Valves.—

of 100 volts. The curves in group A are for a grid bias of +2 volts, and separate curves are given for each of the six specimen valves on test. Groups B and C are for grid potentials of 0 and −2 volts respectively. Similar groups of curves were also obtained for anode potentials of 75 and 50 volts respectively.

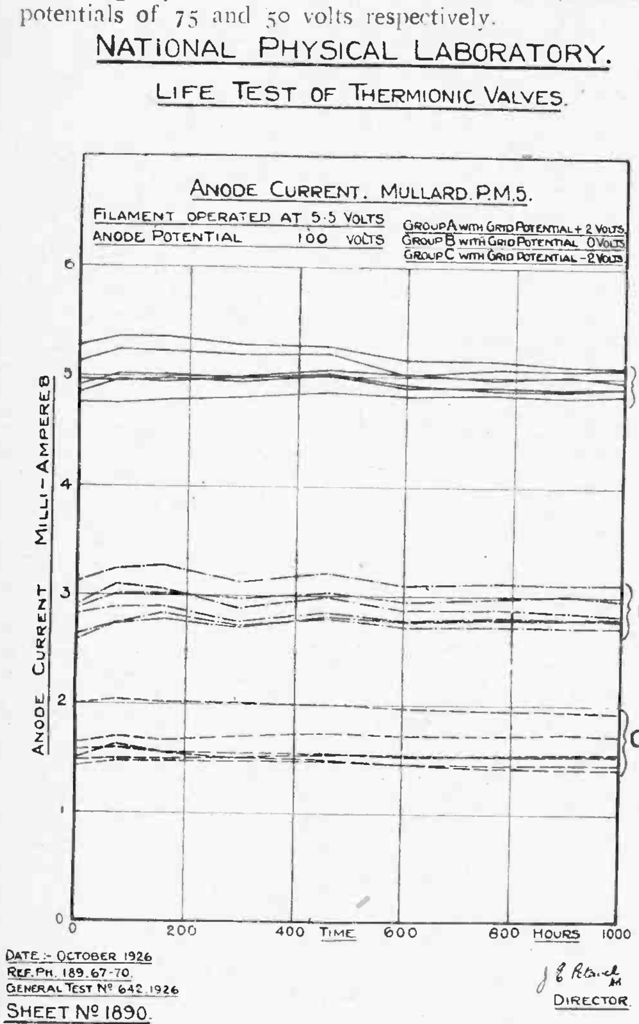


Fig. 1.—Curves of anode current for various values of grid bias with 100 volts H.T.

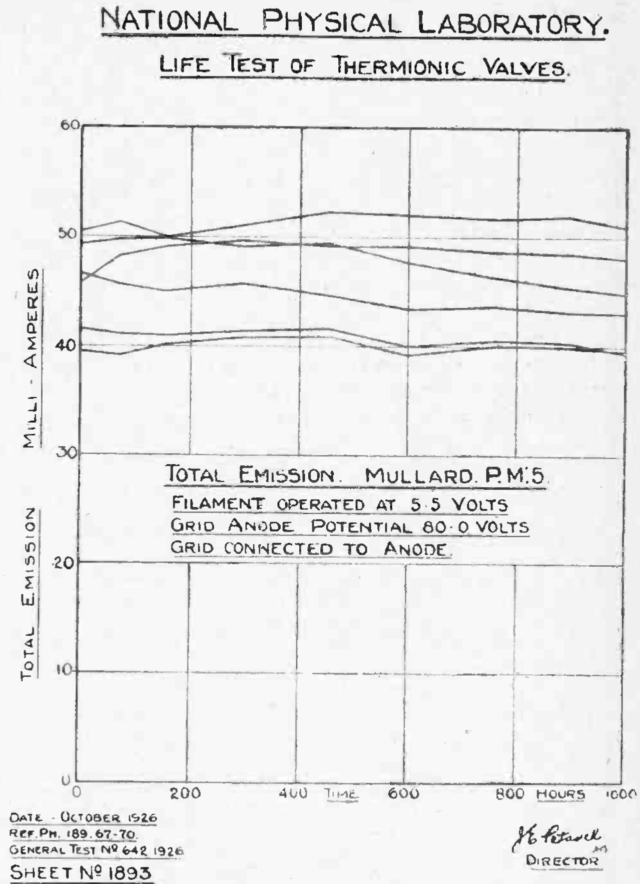


Fig. 2.—Curves of total emission for the 1,000 hour test.

The results of the measurements of total emission are shown in Fig. 2. For these measurements the valves were operated at the correct filament voltage for one minute, and the observation of the total emission was made ten seconds after the application of the anode-grid potential.

Tables of figures from which the anode current-grid voltage characteristics may be plotted are given in the N.P.L. report, copies of which are obtainable from the Mullard Wireless Service Co., Ltd., Mullard House, Denmark Street, London, W.C.2.

TRANSMITTING LICENCES FOR BELGIAN AMATEURS.

BELGIAN amateurs are in a state of jubilation. The Belgian Government has decided to grant transmitting licences to duly qualified persons.

Classification of Stations.

Private transmitting stations are to be divided into the following classes:—

(1) Fixed or portable stations for the exchange of private communications.

(2) Broadcasting stations.

(3) Stations designed for communications relating to public services or those which may be required for public services.

(4) Stations for testing and scientific research.

(5) Stations for demonstration, tests, and research. This last class is divided into two sections: (*a*) Low power, 1 to 20 watts; (*b*) Medium power, 20 to 100 watts.

Wavelength Allocations.

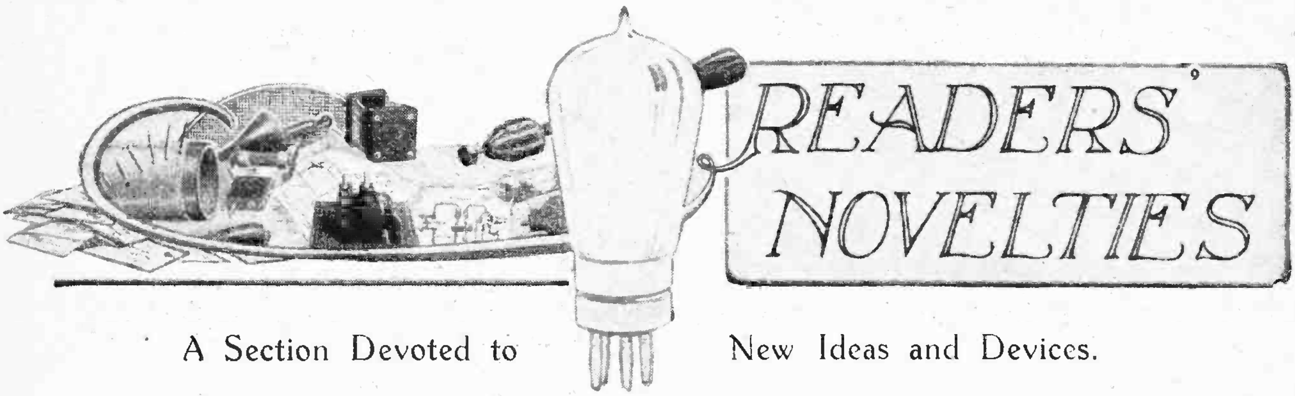
The waveband allotted to stations of the first class is 150 to 200 metres, and the power limited to 200 watts, except for international communication, when an increase to 300 watts may be granted.

Stations in the 5th class may use the following wavelengths: 15-20, 43-47, 95-105, and 135-145 metres.

The general regulations follow, in the main, those adopted by most other countries. Pure C.W. only is allowed for telegraphy, and C.W. modulated by speech or music for telephony. In special cases spark or I.C.W. may be permitted for stations in the 4th class.

Call Sign Difficulty.

The call-signs at present proposed are 4AA to 4ZZ, but as these may possibly clash with the new German amateur call-signs the "Reseau Belge" is endeavouring to get them altered to 3AA to 3ZZ. When these call-signs are allotted, the old "piratical" calls hitherto used by Belgian amateurs will, of course, be discontinued.



A Section Devoted to New Ideas and Devices.

H.T. HINT.

It is a good plan for the economical working of a receiver to employ two H.T. batteries in series instead of one large one. The lower part of the H.T. which is called upon to supply the H.F. and detector valves, as well as the L.F. valves, is subjected to a higher rate of discharge than the upper portion. Consequently, one half of the battery will be exhausted before the other half is run down. Instead of throwing away the *whole* of the battery only one section at a time need be renewed if the battery is divided into two parts in the manner suggested.—B. R.

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WINDING H.F. TRANSFORMERS.

When making H.F. transformers similar to those used in the "Everyman's Four" receiver, difficulty may be experienced in holding the ebonite spacers at equal distances round the circumference of the secondary winding. The assembly of these spacers will be greatly facilitated by the use of a jig, as shown in the diagram.

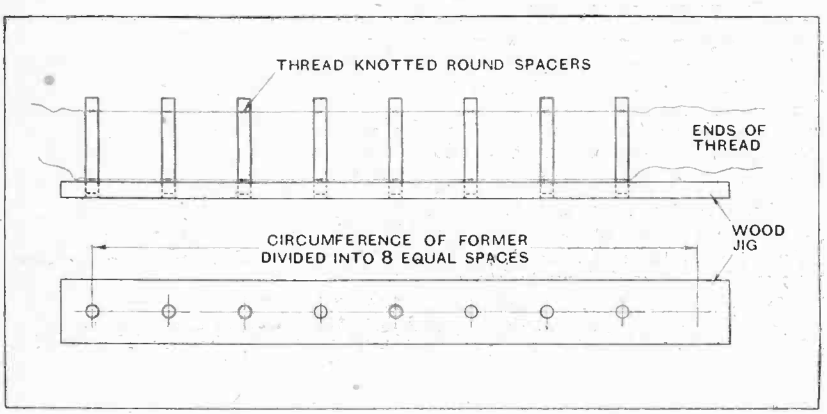
A piece of wood, 12in. × 2in. × ½in., is cut to size, and a distance equal to the circumference of the secondary coil is marked off on the centre line; this is subdivided into eight equal parts, and eight holes are drilled of such a diameter that the spacers will fit in tightly. If possible, the holes should be machine drilled to ensure that they are absolutely vertical; on this will depend the parallel alignment of the spacers.

The spacers are then tied together with thread as shown, care being taken to draw the thread taut. They are then removed in a chain from the jig and tied round the secondary coil of the transformer. Not only does this method ensure even and parallel spacing, but the spacers cannot move when subjected to the strain of winding the first few turns.—C. M. A.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A dull emitter receiving valve will be despatched to every reader whose idea is accepted for publication.

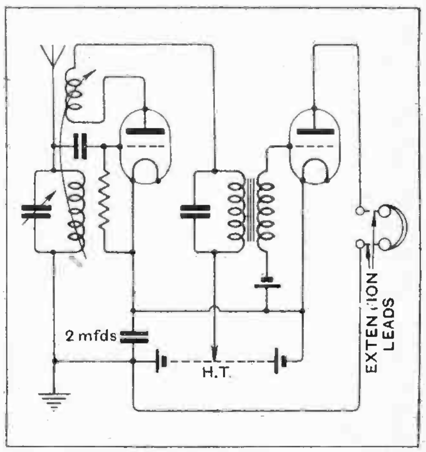
Letters should be addressed to the Editor, "Wireless World and Radio Review," Dorset House, Tudor St., London, E.C.4, and marked "Ideas."



Jig for assembling H.F. transformer spacing strips

LEAKAGE IN EXTENSION LEADS.

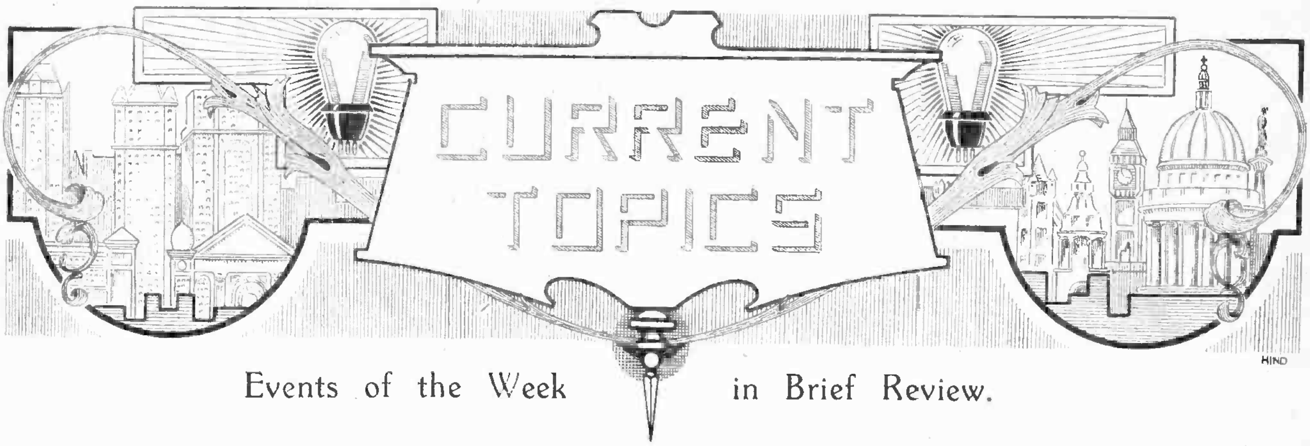
Not only are signals reduced in strength, but considerable damage to the H.T. battery results if a leak to earth is caused in telephone extension wires through moisture or any other cause. In the ordinary receiver both telephone leads are above earth potential, and since the negative end of the H.T. battery is earthed at the receiver the insulation of the leads must be above reproach if a short circuit is to be avoided.



Circuit for keeping extension leads at earth potential.

The circuit shows how a simple two-valve set may be modified so that the telephone leads are at earth potential. The filaments are "earthed" as far as H.F. and L.F. currents are concerned by the 2 mfd. condenser.

It is important to pay attention to the insulation of the L.T. accumulator, but this can be more easily attended to than a long extension lead. A good plan is to stand the battery on a sheet of plate glass.—P. R. W. B.



Events of the Week in Brief Review.

THE ALL-ABSORBING TOPIC.

Books dealing with wireless lead the way in popularity among young people, according to the Middlesbrough Librarian.

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THE REALM OF PROPHECY.

"I am always averse from entering into the realm of prophecy."—Senator Marconi.

The famous inventor evidently realises that the realm is already overcrowded.

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THE BITER BIT.

A Leytonstone wireless dealer, Arthur Frank Harrison, who placed his signature on a petition of protest against local oscillators, was found to be using a wireless set without a licence. In fining him £2 the chairman of the Stratford magistrates described Harrison's conduct as "a bit of cheek."

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LICENCES FOR THE BLIND.

Rarely has any Parliamentary measure received such universal approbation as Capt. Ian Fraser's Bill for providing free wireless licences for the blind. The Bill, under the title Wireless Telegraphy (Blind Persons' Facilities) Bill, received the Royal Assent before Parliament rose on Wednesday last.

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EXPERIMENTS WITH SHORT WAVES

"Short Electric Waves treated Experimentally" will be the title of six evening lectures to be given by Mr. J. H. Morrell, M.A., of the Electrical Laboratories, Oxford, during February and March at the East London College, Mile End Road, E.1. It is understood that the lecturer will demonstrate with waves from 200 metres down to 1 metre. Further particulars will be announced shortly.

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RESEARCH BY AMATEURS.

Further particulars are now available concerning the new Research Sub-Section of the Radio Society of Great Britain, to which reference was made in these columns last week.

When the scheme is formally launched in January next a *questionnaire* will be addressed to all members of the Transmitter and Relay Section to discover what line of research appeals to various individuals. When the replies are collated the members will be divided into groups according to the subjects chosen. Each group will appoint a member to submit *résumé* of work to the Sub-Committee, which will issue periodical circulars to all members setting forth the work accomplished.

Besides co-ordinating and organising research work, it is hoped that the new scheme will encourage real research as distinguished from mere "brass pounding" or "DX hunting."

The chairman of the Sub-Section is Mr. G. L. Morrow (G 6UV), "Penolver," Berkhamsted.

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THE OLD BRIGADE.

Fines of between 10s. to 30s. each have been levied on eight Croydon residents for using unlicensed wireless sets.

STANDARDISING WIRELESS PARTS.

Wireless dealers in Holland are reported to be organising the standardisation of parts and accessories. Uniformity is also being sought in regard to technical terms.

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NEW BELGIAN WIRELESS SCHOOL.

The Brussels correspondent of *The Times* states that the "Moniteur Officiel" publishes a Royal Decree for the creation of a School of Wireless Telegraphy.

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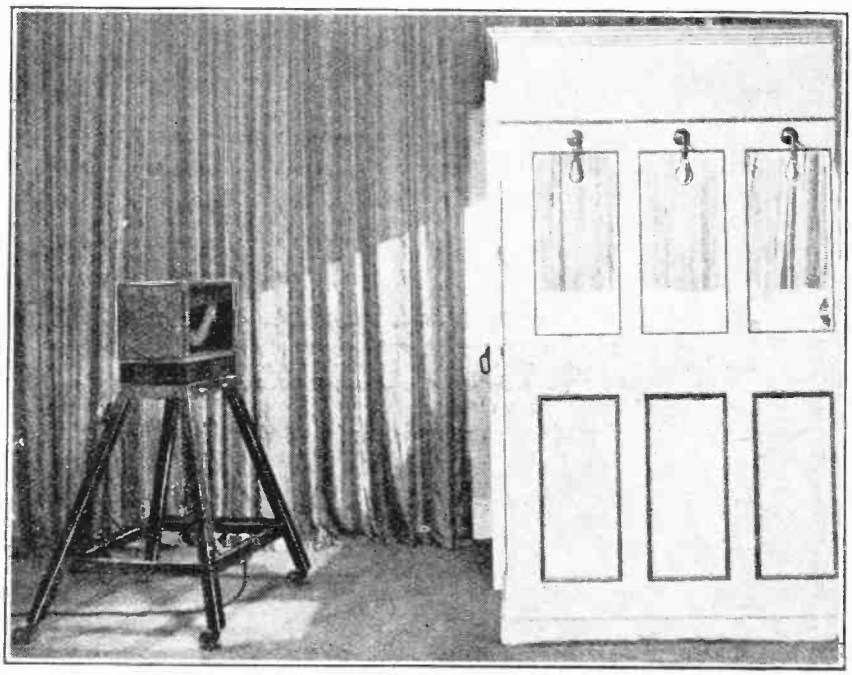
TRANSATLANTIC TELEPHONY.

It is understood that a commercial wireless telephone service between London and New York will be possible early in the New Year. Charges will probably amount to something between £3 and £5 for a three-minute talk.



CONTROL IN THE STUDIO. The advantage of having an engineer "on the spot" has been recognised in designing the new studios at 2LO. This photograph shows a "control box" situated in the corner of one of the larger studios. The controlling engineer can observe the artistes throughout a performance and can signal by means of coloured lamps.

LIGHTHOUSE WIRELESS.

The Clyde Lighthouse Trustees have decided to install a wireless telephone on Little Cumbrae for communication between the lighthouse on that island and Toward Point.

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TALKING AND LISTENING.

"To speak into the microphone requires the courage of Nelson, the brains of Napoleon, and the honesty of Washington," according to Will Rogers, the American humorist. To which our tame cynic retorts that much more is sometimes required of the listener.

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RADIO CLUB FOR THE PUNJAB.

Subscribers to *The Wireless World* in the Punjab may be interested to learn of the proposal to form a wireless club in Lahore. Persons interested in the scheme are invited to write to Mr. D. J. Horn, Faletti's Hotel, Lahore.

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INJUNCTION FOR B.B.C.

The British Broadcasting Co., Ltd., has been granted an injunction restraining the B.B.C. Assurance Association from trading in any name containing the letters "B.B.C.," or any colourable imitation, likely to suggest that its insurance policies are authorised by the B.B.C.

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HAVE YOU HEARD THEM ?

Two interesting short-wave broadcasts are coming over fairly regularly from America. WGY's experimental transmitter 2XAF, operating on 32.79 metres, is now relaying regularly the complete programme of WGY on Tuesday and Saturday nights from 11 p.m. (G.M.T.) onwards, closing down about 5 a.m.

KDKA is transmitting on 63 metres every day of the week except Monday between 1.30 and 3 a.m. (G.M.T.). A further short-wave programme from the same station can be heard on Wednesdays and Fridays from 4.30 to 6 a.m. (G.M.T.).

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PHOTOGRAPHS OF 1926.

To all lovers of good photography—and there must be many among *Wireless World* readers—"Photograms of the Year" for 1926, just published, should prove of special interest. Now in its 32nd year of publication, "Photograms of the Year" is recognised as the international art annual of pictorial photography, including as it does a series of the most notable pictures produced during the past year by leading workers in all countries. It is edited by Mr. F. J. Mortimer, editor of our sister-journal, *The Amateur Photographer*, and is published by Messrs. Iliffe and Sons Ltd., Dorset House, Tudor Street, London, E.C.4. The price is 5s. nett (by post, 5s. 6d.) in stout paper covers, or 7s. 6d. nett (by post, 8s.) in cloth boards.

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PORTUGUESE WIRELESS DEVELOPMENTS.

A direct high-speed wireless telegraph service between England and Portugal was opened on Wednesday last.

The new service is the first of a number of Portuguese Colonial and foreign wireless routes which are being established by the Portuguese Marconi Company under a 40 years' concession granted by the Portuguese Government to Marconi's Wireless Telegraph Co., Ltd.

THE B.B.C. DINNER.

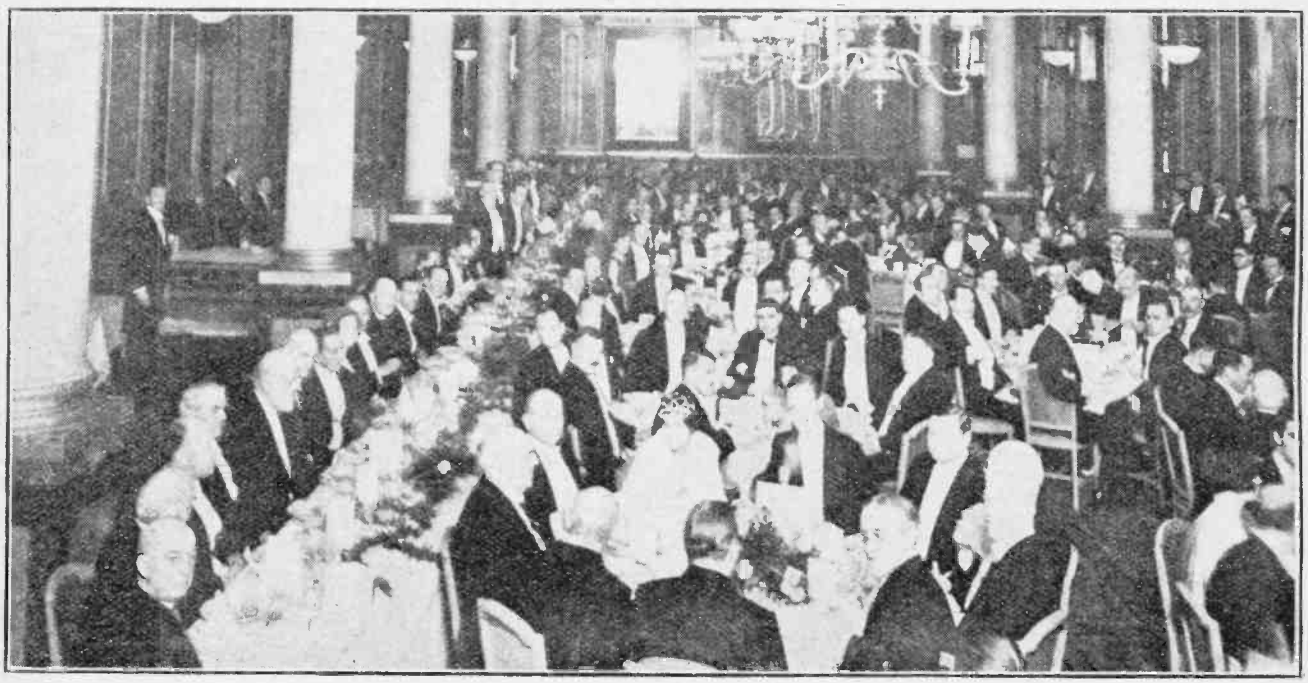
MANY distinguished guests attended the B.B.C. dinner in honour of the Prime Minister at the Hotel Metropole on Thursday last, December 16th. In many respects the function could be regarded as a preliminary Swan-Song of the British Broadcasting Company prior to its abdication in favour of the new Corporation.

In a speech of welcome to the Prime Minister, to the retiring Directors, and to the Governors-Designate, Mr. J. C. W. Reith spoke of the work already accomplished by the B.B.C. in its advance "through unknown and dangerous country with adversities and conflicts which will never in like degree beset us again." The B.B.C. had tried to found a tradition of public service, and he ventured to believe that a new national asset had been created.

Mr. Baldwin's reply contained a special reference to the confidence and affection which the B.B.C. had inspired among the British people, particularly in the time of the General Strike, when the news bulletins from 2LO averted the possibilities of panic caused by the dissemination of false news.

Sir Wm. Mitchell-Thompson, the Postmaster-General, stated that there was nothing further from the truth than the suggestion that the British Broadcasting Corporation would be merely Government Broadcasting.

An amusing feature of the evening was the "News Bulletin," specially prepared for the B.B.C. Dinner, in which guests received intelligence of numerous incredible events at home and abroad.



AT THE B.B.C. DINNER.—A photograph of the distinguished assembly at the Hotel Metropole on Thursday last, when the British Broadcasting Company's Staff gave a dinner to welcome the new Governors-Designate of the Corporation and to bid farewell to the old Directorate. The Prime Minister and Mrs. Baldwin, as well as many famous representatives of politics, science and the arts, were present.

VALVES WE HAVE TESTED

The S.T. and Octron Series.

THE S.T. series of radio valves comprises valves for working from a 2-, 4-, and 6-volt filament heating battery. Three types in each range are provided, and it is easy to identify them by the type numbers. Thus, the S.T.21, 41, and 61 valves are of the high-impedance, high-amplification factor type with 2-, 4-, and 6-volt filaments respectively. The S.T.22, 42, and 62 valves are of the medium- or low-impedance, medium-amplification factor type with 2-, 4-, and 6-volt filaments, whilst the S.T.23, 43, and 63 are valves designed for the power or output stage of a set.

A complete test report of a specimen valve of each type is given below. It should be noticed that the filament current taken by all valves of the "1" and "2" class is 0.1 ampere, whilst the S.T.23 takes 0.15 ampere, and the S.T.43 and 63, 0.25 ampere, the latter valves being power valves capable of dealing with large inputs.

Two-volt Valves.

From the characteristics given in the tables it will be seen that there is a valve for every purpose, and that in spite of the very low filament consumption the value of A.C. resistance for a given amplification factor is remarkably low. For instance, in the 2-volt range we have the S.T.21, with its average A.C. resistance of 24,000 ohms and amplification factor of 13.8, these being working values. This valve is, therefore, suitable for most high-frequency amplifiers, as a detector, and as a low-frequency amplifier with transformer coupling.

TYPE S.T.21.

Filament voltage, 1.8. Filament current, 0.1 ampere.
Anode voltage, 40–120. Total emission, 10 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
60	1.3	0	25,000	13.0
80	1.57	−1.0	26,000	14.1
100	2.05	−1.5	23,500	13.8
120	2.1	−3.0	23,500	13.5

TYPE S.T.22.

Filament voltage, 1.8. Filament current, 0.1 ampere.
Anode voltage, 40–120. Total emission, 10 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
60	2.33	0	15,000	9.1
80	2.75	−1.5	15,200	9.3
100	3.13	−3.0	15,000	9.5
120	3.45	−4.5	15,100	9.5

TYPE S.T.23.

Filament voltage, 1.8. Filament current, 0.15 ampere.
Anode voltage, 80–120. Total emission, 20 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
80	5.3	−4.5	8,000	5.4
100	6.8	−6.0	7,800	5.2
120	7.5	−9.0	7,700	5.5

TYPE S.T.41.

Filament voltage, 3.8. Filament current, 0.1 ampere.
Anode voltage, 40–120. Total emission, 40 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
60	0.98	−1.0	19,500	12.9
80	1.62	−1.5	17,700	13.9
100	2.31	−2.0	15,200	13.7
120	2.81	−3.0	15,100	14.3

TYPE S.T.42.

Filament voltage, 3.8. Filament current, 0.1 ampere.
Anode voltage, 40–120. Total emission, 40 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
60	5.4	−1.5	4,900	5.1
80	7.8	−3.0	4,750	5.5
100	9.9	−4.5	4,450	5.4
120	12.1	−6.0	4,250	5.6

The S.T.22 has a lower impedance with a lower amplification factor than the S.T.21, and, besides being suitable for high- and low-frequency amplifiers, will also serve as an output valve in a set designed to work a small loud-speaker. The third valve in the 2-volt range, S.T.23, is an output or loud-speaker valve, having an average A.C. resistance of 7,800 ohms and an amplification factor of 5.3. Used with an anode voltage of 120 and a grid bias of − 9, really loud signals can be handled.

Four-volt Valves.

In the 4-volt range is the S.T.41, which is similar in some respects to the S.T.21, but its A.C. resistance is lower, having an average value of 16,000 ohms. This valve will, therefore, give a bigger output than the S.T.21, provided the circuit is properly designed. S.T.42 has an average A.C. resistance of 4,500 ohms and an amplification factor of 5.4. If these values are compared with those of the S.T.23, it will be seen that, considered simply as a valve, S.T.42 is much better than S.T.23.

Valves We Have Tested.—

Battery considerations may, in many cases, make a reader decide to use the 2-volt valve instead of the 4-volt. These two factors, therefore, tend to cancel out.

TYPE S.T.43.

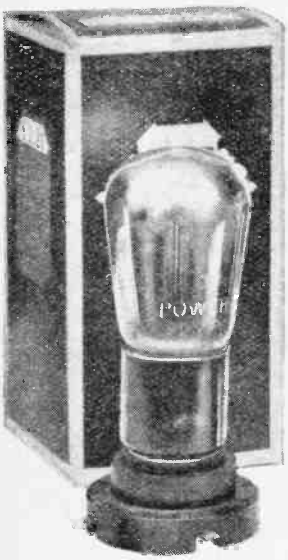
Filament voltage, 3.8. Anode voltage, 80–120. Filament current, 0.25 ampere. Total emission over 50 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification. Factor.
80	8.8	−9	3,700	3.7
100	11.3	−12	3,200	3.4
120	12.8	−16.5	3,180	3.4

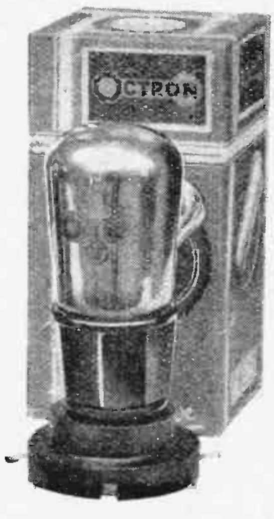
The power valve of the 4-volt series is the S.T.43. With an anode voltage of 120 and a grid bias of − 16.5 volts, the valve has an A.C. resistance of 3,200 ohms and an amplification factor of 3.4. This valve is, therefore, very suitable for working into a large loud-speaker of moderate resistance, such as the "Kone," and will give signals of strength sufficient for most domestic purposes.

Six-volt Valves.

The characteristics of the 6-volt valves are, on the whole, even better than those of the 4-volt valves, as one would expect. S.T.61 is the valve with the highest amplification factor in this range, having a value of over 16 for an A.C. resistance of about 22,000 ohms. This valve can be used as a high-frequency amplifier if the coupling is of modern design, and as a detector or low-frequency amplifier with any form of coupling, it being understood that, if transformer coupling is used, the transformer should be of suitable construction; usually it will have a low ratio.



A typical S.T. valve.



The Octron power valve.

S.T.62 has an average A.C. resistance of about 6,200 ohms and an amplification factor of 8.3; the valve is a remarkably good one, and can be used for H.F. or L.F. amplification with suitable couplings. In many instances it will be found that the valve will deal with all the power that is required to work an average loud-speaker, as when the anode voltage is 120 a grid bias of − 4.5 volts or slightly more can be used.

For very strong signals the S.T.63 should be employed in the output stage, as with an anode voltage of 160 a grid bias of at least − 18 volts can be used.

TYPE S.T.61.

Filament voltage, 5.6. Anode voltage, 60–120. Filament current, 0.1 ampere. Total emission, 50 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
60	0.82	−0.5	25,200	15.3
80	1.31	−1.0	24,000	16.5
100	1.76	−1.5	20,000	16.2
120	2.31	−2.0	18,300	16.9

TYPE S.T.62.

Filament voltage, 5.6. Anode voltage, 60–120. Filament current, 0.1 ampere. Total emission, 50 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
60	3.51	−0.5	6,280	8.0
80	1.8	−1.5	6,300	8.3
100	5.8	−3.0	6,250	8.5
120	7.0	−4.5	5,900	8.4

TYPE S.T.63.

Filament voltage, 5.6. Anode voltage up to 150. Filament current, 0.25 ampere. Total emission, 50 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
120	14.5	−12	3,130	4.0
110	17.1	−15	3,060	3.9
160	20.25	−18	2,920	3.7

When these valves are burning no glow can be seen. In all examples it is possible to reduce the filament voltage a little below the rated value without materially altering the characteristics given in the tables.

Octron Valves.

A series of four types has been provided to work from 2- or 4-volt batteries. The valves have a bakelite base of octagonal shape and a pipless bulb. Each series comprises valves of the H.R., H., I., and L.P. types, representing valves intended for H.F. and resistance capacity amplification, H.F. amplification and detection, L.F. amplification and detection, and for L.F. amplification and the output power stage.

Two-volt Valves.

H.R.210, H.210 and L.210 take a filament current of 0.1 ampere, whilst L.P.240 takes 0.4 ampere. The results

TYPE H.R.210.

Filament voltage, 1.8. Anode voltage, 80–120. Filament current, 0.1 ampere. Total emission, —

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
120	1.0	−1.5	77,000	15.6
100	0.85	−1.0	77,000	16.2
80	0.72	−0.5	83,000	16.2

Valves We Have Tested.—

of tests on specimen valves are given in the table, from which it will be seen that for a given amplification factor the valves have fairly high A.C. resistances. This, no doubt, is due to some extent to the type of anode and grid employed, these being of the cylindrical pattern (for the first three valves of the series) instead of the more usual box or oval shape. Nevertheless, the valves are quite satisfactory, and are non-microphonic.

TYPE H.210.

Filament voltage, 1.8. Filament current, 0.1 ampere.
Anode voltage, 60–100. Total emission, —

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
100	1.15	−2	51,200	10.5
80	0.86	−1.5	52,600	9.7
60	0.6	−1.0	55,500	9.1

TYPE L.210.

Filament voltage, 1.8. Filament current, 0.1 ampere.
Anode voltage, 60–100. Total emission, —

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
100	0.86	−4.5	51,300	11.4
80	0.75	−3.0	51,300	10.8
60	0.63	−1.5	52,600	10.0

TYPE L.P.240.

Filament voltage, 1.8 Filament current, 0.4 ampere.
Anode voltage, 80–120. Total emission, —

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
120	5.8	−9.0	11,700	4.6
100	5.2	−6.0	11,700	4.6
80	4.5	−3.0	11,100	4.4

TYPE H.R.408.

Filament voltage, 3.7 Filament current, 0.08 ampere.
Anode voltage, 80–120. Total emission, —

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
120	1.5	−1.5	44,500	16.0
100	1.18	−1.0	45,500	16.1
80	0.94	−0.5	51,000	17.2

TYPE H.408.

Filament voltage, 3.7. Filament current, 0.08 ampere.
Anode voltage, 60–100. Total emission, —

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
100	1.48	−2.0	34,500	13.3
80	1.31	−1.0	34,500	13.3
60	0.91	−0.5	33,800	12.5

TYPE L.408.

Filament voltage, 3.7. Filament current, 0.08 ampere.
Anode voltage, 60–100. Total emission, —

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
100	2.57	−4.5	16,800	6.9
80	2.1	−3.0	19,600	7.2
60	1.61	−1.5	18,500	6.95

Four-volt Valves.

Of the 4-volt valves three specimens were tested, and the results are given in the tables. It should be noticed that these valves take a filament current of only 80 milliamperes, and, as would be expected, have better characteristics than similar valves in the 2-volt range. H.408 can be used as a detector, H.F. or L.F. amplifier with suitable couplings, while L.408 when used in the output stage of a receiver will satisfactorily operate a loud-speaker of average size.

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Christmas and the Clubs.

The return of Christmas always signals a momentary lull in club activities, but it is noteworthy that those organisations which are in the most thriving state are the quickest to recover from the season's festivities! The majority of societies will resume meetings soon after New Year's Day.

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Short Waves in Belfast.

From the City of Belfast Y.M.C.A. we have received a well-produced little syllabus of the association's activities, which include a radio club. The club possesses a short-wave transmitter, and experiments are conducted on wavelengths of 23, 45, and 150 to 200 metres (C.W. telephony).

At the December monthly meeting Mr. W. C. Haddick lectured on "The Two-electrode Valve," adding interest to his remarks with the aid of coloured diagrams.

Hon. secretary, Mr. John J. Cowley, 4, St. Paul's Street, Belfast.

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Superheterodynes in Practice.

The construction of a superheterodyne set stage by stage was described by Mr. C. W. Peck in his lecture on "Superheterodynes in Practice" at the last meeting of the Sheffield and District Wireless Society. A feature of the lively discussion was the diversion of opinion on the respective merits of the superheterodyne and neutrodyne principles.

Hon. secretary, Mr. T. A. W. Blower, 129, Ringinglow Road, Sheffield.

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Yesterday and To-day.

Those who may wish to spend an interesting half-hour are recommended to peruse the advertisement pages of a wireless periodical of, say, 1922 or 1923, making comparisons with those of the present day. There were some highly amusing moments at the last meeting of the Tottenham Wireless Society, at which Mr. D. S. Richards, of the Ilford Radio Society, gave an address on the development of radio apparatus, in which some astonishing changes were referred to. The early loud-speaker was designated as "phones with a trumpet," while thoughts were directed to the old general-purpose bright-emitter valve, which had been almost superseded by dull-emitters in bewildering variety. On the subject of coils Mr. Richards remarked that the early broadcast set, with its enormous solenoid, reminded one chiefly of a child's toy engine! The lecturer summed up by saying that, while the infant "wireless" had made astonishing progress, it was only reasonable to suppose that further strides would still be made.

Hon. secretary, Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

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All About the Condenser.

Members of the Stretford and District Radio Society spent an interesting evening on December 9th, when Mr. Hayward (of the Dubilier Condenser Co.) lectured on condensers as used in receiving sets of to-day. With the aid of lantern slides Mr. Hayward supplied a fascinating account of the various stages through which the condenser passes before it is finally placed on the market.

The Stretford Society is now concentrating on short-wave transmissions, and hopes in a few days to be transmitting on 8 metres with the call sign of G5SS. The transmitter is receiving final calibration, and the Society will welcome reports of reception.

Hon. secretary, W. Hardingham, 21, Burleigh Road, Stretford, Manchester.

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Current from the Mains.

"Battery elimination" has received so much attention that the subject would seem almost threadbare, but Mr. F. H. Haynes, of *The Wireless World*, made it as interesting as an entirely new subject when he lectured recently to the Golders Green and Hendon Radio Society. He described half wave and full wave rectifiers of every known variety, and dealt exhaustively with the subject of "smoothing." A valuable hint in guarding against R.F. interference advised the screening of the transformer primary by a copper foil screen. In response to a request Mr. Haynes concluded his lecture with a talk on transformer construction.

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B.B.C. and the Societies.

The relations which should subsist between the radio societies and the local station were referred to by Mr. E. R. Appleton, director of the Cardiff Broadcasting Station, addressing members of the Bristol and District Radio Society on December 3rd. He pointed out that reports of broadcast transmissions and programmes from a society were of more value to the station than reports from individuals. Mr. Appleton considered that radio societies would have to adapt themselves to changing conditions if they were to continue in an active state. He thought that this might best be done by grading members according to their needs and technical knowledge, and that the societies should extend their activities amongst schoolboys.

Hon. secretary, Mr. S. J. Hurley, 46, Cotswold Road, Bedminster, Bristol.

New Headquarters.

The North London Experimental Radio Society now has new headquarters at the Scout Hut, Holly Park Council Schools. The new meeting place is approached through the schools playground from the gate nearest to Friern Barnet Road.

Hon. secretary, Mr. W. Parker Angus, 61, Carey Street, W.C.2.

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New Irish Society.

Monday, December 6th, saw the formation of the Bangor (Co. Down) and District Radio Society, with Mr. R. W. Richardson as chairman. It is hoped that the new society will stimulate local interest in the subject of wireless, and bring amateurs in contact with each other.

The hon. secretary is Capt. J. W. C. Coulter, 8, Shandon Drive, Bangor, Co. Down, to whom enquiries should be addressed.

At the conclusion of the lecture Mr. Baird and Capt. Hutchison were elected members of the society. The club's second dance and whist drive will be held at the club house at 8 p.m. on December 29th. Full particulars can be obtained from the hon. secretary, Lt.-Col. H. Ashley Scarlett, D.S.O., 357a, Finchley Road, London, N.W.3.

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No Perfect Loud-speaker?

Mr. Duvont (of Messrs. Alfred Graham and Co.) gave an illuminating lecture on the subject of loud-speakers at the last meeting of the Ipswich and District Radio Society. Mr. Duvont candidly admitted that all manufacturers were still a long way off what they termed a "perfect loud-speaker," but added that step by step progress was being made, although at present it was a somewhat slow process.

Hon. secretary, Mr. H. E. Barbrook, 22, Vernon Street, Ipswich.

WIRELESS IN LONDON SUBURBS. In view of the ever-increasing popularity of wireless the London County Council has concluded arrangements with Captain J. Frost for a series of evening lectures. Captain Frost is seen above giving his first lecture at the Streatham and Tooting Literary Evening Institute.

Television Described.

More than sixty members of the Golders Green and Hendon Radio Society were recently privileged to witness a demonstration of television given by the inventor, Mr. J. L. Baird. Having provided a few words in explanation, Mr. Baird handed over the duty of lecturer to Professor Denton, who proceeded to give a fascinating description of many scientific experiments relating to television. During the evening Mr. Baird escorted parties of ten to visit his apparatus, which has taken many years to develop.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 22nd.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Sale or Exchange.
Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Sale of Wireless Apparatus.
Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Informal Meeting. Photograph of members with apparatus.

THURSDAY, DECEMBER 23rd.

Stretford and District Radio Society.—At "The Cottage," Derby Lane, Derbyshire Lane. Talk on "Amateur Work," by Mr. A. Ince (ex 6LC).

Individual Research.

Reference has already been made in these columns to the "Individual Research Scheme" initiated by the Radio Experimental Society, Manchester, and we are glad to hear it is progressing even beyond anticipations. Various members of the Society are hard at work on the following problems:—

1. Measurement of small alternating current and Bolometer Bridge work.
2. Research work on wet cells.
3. Sensitivity of receiving sets.
4. Crystal research work, including oscillating crystals.
5. Screening and elimination of interference.
6. Coils, etc.
7. Valve research.
8. Short-wave work.
9. Economy in design.
10. Neon tube uses.

Much work has already been carried out, and it is hoped that the research workers will give the Society the benefit of their labours in the form of demonstrations and lectures.

The Society will shortly install a new transmitter.

Hon. secretary, Mr. J. Levy, 19, Lansdowne Road, West Didsbury, Manchester.

By Our Special Correspondent.

New Year Prospects—Geneva and the Plan—Touring Europe—Humour and the B.B.C.—Big Business in America—Microphones at Liverpool.

Black Prospects.

New Year prospects are growing blacker and blacker for all ether hogs, oscillators, unlicencees, and other fry who, with malice aforethought, obtrude their obnoxious personalities upon the chaste ether at honest folks' expense.

An official of the General Post Office tells me that an offensive is "in the air," and I gather that ere long offenders will have something to think about.

The Post Office wireless van is actually in commission, being at present "somewhere in the provinces." It is equipped with a frame aerial and a galaxy of H.F. valves, and, according to rumours, is so sensitive that the detector burns out when a "fan" shorts his H.T. battery in Thurso. (But, of course, such things are not done in Thurso.)

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Say, Guys!

A programme after the American style is to be broadcast this evening (Wednesday). This programme will reproduce the music of some of the best-known broadcast artists and dance bands in the United States, and is being arranged by Captain A. G. D. West, whose experiences in Transatlantic reception at Keston should be decidedly helpful! The announcer will be Eddy Reed.

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Confidence at Geneva.

The Council of the Union Internationale de Radiophonie, which met at Geneva on December 6th and 7th, has decided that the difficulties which still beset the wave allotment plan, due to unforeseen clashing between stations, by no means invalidate the value of the plan itself. With this sentiment most listeners will agree. The Technical Committee of the Union has been faced with an ambitious task, but it has approached it courageously, and there can be little doubt that sooner or later the desired results will be obtained.

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A Newcastle Scare.

Novocastrians were subjected to an alarming rumour last week to the effect that 5NO would shortly close down. On enquiry at Savoy Hill I learnt that there is not a shred of truth in the suggestion.

"The possible explanation of the rumour," said an official, "is that someone has anticipated the regional scheme under which certain existing stations would close down in favour of high-power stations. Until the scheme comes into effect, however, there is no likelihood of any of the present stations going out of existence."

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Esperanto in Europe.

Esperanto is undoubtedly securing at least a foothold in the European ether, to judge from the number of stations which provide items in this international language. Among the latest to join the movement are Konigswusterhausen and Radio Geneva, both of which are transmitting a regular Esperanto course. Radio-Vienna and Zagreb both give weekly talks in Esperanto.

A Sunday Evening Tour.

Most listeners long ago discovered that the best time to hear the European stations with a minimum of interruption is between 6 and 8 p.m. on Sundays. Even those tireless manipulators of ship spark sets seem to take time for a "breather" between these hours, and the ether is tolerably quiet. The other Sunday evening I "toured" Europe with comparative ease, and would recommend those who have not tried it to do the same.

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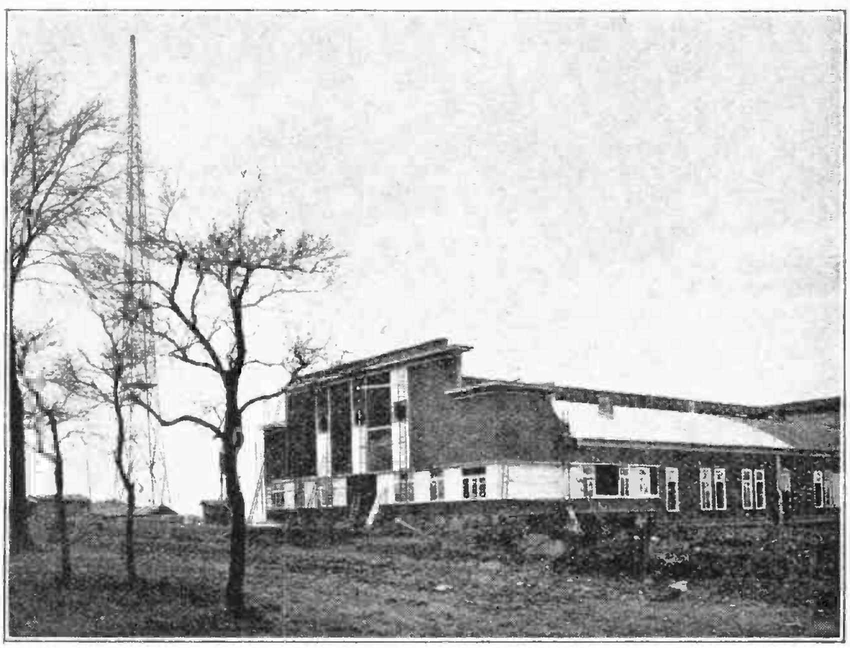
Time, Gentlemen.

One thing that always astounds me is the appalling length of the intervals between items at many of the German stations. You come across the whisper of a carrier wave and you wait. After a time you decide to continue waiting.



EUROPE'S MOST POWERFUL STATION? A general view of the new German broadcasting station at Langenburg, near Elberfeld. Experimental transmissions have already begun and the station may be expected to use its rumoured maximum power of 60 kilowatts in the near future. It will open officially early in the New Year, employing a wavelength of 468.8 metres. The studios are situated at Cologne and Dusseldorf.

Finally, when you are on the point of switching over to something more exciting, the announcer's voice bursts upon you. Several of the German stations now employ interval signals which are operated at definite periods of about five or six seconds. Hamburg uses a clock tick, while Stuttgart and Munich both employ a combination of three notes which are easily recognisable.

In justice to the B.B.C., it may be mentioned that the British stations have no need for these devices, as the intervals between items are negligible.

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A Vexed Question.

"Need jazz be vulgar?" is the leading query contained in the broadcast from 2LO on January 3. The transmission will present another view-point in the "Jazz v. Classics" controversy. The broadcast will be conducted by Percy A. Scholes and Eugene Croft and his Octet.

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Is it Humour?

In disquisitions on the sacred question of what is and what is not "humour," the B.B.C. generally receives more kicks than ha'pence.

Hear, O Programme Directors, the words of wisdom as they were written in the correspondence column of a London newspaper last week :—

> "Sir,—If the B.B.C. are so hard up for humour that they must broadcast 'funny' remarks in a revue about *marriage, mothers-in-law,* other nation's affairs, and *such unnecessary things,* I would strongly recommend an adviser in —— or some other Scotch humorist.
>
> Yours, etc., ——"

Admitting the ruthless logic of the implication that if marriage is unnecessary, so are mothers-in-law, let the B.B.C. consider how many comedies, farces, or merely humorous situations they can build up which do not involve marriage and *such unnecessary things.* In their strivings I wish them well. They will need all the help that all the Scotch humorists can give them, and then some!

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It's all Wrong.

Later: The letter reproduced above was *not* written by Mr. John Henry.

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Welsh Prowess.

Cardiff station has arranged a programme in honour of famous Welsh soldiers, which will be entitled "Stickit the Welsh" and broadcast on January 13. Stories will be told of Welsh prowess on the field of battle from the days of Cadwalladr in Rome to the famous stand of the Welsh Division in Mametz Wood.

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Big Business.

From all I hear, the National Broadcasting Company of America really means business. So that there may be no mistake about it, the company will occupy a fifteen-storey structure now under erection at the corner of Fifty-fifth Street, New York, to be known as the National Broadcasting Company Building and housing the greatest broadcast plant in the United States. It will contain eight completely equipped studios in addition to an auditorium studio on the top floor large enough to accommodate an orchestra of one hundred and fifty, with reserved seats for distinguished guests.

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Looking Through the Ceiling.

The ceilings of the studios on the twelfth floor will contain glass panels so that spectators seated on the thirteenth floor will be able to view the artists at the microphone; and to avoid any possibility of *ennui* among the company's staff, loud-speakers will be installed in practically every room in the building!

FUTURE FEATURES.

Sunday, December 26th.

LONDON.—Organ Recital, Carols and Christmas Hymns from Norwich Cathedral.

ABERDEEN.—Concert organised by the Augmented Musicians' Union in aid of the Benevolent Fund.

Monday, December 27th.

LONDON. — Pantomime "Cinderella."

BOURNEMOUTH. — Programme of Original Music.

Tuesday, December 28th.

MANCHESTER.—"Hiawatha's Wedding Feast" (Longfellow). (Cantata.)

GLASGOW. — "Managin' John's Mither," Scots comedy.

BELFAST.—"The Lily of Killarney" (Benedict).

Wednesday, December 29th.

LONDON.—Symphony Orchestra conducted by Sir Landon Ronald; Laffitte (solo pianoforte).

CARDIFF.—"The Blue Penguin."

Thursday, December 30th.

LONDON.—A Bygone Christmas with the Mellstock Quire.

BOURNEMOUTH. — Wessex Programme arranged in collaboration with Mr. Thomas Hardy.

NEWCASTLE.—"The Valkyrie," Act 1.

Friday, December 31st.

LONDON.—Reminiscences of 1926.

BIRMINGHAM.—Broadcast Reminiscences.

BOURNEMOUTH.—Reminiscences of 1926.

GLASGOW. — "Eight O'clock." Melodrama in one act.

Saturday, January 1st.

LONDON.—"The Country Girl."

BIRMINGHAM.—Pantomime "Switching Over."

MANCHESTER.—"My Programme," by Editor of the *Manchester Evening Chronicle.*

BELFAST.—"The Ulster Ceidlidh."

Order Out of Chaos.

Mr. Merlin H. Aylesworth, President of the Company, announces that the new building will be taken over on about June 1st, 1927. An agreement has been signed with the Radio Corporation of America whereby the National Broadcasting Company will direct the activities of WJZ, which will be the central service station for a new broadcasting network, but will not be merged with the chain of stations interconnected by wire with WEAF. Under this scheme the American public will enjoy the benefit of two chains of stations supplying alternative programmes. Is this the dawn of order in the U.S. ether?

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Carols from Norwich.

Christmas carols will be relayed from Norwich Cathedral to 2LO and 5XX on December 26th from 8.0 to 9.0 p.m. An address by the Dean of Norwich will also be broadcast. For three-quarters of an hour prior to this transmission an organ recital by Mr. R. J. Maddern Williams, F.R.C.O., is to be broadcast from the Cathedral.

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Broadcasting the Liverpool Organ.

Anent my remarks concerning the recent transmission of a recital on the Liverpool Cathedral organ, I am taken to task for suggesting that only one microphone was used, and that this was responsible for the general lack of balance. As a matter of fact, five microphones were used, but whether they were placed too near the organ or were not arranged to the best advantage, the results were flattering neither to the organ nor to the Broadcasting Company.

The single microphone suspended at a reasonable distance from orchestra and organ at the Albert Hall produces infinitely better results. Presumably the B.B.C. engineers at Liverpool were unable to adopt a similar arrangement owing to extraneous noises in the Cathedral.

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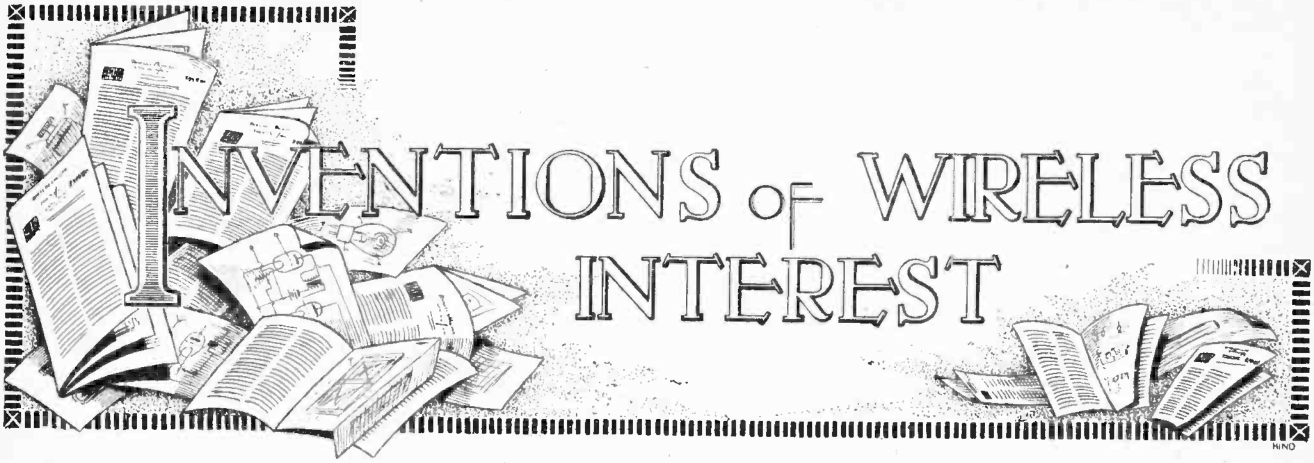
The Drama in Toulouse.

Apropos the account which appeared in these columns last week regarding the strange clash of opposing broadcasting interests in Toulouse over the matter of transmitting services from St. Etienne's Cathedral, I learn that peace has been restored.

It will be recalled that when *Radio Toulouse* installed a short-wave transmitter in the Cathedral the postal authorities not only protested on the grounds that the Cathedral was a State-owned edifice, but installed a microphone of their own for broadcasting the services *via* PTT Toulouse. This undignified counter-stroke drew forth a shower of public protests, with the result that the postal authorities have hastily withdrawn from the field. *Radio Toulouse* is highly popular with amateurs in the south-west, and has lost nothing in prestige by the events of the last few weeks.



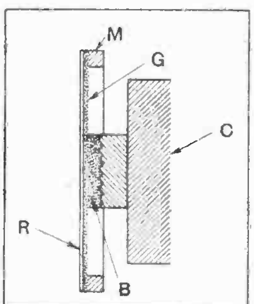
INVENTIONS OF WIRELESS INTEREST

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

Reisz Microphone.
(No. 258,476.)

Appl. Date, Feb. 8th, 1926.

The novelty of the Reisz microphone lies in the construction of the diaphragm, details of which are described by E. Reisz in the above British Patent. The accompanying illustration shows one form of microphone incorporating this diaphragm. Here, the diaphragm consists of a sheet of thin rubber R which is not stretched, or only stretched to a very small extent. The diaphragm is coated with a thin layer of rubber solution, and is then dusted over with carbon granules G. Only sufficient solution is used to enable the granules to adhere to the diaphragm, without any possibility of adjacent granules becoming mechanically united. Contact with the diaphragm is made by means of a metal ring M, which is fixed round the edge. Some larger granules B are placed between the centre of the diaphragm and a block of carbon C, connection being made between the block and the metal ring.



Principle of the Reisz microphone. (No. 258,476.)

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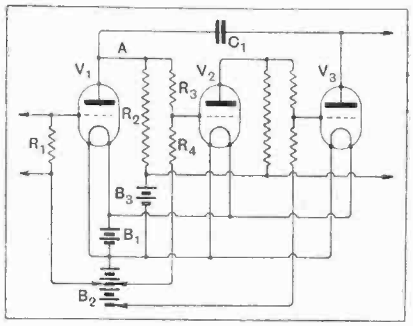
Resistance-coupled Amplifier.
(No. 258,315.)

Application Date, May 18th, 1925.

A resistance-coupled amplifier obviating the use of coupling condensers is described by S. B. Smith in the above British Patent Specification. It will be noticed that the amplifier shown in the illustration utilises a potentiometer form of coupling to the grids of the various valves, the positive potential which would otherwise be communicated to the grids from the anodes of the preceding valves being counteracted by an opposite negative potential from a bias battery. The amplifier can, therefore, be used for magnifying the effect of direct current potentials applied between the grid and the filament of the first valve. The action of the amplifier can be easily understood by referring to the illustration. The input of the first valve V_1 comprises a resistance R_1, across which the potentials to be amplified are introduced. The lower end of the resistance R_1 is taken to a tapping on the bias battery B_2, so as to give the grid of the first valve a suitable negative bias. The anode circuit of the valve V_1 contains an anode resistance R_2, which is connected to the positive side of the anode battery B_3. The anode A of the valve V_1 is coupled to the grid of the valve V_2 through one section of a potentiometer comprising two resistances R_3 and R_4. The ohmic value of these resistances is considerably greater than that of the anode resistance R_2. The other half of the potentiometer R_4 is taken to a negative tapping on the bias battery B_2, this negative bias being suitably adjusted so as more than to counteract the positive potential which would otherwise be conveyed to the grid from the anode of the valve V_1, the grid potential, of course, becoming negative with respect to the filament. The valve V_2 is coupled to the valve V_3 in a similar manner. In order to overcome any regenerative effect which may occur in the amplifier, thus giving rise to low-frequency oscillation, a stabilising condenser C_1 may be connected between the anode of the valve V_1 and the anode of the valve V_3, acting, of course, in the manner of an ordinary anti-reaction condenser.



Resistance-coupled amplifier. (No. 258,315.)

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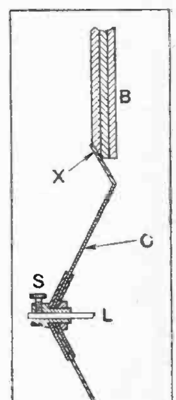
A Loud-speaker Diaphragm.
(No. 258,502.)

Con. Date (U.S.A.), Jan. 5th, 1926.

The Hopkins Corporation claim in the above British Patent a loud-speaker introducing a particular form of paper diaphragm, in conjunction with a wooden sound board. The diaphragm constitutes a paper cone C which is attached to a driving mechanism through a link L by means of the usual collar and set-screw S. The periphery of the conical diaphragm is bent back as shown at X, so that it can be attached to the bevelled edge of a three-ply sound board B. A feature of the sound board is that it has considerably greater area and mass than that of the diaphragm itself. The novelty of this sound board lies in its construction from Balsa wood, three-ply wood being employed. The specification states that the Balsa wood has some very marked effect upon the reproduction, giving a somewhat mellow tone. It is further stated that the inventors do not know the nature of the property of the Balsa wood which brings about this effect.

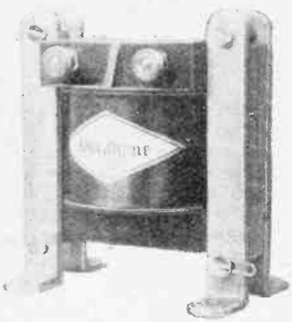


Conical loud-speaker diaphragm and baffle. (No. 258,502.)

A Review of the Latest Products of the Manufacturers.

PURADYNE L.F. TRANSFORMER.

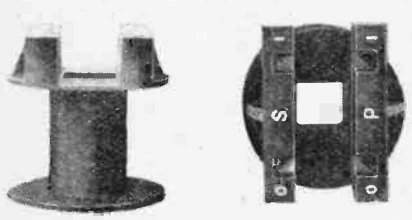
Although the price for which an intervalve transformer is sold cannot be regarded as a measure of its merit, it is obvious that limitations in the cost of production will govern the design. The



The Puradyne intervalve transformer. The height is 3½in. and the diameter of the spool 2in.

price of an intervalve transformer is usually assessed by the amount and gauge of the wire with which it is wound, and many of the cheaper transformers, therefore, possess windings of low inductance. High primary inductance is the principal property looked for, the windings being carefully arranged to limit self-capacity to a minimum.

An inexpensive transformer is produced by the Puradyne Manufacturing Co., 27, Elgin Road, Seven Kings, Essex, the general overall dimensions of which are approximately the same as many higher priced transformers. The windings are



A moulded spool carrying the terminal bars is used in the construction of the Puradyne transformer. This facilitates the terminating of the wires when the spool is wound and eliminates the risk of the terminals becoming loose or rotating.

carried on a moulded spool which carries the terminal strips, simplifying the construction, and allowing the windings to be properly terminated before the transformer is assembled.

For use as an intervalve transformer it is available with windings of three ratios, 2.7 to 1, 4 to 1, and 6 to 1, while it is supplied as an output transformer in ratios of 1 to 1 and 5 to 1. Although the windings are of comparatively heavy gauge wire, the primary inductance in the case of the 4 to 1 ratio model when measured was found to possess an inductance of 13.3 henries.

The general finish is good, being dull black with nickel plated mounting bars and terminals.

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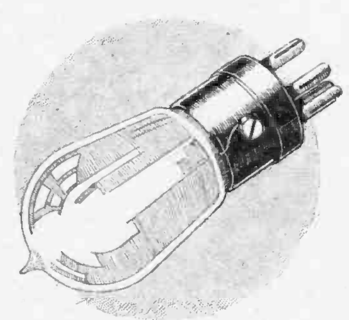
ANELOY FOUR-ELECTRODE VALVES.

Two types are available, differing in the class of filaments with which they are fitted. For use with a 2-volt accumulator the filament passes a current of 0.35 amperes, and a 4-volt valve is provided with a low-consumption filament requiring a current of 60 mA.



The Aneloy valve is available in two types, a 4 volt 0.06 and a 2 volt, passing 0.35 amperes.

It is encouraging to see that Aneloy Products, of Eton Works, East Dulwich, London, S.E.22, are interesting themselves in the production of four-electrode valves, and the advent of a British valve of this type fitted with the 0.06 filament will further the making up of sets which can be operated from quite small H.T. and L.T. batteries, the additional grid permitting of the use of a low anode potential.

It is hoped, however, that the manufacturers will not neglect the four-electrode valve with a power filament for loud-speaker work, which will undoubtedly help to make the four-electrode valve really popular.

Contact is made with the inner grid by means of a wire passing out over the top of the cap, and held down under a screw, and consequently care is needed to avoid this wire becoming broken off and the connection lost.

The valve is moderate in price, and compares very favourably in actual performance with other four-electrode valves already on the market.

TRADE NOTES.

Buried Treasure.

"A Buried Billion at Your Doorstep" is the alluring title of the radio catalogue for 1927 produced by the Rothermel Radio Corporation of Great Britain, Ltd., 24-26, Maddo Street, London, W.1. The catalogue (price 9d.) covers a wide field of well-known American apparatus, including coils, transformers, condensers and other components and accessories. A useful supplement is included setting forth "America's Foremost Circuits."

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The "Puremax" Loud-speaker.

We are informed that the manufacture and distribution of the "Puremax" loud-speaker has been taken over by Messrs. H. Lenglen, Ltd., 14, Bartlett's Buildings, London, E.C.4.

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Wireless at British Industries Fair.

No fewer than 33 wireless manufacturers will be exhibiting in the Radio Section of the British Industries Fair, White City, Shepherd's Bush, to be held next spring.

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Unlikely.

Customer: "Are you the man who cut my hair the last time?"

Barber: "I don't think so. I've only been here six months."

—Cossor's *Radio Mail.*

BUILDING A MODEL BOAT.

Details of Construction of the Hull of the Radio Ship "Telearch I."

By A. P. CASTELLAIN, B.Sc., D.I.C., A.C.G.I.

THE following short article has been written in response to a number of requests for further constructional details of the hull and method of propelling the radio ship *Telearch I*.

The motor used to drive the ship was, in the writer's case, one supplied by the Economic Electric Co., complete with propeller. The type used was suitable for a five-foot model boat, so it was thought to be sufficiently powerful to push *Telearch I* (which is about 4ft. in length) along at a reasonable speed with all its batteries and control gear. It should be emphasised, however, that the hull used for the control gear to operate was not designed for speed—or with an eye to beauty—but essentially for stability with the heavy apparatus on board.

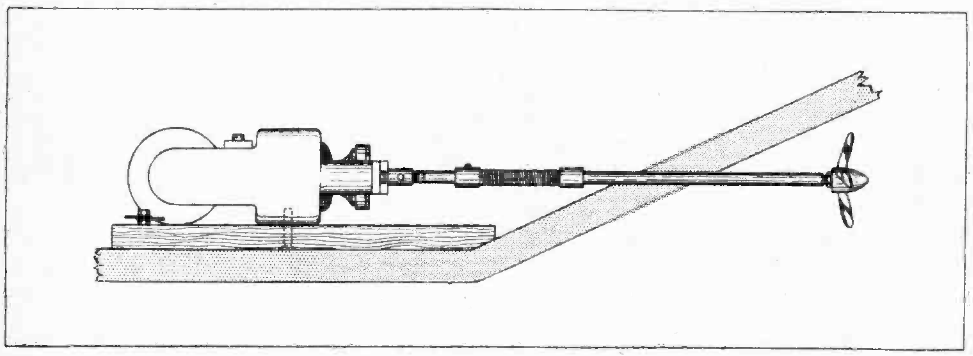


Fig. 1.—Showing how the motor and the propeller shaft are mounted in the bottom of the boat.

The Driving Motor.

The motor chosen turned out to be rather on the small side for reasonable acceleration to be obtained, although the maximum speed obtained is not too bad for a flat-bottomed boat such as this is, so that the writer advises a more powerful motor be used than the one illustrated.

The method of fixing the motor is shown in Fig. 1, while the photograph on the next page shows the actual mounting of the motor in *Telearch I*.

It is not necessary to give fuller details of the motor-mounting since it depends so much on the actual motor used. However, the main point to see is that the motor is firmly fixed to the bottom of the boat, as otherwise the propeller-shaft is sure to jam in its tube when the boat is nicely out of reach on the water.

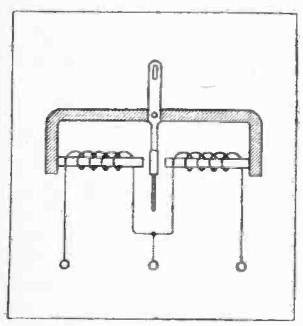


Fig. 2.—Circuit of the steering magnets.

The next point to consider is the steering gear. The simplest type, using two double coil electro-magnets, is sketched in Fig. 3, and the circuit of the arrangement is given in Fig. 2. When current is applied between the two left-hand terminals the armature A (Fig. 3) is pulled to the left and in so doing pulls the rudder over to the right, and is held there as long as current is flowing.

Similarly when the two right-hand terminals are used, the rudder is pulled over to the left. When no current is flowing, the armature—and hence the rudder—is kept in a central position by means of two coil springs shown in Fig. 3 and in the photograph of the steering gear.

A rather better arrangement, though not so easy to construct, is one using a cylindrical armature sliding inside the magnet coils instead of a flat armature and fixed projecting cores to the coils, as illustrated. However, in the case of *Telearch I* there was plenty of power to spare, so the method illustrated was used as being simpler to experiment with and to construct.

The magnet cores used are made from $\frac{3}{8}$in. soft iron bar and are yoked together in pairs by means of a piece of $\frac{1}{8}$in. iron strip. Steel screws are used to fix the cores

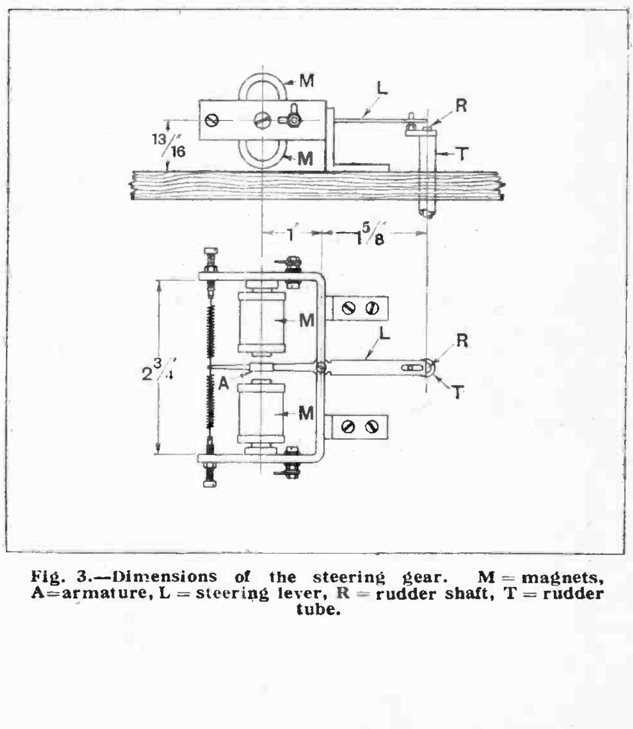


Fig. 3.—Dimensions of the steering gear. M = magnets, A = armature, L = steering lever, R = rudder shaft, T = rudder tube.

Building a Model Boat.—

to the bars, the latter being drilled and tapped to suit. The bobbins to hold the wire on the cores may be turned out of hard wood, such as boxwood, or out of ebonite or fibre, to the dimensions roughly indicated in Fig. 3, which is a scale drawing of the steering gear on *Telearch I.*

The bobbins are wound full of 28 S.W.G. D.C.C. wire, and each pair connected in series. It is sometimes possible to buy these magnet cores with bobbins already wound for using in electric bells, in which case much labour would be saved by using these instead of making them.

The iron armature A is also made from a piece of $\frac{1}{8}$in. iron strip of suitable length to cover the electro-magnet pole pieces, while the strip L (Fig. 3) is made from brass. The frame which supports the two magnets and to which the rod L is hinged is made of brass of about $\frac{1}{8}$in. thick by $\frac{5}{8}$in. or so wide. The strength of the retaining springs will have to be found by experiment with the actual mechanism constructed. It should be remembered that the longer the spring spiral the weaker are its effects for a given extension.

The Hull.

As has been said before, the hull was designed from the point of view of stability and ease of construction, and not for speed, so that a flat-bottomed type was chosen. The hull is constructed of mahogany and tinned sheet-iron of about 22 gauge, the flat bottom being cut out of a single piece of wood and grooved near the stern (as shown in Fig. 4), so as to make a sloping part to take the propeller. Fig. 4 shows the main dimensions for the wooden parts, and Fig. 5 shows the shapes and sizes of the pieces forming the iron sides.

These sides have to be made in two parts, since it is not easy to obtain sheets of tinned iron of sufficient length to cut out each side in one piece, as the length of the side is 50in.

In constructing the hull the part first tackled was the wooden bottom, D in Fig. 4. When this was cut out and shaped as shown, pieces A and B and the small pieces shown at the top of Fig. 4 are dealt with. The length of the piece D is about 48in.

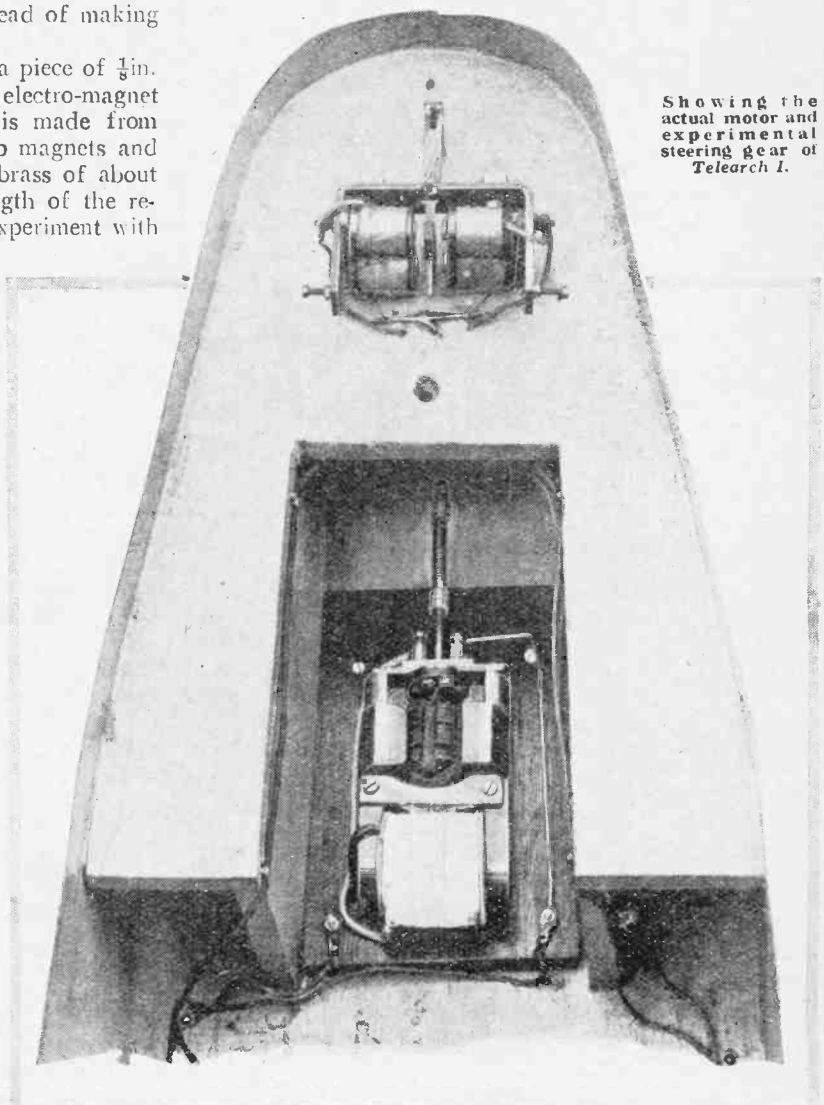
The small pieces, 4in. × 6½in., shown above in Fig. 4 are used to position the fore-deck A above the bottom D, and the other two small pieces serve to position the stern-deck B and also to fix the rear sloping portion in position. These pieces are fixed by means of long brass screws countersunk in position, and it is a good plan to use plenty of good, old-fashioned glue as well after the screws have been fixed.

In fixing the fore-deck A it should be noted that the pointed part does not come vertically over the corresponding part of the bottom D, but slightly in front of it, so as to give a better appearance to the finished boat.

When the woodwork is finished it should be well painted or varnished all over, as when the sides have been put on there will be parts of the woodwork which are inaccessible for painting.

Fixing the Sides.

It was found that the easiest way to fix the sides was to make about twenty tiny holes along the bottom edges



Showing the actual motor and experimental steering gear of *Telearch I.*

of the iron sides and to tack the latter in position with small brads. The dimensions given in Fig. 5 allow of a quarter of an inch overlap at the join in the centre of the boat and the same amount at the stern.

Making the Hull Watertight.

To help in the fixing it is desirable also to clamp the centre joins, at any rate, with a small BA screw—say, No. 6BA—and then to solder all the joins well and truly, using a large soldering iron. Soldering large pieces of metal is quite easy when a large and properly heated

Building a Model Boat.—soldering iron is used, but it is a very long and irritating job to do with a small iron, and the results with the latter will probably not be too good.

For the bows of the boat a small piece of tinned iron about 6¾in. by about half an inch wide is bent along its length into a long V-shape and used as a clamp for the sides by being nipped over them and then soldered in position over the join at the front.

A few thin brass screws should now be distributed along the bottom edges of the sides, to reinforce the brads. Care should be taken, in first fixing the sides, to see that they fit smoothly against the wooden bottom and do not go in wrinkles, as in the latter case it is difficult to make the boat watertight.

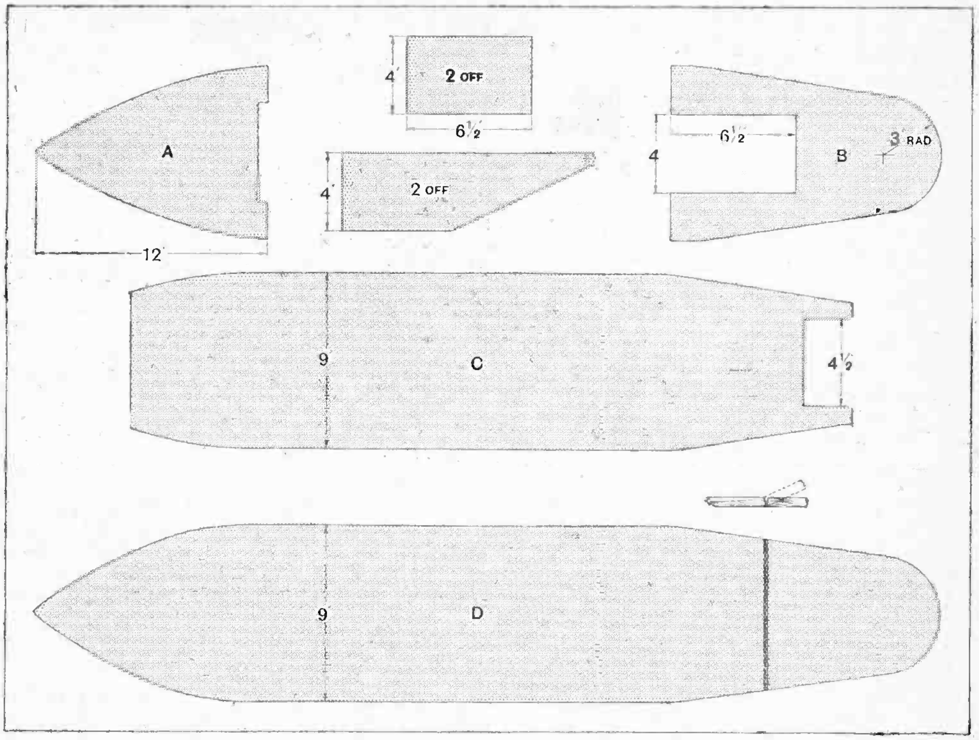


Fig. 4.—Woodwork of the hull. A = fore-deck, B = stern-deck, C = main deck, carrying the masts, D = bottom of ship; note how this is grooved to get the sloping part.

Finally, the junction between wood and metal should be carefully gone over with putty, or a mixture of putty and glue, and the whole hull painted. When dry, the boat should be tried in water with more weight in it than it will have to carry, so as to see if it is watertight.

The hull described was tested with about 50 lb.-wt., the weight of the gear being about 32 lb.

The best plan is to load up the boat until about three inches are below water, and then to leave it floating for a few hours. If any water has got in, it will be necessary to go over the joints again, this time with hot glue, as putty will not stick well with the hull wet. It should be possible to make the ship watertight after two such attempts, at any rate.

Should the sheet-iron sides have kinked a bit at the join with the wood base, it is a good plan to cut a wood shaving to fit the crack and to dip it in glue before fixing in position, and in any case it is quite a good plan to try to force such wood shavings in wherever they will go before putty is used at all.

It is hoped that the above short description will enable any reader who so desires to build a hull capable of carrying, in a stable fashion, quite a large amount of apparatus.

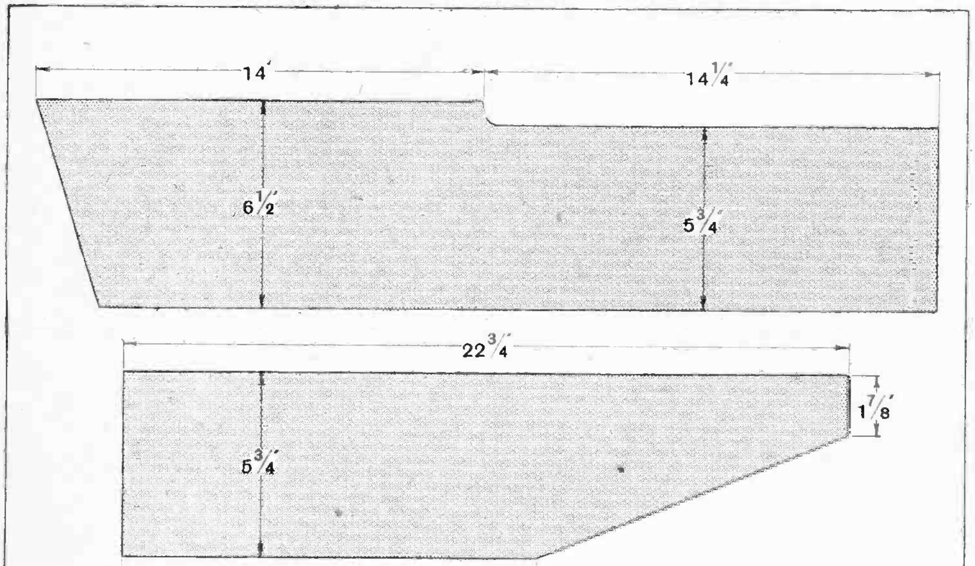
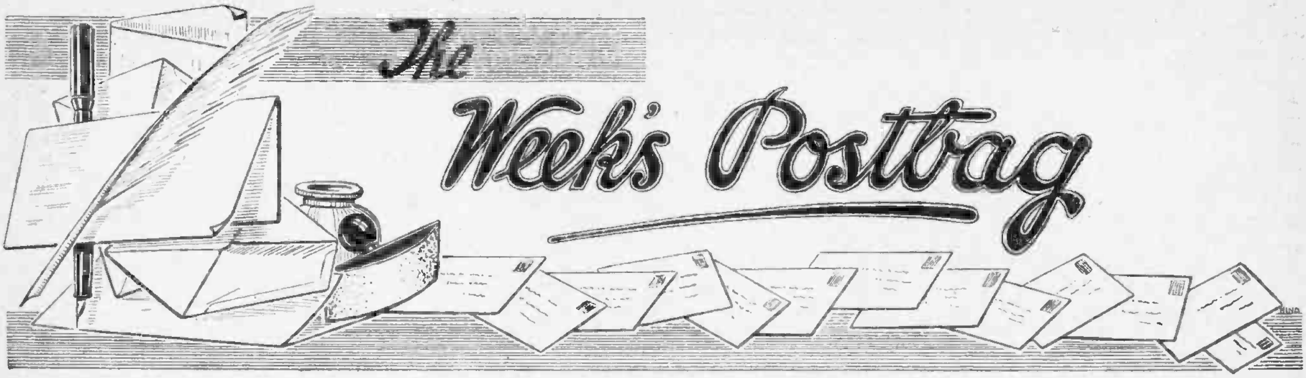


Fig. 5.—Showing the dimensions and shapes of the sheet-iron sides. Two of each shape will be required.



The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

THE SALES POLICY OF MANUFACTURERS.

Sir,—Might I be permitted the use of your space to draw the attention of manufacturers to a policy that is creating considerable dissatisfaction amongst wireless enthusiasts and home-contructors throughout the country. I refer to the very prevalent practice of creating public demand by advertising and exhibition demonstrations before production or distribution has been started.

It seems to me to be very short-sighted, as it is bound to turn orders to competitors who adopt the sound policy of holding up their advertising until they are ready to sell, and who, by being able to guarantee delivery, become to be known by traders and the public as firms with whom it is safe to place orders.

Some six weeks ago I ordered a power transformer, smoothing choke, and two 10 mfd. condensers from a firm whose name is a household word, and, although these components had been advertised and shown at the big wireless exhibitions this autumn, I am still waiting delivery. This is not the only case that has come my way this autumn, but it did concern a firm who, in my opinion, ought to have something different from this for their sales policy. The result is that, as nearly all wireless dealers can prove, manufacturers can be divided into two classes: those behind whose advertisement lies actual production, and those who have to await orders before commencing production. Furthermore there are growing up in the country a number of people who can name the members of each category.

It would be interesting to hear other readers' opinions and experiences of the same practice. At any rate it is not calculated to improve the wireless trade, and, in your readers' interests, it is a matter that deserves attention.

Preston. J. M. TOULMIN.

December 1st, 1926.

IDENTIFYING BROADCAST TRANSMISSIONS.

Sir,—I should like to reply to a few points which have arisen from the correspondence concerning my scheme for identifying broadcast transmissions which you published on November 17th.

The objection raised by "Jay Coote" that the last word of the announcement might be missed can easily be overcome by transposing the order of the words, making it "Unua Brita Stacio" instead of "Brita Stacio Unu." "Jay Coote" and some other correspondents also apparently forget that the whole trend of broadcasting is towards the provision of high-power stations, which means that no spoken announcement will be in any danger of being lost.

The suggestion that Morse should be used is entirely negatived by the fact that all around the coast there is so much interference that such Morse calls would be completely lost in the general confusion. Apparently those correspondents who favour Morse code announcements are doing most of their listening somewhere inland where they are free from Morse trouble, which is so great a feature of broadcast reception in every home anywhere near the coast line, especially in the South and the West.

Considering that some expert oscillators can now play the first verse of "God Save the King" when they are tuning in their instruments, I fail to see that any scheme of call signs based on a purely musical note would not also be liable to a good deal of confusion.

If there were any scheme suggested which I could honestly believe to be better than my own I should immediately be willing to support it, but I cannot see that any of the suggestions made improve in simplicity or usefulness on that which I have myself put forward.

With regard to Mr. Schaschke's lack of conviction that the standard pronouncement and interpretation of Esperanto are quite simple, I am afraid that the only explanation is that that gentleman has had no experience of the international language in action. If he could see it standing the wear and tear of a big Congress of three or four thousand people of diverse nationalities, and presenting absolutely no difficulty in pronunciation or interpretation, his doubt would immediately disappear. I hope that at some future date he may have that privilege.

Thanks are due to *The Wireless World* for ventilating this important matter. I may say that my own article has received considerable attention on the Continent, and that my scheme has had a favourable reception there. C. F. CARR.

Southampton.

December 9th, 1926.

AMERICAN RECEPTION.

Sir,—Your correspondent who reported reception of American speech in the "Transmitters' Notes and Queries" section of the December 15th issue may be interested in the following.

The transmission he heard on November 27th lasted from about 11.45 to 2 p.m. and was extended to engineers in (apparently) the American Telephone and Telegraph Co. and the British Post Office by means of land lines through ordinary exchanges. This was obvious from the standard expressions used by the operator and also from the fact that some of the subs. said how far they were from the Central Office (*i.e.*, Exchange).

The wavelength was about 25 metres and strength here R.5 on an 0-v-1 Reinartz without aerial. I concluded it was a harmonic of the station working Rugby. R. S. FOSKETT.

London, S.E.7.

December 15th, 1926.

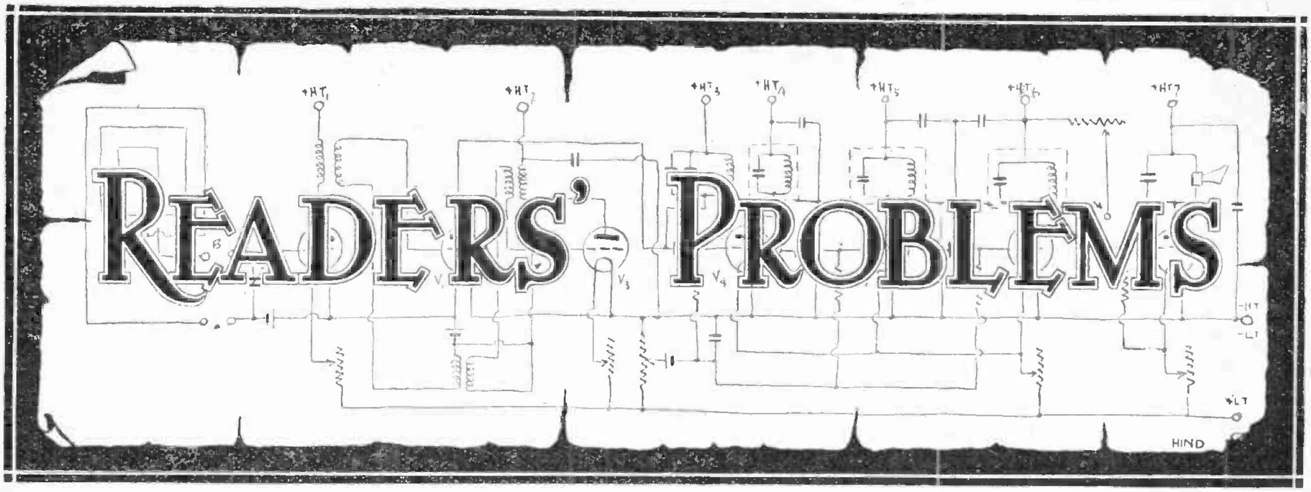
MANUFACTURERS AND RADIO SOCIETIES.

Sir,—Referring to the letter in your issue of Nov. 17th from Mr. A. H. Banwell, I feel I should like to say a few words on behalf of the manufacturers.

I was for two years (1924 and 1925) hon. secretary of The South Croydon and District Radio Society, and during that period I wrote a very considerable number of letters to all sorts of manufacturers, and I do not remember ever once not receiving a most courteous reply; in fact, during my term of office we had many very fine lectures and demonstrations given by manufacturers. GEORGE H. TOZER.

South Croydon

December 15th, 1926.



"The Wireless World," Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

A Superheterodyne Attachment.

I have constructed the "All Europe Broadcast Receiver" described in the issues of November 18th and 24th, 1925, and wish to use it as the amplifier of a superheterodyne receiver. If this can be done, will you please give me the connections of an attachment as I wish to be able to receive short wavelength signals. J. B.

The receiver is quite suitable for your purpose, and by adding a two-valve frequency changer you will have a good superheterodyne receiver. A diagram of the two-valve frequency changer required is given below, and comprises a detector and oscillator valves.

A frame aerial is connected to a tuning condenser C_1 of 0.0003 mfd. or 0.0005 mfd. and to the detector valve through a small coil which is used as a coupling coil and a grid bias battery, G.B. The valve is used as an anode rectifying valve by adjusting its anode voltage, and one of the high-impedance type should be used. Points A, B, are connected to the earth and aerial terminals of the six-valve set, but it should be noticed that the wire connecting the earth to the filament circuit of the set should be removed. This can be seen by referring to the original diagram given on page 686 of the issue of November 18th, 1925, and the object is to remove the direct connection between the aerial circuit and the secondary and filament circuits. When the points A and B are connected, the primary winding of transformer TR_1 is connected to the anode circuit of the detector valve.

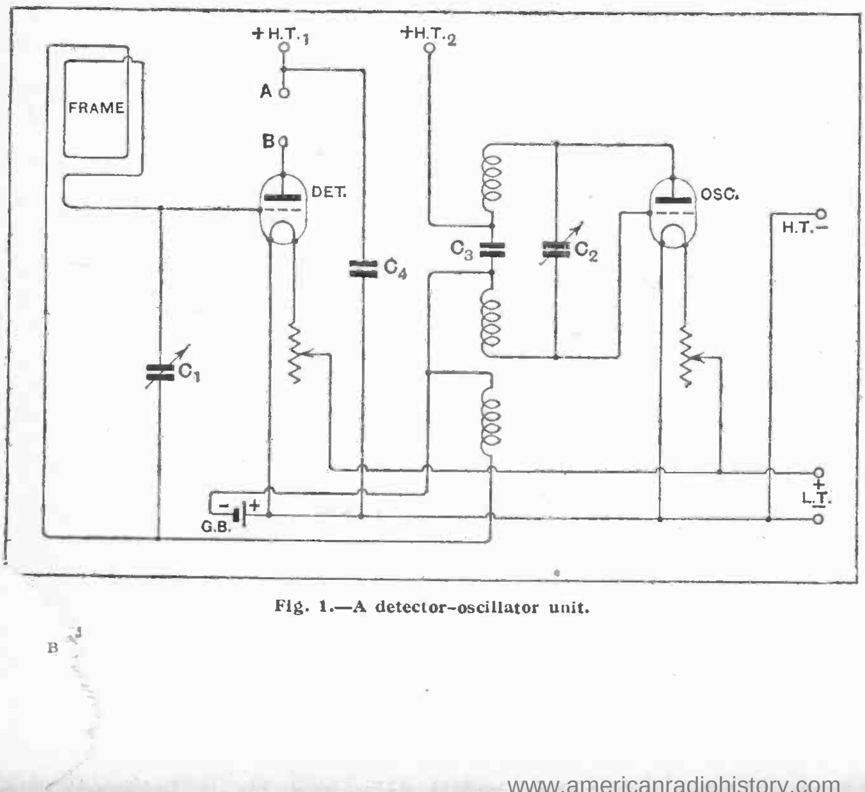


Fig. 1.—A detector-oscillator unit.

The second valve shown in the diagram below functions as an oscillator and has a tuning condenser, C_2, of 0.0003 mfd., or 0.0005 mfd., a split tuning coil, and a by-pass condenser, C_3, of approximately 0.1 mfd. The split coil can be a "Dimic" coil of suitable size and should be mounted near the coupling coil. This coil can be of the plug-in type and may have, to begin with, one-quarter the number of turns of the split coil. For the oscillator a low-impedance valve is required and its anode voltage is connected to $+H.T._2$. This valve has the same grid bias as the detector.

Control of the strength of the oscillations generated is obtained by adjusting the anode voltage and the filament current of the oscillator, while the strength of the oscillations induced into the grid circuit of the detector is controlled by varying the coupling between the two circuits and by varying the number of turns in the coupling coil. Condenser C_4 can have a value of approximately 0.1 mfd.

oooo

A Tuning Difficulty.

I have an "Everyman's Four-Valve" receiver, made precisely as described in this journal, with which I obtain excellent results. There is one thing, however, which I do not understand. I find that the local station can be received at two points on the aerial tuning condenser; the points are separated only by a few degrees on the dial, and the effect puzzles me, since distant stations are received at one point only, in the normal manner. E. C. L.

The local station appears to be received at two points on the aerial tuning condenser because of the strength of the signals. When both tuning condensers are set to tune the circuits exactly to the wavelength of the local station, the valves are grossly overloaded.

The voltage applied to the valves is reduced by detuning the aerial condenser either up or down, with the result that the station is received clearly at these two points. To receive the local station properly it is necessary to make full use of the volume control provided, which takes the form of a filament rheostat connected to the H.F. valve. If the filament temperature of this valve is reduced by increasing the amount of the rheostat in circuit, the A.C. resistance of the valve is increased, which has the effect of reducing the amplification.

When a receiver is used at a place quite close to the local station it may be necessary to turn off the first valve or to detune the aerial circuit considerably. It is sometimes found that the slight coupling between the aerial and detector circuits is sufficient to pass signals strong enough to work the loud-speaker, but if this is tried and it is found that the signals are not of sufficient strength, the first valve should be turned on and the aerial circuit be considerably detuned.

oooo

A Resistance-capacity Coupled "Everyman's Four."

I am about to construct "Everyman's Four-Valve" receiver described in the issue of October 13th, 1926, as several of my friends have made this receiver, with excellent results. The quality of reproduction is really all that could be desired, but the amplification is so great that many stations have to be reduced in strength by turning down the volume control. This leads me to think that I could replace the L.F. transformer by a resistance-capacity coupling and so save in the initial cost and in running expenses. If I am correct will you please give me a diagram showing the necessary alterations?

K. A.

The low-frequency transformer used in "Everyman's Four-Valve" receiver described in recent issues of this journal had a ratio of 3.5 : 1, and when used with a valve of the D.E.5B or P.M.5 type, which have an amplification factor of 16 to 20 and an A.C. resistance of approximately 20,000 to 30,000 ohms, with appropriate anode and grid voltage, gave a low-frequency voltage amplification for the stage of between 56 and 70.

The amplification is fairly uniform from 100 cycles to 6,000 cycles; hence the quality of the amplification is very good indeed. If a resistance-capacity coupling is used here the amplification obtained will be about 70 per cent. of the amplification factor of the valve used, so that if a valve with an amplification factor of 25 is employed, the amplification obtained will be about 18. The resistance-capacity stage is connected as indicated in the diagram, where R_7 is the anode resistance, being a grid leak of 1 megohm, C_8 a mica coupling condenser of 0.001 mfd., and R_8 the grid leak of 2 megohms. The value of the coupling condenser recommended is such that good quality amplification will be obtained.

By using this resistance-capacity coupling, a saving in first cost and in running costs is effected. For instance, the anode current passing through the first low-frequency stage when a transformer coupling is used is of the order of 1 or 2 milliamperes, depending on the voltage of the anode battery. When the resistance-capacity coupling is substituted, the anode current is only 0.1 to 0.15 milliampere.

A valve taking a filament current of 0.1 ampere can be used in this stage, and the one recommended is the P.M.5A, which has an amplification factor of 25 and a low A.C. resistance.

A valve of this type can also be used with success as a detector and as the H.F. amplifier. When the receiver was first described the P.M.5A valve then available had a very high A.C. resistance, which made it unsuitable for use in the H.F. or L.F. positions, although it functioned quite well as the detector, but now that this valve has been redesigned it can be recommended for use in the first three positions in the receiver. A low-impedance valve should, of course, be employed in the last or output stage of the set.

The substitution of a resistance-capacity coupling for the transformer coupling is not recommended for general use, as nothing is gained from the point of view of quality, and a good deal of amplification is lost. The only justification for using it is one of cost.

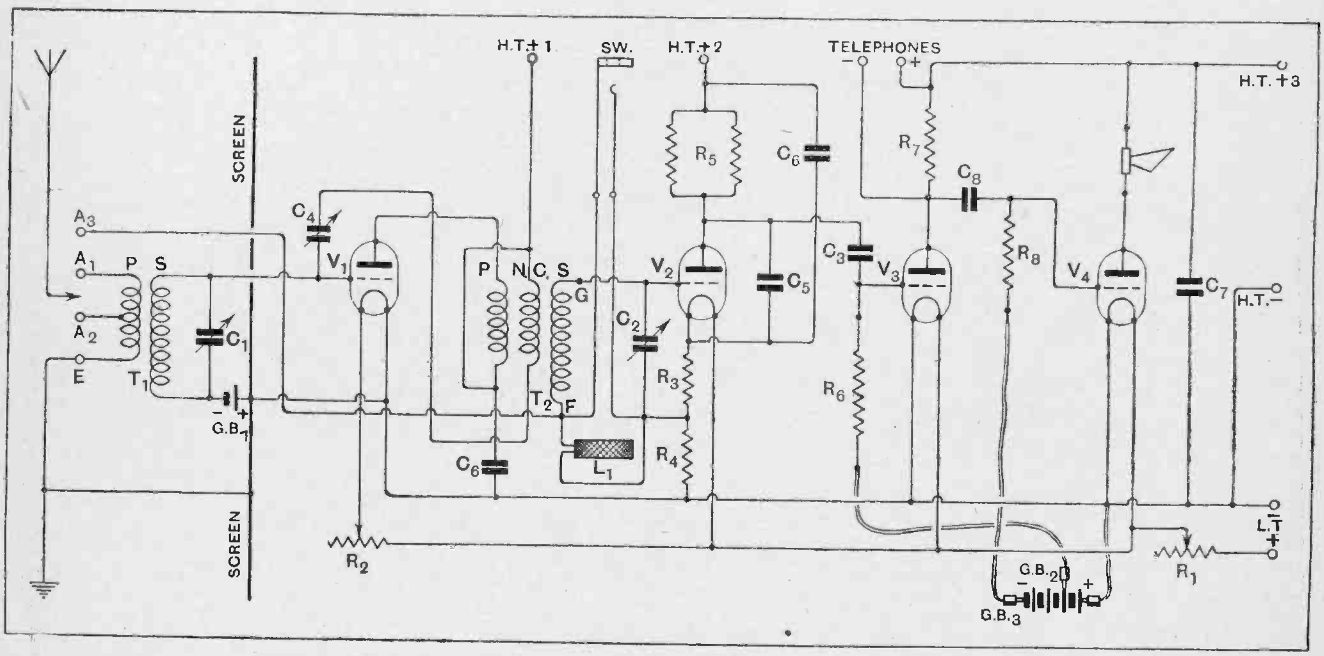


Fig. 2.—"Everyman's Four Valve" receiver with two resistance-capacity coupled stages

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

THE PROGRAMME FOR 1927.

WITH the conclusion of the year 1926 we can look back with something of pride in our feelings towards those who have been responsible for the building up of our great organisation of broadcasting in this country. The retiring directors of the B.B.C. are in a position to give a very satisfactory account of their stewardship of the service during their term of office. They have built up from nothing an organisation which is the pride of our own country and the envy of our neighbours because of its remarkable efficiency. All this has been done in the face of many and often great difficulties, because most of it has been pioneer work, and pioneering is always a strenuous task where there exists no precedent of any kind on which to fall back for guidance when problems arise which have to be solved. Step by step the B.B.C. has surmounted the difficulties as they were encountered, or has tactfully circumvented those which were at the time insurmountable, but in no case has a retreat been resorted to. The B.B.C. has surmounted one after another the technical obstacles which have met it in its path; it has circumvented the Post Office, the Daily Press, the Entertainment industry, and a host of other oppositions which tact dictated the time had not yet arrived for assailing, and we cannot recall one instance where progress has been definitely barred. We trust that the debt which we owe to the first directors of the British Broadcasting Company under the chairmanship of Lord Gainford may never be forgotten.

In welcoming the new Governors, who take control in the New Year, our feelings are almost of condolence because we recognise that their task is a difficult one, made none the less so in view of the high standard set by their predecessors in office. The difficulties are, however, greatly lessened by the continuance in office of Mr. Reith, and by the presence on the new Governing Board of the former chairman, Lord Gainford, in the capacity of Vice-Chairman. The experience of these two will ensure continuity of policy and action under the new control.

In view of the fact that the new governing body is so far untried, it is to be expected that its conduct of the affairs of broadcasting will meet with at least as large a share of criticism as the former body enjoyed, and until the confidence of the public has been earned critics will be ever on the watch for some excuse for protest. In the matter of programmes especially the public can never be completely satisfied on account of the divergence of tastes. If the new Board is in sympathy with their task they will welcome criticism and make good use of any helpful suggestions.

It will be our endeavour to put forward useful suggestions whenever possible, and our readers can materially assist by forwarding their own criticisms and suggestions to us in order that expression may be given to them through the columns of this journal. By so doing the opportunity will be provided of discussing suggestions through the Correspondence columns.

CONTENTS.

TRANSMISSION ON SHORT WAVES.

Some Quantitative Measurements of Wave Propagation.

SINCE the vast distance-covering powers of short waves first came into prominence a few years ago, the tendency on the part of experimenters has been to go lower and lower down the wavelength scale in search of new phenomena. In the course of the experiments these short-wave enthusiasts have made many remarkable and startling discoveries. They have shown that short waves are capable, under certain conditions, of covering enormous distances with the expenditure of very little power. They have also discovered the peculiar phenomenon of skip distances, and ascertained that the length and distance from the transmitter of these skip distances depends upon the time of day and upon the wavelength employed.

A careful study of these results seemed to indicate that, to enable a twenty-four-hour communication service to be maintained on short waves over a given distance with a given power, it would be necessary to vary the wavelength employed to suit the time of day. The results have been so variable and confusing, however, that it has not, so far, been possible to lay down any definite rulings on the subject, owing to the absence of quantitative data.

In these circumstances, therefore, research engineers attached to the American Telephone and Telegraph Company and the Bell Telephone Laboratories, Inc., commenced to conduct a serious investigation into the problems of short-wave transmission with a view to securing the missing quantitative data. Some of the preliminary results of these investigations were made public at a meeting of the Institute of Radio Engineers in New York.[1]

Since the matter contained in this paper is of primary importance to short-wave workers, and the first to be published on the subject, it is thought that readers may be interested in the following *résumé* of the paper, taken from the *Proceedings of the I.R.E.*

Scope of the Experiments.

The data presented in the paper under review cover measurements of field strength, fading and telephonic intelligibility, together with some of their variations with time and distance. The studies of which these data form a part are still incomplete, and do not include a sufficient range of conditions to be altogether conclusive, but certain points of importance have already emerged.

The plan adopted throughout the experiments was to send observers with the necessary measuring apparatus to points of vantage, where they could make observations on test signals sent out hourly on each of several frequencies in accordance with a prearranged schedule. The tests were arranged to provide specific information on the diurnal variations of electric field strength, intelligibility and noise for each frequency, and for each distance where observations were made.

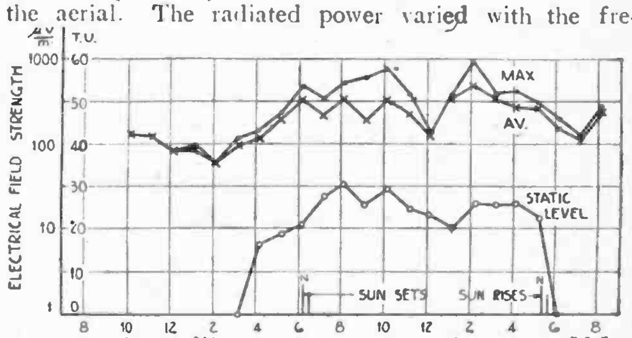
[1] "Some Measurements of Short Wave Transmission." By R. A. Heising, J. C. Schelling, and G. C. Southworth. Presented at a meeting of the I.R.E., New York, June 30th, 1926.

The observation points were so selected, in some cases, as to bring out any marked differences that might exist between over-land and over-water transmission, and in others they were arranged in a straight line to reduce the number of possible variables. Simultaneous measurements were made at as many as six locations, and the observations totalled over 6,000, where each observation consisted of an average field strength measurement, noise measurement, intelligibility measurement, and fading observation.

The frequency range covered was from 2.7 to 18 megacycles, roughly 111 to 16½ metres. This range was covered in seven convenient steps with occasional tests on other frequencies. The greater part of the observations were made on 2.7, 4.5, 6.8, and 9.7 megacycles (million cycles), approximately 111 metres, 66 metres, 45 metres, and 31 metres. Most of the tests were made between September and December, 1925, and include observations in several directions up to over 1,000 miles, together with a few in England.

Experimental Apparatus.

Transmissions were made largely from the American Telephone and Telegraph Co.'s short-wave laboratory at Deal, N.J., which is on the sea coast, within about 50 miles of New York in a south-easterly direction. The transmitter is of the master oscillator type, the oscillator being stabilised against frequency variations. The carrier was modulated at a level of about 200 watts, after which it was amplified by water-cooled valves and delivered to the aerial. The radiated power varied with the fre-



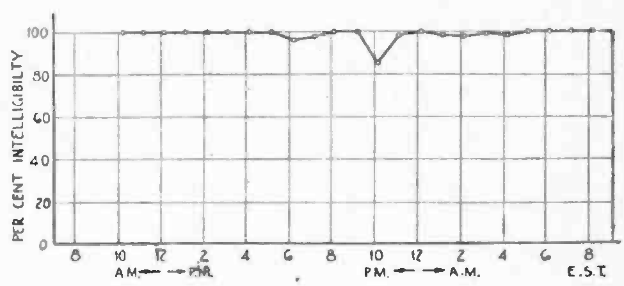


Fig. 1.—Typical curves of field strength, noise and intelligibility taken at Nantucket, Mass., Sept. 11th and 12th, 1925. Frequency 2.7 megacycles.

Transmission on Short Waves.—

quency, being about 1 kW. on 9.7 megacycles (31 metres) and 4 kW. on 2.7 megacycles (111 metres).

In addition to the regular Deal transmitter, a similar low-power transmitter was operated from the building

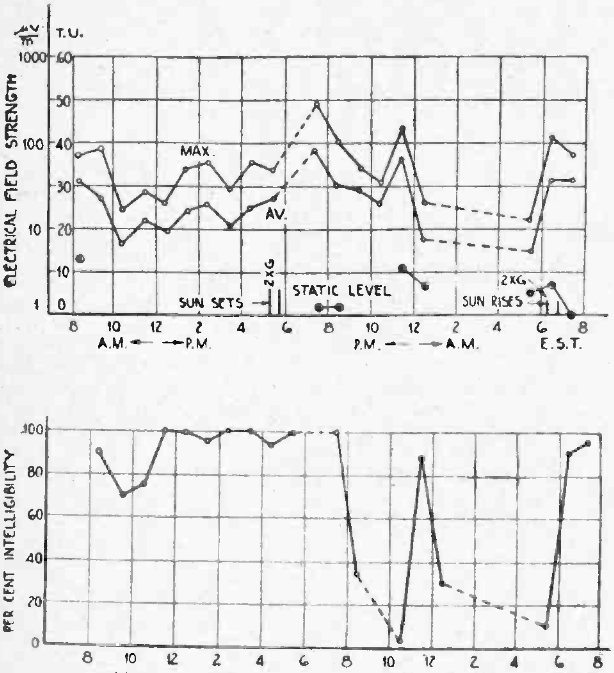


Fig. 2—Curves taken on 6.7 megacycles at Detroit, Mich., Oct. 21st and 22nd, 1925.

of the Bell Telephone Laboratories, in the heart of New York City. It may be of interest to note in passing that the aerial on this building is entirely unscreened by high buildings, the nearest higher buildings being nearly two miles away. This transmitter was employed during two of the regular tests and extended the frequency range to 18 megacycles (16½ metres). The radiated power did not exceed 200 watts.

Various types of aerials were used at Deal. That usually employed on the lower frequencies consisted of a vertical conductor functioning approximately as a quarter-wave radiator. For the higher frequencies a vertical copper rod was used, which operated substantially as a half-wave radiator. At the New York transmitter half-wave radiators were used in all cases.

Diurnal Transmission Curves.

Sample field-strength curves are given in Figs. 1 to 4, inclusive, of 24-hour periods for Nantucket (Mass.), Detroit (Mich.), Columbus (Georgia), and a complete voyage on a steamer between New York and Bermuda. The diurnal curves vary from day to day, but in the main they have certain characteristics which repeat. Where the tests ran for several days, the readings were averaged for each hour of the several days to secure an average diurnal curve for each observing point. Such a curve is shown in Fig. 5 for England.

As a rule, on the lower frequencies, it was found that a minimum field strength occurs during the day. On 6.8 megacycles (44 metres), at about 200 miles, the minimum usually occurs at night. On still higher frequencies at 700 miles there appears to be a minimum both during the day and during the night.

The curves for 4.5 megacycles taken in England, Fig. 5, show an absence of signal during the day, but a fairly strong signal at night. The authors of the paper state, however, that this curve should not be taken as an example of what can be expected at that distance every time, as other experiments showed that at the time of these particular tests the transmission to England at this frequency was exceptionally good.

Before short waves attracted so much attention recently, it used to be thought that their attenuation as a function of distance was always very much greater than for the longer waves. For distances up to 100 miles this was found to be correct, but the phenomenal distances covered by short waves with small power have shown that the theory of transmission was incomplete. Therefore, in order to explain how such distances are covered, it has been assumed that at least a portion of the wave travels in an indirect overhead path, being deflected back to earth by the Heaviside layer, and suffering little attenuation over this longer path.

The observations under review bear this out. Up to about 100 miles the attenuation was of the order of magnitude expected, after which the signal, instead of decreasing with distance, actually increased. Several curves are given in the original paper which prove this point over varying distances up to 1,050 miles, using different frequencies. They show that the transmission curve, as a function of distance, varies from time to time, and in some cases varies over a wide range.

Mean daylight values were obtained for each location

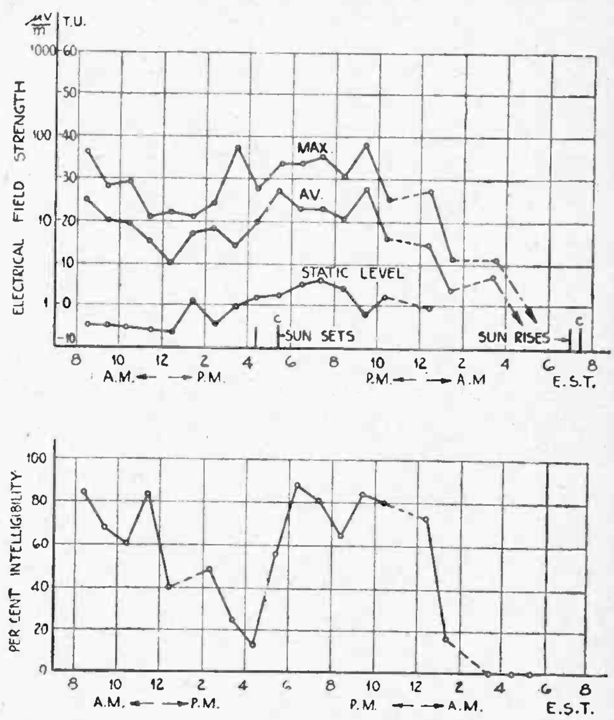


Fig. 3.—Curves taken on 9.7 megacycles at Columbus, Georgia, Dec. 14th and 15th, 1925.

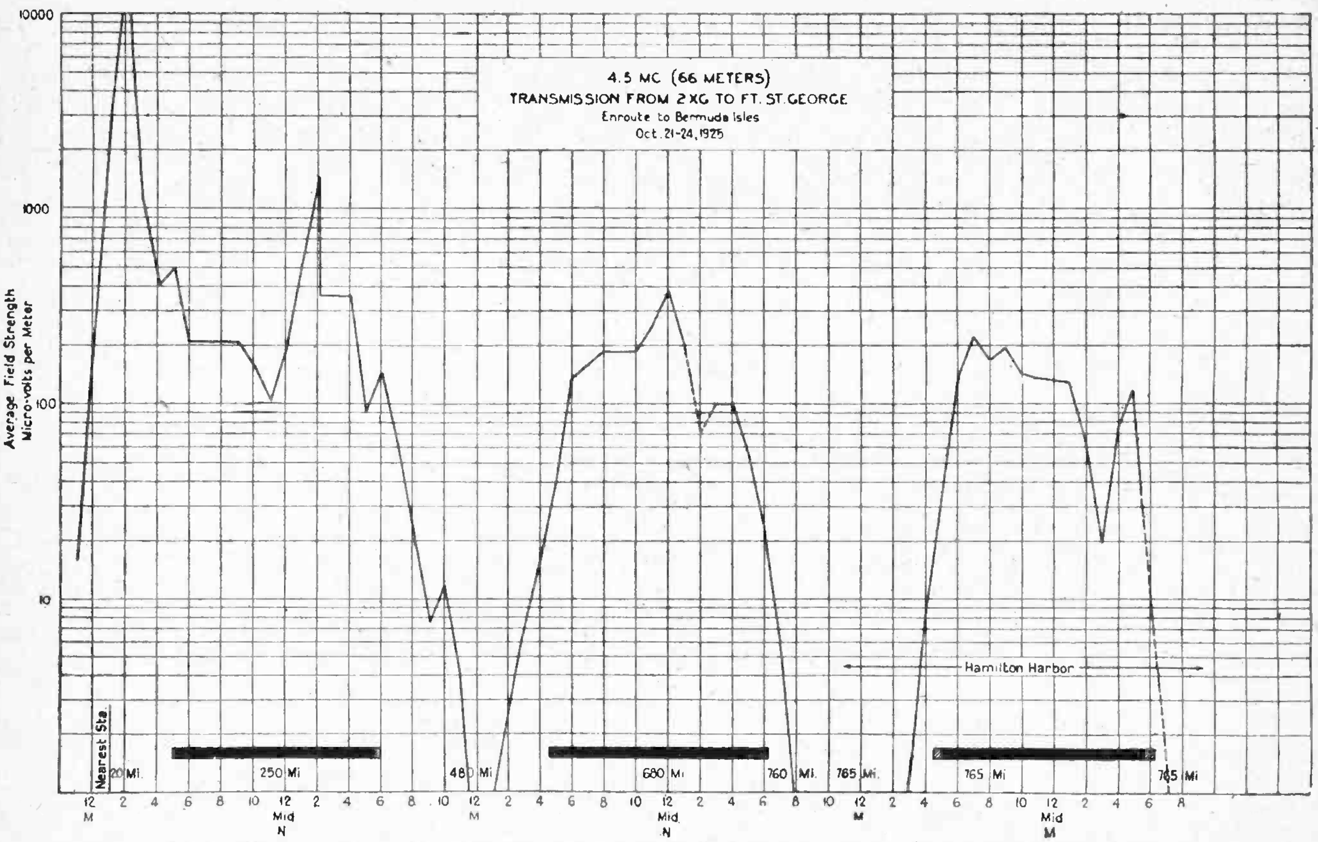


Fig. 4.—Field strength curves on steamer plying between New York and Bermuda, Oct. 21st to 24th, 1925.

by averaging all the readings taken when the path of the wave lay entirely in a daylight region. A night average was obtained in a similar way, using several days' data in each case. Curves are given showing these average values as a function of distance on the several frequencies employed. One of these curves shows that the overhead wave on 6.8 megacycles (44 metres) comes back to earth, giving a maximum signal about 600 miles away at night, or 350 miles during the day. At these points the signal strengths are of the order of magnitude that are normally received over 50 miles of water.

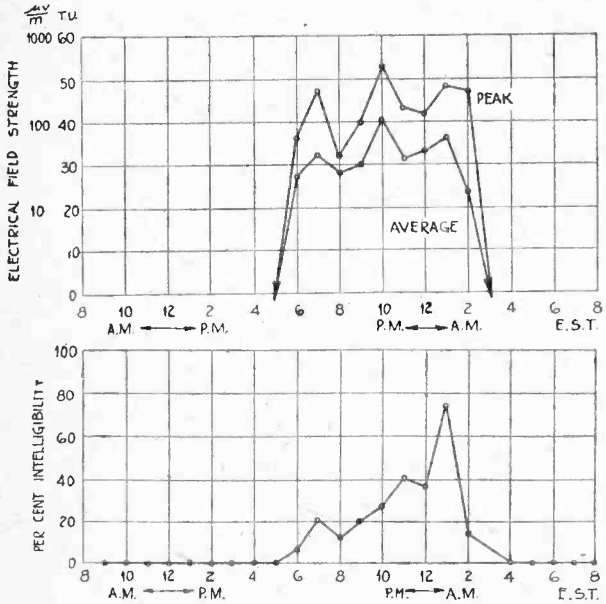


Fig. 5.—Curves of average field strength and intelligibility received at Chedzoy, Somerset from Deal, N.J., Sept. 10th to 13th, 1925. Frequency 4.5 megacycles.

There is a region of low field strength a short distance from the transmitter which is at present interpreted by the investigators as a region which is too close to the transmitter to receive much by the indirect, or space wave, and a little too far to receive much by the direct, or ground wave. This effect gives a decided depression to all curves, near the transmitter, and the region of weak signals becomes much more pronounced at shorter wavelengths and gives rise to the so-called skip-distance. This skip-distance hollow was found to increase in width and depth as the frequency was raised.

Three-dimensional Curves.

We now arrive at one of the most interesting features of the paper.

As indicated above, field strength is a function of both distance from the transmitter and the time of day. In order, therefore, to give a complete and comprehensive graphical representation for any one frequency, it is necessary to do so by means of a three-dimensional figure. The group of figures drawn by the authors to cover the frequencies investigated are shown in Fig. 6, and may be considered as surfaces made up from an infinite number of diurnal variation curves, each taken at a different

Transmission on Short Waves.—distance from the transmitter. Owing to the wide variations met with, the investigators found it necessary to idealise the data somewhat in order to arrive at these figures, taking into consideration only those characteristics which are known to repeat day after day.

A plane passed through each figure at the 1 microvolt level has been taken arbitrarily as the limit, or noise level, below which a signal is no longer useful. A choice of a higher level would not seriously affect the shape of the figures.

In constructing the surfaces, the general procedure was to smooth out each data curve and correct it to approximately 1 kW. of radiated power, then piece the whole into a general mean which seemed to be most representative of average conditions. The authors of the paper point out that it should be borne in mind that data taken at a given place vary considerably from day to day, so that the surfaces, as well as the average curves given in the paper represent only the outstanding characteristics to be expected in the region of the radio-frequency spectrum specified.

Discussion of Transmission Surfaces.

Proceeding to a detailed discussion of the transmission surfaces, the authors point out the general characteristics of each one, starting from the lowest frequency, and indicating how these characteristics become more pronounced as the frequency is raised.

In the case of the surface for 2.7 megacycles (111 metres), the difference between day and night signals for points near the transmitter is less than at a distance, and at no time does the signal sink below the arbitrary datum level of 1 microvolt per metre. At more remote points, say 500 miles, the signal is heard only during the night, and the number of hours for good signals becomes less and less the greater the distance, till, from observations made in England at this frequency, it is found that, if the signal does appear when only moderate power is used, it appears about midnight, Eastern Standard Time (5 a.m. G.M.T.). The distance of 300 miles is pointed out as being of particular interest, in that beyond this point signals would not normally be heard throughout the 24 hours.

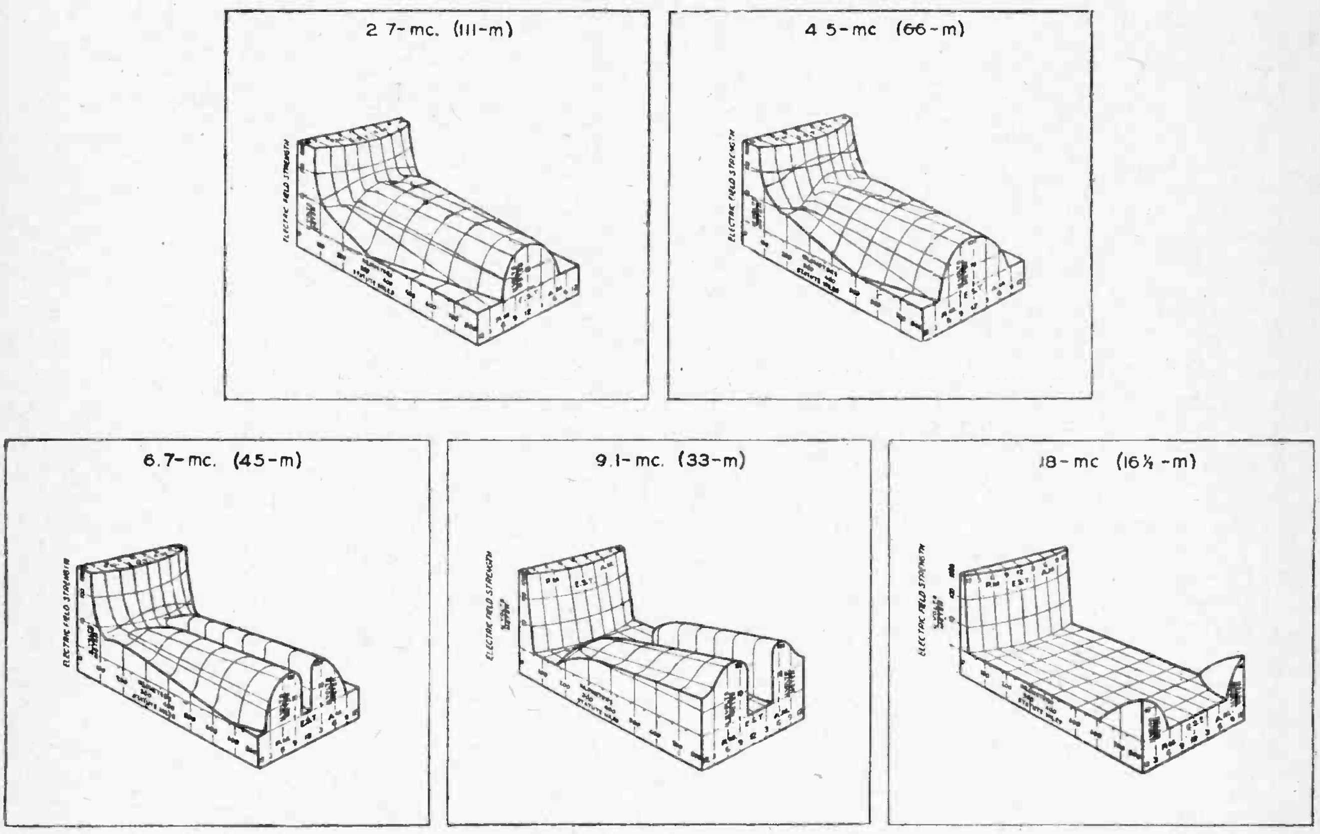


Fig. 6.—Three-dimensional drawings from averaged results, showing variation of field strength at different frequencies with time and distance.

The surface for 4.5 megacycles (66 metres) closely resembles the previous one, but closer examination will reveal that maximum night signals are somewhat stronger, and signals may be heard during more hours of the day. Also, the night depression observed for this surface is much more pronounced than in the preceding one.

The distance at which noon signals may be heard becomes considerably greater as the wavelength is reduced, from which it might be inferred that for a given amount of radiated power the shorter wavelengths would in all cases be more efficient. The authors prove that this inference is not correct.

The surface for 6.7 megacycles (45 metres) differs markedly from those for the longer waves. The slight

Transmission on Short Waves.—depression noticeable in the 4.5 megacycle surface at 200 miles after midnight has now developed into a pronounced trough extending beyond the limits of the figure. The lowest point is probably about 300 miles from the transmitter and is below zero level. The maximum distance for noon signals has now been pushed out to about 700 miles.

In passing from the 6.7 megacycle surface to that for 9.1 megacycles (33 metres), it may be observed that the previously-mentioned troughs have become so accentuated that a short skip-distance results where no signal is heard at any hour of the day, and the night opening has considerably widened. It will be noticed also that the maximum distance for noon signals has now passed out beyond the 800 mile limit of the figure, but there is still an indication of a noon reduction in signal strength remaining.

The last surface for the very high frequency of 18 megacycles (16½ metres) shows what might be expected from the tendencies of the preceding surfaces. The skip-distance has increased considerably, and the period of time during which signals may be heard has been reduced to a very few daylight hours.

Considered as a whole, these surfaces clearly indicate the transition stage which appears to take place as the wavelength is reduced. On longer wavelengths most of the received signal is probably derived from the ground wave, which does not suffer much absorption. As the wavelength is reduced so the absorption of the ground wave increases, and the received signal becomes more and more dependent upon energy derived from the space wave alone.

Other Investigations.

Other questions which were simultaneously investigated by the authors are speech intelligibility, over-land *versus* over-water transmission, transmission as a function of frequency, night and day effects, fading and quality, together with a comparison of the results obtained from both horizontal and vertical transmitting aerials.

Intelligibility necessarily followed the curves for signal strength to a great extent, but was dependent largely also on fading, which was found to be extremely rapid at certain frequencies. Fading records are given in the original paper which show fading intervals occurring as rapidly as 100 per second. Such rapid fading, whilst not injurious to telegraphic signals, plays considerable havoc with telephonic signals.

Experiments with over-land and over-water transmissions at equal distances showed that for distances greater than a few hundred miles and less than 1,000 miles there is very little difference.

The conclusions reached with regard to transmission as a function of frequency, and comparison between day and night effects lead the authors to believe that there is no doubt remaining that short-wave transmission over great distances is possible only by virtue of the overhead, or space wave, which, after leaving the earth, becomes deflected back down again some considerable distance from the transmitting station. They also express the opinion that the strength of signal obtainable at such points of return will depend upon the amount of wave energy which is deflected, i.e., upon the extent of ionisation of the upper atmosphere. Thus, the greater the ionisation, the stronger will be the signal, for more energy will be deflected, and less lost into space beyond the limits of our atmosphere.

In the tests described above, the investigators employed vertical aerials at the transmitting stations, but, in addition, special tests were carried out with horizontal aerials with a view to eliminating the usual ground wave, and seeing whether, under certain conditions, such aerials would not prove more efficient than vertical radiators.

It was soon found that there are times when the signal from the horizontal antenna is actually greater than that from the vertical antenna, the currents in both being equal. The authors observe that the fact that any signal is received at all at a point on the earth's surface at right angles to the antenna seems to be direct proof that there is, somewhere above the earth's surface, a deflecting layer which is able to bend a wave, originally proceeding upward, so that it will return to earth.

Curves are given showing comparative field strengths at given locations of signals received simultaneously from vertical and horizontal aerials. The general characteristics of these curves are that at distances within about one hundred miles of the transmitter (within range of the ground wave), the signal from the vertical aerial remains comparatively constant in strength throughout the twenty-four hours, whilst that from the horizontal aerial fluctuates considerably, indicating severe fading. The authors conclude that this evidence of the difference in character between the two signals shows that the received signal is made up of components which are travelling along different paths.

As the distance between the transmitting and receiving stations is increased, the curves tend more nearly to coincide with each other, till, at a distance of 1,050 miles, there is scarcely any noticeable difference. This is evidence that the wave follows the same path to distant points regardless of the form of the transmitting antenna, and hence its initial state of polarisation.

Discussion of Results.

In summing up the results of their investigations, the authors state broadly that most of the short-wave characteristics may be interpreted in terms of the Eccles-Larmor theory of ionic refraction. Referring to the skip-distance effect, they state that, as the frequency is increased, the skip-distance increases, as does also the time during which it occurs, as should be expected from theory. In addition, the high degree of ionisation during the day becomes less harmful to the signal, a result which is also in accordance with theory, and which indicates that under similar conditions the absorption constant should be inversely proportional to the square of the frequency.

Thus the signal is weakened during the night and strengthened during the day, a reversal of the trend on long wavelengths. At a distance of 800 miles the frequency of eighteen megacycles is so high that the noontime ionisation is just barely sufficient to produce the necessary bending. A small increase of frequency would probably cause the signal to be inaudible altogether throughout the twenty-four hours at that distance.

On the question of the practical application of the results of their experiments, the authors state that the

Transmission on Short Waves.—
frequency which can best be used for a particular service is a function of distance and time of day. The results of the present study indicate that for telephonic communication over distances up to 200 miles frequencies of three megacycles or less are the most useful of the short-wave range, whilst distances of 500 miles call for about six megacycles. These frequencies will, in general, provide a twenty-four-hour service on a single wavelength.

Continuous communication between stations separated by much greater distances requires, in general, a shifting of frequencies. Thus, for distances of 1,000 miles, frequencies of the order of 10 megacycles are of use during the day, while lower frequencies become preferable during the night and occasionally at other times.

For transatlantic communication the three megacycle frequency is not of much use for telephony even at night when the radiated power is a few kilowatts. This statement is made with the reservation that it may not be correct when the single side-band carrier-eliminated system is employed, or when directive radiation or reception is made use of. The authors add that on those occasions when the signal has been strong on this frequency the quality has usually been superior to that on the higher frequencies. During the day frequencies of the order of fifteen megacycles appear to be suitable, but the indications are that for a continuous twenty-four-hour service a frequent shift of wavelength will be necessary.

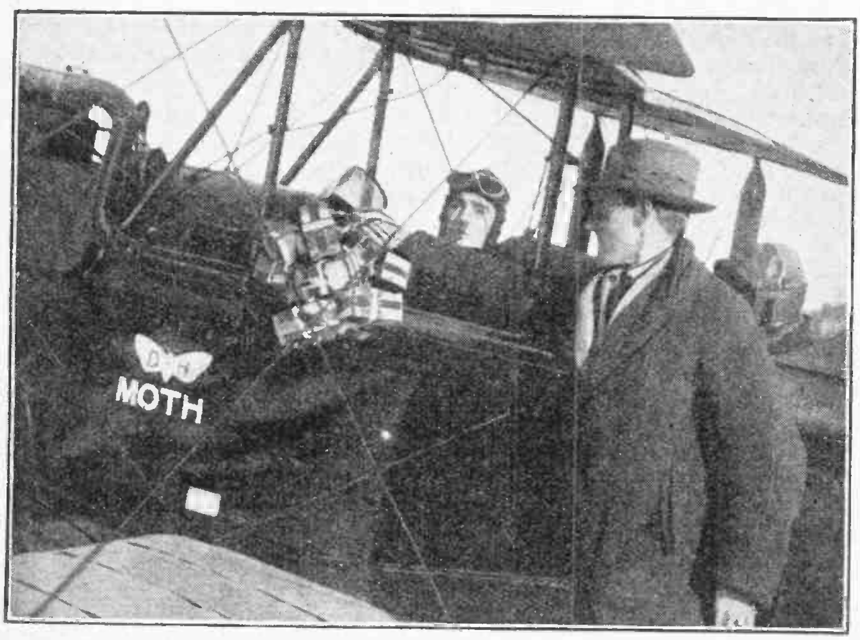
Those readers who have only had the opportunity of making qualitative observations on the peculiarities of short-wave working may, after reading the above reported results of quantitative measurements, be able to crystallise their own observations and correlate them into some semblance of order. Signals on short wavelengths vary so widely under apparently similar conditions that it is most difficult for the individual observer, unequipped with exact measuring instruments and facilities for making a large number of measurements, to obtain a clear idea of their repetitive characteristics, and isolate them as such from purely superficial variations. To such experimenters the work of the authors of the paper under review should prove most interesting and instructive. A. D.

BIG VALVE DROP.

An Original Experiment with Surprising Results.

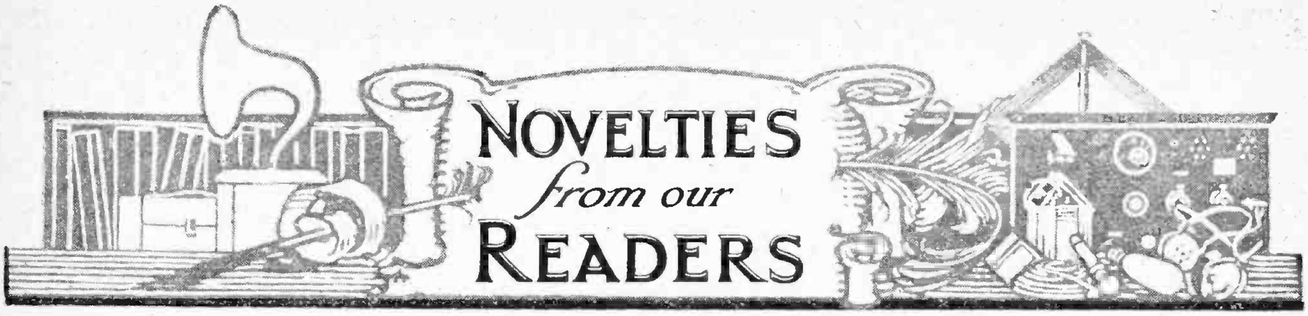
IT speaks volumes for the robustness of the modern valve that, in order to stage a more or less convincing demonstration of its physical strength, it is coolly dropped from a giddy height of five or six hundred feet. For such was the novel feature of an original experiment to which a dozen Cossor valves were subjected last week.

A representative of *The Wireless World* was enabled to witness the experiment from start to finish.



A NEW TEST FOR VALVES. A number of Cossor valves were subjected to drastic treatment at Stag Lane Aerodrome, Hendon, last week, when they were thrown from an aeroplane at a height of 600 feet. The filaments remained intact. Captain Barnard, the pilot, is here seen receiving his "cargo" prior to the flight.

First, the valves were picked haphazard from a tray of finished specimens at the valve works. They were then numbered, tested for amplification and emission, and packed in ordinary cartons. At Stag Lane Aerodrome they were taken for a flight by Capt. C. D. Barnard, who dropped them one by one in their ordinary cartons from a height of about 600ft. Some idea of the force with which they struck Mother Earth can be gathered from the fact that even those which landed in mud patches were seen to bounce! Of the twelve valves thrown out, one was smashed to fragments through hitting the tail plane, one was lost, and the remainder were taken back to the works for testing. The results of the test were illuminating, and undoubtedly proved the efficiency, from the point of view of strength, of the co-axial method of mounting the three elements. When the valves were brought to the testing bench at the works the filament was found to be intact in every case, while one valve was discovered to be perfectly normal in every respect. In the majority of the valves, however, the amplification factor had dropped, due to the slight displacement of the electrodes, but nearly every specimen was found to give a reasonable result when tested on a set. A new line of research was suggested by the discovery that one specimen had increased its emission by twenty-five per cent.

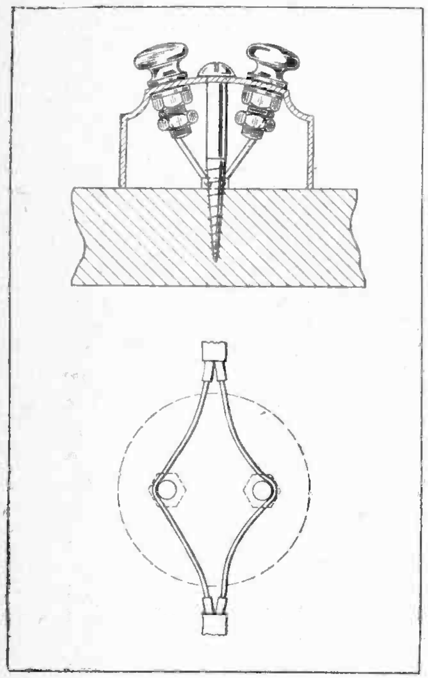


A Section Devoted to New Ideas and Practical Devices.

TELEPHONE DISTRIBUTION LEADS.

A neat and inconspicuous method of laying distribution leads is shown in the diagram.

High-grade twin bell wire is used for the leads themselves, and will be found perfectly satisfactory. The individual strands are insulated with rubber and the cotton covering is impregnated with wax to exclude moisture.



Junction box for telephone extension leads.

The junction boxes are made with the caps of celluloid shaving soap containers, and are fitted with Newey snap terminals.

The connection to the terminals is made without breaking the wire by baring both strands for a distance slightly greater than the diameter of the celluloid box and clamping one strand to each of the terminals.

The telephone leads are fitted in each case with snap connectors in place of the usual tags.—W. M. H.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A dull emitter receiving valve will be despatched to every reader whose idea is accepted for publication.

Letters should be addressed to the Editor, "Wireless World and Radio Review," Dorset House, Tudor St., London, E.C.4, and marked "Ideas."

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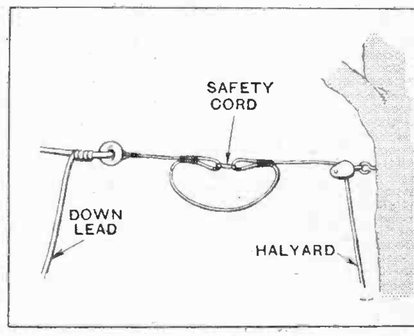
CONDENSER CONTROL.

The sketch shows an effective arrangement for obtaining fine adjustment of a variable condenser or two condensers coupled together. A 10in. gramophone record is used as a dial and is fixed to the condenser spindle. The condenser is inclined so that the edge of the dial protrudes slightly through a gap specially cut at the lower edge of the front panel. The advantage of this scheme is that the large diameter of the dial allows a greater subdivision of degrees than is possible with the ordinary condenser dial.—J. T.

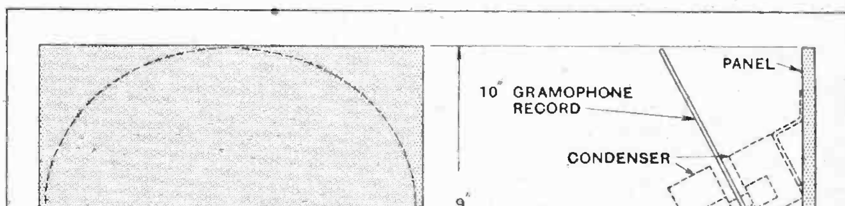
SAFETY CORD.

Trees when used for supporting an aerial have the disadvantage that they sway in a high wind and are liable to snap the aerial or halyard if rigidly attached.

By making a loop in the halyard as shown in the diagram, and securing the ends with a piece of thin cord or a few turns of fuse wire this trouble may be overcome. If a gale springs up in the night the turns of safety cord break and automatically slacken the aerial, which, when the weather permits, can be lowered and the safety cord renewed.—I. G. B.



Protecting the aerial from strain in high winds.



Condenser control with 10in. dial.

MODERN AMPLIFIER PERFORMANCE.

Commercial Receivers Compared with a Laboratory Ideal.

By P. K. TURNER, A.M.I.E.E. (Research Department, Burndept Wireless Limited).

READERS of *The Wireless World* are by now accustomed to examining the advertised curves of transformers, and may be interested in the accompanying curves of the same type, showing the performance of the L.F. end of some complete receivers.

Curves of three receivers are shown. In each case the L.F. end comprised a detector and two amplifiers, and in each case, for the purpose of measurement, the detector grid leak was connected to L.T. – instead of L.T. +, so that this valve acted as a pure amplifier, instead of (as usual) combined rectifier and amplifier. The tests were taken by applying a small measured voltage of pure audio input, of varying frequency, and measuring a known fraction of the output with a valve voltmeter, which was also used to check the input.

The three sets were as follow :—

No. 1.—A set typical of hundreds built both at home and commercially for sale. It has a 3-volt "H.F." valve as detector, followed by two power valves of the ordinary L525 type, each with an amplification factor (μ) of about 6. The detector has 50 volts H.T., and the power valves 120 volts H.T. and 9 volts bias. The couplings are transformers, the first of 4 : 1 ratio, and the second 2.6 : 1.

No. 2.—A standard Burndept 1926-27 model. Detector and first L.F. are H512 valves, of $\mu = 20$, last valve an LL525, $\mu = 3.3$. All fed at 120 volts, last valve 15 volts grid bias. First coupling by a 45,000-ohm wire-wound resistance and 0.1 mfd. condenser, leak of 0.25 megohm. Second coupling a 2.7 : 1 Marconiphone "Ideal" transformer.

No. 3.—A special laboratory-built, resistance-coupled set. Valves as for No. 2, but anode resistances 1 megohm, coupling condensers 0.005 mfd., leaks 5 megohms. It was found that to get a reasonable volume without obvious distortion due to grid currents it was quite necessary to supply the set at 150 volts and bias the last valve 22.5 volts.

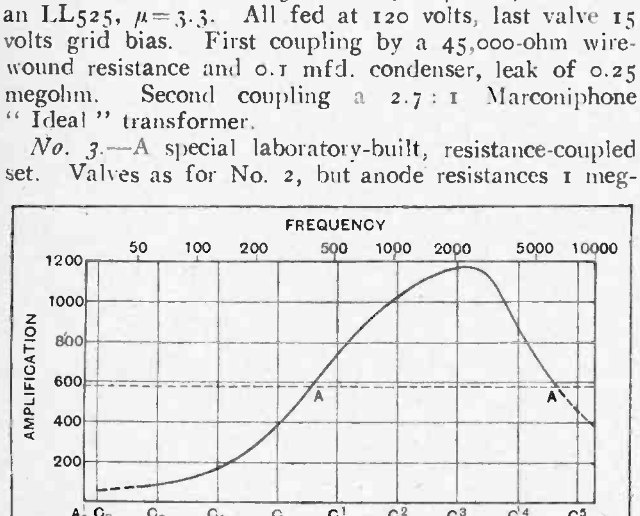


Fig. 1.—The performance curve of an indifferent set; vertical scale of amplification. The horizontal dotted line indicates perceptible loss of amplification.

The sets were tried out on actual broadcasting and careful notes made, in addition to the measurement tests. This is important, for two reasons. First, the effect of the H.F. tuning is not allowed for in the measurement tests; second, while the measurement shows up frequency distortion due to the intervalve coupling, it gives little indication of the introduction of harmonics such as cause shrillness.

Before comparing the results in detail, a word as to the way in which the curves are drawn. As usual, the scale of frequency is arranged "logarithmically," so that each octave is represented by an equal interval. But in these curves the vertical scale is also arranged in this way, as is usual among telephone engineers. The reason for this can be seen by comparing Figs. 1 and 2. Fig. 1 shows the curve of No. 1 set with a vertical scale of amplification, Fig. 2 with a vertical scale of loudness, in "Transmission Units."

In each case a horizontal line marked AA has been drawn to show the limit at which the loss of amplification (as compared with that at 2,000 cycles) becomes noticeable. It is obvious that the curve of Fig. 1, without the line AA, would not give a fair impression to the eye—one would think on glancing at it that the effective range of frequencies was perhaps 1,000 to 3,500 instead of 400 to 6,000. Fig. 2 gives a much truer impression.

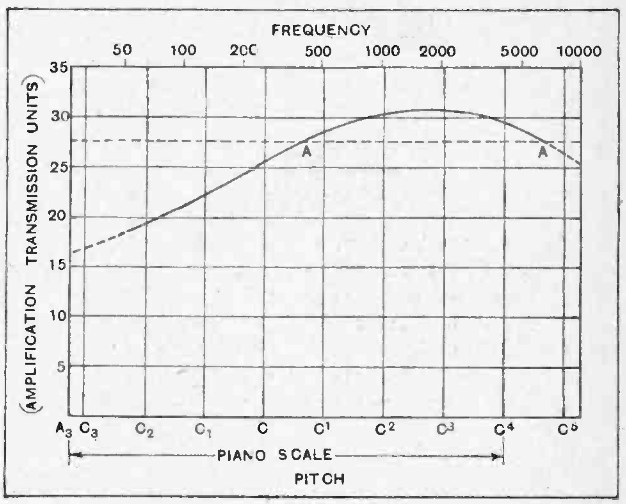


Fig. 2.—The same curve as in Fig. 1, but to a vertical scale of loudness, or "gain." (30 T.U. = 1,000-fold amplification.) Note that the points AA indicate the same performance as in Fig. 1, but that the whole curve gives the eye a more truthful impression of the set's quality.

Set No. 1.

Coming now to a detailed consideration of the performance of this set, we see that it is pretty bad. The effective range for pure notes is about 400 to 6,000 cycles. For music it will be better, for the harmonics which accompany all ordinary musical notes cause the funda-

Modern Amplifier Performance.—

mental to be more or less reconstructed in the ear, so that one might expect frequencies from 200 upwards—say, about middle C—to come out fairly well. But below this there will not be much.

Although the greatest output was never excessive, there was an obvious generation of harmonics, the loud-speaker tone being quite different from that of the pure note input. On broadcast, the tone was shrill and bad on a "Kone" loud speaker; on a horn type it was "gramophoney."

The maximum amplification was 1,170 to 1.

Set No. 2.

Fig. 3 shows the curve for this set, together with the "limit line." It will be noted that the effective range is actually from about 28 cycles to just over 6,000. The

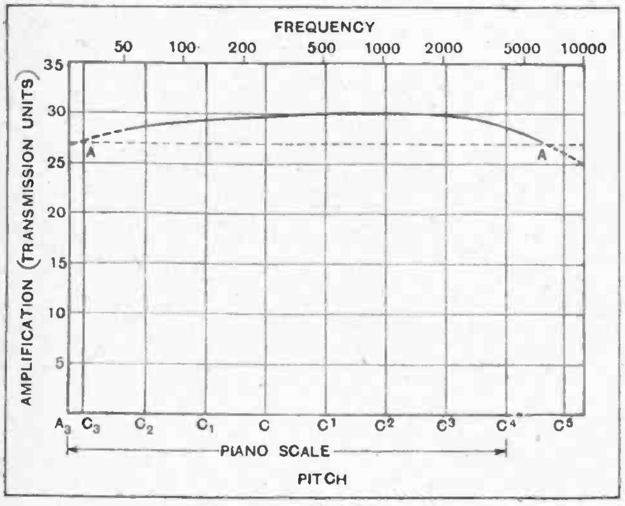


Fig. 3.—To the same scale as in Fig. 2; the performance of the standard Burndept 1926-7 sets.

frequencies cannot be given quite definitely, for the test was only carried from 50 to 6,000 cycles: the dotted parts of the curves have been calculated to fit in with the solid part, which is not a difficult matter.

It would hardly become the writer to give his impressions at length of the broadcast performance of this set, for obvious reasons. But some comparisons are made in the next section, dealing with the resistance set.

The maximum amplification was 1,010 to 1.

Set No. 3.

As was expected, this set gave a splendid curve (see Fig. 4). One or two interesting points arise. The effective frequency range appears to be 20 to 16,000 cycles. As in the case of set No. 2, the limits can only be given approximately, as they are on the calculated extension to the curve beyond the measured range. On the basis of 0.005 mfd. coupling condensers and 5-megohm leaks,

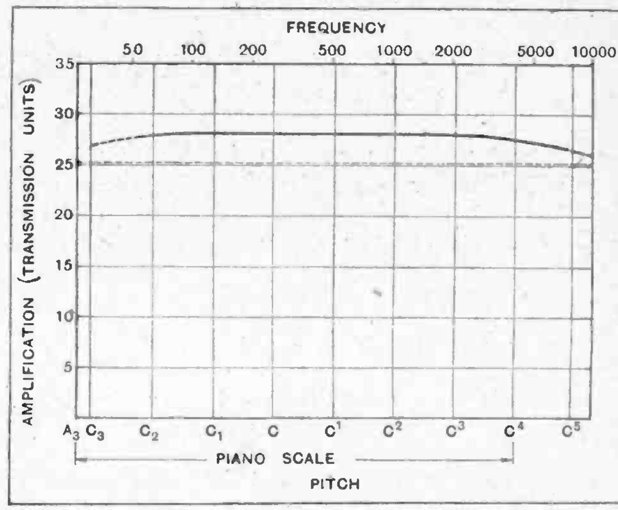


Fig. 4.—Performance of a special laboratory-built pure resistance amplifier.

the performance at the low frequencies should be still better. Calculation shows that the valve and wiring across the leak reduce its effective value to 1.5 to 2 megohms. The falling-off at the high frequencies is due to stray capacities, and corresponds to about 0.00005 mfd. across the resistance.

The maximum amplification was 620 to 1.

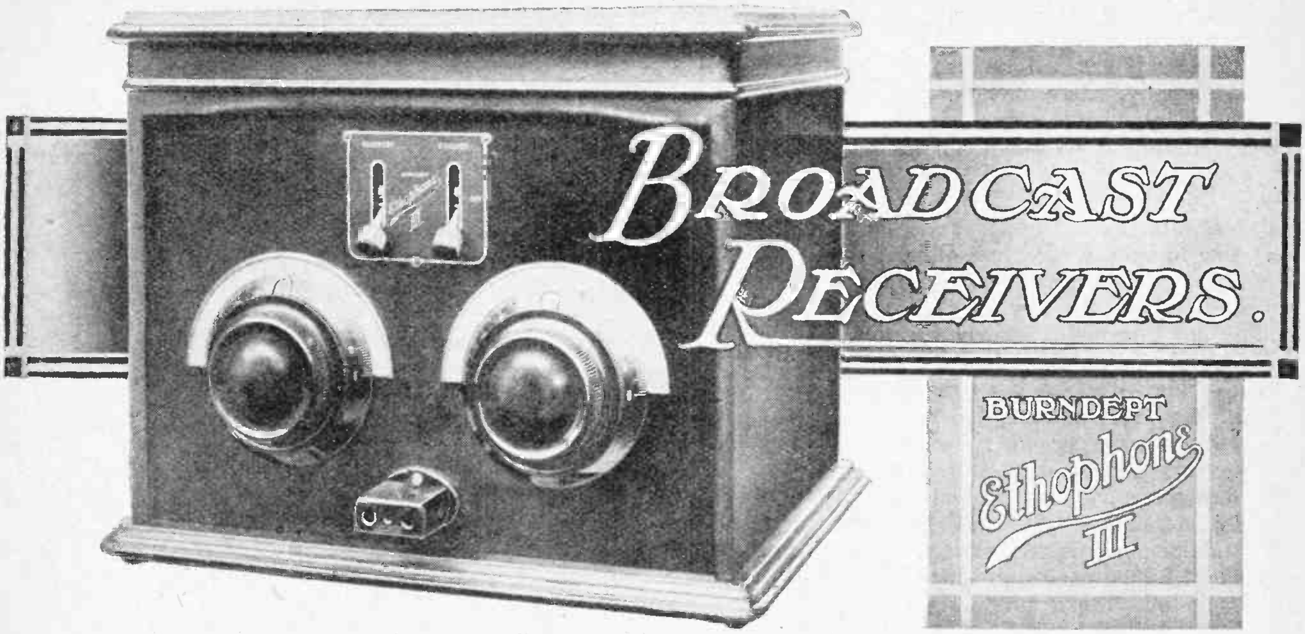
On broadcast the tone was extremely good; but care had to be taken. At first there was quite a lot of trouble from hissing noises due to the anode resistances, which were not wire-wound. When good ones had been found, by trying out a large quantity, it was found that the grid bias had to be increased, and the H.T. correspondingly raised. In set No. 2, occasional flicks of grid current did not appear to affect the tone; but they had to be cut out in set No. 3, and for the same output 50 per cent. more grid bias was advisable.

When sets Nos. 2 and 3 were tried separately, there seemed no difference whatever—No. 2, of course, was used on a small aerial so that the output strengths of the two sets were equal. But on rigging the two sets on a switch, so as to get an instantaneous change over, one could just detect a difference. The pedal notes of an organ, the double bassoon, and the double bass, were just perceptibly louder on the resistance set when a quick change over was made. Of course, both sets were used with a "Kone" loud-speaker.

But apart from such a special test there was no perceptible difference, and the higher amplification, lower H.T. voltage and absence of noise, make No. 2 set preferable as a receiver to be sold complete to the public. It is quite interesting that such a good curve can be got with one of the stages transformer coupled.

"THE WIRELESS WORLD" FIVE.

The first instalment of a constructional article under the above title will be included in our next issue. The five-valve receiver to be described includes two stages of H.F. coupling, and has been specially designed to give high amplification with great selectivity.



BROADCAST RECEIVERS.

High Quality Loud-speaker Reception from the Local Station and Daventry.

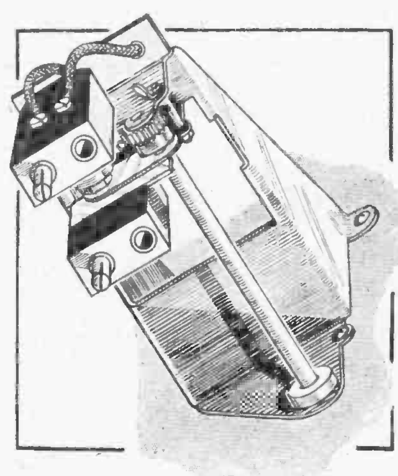
IT is interesting to note that the makers insist on supplying with this receiver valves having characteristics suited to the electrical constants of the circuit, and the cost of these valves (and also a set of coils) is included in the price of the instrument. Of course, the set would emit sounds from the loud-speaker with any valves, and the *apparent* price of the set could have been reduced by selling the instrument alone, leaving the purchaser to fit other valves which he believed to be "just as good." But the couplings in the Ethophone III have evidently been designed for valves of specific characteristics, and it is, therefore, in the interests of the purchaser to insist on fitting appropriate valves in order that the maximum power and quality of reproduction may be extracted from the set.

It is also noteworthy that a proprietary make of inter-valve transformer has been fitted. It is evident that, pending the development of a transformer of similar characteristics in their own works, the makers are determined that their clients shall not be deprived of the results already attainable with other makes.

Lucid Instructions.

The instructions for erecting and operating the set are unusually complete. In addition to an extremely lucid instruction book there are tables on the instrument itself giving guidance for the choice of coils for different wavelengths and grid bias corresponding to various values of H.T. voltage. The valve holders and fixed resistor holders are also engraved with appropriate figures and identification numbers so that there can be no excuse for inserting the wrong kind of valves or resistances. As an example of the lucidity of the book we may quote the section dealing with oscillation :—

"With regard to the question of 'oscillation,' care should be taken not to use so much reaction as to cause one's own valves to oscillate; this not only leads to very bad reproduction, but may spoil the pleasure of your neighbours over a wide area. The fact that one is 'oscillating' is usually detected by a fairly loud whistle or musical note audible continuously in the loud-speaker, but, unfortunately, this same whistle may be heard in your loud-speaker when you are not causing the trouble but your neighbour is. To find out whether you are the culprit, should you hear such a whistle, turn your 'tuning dial' (right-hand dial) a little first one way and then the other. If the note alters in pitch you are at fault (reduce the setting of the reaction dial immediately); if the note merely changes in intensity, but not in pitch, somebody else is causing the trouble."



Geared variable coil holder used in the "Local" tuner.

Other features in the instruction book clearly show that the designers have succeeded in discovering and understanding the point of view of the listener.

The Circuit.

In principle the circuit of the receiver is similar to other local station loud-speaker sets; a detector valve with reaction is followed by two stages of low-frequency amplification.

There is a current belief that the performance of a set depends on its

Broadcast Receivers.—

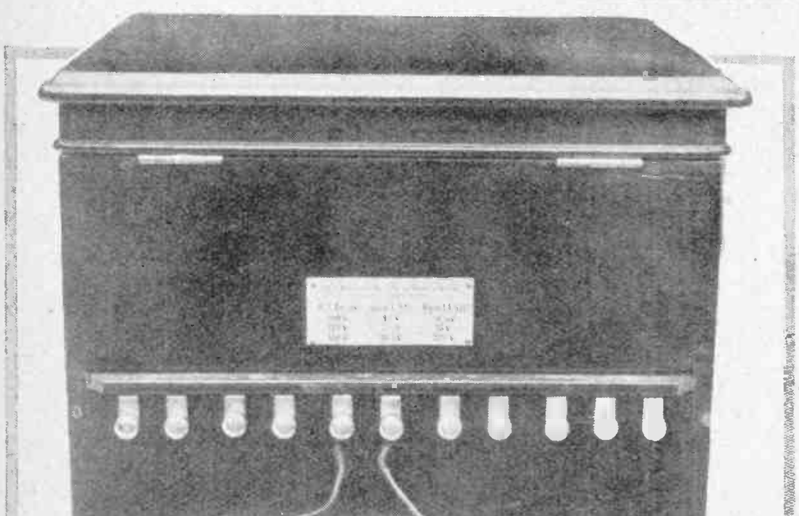
circuit. "Can you give me a good circuit?" is a question frequently asked of *The Wireless World* Information Department. Actually, much more depends on the manner in which the circuit is put into practical form than on the circuit itself.

Tuning Arrangements.

The success of the Ethophone III is entirely due to careful electrical design; the circuit itself is quite simple and straightforward. There are two distinct tuning circuits, one intended primarily for short-wave reception, and the other for the reception of Daventry. A key switch on the front of the panel marked "Local" and "Daventry" connects either one or other of these circuits to the detector valve. The tuners are connected to the aerial through alternative terminals "S" and "L" for short and long aerials respectively. The terminal "S" connects directly to the aerial coil, but when a long aerial is connected to "L" a small fixed series condenser compensates for the high aerial capacity.

The method of coupling the amplifying valves calls for special comment. A combination of resistance-capacity and transformer coupling has been adopted, the resistance coupling being inserted between the detector and first amplifier, and the transformer between the first amplifier and the power valves. This sequence has been arrived at independently by several competent authorities on distortionless amplification, and is now generally accepted as standard practice for high-quality reproduction. With modern valves and properly designed resistances and condensers, resistance coupling is no longer open to the objection of inadequate amplification. Indeed, the amplification in the set under review is high enough to justify the inclusion of a switch to cut out the middle valve of the combination, and the change in volume when this switch is operated is ample testimony to the amplifying powers of the first L.F. valve. The same switch is used to switch the set on and off, and is mounted on the front panel at the right-hand side of the "Local-Daventry" change-over switch.

The interior of the set presents a particularly clean appearance. Note the tuning chart inside the lid and engraved resistance sockets and valve holders.



The grid bias battery is incorporated in a recess at the back of the cabinet and the correct tapping for a given value of H.T. is given by the table above the terminal strip.

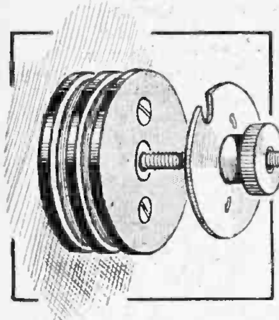
For the last stage of the receiver the makers recommend their LL525 valve, but will supply a valve of smaller power handling capacity (L525) if specially

Broadcast Receivers.—

requested. We would, however, strongly advise readers to follow the advice given to use the LL525 valve, which with a H.T. voltage of 120 volts is capable of taking input amplitudes up to 15 volts—just twice as much as the L525 for the same H.T. Valves of the LL525 type, which is in the same class as the D.E.5A, SP55/R, and P.M.256, are now regarded as absolutely essential in the output stage for even moderate volume if full justice is to be accorded to the distortionless qualities of modern circuits.

Telephone Connections.

The provision of sockets on the front panel for the insertion of telephones after the first amplifier will be appreciated by many. If only one person wishes to listen, it is rather irksome to the remainder of the household to have to put up with the full volume of sound from the loud-speaker. It should be noted that it is advisable, though not essential, to disconnect the phones when using the loud-speaker only. This point is dealt with in the instruction book.



Daventry unit with adjustable damping plate.

It is gratifying to note that a reservoir condenser is connected across the H.T. terminals. This necessary item is too frequently omitted by price-cutting manufacturers.

Plug-in coils are used in the short-wave or "Local" tuner, and are mounted in a variable coil holder supported behind the front panel on a metal angle bracket. The swinging movement of the reaction coil is controlled through reduction gearing, and is operated by a shaft passing through the front panel. This shaft in turn is rotated by an Ethovernier dial, which gives a gear ratio of 18 to 1, so that an extremely fine control of reaction is obtainable.

The Tuning Dials.

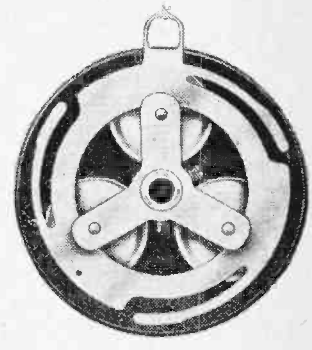
A similar dial on the right-hand side of the panel operates a compact tuning condenser of the solid dielectric type. Both dials are fitted with the Burndept "Etholog" —a semi-circular paper scale held in a detachable metal frame behind the condenser dial. On this scale it is possible to record in pencil the tuning and reaction settings for different stations. A spare set of scales is provided with each receiver.

From the photograph it will be seen that both dials are set low down on the panel. This feature will be much appreciated when searching for any length of time for distant stations, as it is possible to rest the hand and forearm on the table, and is consequently far less fatiguing than if the dials were, say, 6in. above the table level.

A special tuning and reaction unit for Daventry is incorporated in the receiver in order that a rapid change-over to Daventry from the local station may be made without replacing plug-in coils. The sketch of the Daventry unit shows that the grid and reaction coils are wound in adjacent slots in an ebonite former, thus giving a fixed maximum reaction effect sufficient for aerials of poor efficiency. The degree of reaction may be reduced by screwing a metal disc towards the coils, minimum reaction being obtained with the damping disc in contact with the ebonite former. A wire spring pressing against the threaded spindle imparts a certain amount of friction to the movement of the damping plate, and prevents rotation when the correct setting has been found. When adjusting the damping plate, slight retuning of the right-hand dial is necessary, as the plate affects the grid coil to a slight extent as well as the reaction coil.

The grid bias is accommodated in a slot at the back of the set immediately below the terminal strip, and a small tablet is permanently fixed to the back, which indicates at a glance the correct grid bias for the particular value of H.T. in use. It should be noted, however, that while the table indicates grid bias values up to $22\frac{1}{2}$ volts the set will accommodate nothing larger than a $16\frac{1}{2}$-volt grid bias battery. Readers are, therefore, recommended to use 120 volts H.T. for which this bias is suitable.

Actually, the set was tested with 100 volts H.T. and a negative grid bias on the power valve of $10\frac{1}{2}$ volts. Excellent results were obtained with these values, but readers are advised to use 120 volts H.T. if possible.



Underside of Ethovernier dial showing double epicyclic friction gear.

The first test applied was for wavelength range. The coils supplied with the set were a Burndept No. 35 for the fixed coil and a No. 50 for reaction, and the wavelength ranges on the particular aerial in use were as follow :—

Aerial Terminal.	*Wavelength Range (metres)*
L	200—435
S	285—490

When using the Daventry unit the wavelength range was the same on both aerial terminals, and was 1,050 to 2,000 metres.

Current Consumption.

The high efficiency of the valve filaments results in a low filament current—only 0.5 amp. for the whole set. Thus a 100-hour service is given by a single charge when using the 6-volt 50-ampere-hour battery recommended. The total anode current for the set when using 100 volts H.T. was only 6.5 milliamperes, so that the Siemens Super Radio dry batteries recommended will give excellent service if used instead of high-tension accumulators where there are charging and maintenance difficulties.

A test was then applied as indicated in the Editorial of the issue of December 15th, to ascertain the overall amplification. The result was distinctly above the average for this class of receiver as far as the "Local" range was concerned, but the amplification on the "Daventry" range was not quite so good. This does not necessarily mean that the amplification on Daventry is inadequate; indeed, it will be found satisfactory in

Broadcast Receivers.—
most parts of the country, and the idea of incorporating a separate unit to save changing coils is a good one. But should the set be installed just outside the range of Daventry as received with the special unit there is just a possibility that it could be received on the "Local" range by using the appropriate plug-in coils. The correct coils to use are indicated by the chart in the inside of the receiver lid.

Judged from the point of view of quality, the set was again decidedly above the average. Two loud-speakers were tried—the Burndept "Ethovox" with mahogany horn and the "Etho-Cone." The former gave excellent results with particularly clear definition, but we personally preferred the "Etho-Cone," and we think the merits of the set are such as to deserve the better loud-speaker. Further, the impedance of the "Etho-Cone" is matched to the output valve, and the difference in price is only a small proportion of the total outlay. That the high-quality reproduction obtainable with this set is, indeed, a reality is shown by the frequency characteristic which is given in another article in this issue.

This is a set we can recommend without reservation as being an outstanding example of high-class design, construction, and performance.

The price of the receiver inclusive of royalty, valves and coils is £19 17s. 6d. The cost of necessary accessories to go with the set would be between £14 and £16, depending on the choice. The address of the makers is Burndept Wireless, Ltd., Blackheath, London, S.E.3, and the London office and showrooms are at Bedford Street, Strand, W.C.2.

NEWS FROM THE CLUBS.

A Retrospect.

The Council of the Croydon Wireless and Physical Society reported a successful year when the Society's annual meeting was held on December 13th. During the year "practical" meetings have alternated with the regular fortnightly gatherings, and the class for Morse instruction has fully justified its existence.

Mr. Gee has been re-elected hon. secretary, with Mr. Iserbyt as hon. treasurer.

After the business of the evening had been disposed of, Mr. A. C. Dale delivered a lecture on "Some Fundamental Formulæ Used in Wireless." Inductance, Reactance, Capacity and Impedance were separately touched upon, and Mr. Dale showed clearly how necessary a knowledge of these properties is to a proper understanding of wireless fundamentals. Full particulars of the Society can be obtained from the Hon. Secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

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Exhibition at Southend.

The Southend and District Radio Society will hold their third Annual Radio Exhibition at the Boys' High School, Southend-on-Sea, on January 8th, 1927.

Last year's exhibition was a big success, and it is hoped that this year's effort will be still more gratifying.

Members are putting the finishing touches to their new sets, and are busy making novel loud-speakers, coils, H.T. units and accessories in the contemplation of winning prizes, which have been given by various donors both in the trade and outside.

A silver challenge cup, kindly presented by Mr. Hugh S. Pocock, Editor of *The Wireless World*, will be awarded for the best amateur exhibit, and will be held by the winner for one year. This should put a stimulus on those entering. Various firms in the trade have already taken stands, details of which can be had from Mr. H. C. Revell, of 62, Wimborne Road, Southend-on-Sea. Amateurs' entries will be welcomed, and information can be obtained from Mr. F. Waller, "Eastwood House," Rochford, Essex.

Busy Month at Woolwich.

The Woolwich Radio Society has had a busy month, during which several interesting meetings have been held. On November 24th, Mr. A. F. Bartle gave his Presidential Address, in which he dealt with the use of A.C. mains for supplying H.T. and L.T. After explaining his preference for A.C. over D.C. for wireless purposes, Mr. Bartle gave an instructive talk on transformer theory.

Mr. W. James, Assistant Editor of *The Wireless World*, paid the Society a long-awaited visit on December 1st, when he brought with him "The 'Wireless World' Five," which produced a profound impression. After explaining the circuit by means of a large diagram, Mr. James demonstrated the receiver with the assistance of Mr. Houghton. An indoor aerial, consisting of a short piece of wire, was used, and, despite atmospherics, distant foreign stations were received with such strength that two large Kone loud-speakers were strained to their utmost.

At the loud-speaker demonstration and competition held on December 8th, Mr. Budd kindly assisted with his "Everyman Four" (which won the Selfridge Radio Competition). Fifteen concealed loud-speakers were tested in turn, members voting by ballot. The first on the list was a home-made cone constructed from odd parts by Mr. Beeson, a member of the Society.

The Woolwich Radio Society meets at 8 p.m. every Wednesday at Cottingham's College, Plumstead Common Road. Visitors are always welcome. Hon Secretary: Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

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FORTHCOMING EVENTS.

THURSDAY, DECEMBER 30th.

North London Experimental Radio Society.—Informal Meeting.

FRIDAY, DECEMBER 31st.

Bristol and District Radio Society.—Lecture and demonstration by representative of Messrs. Auto Accessories, Ltd. Subject: "The P.D. Receivers."

MONDAY, JANUARY 3rd.

Croydon Wireless and Physical Society.—At 8 p.m. At 128a, George Street. Lecture: "Some New Experiments on the Properties of Dielectrics," by Mr. G. Goulland.

Ipswich and District Radio Society.—At 8 p.m. At the Museum Lecture Hall, High Street. Popular lecture, illustrated with lantern slides, by Mr. J. H. A. Whitehouse, of the B.B.C.

WEDNESDAY, JANUARY 5th.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street, Barnsley. Comparison of loud-speakers.

Edinburgh and District Radio Society.—At 117, George Street. Business Meeting, followed by demonstration.

Muswell Hill and District Radio Society.—Informal Evening.

Behind the Screen.

Fifteen loud-speakers placed behind the screen supplied an element of mystery at the last meeting of the Muswell Hill and District Radio Society. One by one the loud-speakers were tested, each member being requested to vote in favour of what in his opinion were the best three. The instruments were first tested for clarity and afterwards for volume. A home-made loud-speaker worked by a moving armature gave excellent results on music.

Programmes of future demonstrations, etc., may be obtained on application to the hon. secretary, Mr Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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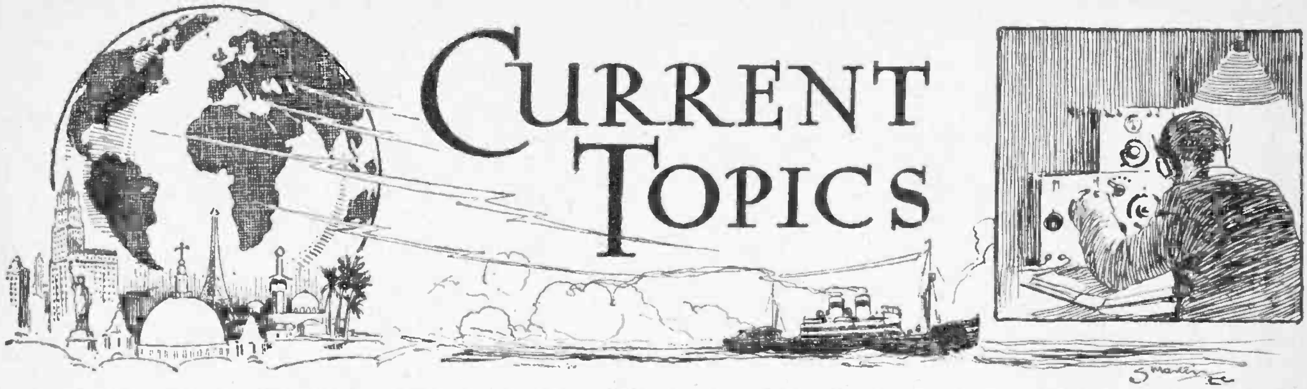
Dissecting a Loud-speaker.

At the North London Experimental Radio Society's last meeting, Mr. R. J. Miller dealt with two interesting instruments, viz., a present-day Kone loud-speaker and a public address unit minus its 20ft. horn.

The lecturer carefully explained the working of the balanced armature and illustrated his remarks with the aid of various parts of the mechanism which he had brought with him. It was soon apparent that the instruments had been very carefully designed and that no part was superfluous.

Full particulars of the Society may be obtained from the Hon. Secretary: Mr. Wilfred J. L. Parker-Ayers, 61, Carey St., Lincoln's Inn, W.C.2.



Events of the Week in Brief Review.

A WIRELESS FLAG DAY.

The Borough of Camberwell held a flag day last week to raise funds for the installation of wireless at St. Giles' Hospital, Brunswick Square.

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WIRELESS IN A STORM.

During the great storm which swept Madeira on December 15th the Marconi station was damaged, but prompt action on the part of the staff enabled the service to be resumed within two hours.

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TOO SANGUINE.

Not everyone will agree with the pronouncement, recently made by Mr. James G. Harbord, president of the Radio Corporation of America, that "the present year closes with the United States in an undisputed position of leadership in world-wide wireless." Therefore the position is not "undisputed."

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CHILDREN'S WIRELESS LECTURE.

"The Story of a Wireless Valve" is the title of a juvenile lecture to be given at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, by Professor Charles R. Darling, F.Inst.P. The lecture will be given in two parts, the first on January 5th and the second on January 12th. Both meetings will begin at 3 p.m.

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AUSTRALIAN BEAM SUCCESS.

The Marconi Company states that the preliminary tests so far carried out with the Australian Beam Service have been highly successful, and it is expected that the stations will be handed over to the General Post Office for the official tests early in the New Year.

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FREE LICENCES FOR THE BLIND.

On and after January 1st blind persons will be able to receive a free wireless receiving licence upon the production of a certificate. As there may be some delay in the issue of certificates, the Postmaster-General states that no legal action will be taken against a blind listener who is prevented by this delay from obtaining a free licence. Certificates will be issued by county and borough councils to registered blind persons in their respective areas. The free licences will be available on the production of the certificates at the local post offices.

THE WILY PIRATE.

The Post Office states that 500 convictions have been obtained against unlicensed listeners since the passing of the Wireless Act in 1925. Each conviction has been followed by a large demand for licences!

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NEW TRADE ASSOCIATION.

The inaugural meeting has been held of the Radio Manufacturers' Association, which supersedes the N.A.R.M.A.T. and the Society of Radio Manufacturers. At present the R.M.A. has nearly fifty members.

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LONGITUDE BY WIRELESS.

The experiments which have been undertaken at various observations throughout the world during the past autumn to verify longitudes by wireless have now been completed, but it is stated that the task of collecting and summarising data will take a considerable time. The wireless stations participating in the experiments included those at San Diego, Paris, Berlin, Washington, Algiers and Shanghai.

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FINGER PRINTS BY WIRELESS.

For the first time in police history Scotland Yard has been asked to assist in tracing a criminal by means of his finger prints transmitted by wireless. The request has come from the New York police, and it is understood that the finger prints as shown on the photogram are sufficiently clear to enable the Finger Print Department to search their records. The criminal belongs to the "gentleman burglar" type.

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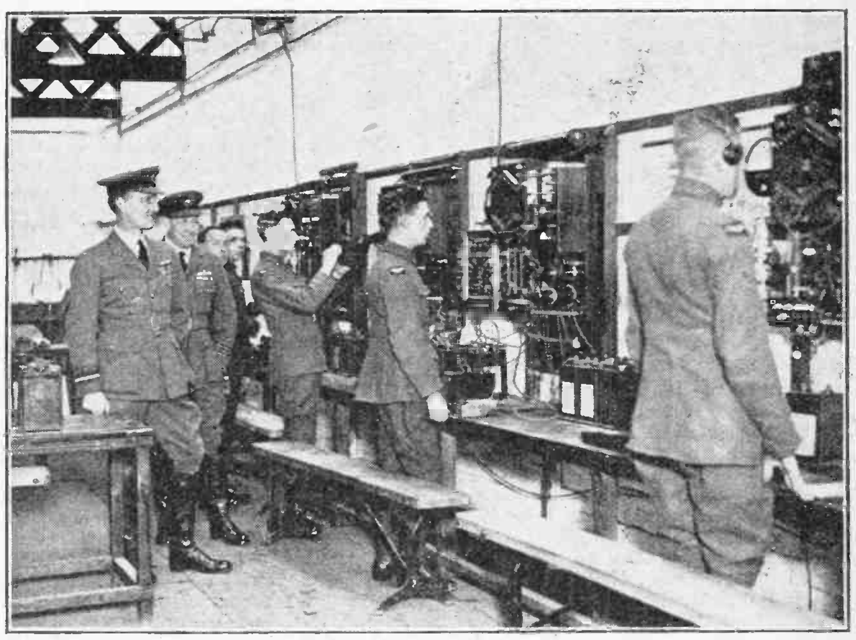
A TELEVISION IMPROVEMENT.

Hitherto the Baird system of television has suffered a drawback owing to the fact that the object transmitted had to be sub-



WIRELESS IN THE R.A.F. Air Vice-Marshal Sir J. M. Steel conducting a passing out inspection of apprentices at the Royal Air Force Wireless School, Flowerdown, near Winchester. The photograph was taken in the H.F. High Power Transmitter Section.

jected to an extremely powerful light which was liable to prove dangerous if the head or face were exposed to it for any length of time. Mr. Baird has now discovered a method of overcoming this obstacle.

A practically opaque screen is now interposed between the electric lamps and the subject for transmission leaving the latter bathed in the infra-red rays which are permitted to pass through the screen or filter. These are sufficient to project the image on the screen of the receiving apparatus, and good results have been obtained when the subject is in complete darkness.

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ACTIVITY IN CEYLON.

The Ceylon Amateur Radio Society is doing good work in fostering public interest in broadcasting and wireless generally. Early in February the Society will have a stand of its own at the All-Ceylon Motor Exhibition.

The Colombo broadcasting station, with a power of 1.75 kilowatts, transmits regularly on 800 metres, and, according to a correspondent, is received with remarkable clarity throughout Ceylon.

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WIRELESS-CONTROLLED AEROPLANES.

Mr. Elmer A. Sperry, of aerial torpedo fame, has been awarded the John Fritz gold medal, representing the highest award in the United States engineering profession.

In bestowing the medal, Mr. William Saunders, of the Naval Consulting Board, referred to Mr. Sperry's experiments with wireless-controlled aeroplanes. Shortly before the Armistice Mr. Sperry had succeeded in directing an aeroplane automatically against a target 35 miles distant. If there were ever another war, said Mr. Saunders, the winning nation would be the one able to produce 10,000 of such "flying guns."

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BRITISH INDUSTRIES FAIR.

A remarkable feat in connection with the organisation of the British Industries Fair at which many wireless firms will exhibit, is the preparation by the Department of Overseas Trade of an advance overseas edition of the catalogue in English, French, German, Dutch, Swedish, Danish, Spanish, Italian and Portuguese, which is to be ready seven weeks before the opening of the Fair on February 21st.

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NEW AMERICAN TELEVISION DEVICE.

A forecast of the time when Transatlantic telephony will be accompanied by television has been made by Dr. E. F. W. Alexanderson in a lecture before the American Institute of Electrical Engineers, in which he described his new television device. When the machine is perfected, Dr. Alexanderson states, it will be necessary to establish a complete television wave-band 700 kilocycles wide or a radio channel occupying the waves between 20 and 21 metres.

The device works on a principle employing seven separate circuits of 40,000 picture-units a second. Seven modulated beams project crude pictures on the transmitting screen, and by means of perfect synchronisation a single clear image is produced.

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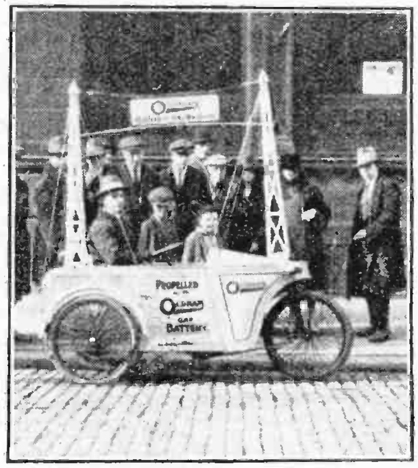
TWO-RANGE REINARTZ.

In the description of the above receiver in the December 15th issue a discrepancy appeared regarding the thickness of the ebonite discs used in the former for the long-wave coils. In order to accommodate the 200 turns of No. 30 D.C.C. required for the grid coil, it is recommended that one of the $2\frac{3}{4}$in. diameter discs should be cut from $\frac{1}{4}$in. ebonite. The other discs may be cut from $\frac{1}{8}$in. sheet as indicated in the list of components.

If difficulty is experienced in spacing the sections of the single-layer coil as shown in the photographs, No. 26 D.C.C. wire should be used instead of the No. 24 D.C.C. specified.



A NOVEL RADIO CAR. This strange vehicle was photographed recently in Manchester. It is propelled by Oldham batteries.

DESIGNING LOW-LOSS RECEIVING COILS.

On page 758 of the December 8th issue the answer to an exercise in working out the optimum diameter of wire was given in line 16 of the second column as 0.58 mm. The correct answer is 0.43 mm., the miscalculation being due to an error in reading off the value of Pd as 0.385 instead of 0.285.

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FREEDOM FOR LISTENERS.

Inhabitants of the Dutch East Indies are to be allowed to use radio receiving sets in the New Year, the Dutch Colonial Government having decided to remove the present restrictions and to introduce a licensing system.

Broadcasting in the Dutch East Indies is under the exclusive control of the Government and the prohibition against the operation of broadcasting stations has been rigidly enforced. No legal action has been taken against the owners of receiving sets, and several radio societies have been formed, which will doubtless increase their activities under the new conditions.

Calls Heard.

Extracts from Readers' Logs.

Rome.

Luxembourg :—L 1JW. Finland :—S 2CO. Morocco :—FM 8PMR. Yugo-Slavia :—YS 7XX, 7WW. Austria :—Ö HL, KE. Lettonia :—TZ AR. Russia :—R 1NN. Switzerland :—H 1CZ.

(Reinartz, 0-v-1.)

G. P. Ilardi (I 1DO)

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Weybridge.

New Zealand :—Z 1AO, 2AC, 2BG, 2TU, 2XA, 3AG, 3AR, 4AA, 4AM. Australia :—A 6TD, 6MA, 5HB. Tasmania :—A 7CW. Philippine Islands :—PI 1BD. Borneo :—BN SK2. Chile :—CH 2AH. Brazil :—BZ 1AM, 1AW, 2AF, 2AG, 9QA. Canada :—C 1AR. United States :—U 1AKM, 1AYG, 1AER, 1ADE, 1AAP, 1AAY, 1AFF, 1BNL, 1BQQ, 1CCX, 1CIB, 1CTP, 1CNP, 1GA, 1GP, 1UU, 2AGT, 2AAI, 2BIR, 2MM, 2OAI, 2TB, 2IZ, 4KJ, 4SL, 4JM, 4BU, 5YB, 8DNE, 8CC, 8BSU, 8AVD.

(0-v-1.) All on 32 to 42 metres.

R. C. Nisbet.

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Hale, Cheshire.

(October 31st to December 1st.)

On 20 metre band :—U.S.A. :—U 1RD, 1XX, 1XAM, 1AJ, 2BQH, 2AOL, 2AMJ, 3AQE, 3CDV, 3GW, 4DW, 8GZ, 8AUL, 8CBI, 8CUG, 9BSK, 8AXA. Canada :—C 1AK, 1DD, 1AR, 3FC. France :—F 8CT. Brazil :—BZ 2AB, 1AN. On 40 metre band :—South Africa :—O A3B, A3E, A4Z, A4V, A5X, A5Z, A6N. Philippines :—PI 1BD, 1CW, NARX. Chile :—CH 2LD, 2BL, 3AJ. Argentine :—R BA1, CB8, HB5. Canada :—C 1AR, 1DD, 3XI, 2BE, 4DQ. New Zealand :—Z 2AR, 2AK, 2XA, 2AC, 3AR, 3AI. Singapore :—SS 2SE. Borneo :—BN SK2. Honolulu :—HU 6AFF.

F. N. Baskerville.

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Friern Barnet.

(October 25th to November 8th.)

U.S.A. :—U 1APE, 1AR, 1AW, 1AXX, 1AWI, 1BHS, 1BJK, 1BKE, 1BDT, 1BFP, 1BZP, 1BMS, 1CJH, 1CW, 1CNZ, 1CKP, 1FX, 1LJ, 1PE, 1XV, 1RP, 2BW, 2AVJ, 2AM, 2AWQ, 2AEV, 2AGQ, 2ALM, 2ATK, 2AGP, 2CXL, 2CS, 2HA, 2NZ, 2QR, 2WJ, 2MY, 3BUV, 3BWG, 3EF, 3DH, 3JN, 3LW, 3TR, 4IZ, 4RI, 8BG, 8XE, 8CLS, 8QB, 9CEJ, 9DRS. Spain :—EAR6, 15, 18, 19, 26, 38, 42. Portugal :—P 1AK, 1AF, 1AJ, 3FZ. Sweden :—SMUV, VJ, WR, WU, ZN. Italy :—I 1AY, 1BW, 1CO, 1DR, 1FC. Tunis :—TUN2. Russia :—R 1NN. Miscellaneous :—HIK, L 1AG, LA 1A, LA 1E, C 2BE, LIT 1B, YS 7XX.

(0-v-1) on 30 to 48 metres.

J. Clarricoats (G 6CL).

OUTSIDE BROADCASTS.

With Special Reference to the Liverpool Organ.

By "HENRY MICRO."

"WE are now taking you over to . . . ." says the announcer, and thousands of listeners settle down to hear a transmission from some distant point, often remote from the broadcasting station, such as a church, hotel, theatre, club, or even an aeroplane. But how many listeners really trouble to conjecture how these relays are carried out? No doubt many of the more curious do try to picture to themselves for a moment what the B.B.C. engineers are actually doing, but even they quickly dismiss the matter from their minds as they become absorbed in the new atmosphere to which they are transported.

The writer feels, therefore, that a description of a particular piece of relay work which called for more than average care and preparation may help many listeners to a clearer realisation of the work entailed in these "O.B.s," as these relays are called by the B.B.C. engineers. The relaying of the recitals upon the new organ in Liverpool Cathedral is an excellent choice for this purpose.

Let us take a look at some of the instruments and apparatus used to convey the desired sound waves from these "outposts" to the control room and radiating apparatus of the station transmitting the programme. First, of course, is the microphone. The type of microphone now in general use by the B.B.C. for relay purposes is the Marconi-Reisz, an instrument much more convenient and less conspicuous than the larger, yet extremely efficient, earlier types, and one which is particularly suitable for standing on a reading desk or dinner table so that a speaker's view may be obscured as little as possible.

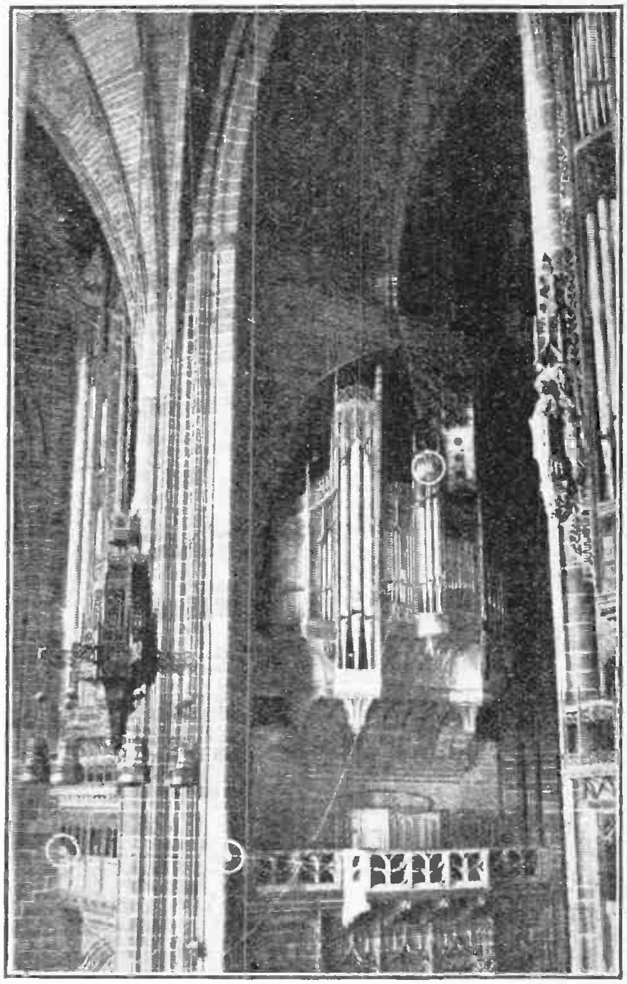
Amplifying the Microphone Currents.

The electrical reproductions into which the sound waves are converted by the microphone and which ultimately are converted back to sound waves by our loud-speaker or headphones are conveyed by wires, encased in suitable sheathing, to an amplifier. Two of these amplifiers can be seen in the photograph on the next page immediately behind the headphones and switches In the background will be noticed the batteries for supplying power to the amplifying valves. The leads from the microphones are seen on the extreme left.

The head telephones enable the engineer to "check" the quality and volume of the music or speech as it leaves the amplifier before going on its land-line journey. The transmission is again "checked" by the Control Room engineer.

These two engineers can keep in communication with each other by means of the hand telephone seen on the extreme right of the picture; this is connected to another pair of telephone lines, and thus communication can be maintained throughout the programme.

When preparing for a relayed transmission the first point to be determined by the broadcast engineers is the position of the microphone, or microphones. In the case of an orchestral broadcast it is generally possible to place the various instruments in positions most suitable for the microphone, so that certain instruments are not "drowned" by others. In broadcasting theatre plays the difficulty of reproducing with even volume the voices of players moving to and fro is chiefly overcome by the control system which is in operation at all B.B.C. stations and with which most readers of *The Wireless World* are familiar. When an organ recital is broadcast from any of our smaller churches and cathedrals, one microphone



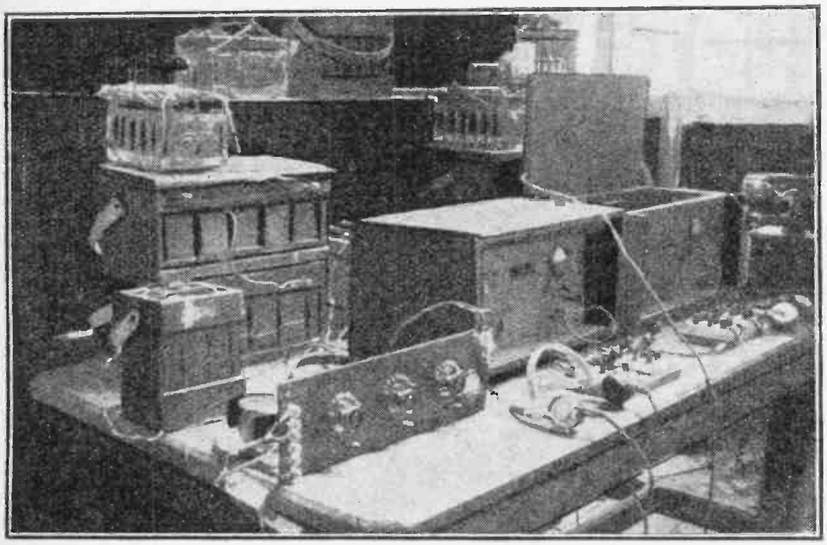
BRITAIN'S BIGGEST VOICE. This photograph shows a portion of the vast organ in Liverpool Cathedral with three of the microphones which are marked by white circles. The special difficulties which faced the engineers in charge of the relays from Liverpool are described in the article.

placed at some particular point may be quite sufficient to effect a true reproduction of every nuance. But let us see what difficulties have to be overcome by the broadcast engineers before listeners can be "taken over" to a vast building such as Liverpool Cathedral to hear for themselves the wonder and beauty of an organ second to none in the world.

Outside Broadcasts.—

It will be recalled that amongst the most notable of recent relayed broadcasts was the Dedication Service of the Liverpool Cathedral organ, and subsequent organ recitals "S.B." from Daventry, London, and Liverpool.

The completion of this organ was a memorable event, as this magnificent instrument has the distinction of being the largest cathedral organ in the world. There are, it is true, organs in other parts of the world which possess a greater number of pipes and speaking stops, yet no other organ has the scales and windage of the flue pipes or the distinct character of every stop preserved so effectively as in the organ at Liverpool.



B.B.C.'s AMPLIFYING EQUIPMENT. To avoid the possibility of breakdown duplicate apparatus is always available for amplification purposes at the microphone. Two amplifiers are seen in the photograph and in the centre foreground can be seen the "fading-in" and "fading-out" gear.

A brief survey of the instrument may be of interest when considering the work which the microphones were called upon to do.

Details of the Organ.

The photograph will give an idea of the dimensions of the cathedral. The interior height of the choir and nave is about 120ft., and it will be noticed that the organ is built into two enormous chambers, one on each side of the chancel at a considerable height above the ground. In the south chamber is to be found the whole of the great organ, with its heavy pressure diapason work; the solo and bombarde organs, which include the colossal Tuba Magna worked on a 50in. wind pressure; and, lastly, the greater part of the pedal organ. On the north side behind the Console (where sits the organist some twenty to thirty feet above the floor of the choir) is situated the swell and remainder of the pedal, whilst above the organist are the lightly voiced choir stops.

Although the organ is now finished, only about one-third of the whole building for which the organ has been designed is as yet completed. This has necessitated a temporary wall being built at the western end until such time as the central space and western transepts are *in situ*. A wall in such a position aggravated the difficulty of finding suitable points at which to place the organ microphones (more than one being necessary in the circumstances), as it constricted the sounds produced by the heavier stops. In a broadcast of this nature it is essential that the microphones should be in a position to deal faithfully with true notes. Not that harmonics and choruses produced by the organ should not be reproduced, but the microphones should be out of range of mere echoes reflected from surfaces such as this enormous temporary screen, otherwise the transmission may be blurred and cause "blasting." They must, in fact, be placed so as to reproduce with fidelity—for they can to a very large extent if their positions are right—the softest "pppp" passage as well as one thundered out fortissimo; perhaps a theme given out on soft diapasons followed immediately by a blare of trumpets and clarions. Now there are over 10,000 pipes in the Liverpool Cathedral organ, the softest effect scarcely audible to the ear of a listener below, and the loudest like a "rushing mighty wind," or the most penetrating trumpet in existence. Remembering these facts, one begins to realise the wonder of the little microphone, a mere 5in. in diameter, upon which engineers and listeners alike largely depended for results. Also, one is better able to appreciate the responsibilities of the B.B.C. if the microphones were to do justice to an instrument possessing such great beauty and variety of tone, and if listeners were to be able to discern its qualities for themselves.

It has been mentioned that the engineers were confronted with acoustic difficulties, partly on account of the reflected effects due to the temporary western wall restricting the travelling space of the sounds produced by the heavier organ stops in full blast, and partly on account of the great variety of tones and the extremes of amplitude of the sound waves. Now, certain spots at ground level were both free of echo effects and suitable for "picking up" both sides of the organ equally well with good unification of tone relationships, but it was not practicable to place microphones in the midst of the congregation, or even just above. By so doing a predominance of noises would have resulted, due to the presence of people even moving occasionally and ever so slightly; and during a soft passage a cough would have momentarily drowned the organ notes and spoilt the pleasure of every broadcast listener. So the microphones (we are dealing with those required to reproduce the organ) had to be suspended well above the congregation. The actual position of some of these can be seen in the photograph, in which one of them can be seen hanging about 90ft. above the centre of the choir and another rather lower and further out to the left of the photograph. It is of interest to note that about 300 yards of cable were used in conveying the sound reproductions of the microphones to the amplifiers which, as already explained, had to be situated as near as possible together—in this instance in an adjoining chapel.

A Section Devoted to the Practical Assistance of the Beginner.

THE TUNING NOTE AS AN AID TO ADJUSTMENT.

It is not generally realised that the preliminary tuning note, as transmitted by the B.B.C. stations, is a valuable aid to the adjustment of a receiver, particularly as far as the L.F. amplifier is concerned. It gives us a persistent signal of approximately constant strength, and with a degree of modulation which, if not quite representative of the average transmission, is near enough to it for practical purposes.

If, for instance, the needle of a milliammeter inserted in the anode circuit of an L.F. valve is deflected downwards when the receiver is tuned to this note, we can assume that more grid bias is required, as (in the case of a resistance-coupled amplifier) the valve is acting as a cumulative grid rectifier with consequent distortion. Should an addition to the bias voltage result in an upward deflection from the normal reading, we know that anode rectification is taking place, due to encroachment on the bottom bend. Under these conditions it can safely be assumed that the valve is overloaded, and that a reduction of the input voltage is necessary. Incidentally, it is just possible that we may strike a balance, and apply a grid voltage at which the two forms of rectification cancel each other out, with the result that the anode current will remain unchanged; this, however, is unlikely unless a potentiometer is fitted. This matter was dealt with on page 743 of *The Wireless World* for December 1st, 1926.

There is some hope that transmissions of steady notes, modulated at different frequencies, will be made in the near future from the British stations. Such signals would be extremely helpful to us in getting an idea of the performance of our L.F. amplifiers, as it would be possible to determine the comparative magnification without any elaborate apparatus, always provided that the amplitude of the emissions is sensibly the same at all periodicities. A determination made in this way would be much more accurate than the result of mere aural observation. Moreover, it would be a comparatively easy matter to decide whether the amplifier or loud-speaker was to blame for a noticeably unequal response over the range of transmitted notes.

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A USE FOR WORN-OUT POWER VALVES.

When signals are barely strong enough to operate the simple form of receiver consisting of a "high-magnification" anode detector, coupled through a resistance to a single stage of L.F. amplification, which was described in *The Wireless World* for October 27th, 1926, a good method of increasing volume is to add a further low-frequency valve. It may seem a heresy to suggest that too much amplification may possibly be obtained from this extra valve, but the fact remains that, if our signals are almost loud enough to give satisfactory volume on two valves, a further voltage amplification of from 15 to 30, or even very much more, as given by the type of valve usually recommended, in conjunction with the conventional form of coupling, will overload any ordinary output valve.

Now an ordinary power valve, with a high resistance in its anode circuit, is capable of giving a voltage magnification of about 4 to 6, and is, moreover, extremely economical in operation, as a very small emission is required from its filament, which may accordingly be run on about half its normal current consumption. Indeed, a dull-emitter valve which has, through long use, lost so much of its emission that it is useless for ordinary purposes, will function quite well in this capacity. Similarly, due to the presence of the large anode resistance, the consumption from the H.T. battery will be almost negligible in comparison with that which is inevitably required for the output valve.

The circuit diagram, with suggested valves, for a complete receiver operating on these lines is given in

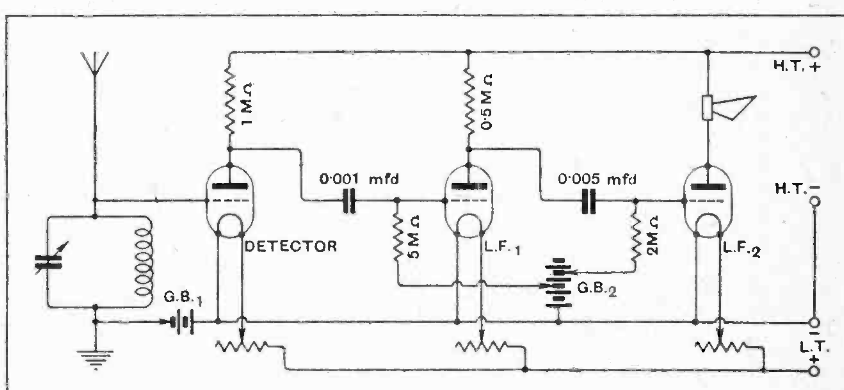

Fig 1.—An economical loud-speaker set.

Fig. 1. For further information, the reader is referred to the article already mentioned. The power valve from which a small emission only is required, is that in the first low-frequency stage (L.F.$_1$ in the diagram). Its filament rheostat should have a high maximum resistance value, in order that the voltage applied may be suitably reduced.

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TESTS WITH A GALVANOMETER.

A galvanometer, in conjunction with a small battery, can be recommended as an indicating instrument for testing the majority of wireless components and sets. Naturally, the more sensitive instruments, which are, unfortunately, the most expensive, are of the greatest value, as those which require a considerable current for their operation are of limited utility as an a' ' to the detection of the small leakages which do so much to impair the efficiency of a receiver.

It is, of course, highly desirable that the galvanometer chosen should be calibrated in microamperes, in order that an actual measurement may be made of the resistance value of such components as grid leaks, anode resistors, etc.

It has been found that a microammeter taking about five microamps. per scale division is extremely useful for all round wireless work, although an instrument of a considerably lower sensitivity will serve admirably.

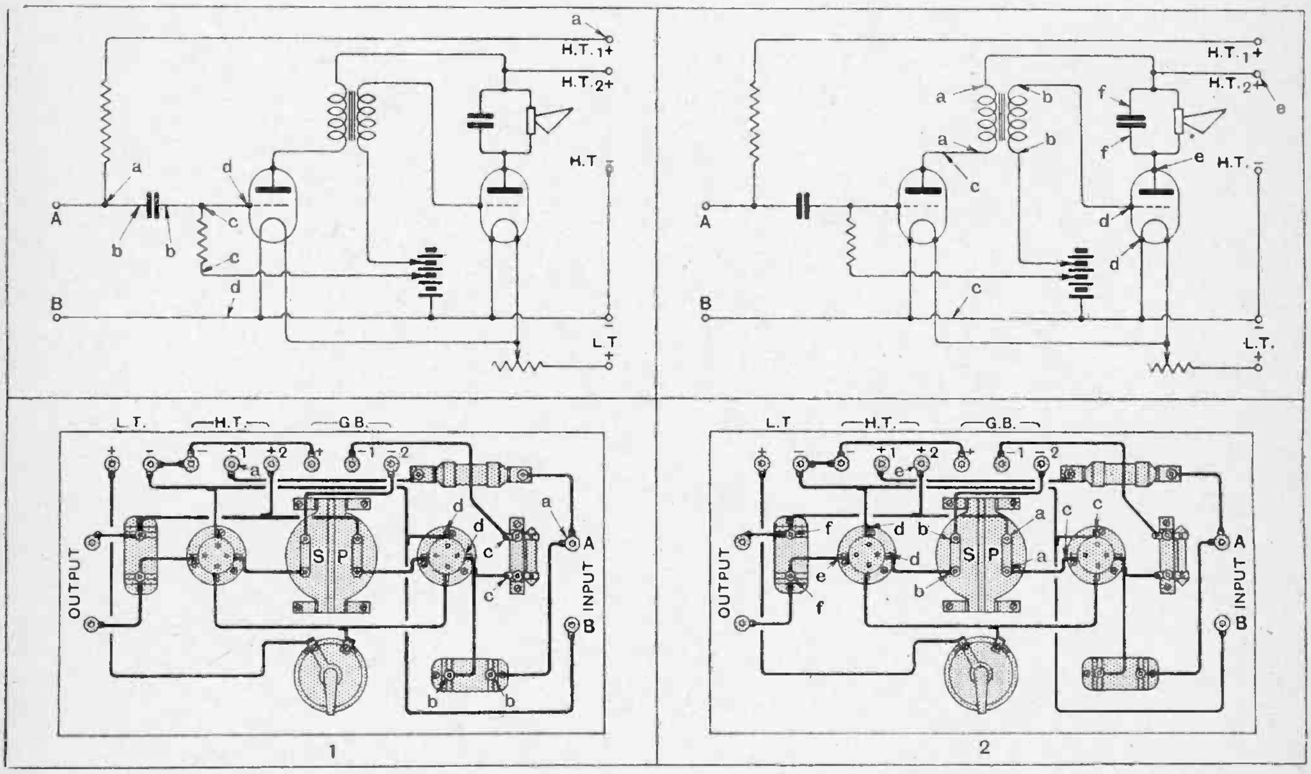
The beginner is apt to be misled by the fact that a deflection is obtained when the meter and battery are connected across a large condenser for testing of its insulation. This is merely due to the flow of charging current, and, if the insulation resistance is sufficiently high, the needle will quickly return to zero.

It is a good plan to insert a high resistance in series with the galvanometer, to avoid risk of damaging it by an inadvertent short-circuit of the testing leads. This resistance should be bridged by a switch, in order that it may be cut out after the user has assured himself by a trial that a sufficiently high resistance exists in the circuit under test.

DISSECTED DIAGRAMS.

No. 53.—A Two-stage L.F. Amplifier.

The present series of diagrams is intended to show simple methods of locating faults in typical wireless instruments. Failing a sensitive galvanometer, it is suggested that a pair of telephones with a small dry battery should be used as an indicating device. These tests will show not only actual faults, but will reveal the small leakages which are so often responsible for poor reception and flat tuning. Batteries should be disconnected before testing.



The anode resistor and its wiring may be tested between points *a* and *a*: insulation of grid condenser (an important matter) between *b* and *b*, and the continuity of the grid leak between c and c. With the leak removed, a test between *d* and *d* will show the insula i n of the grid circuit as a whole. Various other points in the wiring should be tested, as no part of the circuit can be assumed to be in order until it is proved so to be.

The L.F transformer windings may be tested between points *a a* and *b b*, and the anode circuit insulation between c and c The grid insulation of the output valve is tested between *d* and *d*, with bias battery disconnected. Continuity of the plate circuit is shown between e and e, with loud-speaker in position or its terminals short-circuited. An insulation test of the by-pass condenser is applied between *f* and *f*.

DISTORTION IN LAND LINES.

Simple Compensating Circuits for Addition to Existing Receivers.

By PAUL D. TYERS.

PROBABLY the subject of distortionless reproduction of broadcast transmission is one which is engaging the attention of writers more than any other at the present moment. This is due, no doubt, to the fact that there is a general demand for better quality music. It has been pointed out that actually there is no such thing as distortionless reproduction from an electrical point of view. There is only one way in which to deal with the problem. A certain musical performance may take place under certain conditions giving rise to certain acoustic effects. What has to be done, therefore, is to obtain an identical acoustic effect in our own room. When an attempt is made, therefore, to design what is known as a distortionless amplifier it is of little use only to calculate mathematically the electrical constants of an amplifier which deals equally with all frequencies.

Standards of Quality.

In the first place, we have no knowledge whatever of the characteristic of the received broadcast signals. Neither have we any definite knowledge of the characteristic of the electrical, and more particularly the acoustical properties of the loud-speaker, which, it may be mentioned, are also determined to a certain extent by the acoustic properties of the room in which it will operate. Obviously, what we may term the perfect broadcast receiver must be designed empirically.

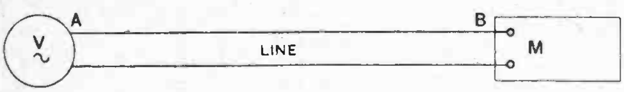


Fig. 1.—Simple method of testing line for distortion. V=source of alternating voltage; M=measuring device for alternating voltage.

It is somewhat disconcerting to find that the characteristic of the B.B.C.'s transmissions varies tremendously. If we arrange a good amplifier and connect it with a good diaphragm type loud-speaker, we find that we may be able to obtain what the ear appreciates as perfect reproduction. By this is meant that we can hear the open E string of the double bass, readily distinguish the pitch of the tympani of a large orchestra, and at the same time reproduce substantially perfectly the pizzicato playing of a violin, or the clapping of hands. As soon, however, as the B.B.C. relays a transmission over some hundred miles of telephone line the reproduction, in the writer's opinion, falls off in quality. Even the characteristic of the Daventry station is entirely different from that of, say, the London station. This variation of transmission characteristic is due chiefly to the introduction of a line between the microphone and the control valves.

The telephone line contains both inductance and capacity, sufficient to make a very material difference to the frequency characteristic. The ordinary Post Office telephone lines, which, it is believed, are employed by the B.B.C., are intended primarily for establishing intelligible speech communication between two points. Now, it is well known that it is possible to eliminate a very large proportion of both high and low frequencies from speech and still obtain quite intelligible communication. The ordinary telephone, as we know it, is a very ready example of this fact. It is remarkable, perhaps, that communication is possible at all on a very bad trunk line. However, if we were to amplify this, and feed the output to a loud-speaker it would then probably be quite unintelligible. What actually happens when the B.B.C. employ a long telephone line is that they feed into it at one end currents at frequencies covering an exceedingly wide band.

Obviously, then, the frequency characteristic at the distant end of the line will be entirely different from that at the input end. The problem is further complicated by the fact that the line may be an underground multiple paper core cable, it may be an open line, and it may or may not be provided with loading coils. The longer the line the greater is the attenuation, and also, of course, the higher the frequency the greater is the attenuation. Thus, for example, on a ten mile length of cable, frequencies of the order of five hundred cycles per second might suffer what we may term a transmission loss of ten per cent., whereas frequencies of the order of, perhaps, four thousand, might suffer a loss of twenty to thirty per cent.

Owing to the line containing both inductance and capacity the losses are not straight line functions. It might seem, then, that the use of a long telephone line between the microphone and the broadcast station must inevitably result in very serious distortion. This, however, is not the case, as it is possible to introduce correction devices, although, as far as the writer is aware, the B.B.C. only use them on the Daventry line.

Inverse Characteristics.

How this can be accomplished can be readily seen by taking a very simple example. Thus, in Fig. 1, we have a telephone line supplied at one end A with a source of alternating voltage, while at the other end B we have a device M which is intended to measure the voltage existing at the distant end. The illustration, of course, is purely diagrammatic, and is not intended to represent any particular apparatus. The source of alternating voltage is also supposed to be capable of variation over a wide frequency range. Suppose, now, a series of alternating voltages be applied at A at frequencies ranging between twenty cycles and five thousand cycles at intervals of fifty cycles. It is further supposed that the voltage supplied by the device V is constant at all frequencies.

Distortion in Land Lines.—

If, then, we want to obtain a constant voltage at the distant end B, the measuring device M would have to record the same A.C. voltage over the entire frequency range. Actually, a very different state of affairs will exist, and if we were to plot a curve showing the voltage at A and the voltage at B we might get something of the general form of that shown in Fig. 2. It will be seen at a glance that the curve of Fig. 2 does not approximate to a straight line. Obviously, then, if the output at B is applied to a broadcast transmitter the characteristic of the transmission will be very different from that of the microphone current. The general shape of the curve shows us that the greatest losses are occurring with the higher frequencies, which is to be expected, owing to the capacity of the line. It will obviously be possible to feed the output from the end B of the line into some electrical network which will have an inverse characteristic. For example, if we take a curve which is the inverse of that of Fig. 2 and superimpose it, and if we sum the two curves we shall obtain substantially a straight line. This, however, cannot easily be accomplished practically.

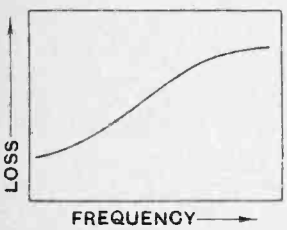


Fig. 2.—Curve showing line distortion requiring correction.

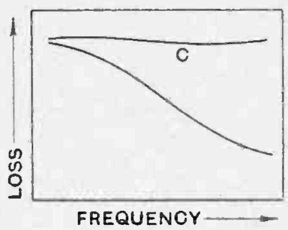


Fig. 3.—Curve of device for correcting the particular form of line distortion represented in the curve of Fig. 2.

Compensating Circuits.

What we have to do, then, is to superimpose a curve of the form of that shown in Fig. 3, which will again give us substantially a straight line (C in Fig. 3), but having a much greater ordinate. In other words, we then obtain a substantially representative voltage for all frequencies, but of considerably diminished value. But this is of no consequence, since it is easily possible to amplify the output. Actually, it is quite possible to devise some combination of resistance, inductance and capacity which can be placed, for example, in parallel with the line, having a frequency characteristic somewhat similar to that shown in Fig. 3. The general form of the curve shows us that we want to increase the effect of the higher frequencies, and diminish that of the lower frequencies. Actually, the problem may frequently resolve itself into that of diminishing a very large proportion of the lower frequencies. With a known line characteristic the actual arrangement required can be calculated from the ordinary resistance, capacity and inductance formulæ.

This form of correction should preferably be applied to the telephone line, but it is obvious that a somewhat similar effect can be obtained if we apply the corrector either to our amplifier, or to the output of the loudspeaker. The very simplest form of circuit is shown in Fig 4, in which an inductance L is put across the line or the loud-speaker leads, and the loud-speaker is connected across this through a capacity C. By reducing the size of the condenser C the lower frequency potentials applied to the loud-speaker are considerably reduced, because the

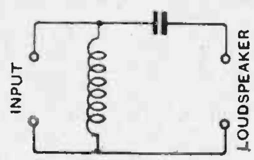


Fig. 4.—Simple circuit for correcting effects of line distortion in the loud-speaker. The values of inductance and capacity are adjusted to suit individual circumstances.

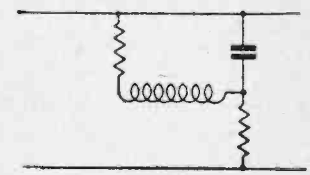


Fig. 5.—Correction circuit capable of dealing with most forms of distortion introduced by land lines.

impedance of the circuit is inversely proportional to the frequency. Similarly, by reducing the value of the inductance L, the value of the lower frequency potentials can be diminished, since the impedance is directly proportional to the frequency. The introduction of a device such as this will cause quite an appreciable correction, but obviously will not correct a line characteristic such as that shown in Fig. 2. A network of the type shown in Fig. 5, comprising two resistances, an inductance and a capacity will bring about a correction which will probably be found sufficiently accurate for most purposes. The calculation of the values is not a very difficult matter once the line characteristic is known, but since, in the case of a relay transmission, the listener has no knowledge whatever of this characteristic the correction must of necessity be found by trial and error.

Some Practical Suggestions.

An arrangement similar to Fig. 5 has been found by the writer to be very convenient for correcting line characteristics. It is shown in greater detail in Fig. 6, and it will be seen that it consists of two tapped resistances, a tapped inductance with a movable iron core, and a bank of fixed condensers. The whole is mounted in one box for convenience, various tapping points being brought out to sockets, wander plugs being used to connect the desired section in circuit. The resistances are preferably wound from good quality resistance wire, the winding, of course, being non-inductive. The inductance may comprise either a number of sections from an "Ideal" transformer, or a number of "Igranic" slab coils, any form

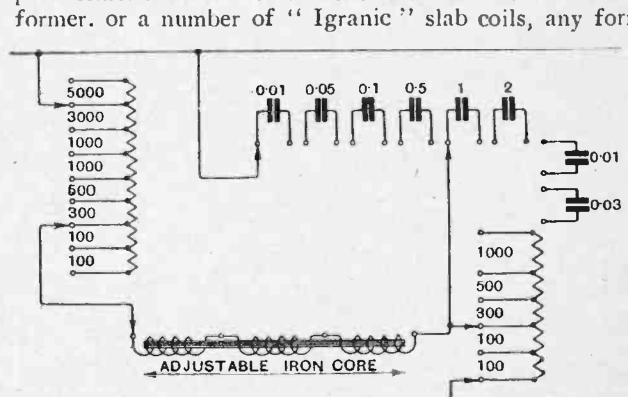


Fig. 6.—Practical circuit for connection across loud-speaker leads.

Distortion in Land Lines.—of laminated iron core being suitable. It is important that the iron core should be of sufficient size, as otherwise it may become saturated. It need not, of course, be as large as that of an ordinary transformer, since the actual steady current flowing through the winding is smaller than that in the anode circuit of a valve. The steady current, of course, is divided between the loudspeaker and the inductance.

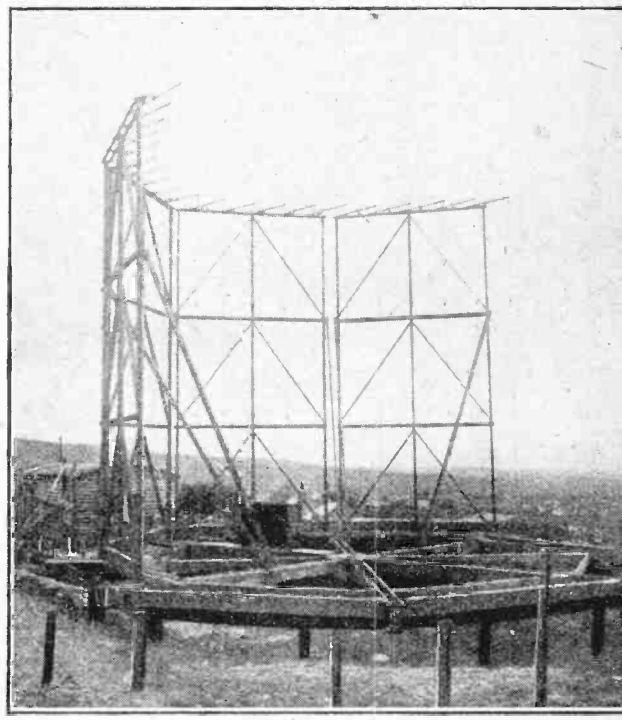
The reader who cares to make up the device on the lines described will, no doubt, be surprised at the very great improvement in tone which will result. In fact, a large proportion of the general sort of "wooliness" which usually accompanies relayed transmissions can be very materially improved, and the effect is most marked if the corrector be suddenly disconnected from the circuit. It is a matter of interest to note that if, when the best correction has been determined, the values of the various components are noted by plotting the frequency characteristic of the network, and taking the inverse a first approximation to the characteristic of the B.B.C.'s line and amplifiers is obtained.

THE WIRELESS BEAM.

A Note on the Work of the Pioneers.

By N. WELLS, M.Sc.

THE subject of short-wave wireless communication has emerged from the bud of interesting possibility and expanded into a flower of achievement and goodly promise, recent results having encouraged amateurs, stirred capitalists, and even stimulated Government Departments; yet it is only fair to recall that as early as 1916 a small band of engineers followed Senatore Marconi's lead and devoted themselves to a painstaking study of the application of very short waves. Amongst these pioneers first place must be given to Mr. C. S. Franklin, whose genius and foresight have been such a large factor in raising the subject to a level of practical utility.



Aerial and reflector used in beam experiments at Carnarvon, October, 1919.

Advantages of Short Waves.

By means of short waves communication has been established between this country and the Antipodes with only a fractional expenditure of the power hitherto deemed necessary, and while the underlying principles are still a matter for speculation there are certain definite features relating to the aerial, which account in part for such results and which may be described briefly somewhat as follows:

For short waves the length of aerial is in direct proportion to the actual wavelength used, a fact which gives it the property of high radiation together with an efficiency of almost 100 per cent.—incidentally the former property tends to reduce the cost of commercial wireless, since an aerial system of quite small dimensions can deal with a large power input. Another point is that the angle of propagation from a short wave aerial is controllable and energy may be projected upwards to that magic mirror known as the Heaviside Layer, at such an angle that the wave will be reflected or refracted back to earth and produce good signals at some far distant receiving station. Also, the Heaviside effect is kinder to short waves than to long, recording a truer likeness; in other words, the received signals are generally less distorted.

Finally, owing to the dimension of short waves it is possible to take advantage of "phasing," and by suitably arranging a system of aerials on a framework, to concentrate and reflect wireless energy into a beam. This last feature is perhaps the most interesting and important, so it may not be out of place to conclude this brief note with a somewhat non-technical explanation of the formation of a wireless beam.

Let a dot represent the position of a simple aerial, and evenly spaced radial lines the energy streaming away broadcast (Fig. 1a). Next imagine the wire of the aerial to be replaced by a copper tube of large diameter, say, 60 feet (Fig. 1b); this abnormal aerial in no way affects the direction of radiation and so we may regard the energy as streaming from the outer surface of the copper tube.

The Wireless Beam.—

If, now, the cross-section of the tube is flattened (Fig. 1c), it will be apparent that radiation is no longer broadcast, but is becoming concentrated fore and aft, while if we flatten the tube right out to form a strip some 95 feet long, radiation becomes still more concentrated fore and aft; in the limit, when the strip is indefinitely extended, radiation takes place entirely at right angles, as sketched in Fig. 1d. This idea of space radiation is the underlying principle of the wireless beam, only the flat strip is replaced by a row of aerials, and, by means of a second and somewhat similar row placed behind the first, the aft beam is projected into the forward beam and both combine into a single shaft of energy. The longer the two rows of aerials, the more perfect the concentration of energy.

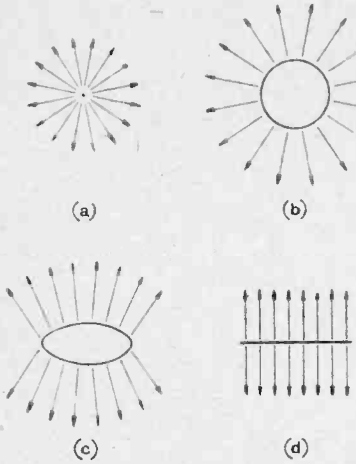


Fig. 1.—Evolution of the beam aerial.

Empire Beam Wireless.

At the present moment beam stations are under construction in this country, in Africa, Australia, Canada and India, and it is hoped that at an early date our Empire will be linked up by direct lines of radio communication. The first tests conducted on a large scale have amply justified the faith of the pioneers, and a service with Canada is already in operation.

TRANSMITTERS' NOTES AND QUERIES.

Duplex Telephony between America and England.

With reference to the note on page 807 of our issue of December 15th, other correspondents inform us that they have overheard duplex telephony between the United States and England.

A correspondent at Billinghurst, Sussex, heard the American station from 1330 G.M.T. onwards on December 14th, the strength being about R4 on a 1-valve straight circuit with a 10-foot indoor aerial. He identifies the station as U 2XG working on 22.5 metres.

Another correspondent in London heard the same station on November 27th between 8.0 and 10.0 p.m., and again the following morning at about 9.30 a.m. transmitting on 33.75 metres.

U 2XG is, we believe, the experimental station of the De Forest Radio Co. in New York.

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Free State Short Wave Record.

Mr. D. G. Kennedy (GW 14C), of "The Irish Radio and Musical Review," has succeeded in creating a new record in short-wave transmission for the Irish Free State. Mr. Kennedy communicated with SS 8MAX (Straits Settlements), using a power of 10 watts, and working on a wavelength of 45 metres.

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Reception of American Broadcast Stations.

A correspondent at Bury St. Edmund's states that on November 12th, at 0930 G.M.T., he received U 2XG on an Armstrong super with a 4 ft. aerial and no earth or counterpoise, at a signal strength of R4 to R6. He also received KDKA on a 20-metre wavelength under the same conditions, as well as Königswusterhausen on about 50 metres. No trouble was experienced with atmospherics, but fading was observed with KDKA at about half-minute intervals.

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General Notes.

S.S. "Derbyshire" (GLYX), now used as an R.A.F. troopship outward bound for Basrah and Karachi, is fitted with a short-wave set transmitting on about 38 metres. The operator will welcome reports from listeners.

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Mr. K. S. Wakefield (P 6PE) is testing nearly every evening on wavelengths between 35 and 43 metres, using an input of 20-30 watts. He will be very glad of any reports on strength, fading, note, etc., and will always answer QSL's. Reports should be enclosed in an envelope addressed to him at Quinto Nova, Carcavellos, Portugal.

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We always welcome information regarding "QRA's Wanted," but would ask readers who reply to verify their accuracy as far as possible. An anonymous correspondent has sent us two of the QRA's asked for on page 807 of our issue of December 15th, one, for G 6IW, gave the address of the Leeds Y.M.C.A., who advised us some time ago that they had given up their licence; the other, for G 2WL, gave the address of G 6WL at Lewisham. Well-meant misinformation often gives considerable trouble.

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New Call-signs Allotted and Stations Identified.

G 2AGB (Art. A.) J. E. Rawnsley, 3, South View, Guiseley, near Leeds.

G 2HJ (ex 2BMM). K. E. B. Jay, The Quinta, Elm Close, Amersham, Bucks; transmits on 8, 23 and 45 metres and welcomes reports.

G 5UY D. B. Fry, "The Laurels," Mayfield, Sussex; transmits on 45 metres and welcomes reports.

G 6HM (Ex 2BVO). H. F. Malcher, Station House North Ealing, W.5; transmits on 45, 90 and 150-200 metres and will welcome reports chiefly on telephony transmission. (This call-sign was formerly held by H. E. Daft, at Peterborough).

GI 2AFD R. S. Holden, 115, Glenwood Street, Belfast (change of address).

P 6PE K. S. Wakefield, Quinta Nova, Carcavellos, Portugal, transmits on 35-43 metres.

Books Received.

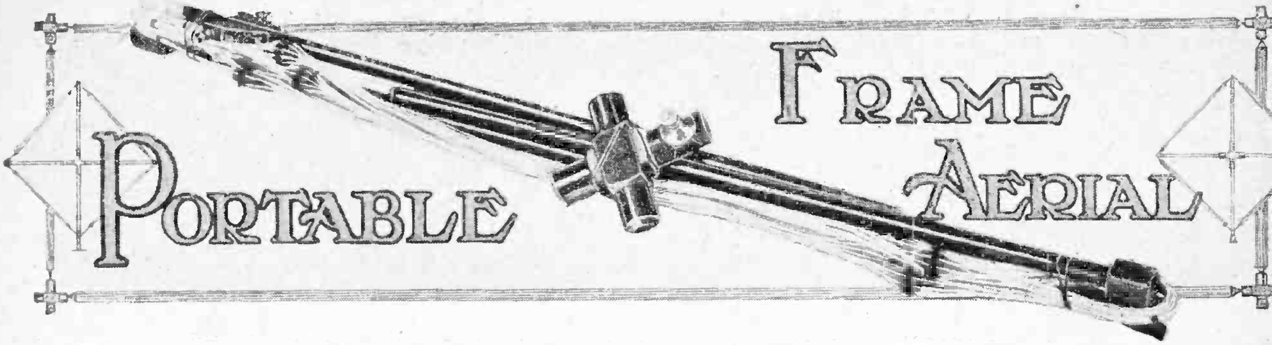
"Television," by Alfred Dinsdale, A.M.I.R.E. A brief description of the early experiments of Van Szezepanik, Rosling, Mihaly, and the more recent achievements of Belin & Holweck, Jenkins and Moore, and J. L. Baird. 62 pages, with numerous photographs and illustrations. Published by Sir Isaac Pitman & Sons, Ltd., London, price 2s. net.

"Our Radio Programmes. What is Wrong, and Why," by Corbett-Smith. Pp. 38, published by J. Bale, Sons & Danielson, Ltd., London, price 1s. net.

"Pitman's Radio Year Book, 1927," contains numerous articles on subjects of interest to amateur experimenters by well-known writers, including an account of the B.B.C. Wireless during 1926 by Capt. P. P. Eckersley, and Television, by Mr. J. L. Baird. Pp. 176, with numerous illustrations and diagrams. Published by Sir Isaac Pitman & Sons, Ltd., London, price 1s. 6d. net.

"Les Ondes Electriques Courtes," by R. Mesny. A short treatise on the theory and practice of transmission and reception on short waves, with a chapter on laboratory experiments on very short waves. Pp. 163, with 68 illustrations and diagrams. Published by Les Presses Universitaires de France, Paris. Price 30 francs.

"Quartz." A summary of the applications of the Piezo-electric effect in radio engineering, by A. Hinderlich. Pp. 16, with 5 diagrams. Published by BCM/N 2ND, London, price 1s.



Portable Frame Aerial

A Neat Design Executed with Simple Materials.

THERE are many occasions when the need is felt for a frame aerial either for ordinary reception purposes or for experimental requirements, and it is always well to have one available. As, however, the frame aerial is rather bulky and awkward to accommodate, unless it is designed so as to be collapsible when not in use, it is best to decide at once before constructing that the first essential is that the frame must be demountable and portable. A special point of the present design is the simplicity with which the frame can be assembled for use.

The illustration, Fig. 1, shows the frame aerial set up for use, whilst in the picture at the top of the page the frame is shown dismantled. The framework consists of four wooden rods fitted into holes in a centre block of wood, the outer ends of the rods supporting the wires of the frame aerial. Rods for the purpose can be obtained at any wood yard or builders' suppliers, and is known as "dowelling." Three lengths of rod of 17in. each and ⅜in. diameter are cut off for the top and side supports respectively, whilst the fourth length, which supports the frame aerial as a whole in addition to carrying the wires, should be 19½in. in length. The details of these supports are given in Fig. 2. It will be seen from Figs. 2 and 3 that the 17in. rods carry ebonite heads, A, which are grooved with ¼in. slots so as to carry the wires of the frame in position. These heads are drilled ⅜in. dia. so that the rods fit tightly. B and C in Figs. 2 and 3 carry the wires of the frame aerial in the grooves, the wires in this case being separated on either side of the rod. These blocks also carry terminals for terminating the ends of the frame aerial wires and to carry the connections to the frame. The end of the 19½in. rod which fits into the centre wood block should carry a brass sleeve for a length of 1¼in., as indicated, the purpose of this being to protect the end of the rod which has to be gripped by a grub screw in the centre block shown in Fig. 4. This centre block must be of good hard wood and a 3in. square block of 1in. thickness will serve the purpose. At D this block should be drilled with a ⅜in. drill so that the rods fit tightly into the sockets so provided. A neater appearance will be obtained if the corners of the square block are cut off, as indicated in Fig. 4, whilst those who aim at still

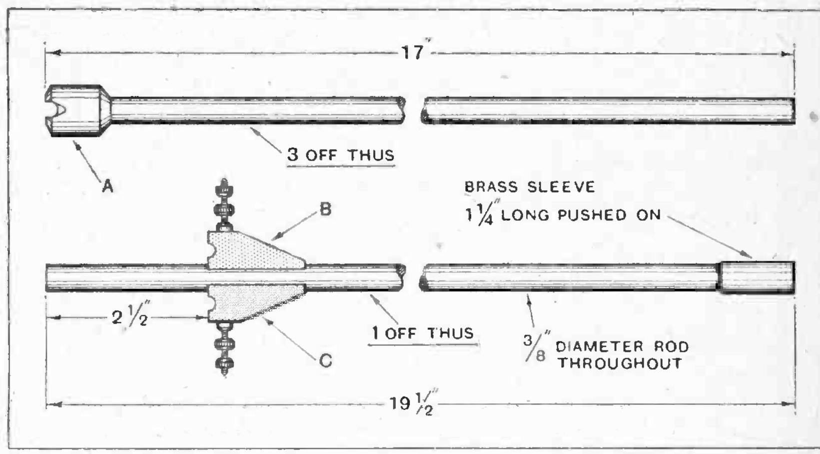


Fig. 2.—Details for the rods to support the frame aerial wires.

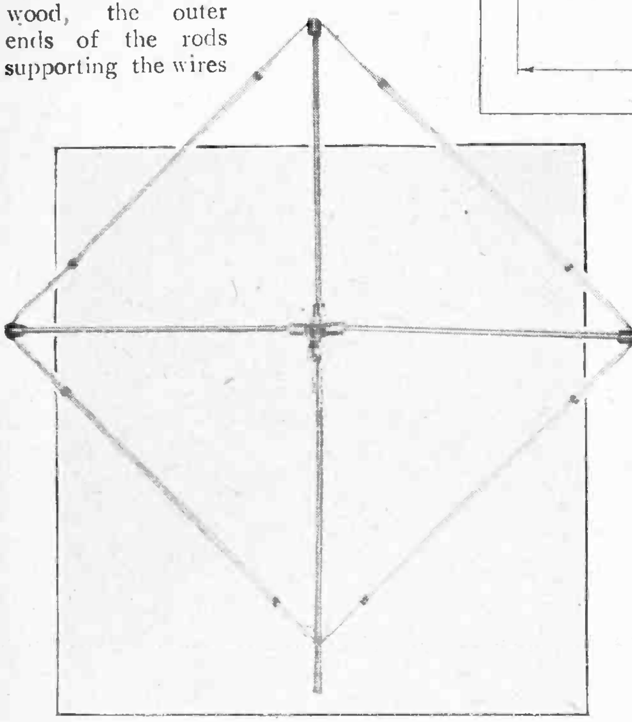


Fig. 1.—Photograph of the frame aerial assembled.

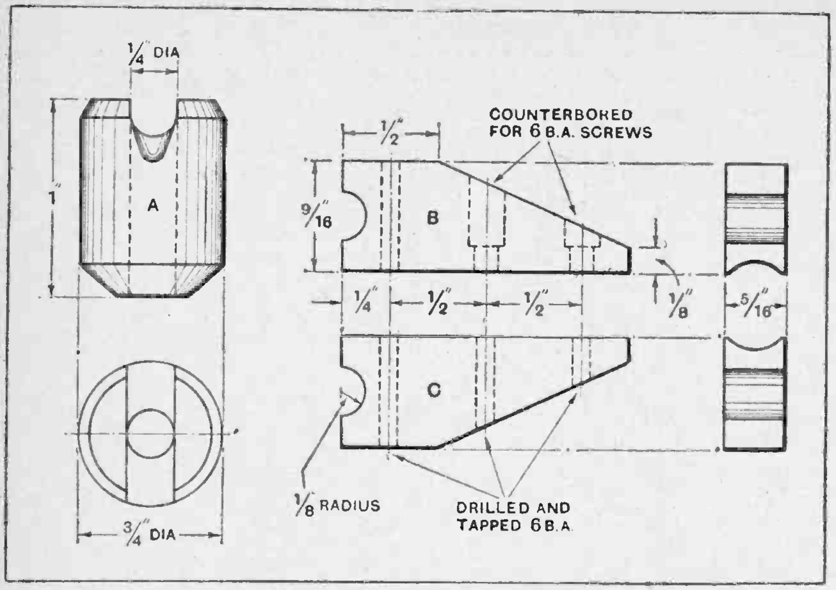


Fig. 3.—Dimensions and details of the ebonite heads A and blocks B C which carry the frame aerial wires.

greater neatness can, if they desire to do so, carve out the centre in the way shown in the photographs, but this, of course, is only a matter for individual taste and is not essential. The wires of the frame are No. 24 S.W.G. D.C.C. wire, and at first it may seem rather strange to use non-flexible wire for such a purpose, but actually, as there is very little bending of the wires to be done, their rigidity is an advantage, as it prevents the wires from getting tangled up when the frame aerial is demounted for portability.

Spacing the Wires.

For the broadcast range 10 wires will be required, and reference to Fig. 1 will show how the wires are separated out by means of little ebonite spacers constructed of ebonite tube with grooves cut to take the wires. When the wires have been fitted into the grooves they are bound round with cotton to hold them in place, a groove being provided round the circumference of the spacer to prevent the cotton from sliding off. To put up the frame the four rods are fitted into the centre block and the wires are then put round the frame in the grooves in the heads of the rods. Then to tighten up the frame wires the supporting rod, which should normally be just slack in its slot, is pulled out a little from the centre block, and when the requisite tension of the wires has been obtained the grub screw G, Fig. 4, is set to prevent the supporting rod from slipping back further into the centre block.

There are, of course, alternative methods of mounting the frame on a base so that it is rotatable, and the best mounting arrangement will often depend upon whether it is desired that the frame aerial should be fitted to the top of the set or rest on an independent base. Where it is required that the frame should rest on the top of the cabinet a very neat arrangement is shown in Fig. 5.

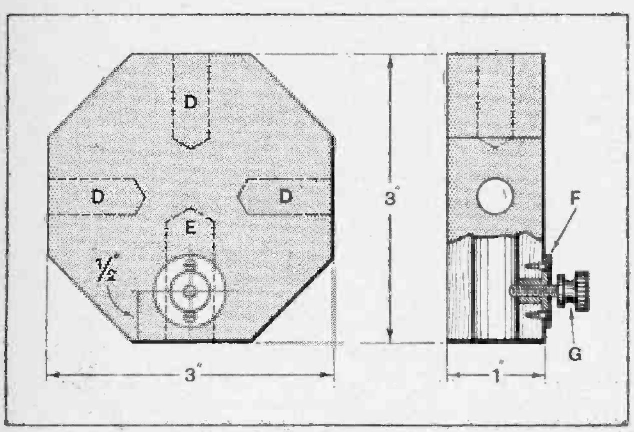


Fig. 4.—Details of the wooden centre block. D=⅜" dia. 1" deep, E=1" dia. by 1¾" deep to take brass sleeve, F=brass bush, G=grub screw.

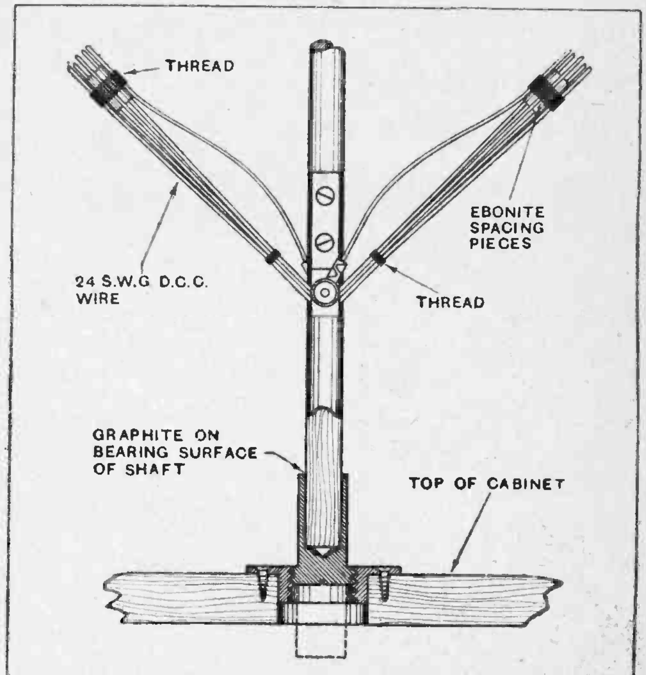


Fig. 5.—The base of the frame aerial showing one method of supporting on the top of the cabinet.

Here a brass socket carries the rod of the frame, this socket screwing into a brass fitting on the top of the cabinet. When the frame is removed the socket can be unscrewed and reversed so that it does not project above the top of the cabinet. The average constructor would be obliged to have a brass fitting of this nature made for him, whereas no other part of the frame requires tools beyond those ordinarily available. If the frame aerial stands on an independent base this can be a block of wood of convenient dimensions with a ⅜in. hole drilled into the centre and carrying a piece of brass tube in which the shaft of the frame aerial can rotate. H. H.

Oscillators and the Post Office—2LO in America ?—Liquidating the B.B.C.—Spark Sets to Go ?—Progress in Norway—" Past and Present."

The Post Office Offensive.

My remarks last week on the "offensive" which is now being planned at St. Martin's-le-Grand for the confusion of ether hogs, oscillators, unlicencees, and other foul fry, are confirmed by the news that two Post Office "wireless tenders" will shortly join in the fray. These delightful vehicles are *not*, I understand, emblazoned with crowns and "G.R.s," nor are they disguised as coffee stalls, laundry vans, or even as "Black Marias."

In future, therefore, we must avoid hasty conclusions when our neighbour is visited by a plain van. It may contain strange "furniture."

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Help from Savoy Hill.

No doubt, when the Post Office opens its campaign, the B.B.C. engineers will be asked to co-operate in locating areas which are on the black list. During the past few months the B.B.C. has had ample opportunity for collecting evidence, letters of complaint have been received to the tune of fifty or sixty per week.

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"Examples."

At the present moment oscillation is so serious that the Post Office probably realises that, unless something is done to counteract the mischief, many people may refuse to renew their licences through sheer discontent. The difficulty of tracking an oscillator even with the best of D.F. equipment is enormous, and the authorities will probably consider themselves lucky if they land one fish a week. But when they do. . . . Poor fish!

The first offenders caught will probably be treated as "examples."

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A 2LO in America ?

The existence of a mystery station in America using the call-sign 2LO is suggested by several letters which have reached Savoy Hill from listeners in the U.S. The natural inference that some station over there has been relaying London's transmissions is vetoed by the fact that the mystery call is heard at midnight, or 5 a.m. G.M.T. Is it possible that our American friends are hearing 3LO, Melbourne?

No Change.

From the general atmosphere at Savoy Hill it is fairly obvious that broadcasting policy in 1927 will be unchanged despite the accession of the new Corporation. It is sufficient to remark that Mr. J. C. W. Reith still holds the reins of executive.

FUTURE FEATURES.

Sunday, January 2nd.

LONDON.—Military Band Programme.

BIRMINGHAM.—Third Concert of Beethoven Centenary Series.

CARDIFF.—Programme of Instrumental and Vocal Trios.

Monday, January 3rd.

MANCHESTER.—London Radio Repertory Players present "A Sharp Attack."

GLASGOW.—Scottish Town Series—Ayr Programme.

Tuesday, January 4th.

LONDON.—"Dainty Diana," first performance of a new Musical Comedy in two acts.

DAVENTRY.—B.B.C. International Concert—France.

ABERDEEN.—"In Bohemia."

BELFAST.—"The Bridge," Dramatic Episode in one act.

Wednesday, January 5th.

LONDON.—"My Programme," by one of the Orchestra.

BIRMINGHAM.—Schubert Programme.

NEWCASTLE.—"Landing the Shark," by Vivian Tidmarsh.

Thursday, January 6th.

LONDON.—Chamber Music.

DAVENTRY.—"Lays O' London."

Friday, January 7th.

LONDON.—"Maud," Song Cycle sung by Frederick Ranalow.

MANCHESTER.—"The Vow," by Gilbert Parker.

GLASGOW.—"Fire," by A. J. Alan.

Saturday, January 8th.

LONDON.—"Winners."

NEWCASTLE.—Concert relayed from the Royal Victoria Infirmary.

Liquidating the B.B.C.

Shareholders in the British Broadcasting Company are not likely to be kept waiting long for an account of the Company's stewardship, for I hear that the one man who knows more about the Company's affairs than anyone else, viz., Mr. Reith, has been appointed liquidator. Early in the New Year a complete balance sheet will be made available for the period ending December 31st. The people who are most to be envied are the new Governors, who will find from the balance sheet that they are taking over a "going concern."

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Who Made the Appointments ?

How many people who were present at the B.B.C. dinner observed Mr. Baldwin's amazing lapse of memory in his reference to Mr. Reith? The Prime Minister actually stated that he had forgotten what was Mr. Reith's new title. This leads one to ask who made the new appointments.

A significant passage occurred in the speech subsequently given by the Postmaster-General, Sir William Mitchell-Thomson, who alluded to his long-standing acquaintance with the former headmaster of Winchester, Dr. Montague Rendell, who, incidentally, occupies a seat on the Corporation. The association is somewhat remarkable; in fact, it would be interesting to know just what part, if any, was played by the P.M.G. when the Corporation was formed several months ago.

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Black Policemen.

The Metropolitan Police Minstrels are to give half an hour of nigger minstrelsy from 2LO on January 3rd.

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Bravo, Dogmersfield !

On the principle that "Full many a gem of purest ray serene, The dark, unfathom'd caves of ocean bear," the B.B.C. is constantly on the alert to discover hidden talent. One such find has been made at Dogmersfield, Hants, where a toy symphony band exists of great local repute. This band has been invited to give a performance at 2LO, whence it will be broadcast on January 21st.

A Policeman's Life.

"A Day in the Life of a Policeman" is the topic for broadcasting at 7.10 on December 31st. This will be given by a member of the Force.

Spark Sets to Go?

Listeners who consider that their enjoyment of broadcasting programmes is marred to a greater extent by morse interference than by foreign stations' heterodynes will be glad to know that an international law will probably be made at the Washington Conference, 1927, prohibiting the installation of spark transmitters on ship or shore, except in very special circumstances.

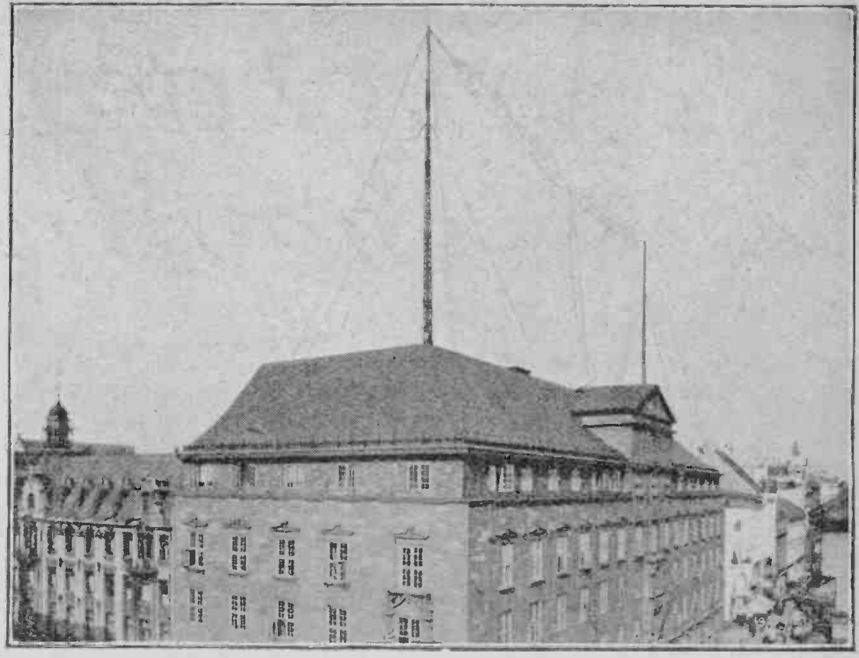
Broadcasting the Boat Race.

Not everybody seems to realise the enormous power which the new Corporation will enjoy in the matter of news. During 1927 we shall doubtless enjoy broadcast descriptions of the Boat Race, the Derby, and a score of events of a kind which the present B.B.C. has been obliged to let slide under agreements with the newspaper interests.

Despite the natural trepidation which this new freedom has kindled in Fleet Street, I understand that the broadcasting and news interests will work in close agreement, with a minimum of encroachment.

Notes on Norway.

Because Norway is situated in a cold, and sometimes forgotten, corner of Europe, it should not be thought that she has neglected the possibilities of broadcasting. Indeed, her people are discovering more and more that wireless is peculiarly suited to the needs of the country, and the discovery has resulted in the establishment of a noteworthy broadcasting system. The difficulties encountered have been considerable, owing to the mountainous nature of the country and to the poor land lines, which were never intended for broadcasting purposes.

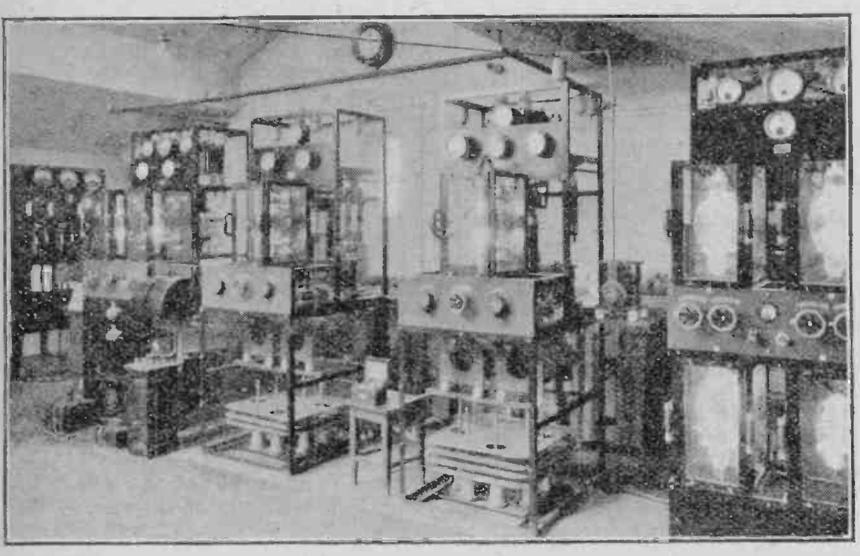


A FAMOUS NORWEGIAN STATION. A new photograph of the Oslo broadcasting station which is so often heard by British listeners. The transmitter is installed in the General Post Office building, seen above. The copper roof is used as a counterpoise.

Oslo and Bergen.

The principal broadcasting station is that at Oslo, which operates on a power of 1.5 kw. and feeds a number of small relay stations. Bergen is the only other station in Norway with a power approaching that of Oslo. For some time past there has been close co-operation between the Norwegian and Swedish stations, and on several occasions Oslo and Stockholm have been inter-relayed by land lines.

Many Norwegian amateurs listen direct to foreign broadcasting. A correspondent tells me that in the western and southern parts of Norway the British stations are received better than any other of the foreign stations, Newcastle and Glasgow coming in at particularly good strength.



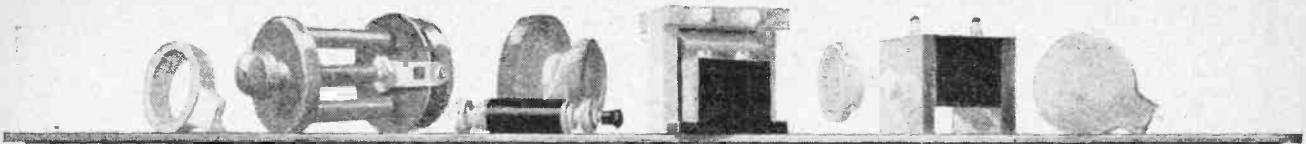
THE TRANSMITTER AT OSLO. Operating on a wavelength of 461.5 metres, the Oslo station employs a transmitter of the well-known Marconi "Q" type, with a power of 1.5 kilowatts. The photograph gives a general view of the transmitter and switchboard.

An All-England Festival.

Parts of the All-England Festival Performance arranged by the English Folk Dance Society will be relayed to 2LO and 5XX on January 1st from the Royal Albert Hall. The broadcast will include massed country dancing by three hundred of the performers; a traditional sword dance from Winlaton, County Durham (first performance in London); ceremonial dances; Morris dances by the London demonstration staff, and general singing conducted by Dr. R. Vaughan Williams.

Then and Now.

Despite our modern pride in the progress of the age, we are naturally retrospective, and nothing delights us more than to gaze back through "the corridors of time." To satisfy this desire the B.B.C. is staging a "Past and Present" programme, which will be given on January 22nd. It will be divided into two episodes, the first representing "A Victorian Drawing Room" and the second "A Modern Revue."



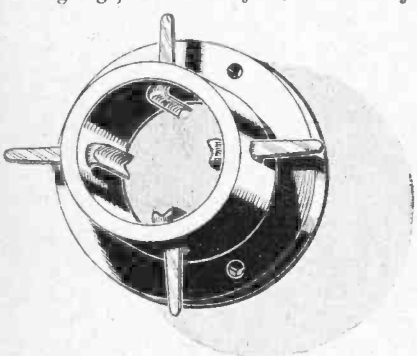
REVIEW OF APPARATUS

Latest Products of the Manufacturer.

THE EXCELSIOR VALVE-HOLDER.

Probably the cheapest valve-holder on the market is that made by the Excelsior Motor Co., King's Road, Tyseley, Birmingham.

In spite of its price it is well made and might be chosen for incorporating in a set entirely on its merits. The contacts are supported on a clean moulding, capacity being kept to a minimum. The four shaped springs which make contact with the valve legs are continued after passing through the moulding to form the connecting tags, so that no joint is necessary



The contacts of the Excelsior valve-holder are assembled around a hollow cylinder.

between the metal of the spring connector and its tag. Care is needed when inserting the valve in the holder to avoid making contact between the filament pins and the tag of the plate circuit, which will, of course, burn out the filament, but this risk must be guarded against with very many of the valve-holders on the market.

The valve-holder is supplied with three screws and nuts for securing to the baseboard.

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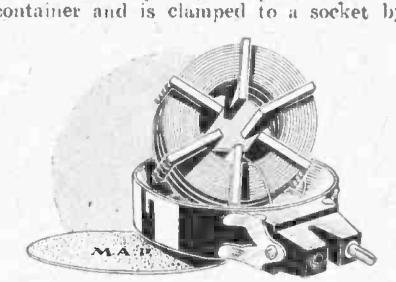
M.A.P. TUNING COILS.

The plug-in coils of the M.A.P. Company, 246, Great Lister Street, Birmingham, are wound in the form of a number of flat single layer windings which are series-connected. In the case of the "50" coil, for instance, four 12-turn coils are wound edgewise turn on turn in the slots of six ebonite spacers. The wire with its covering is moderately thick and fits tightly into the slots so that the turns build up one over the other. This is a form of construction which has been shown to produce a good coil possessing particularly low losses.

The coil is protected by a cardboard container and is clamped to a socket by



The M.A.P. coil is wound on six ebonite spacers the turns being assembled in vertical slots.

means of a black celluloid band. The socket is a clean Bakelite moulding of novel design.

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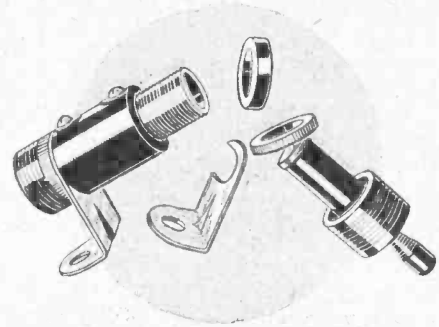
HARMO PERMANENT DETECTOR.

An ebonite tube is provided to totally enclose the detector unit, the detector contacts being carried in a smaller tube. The crystal can be easily withdrawn for inspection either when the detector is mounted on the front of the panel, through the panel, or on the baseboard.

The principal feature of the design is the accessibility which is provided when the detector is mounted through a hole in the panel. By unscrewing the top the complete detector unit is withdrawn without disturbing the contacts between the crystals. It can then, if necessary, be tested, adjusted and reinserted in position, still maintaining a good setting for the contacts. A spring plunger adjustment is also provided.



The Harmo detector. If mounted behind an instrument panel the detector unit can, when required, be completely withdrawn from the front for adjustment. The crystals are contained in the ebonite tube shown on the right.

Two clips are supplied for baseboard mounting, and contact may be picked up either from these supporting clips or by making connection to two small soldering tags.

The ebonite parts are turned and polished and the nickel-plated clamping-down screws are knurled, giving the detector a particularly good appearance.

The crystals with which the detector is fitted are both stable and sensitive.

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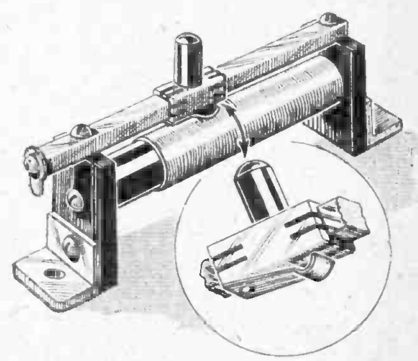
BASEBOARD VARIABLE RHEOSTAT.

It is generally the aim to limit the number of controls on an instrument panel and the tuning adjustments are all that are usually required. Filament rheostats are often mounted on the baseboard behind the panel and fixed resistances, therefore, often take the place of the variables formerly used.



The Loriostat baseboard mounting rheostat.

It is convenient, however, to be able to make an adjustment of the filament current, and provision for this is made in the Loriostat made by A. W. Stapleton, 19a, Lorrimore Buildings, Lorrimore Street, London, S.E.17. The resistance wire, which is enamel-covered, is wound on an insulating rod and mounted with ebonite end pieces and brackets. The rubbing contact is well designed, spring pieces being provided to make firm contact with all four faces of the slider. Good contact is obtained between the resistance winding and the spring of the rubbing contact.

This component is well finished, the brass parts being nickelled, and has a particularly neat appearance. The resistance is supplied in values of 6, 15 and 30 ohms with a current carrying capacity of 1.25, 0.75 and 0.6 amperes respectively. In addition, models are obtainable in which any number of rheostats up to 6 are assembled side by side for individually controlling the filament current of each of the valves in a multi-valve set.

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SHORT-WAVE SUPERSONIC RECEPTION.

The performance of a superheterodyne receiver depends essentially upon the design adopted for the intermediate couplings and the home constructor can be assured of obtaining success with his set if he incorporates a unit embodying the H.F. transformers already connected up to the associate valve holders.

The McMichael five-valve supersonic unit, a product of L. McMichael, Ltd., Wexham Road, Slough, Bucks, is already well known to many readers. It can now be readily adapted for short-wave reception and a blue print is obtainable showing the circuit adaptions necessary for reception on the wave band of 25 to 100 metres. An autodyne circuit is employed in which the first valve serves as detector and local oscillator.

The blue print shows the use of a "Dimic" coil loosely coupled to a "Unimic" coil connected to an external aerial, as apart from the usual tuned frame.

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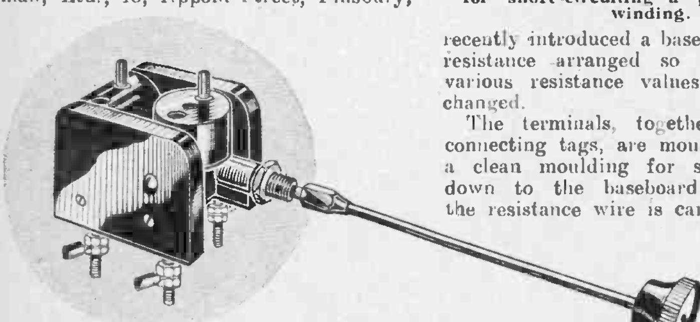
NEW GEARED COIL-HOLDER.

There are comparatively few coil-holders which are suitable for mounting either on the front of the receiving set or if mounted behind the panel can be operated by a knob from the front. The new Critic coil-holder of Franklin and Freeman, Ltd., 13, Appold Street, Finsbury,



The Critic coil holder fitted with worm and segment gearing and a reversing action for the fixed coil.

London, E.C.2, is arranged for mounting either in front or behind the instrument panel and is supplied with an extension handle so that it can be mounted, if need be, well behind other apparatus. The moving holder is operated through a worm and segment, backlash being prevented by a strong spring action which holds the pinions firmly in mesh.

If any system of reduction gearing is incorporated for providing critical control there is always the danger of straining the pinions when the limit of movement is reached. In this holder, however, the worm slips on the segment when the holder is up against the stops.

Contact with the two holders is picked up from four screws attached to the side members and the use of flexible leads to the moving holder is avoided. Tinned soldering tags are supplied. The worm and segment drive are not in contact with either side of the moving holder and the operating shaft can be handled without introducing capacity effects. The fixed coil-holder can be revolved so as to reverse the direction of capacity coupling.

The many refinements which have been introduced appear to add nothing by way of giving the coil-holder a complicated appearance. The ebonite parts are not mouldings, but are cut from ebonite rod and sheet cleanly finished and polished. The metal parts are nickel-plated.

One-hole fixing is provided in addition to mounting by means of the four connecting screws.

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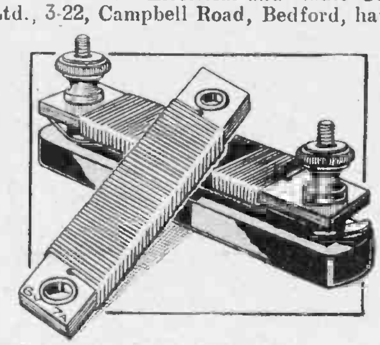
BASEBOARD RESISTANCES.

The Bedford Electrical and Radio Co., Ltd., 3-22, Campbell Road, Bedford, have



The Peerless baseboard mounting resistance with interchangeable resistance units. A spring contact is also supplied for inserting under one of the terminals for short-circuiting a portion of the winding.

recently introduced a baseboard mounting resistance arranged so that spools of various resistance values can be interchanged.

The terminals, together with connecting tags, are mounted on a clean moulding for screwing down to the baseboard, while the resistance wire is carried on a hard fibre strip and terminated on eyelets. When changing valves it is almost an equally simple matter to slack off the holding-down terminals and substitute a suitable resistance unit. A spring blade contact is supplied with each resistance, which may be clamped down under one of the terminals and serves to short circuit a portion of the winding to provide a critical resistance control when required.

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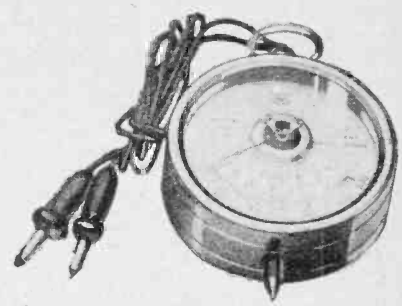
H.T., L.T. VOLTMETER.

It cannot always be inferred that a falling off in the performance of a receiving set is due to the discharge of a high or low tension battery, though the cause of poor results by way of range of reception or falling off in quality is usually due to the accumulator having become discharged or the voltage of the high tension battery having fallen.

Some indication as to the condition of



A useful testing battery voltmeter. Two scales are provided, reading to 7 and 120 volts.

the batteries is therefore essential, and to meet this requirement A. H. Hunt, Ltd., Tunstall Road, Croydon, have introduced a pocket type two range voltmeter.

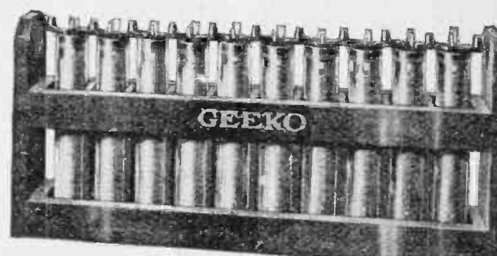
It is fitted with two scales reading to 7 and 120 volts, the readings being found to be accurate on both the high and low voltage ranges. The instrument, which is inexpensive, is of the watch type, has a nickel-plated finish, and is fitted with a pair of plugs for the two voltage ranges.

o o o o

GEEKO HIGH TENSION ACCUMULATOR.

A new type of H.T. accumulator battery has just been put on the market by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. It is built as a 20-volt unit, the tubular cells being carried in a durable wood crate. Cabinets fitted with plugs and sockets are obtainable to accommodate a number of units for setting up a high voltage battery.

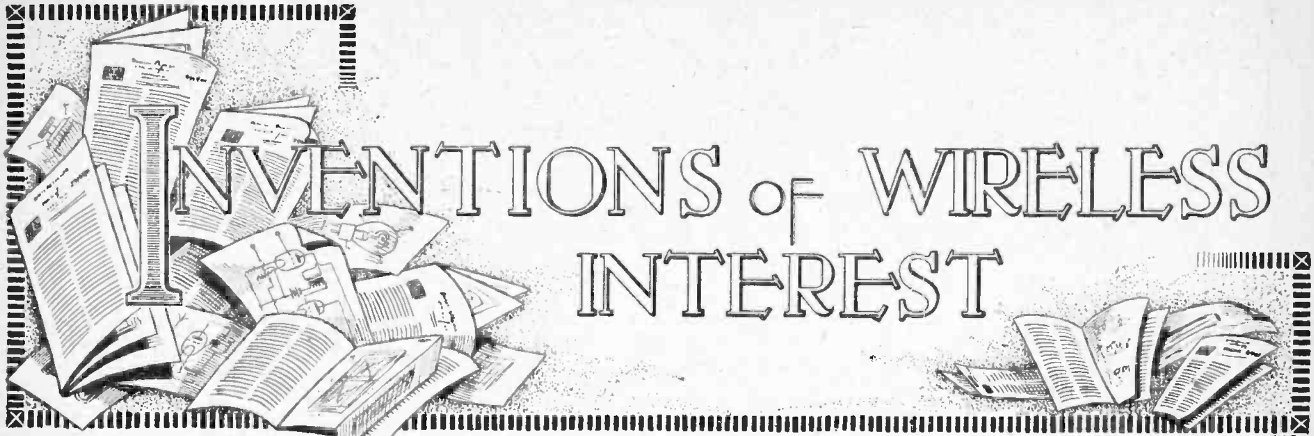
The capacity is 250 milliampere hours



The new 20-volt unit of the General Electric Company's high tension accumulator battery.

at a discharge rate of 15 milliamperes. Cylindrical glass containers are used, and separators are inserted between the plates. Tappings are provided at the junctions between the cells, and filling is rendered easy by the aid of a glass tube embedded in the crown of each cell.

Every care has apparently been taken to render the accumulator as foolproof as possible, and if the instructions as to maintenance are carefully followed it should give unvarying service with very little trouble.

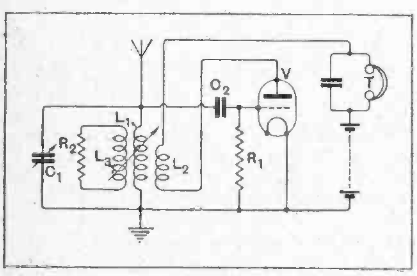


The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

Resistance Controlled Reaction.
(No. 260,359.)

Application Date, July 31st, 1925.

N. H. Clough describes in the above British Patent a method of controlling reaction by a variable resistance. The illustration shows an ordinary single-valve reaction circuit in which the input circuit consists of an inductance L_1 tuned by a condenser C_1 tightly coupled to a reaction coil L_2. The usual grid condenser and leak are shown at C_2 R_1 and the telephones at T. The coupling between L_1 and L_2 is sufficiently great to cause oscillations to be generated, the coupling, of course, being fixed. Variably coupled to the inductance L_1 is another inductance L_3 shunted by a variable resistance R_2. This resistance-controlled circuit consists of one or more turns of resistance wire or it may be one or more turns of copper



Resistance-controlled reaction. (No. 260,359.)

wire shunted by a resistance. The specification is fairly detailed, and shows various constructional arrangements which are found to be useful.

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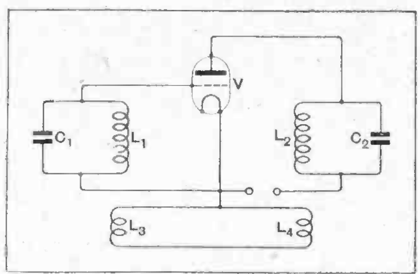
Neutralising Magnetic Coupling.
(No. 260,324.)

Application date, July 2nd, 1925.

P. W. Willans and the Igranic Electric Co., Ltd., describe in the above British Patent a method of neutralising magnetic coupling existing between the input and output circuits of a valve amplifier. Reference to the accompanying illustration shows a valve V provided with a tuned input circuit L_1, C_1, and a similar output circuit L_2, C_2. Normally, the



Circuit for neutralising magnetic coupling. (No. 260,324.)

position of the two inductances is such that there is an appreciable magnetic coupling between the two, sufficient to sustain the generation of oscillations. The effect of this coupling is neutralised by the inclusion of two auxiliary inductances L_3 and L_4. The inductance L_3 is tightly coupled to the inductance L_1, and the inductance L_4 is similarly coupled to the inductance L_2. The number of turns on the auxiliary inductances L_3 and L_4 is smaller than that of the main inductances L_1 and L_2. The inductances L_3 and L_4 are connected to form a closed circuit, and are arranged so that potentials transferred from the output to the input circuit tends to oppose any regenerative effect between the two circuits. A further feature of the invention is the earthing of the two inductances L_3 and L_4.

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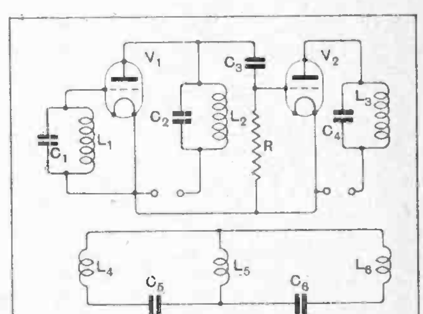
Neutralising Capacitative Coupling.
(No. 260,325.)

Application date, July 2nd, 1925.

The above British Patent, granted to P. W. Willans and the Igranic Electric Co., Ltd., is very similar to British Patent No. 260,324, in which is described a method of neutralising magnetic coupling. The present invention, however, relates to the neutralisation of capacitative coupling, which is brought about through inter-electrode capacity or stray capacity in the circuits. The arrangement is shown in the accompanying illustration as applied to a two-stage high-frequency amplifier. Two valves V_1 and V_2 are connected through the usual tuned circuits, the input of the system being an inductance L_1 tuned by a capacity C_1. The anode circuit contains an inductance L_2 tuned by a capacity C_2. The anode end of the inductance L_2 is coupled through a capacity C_3 and a grid leak R to the input of the valve V_2. An inductance L_3 tuned by a condenser C_4 is included in the anode circuit of the valve V_2, and the three oscillatory circuits are tuned substantially to the same frequency. The stabilising arrangement comprises three inductances L_4, L_5 and L_6, which are respectively coupled to the in-



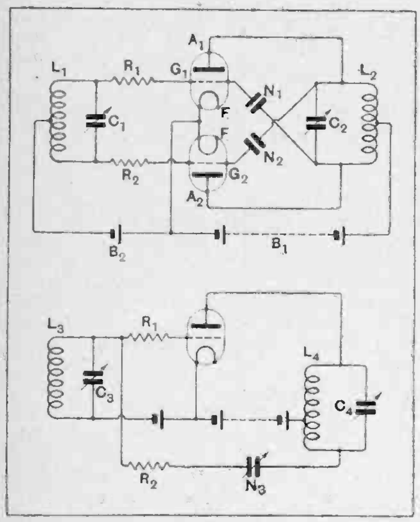
Circuit for neutralising capacity coupling. (No. 260,325.)

ductances L_1, L_2 and L_3. One side of the inductances L_4, L_5 and L_6 is common, while the free ends of L_4 and L_5 are joined through a capacity C_5, and the free ends of L_5 and L_6 are joined through another capacity C_6. The direction of the windings of L_4, L_5 and L_6 is so arranged with respect to the inductances to which they are coupled that the potentials induced by them into the main oscillatory circuits tend to oppose those which are introduced by regenerative effects.

Stabilising Amplifiers.
(No. 260,321.)

Application Date, June 29th, 1925.

The above British Patent granted to G. M. Wright and S. B. Smith relates to stabilising amplifiers of the neutralised type, two circuital arrangements being shown in the accompanying illustration. The specification points out that although a stage of high-frequency amplification may be perfectly balanced, secondary oscillations may be produced which pass from one tuned circuit through one valve, through the second tuned circuit and the second valve and back to the first circuit, the balancing condensers in no way preventing the occurrence of these oscillations. The essence of the invention lies in the use of series resistances, which prevent the secondary oscillations from occurring. One circuit shown is a two-valve push-pull amplifier, in which the input circuit consists of a centre tap inductance L_1 tuned by a condenser C_1, while the output circuit includes a centre tap inductance L_2 tuned by a condenser C_2. The anode potential is supplied through the centre tap of the inductance L_2, and the centre tap of the inductance L_1 is taken to the filaments and earth. The ends of the tuned circuit L_2 C_2 are connected to the two anodes A_1 and A_2, while neutralising condensers N_1 and N_2 are connected between the anode of one valve and the grid of the other respectively. The secondary oscillations are stopped by the inclusion of resistances R_1 and R_2 in the two grid leads, *i.e.*, in series with the grids and the end of the input circuit. A single-valve arrangement is also shown in which the input is an inductance L_3 tuned by a condenser C_3 with an anode circuit consisting of an inductance L_4 tuned by a condenser C_4. The input potential is connected through a tapping, while the remote end of the anode circuit is connected through a neutralising condenser to the grid of the valve. Stabilising resistances R_1 and R_2 are inserted as shown. For the system to be stabilised the product of the valve capacity and one resistance must be equal to the product of the neutralising capacity and the other resistance.

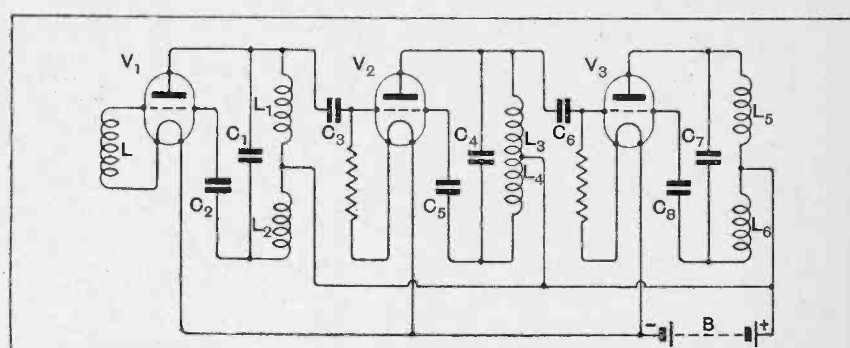


Stabilised amplifier system. (No. 260,321.)

Neutralised Amplifier.
(No. 260,036.)

Application date, July 20th, 1925.

The problem of stabilising a single stage of high-frequency amplification is not very difficult when the valve capacities are neutralised according to well-known methods. When, however, a series of stages is employed the problem is not so easy, since the whole system frequently tends to oscillate very readily, although each stage may be neutralised. H. J. Round describes in the above British Patent a modification in which this difficulty is overcome by the use of alternate astatic and non-astatic inductances in the anode circuits. The arrangement of the valves V_1, V_2 and V_3, is shown in the accompanying illustration. Here the input of the first valve comprises an inductance L, while the anode circuit contains an astatic inductance. This inductance comprises two parts L_1 and L_2 wound in opposite directions. The centre tap is taken to the usual high tension supply B, and the two portions are tuned by a condenser C_1. The anode end of the inductance L_1 is connected through the usual coupling condenser C_3 to the grid of the valve V_2. The free end of the inductance L_2 is taken through the usual neutralising condenser to the grid of the valve V_1. The anode circuit of the valve V_2 contains an ordinary centre tap inductance L_3, L_4, the anode end of which is coupled by a coupling condenser C_6 to the grid of the next valve V_3, the free end again being taken through the usual neutralising condenser C_5 to the grid of its own valve. Similarly, the anode circuit of the next valve contains another astatic inductance L_5, L_6, the arrangement being continued with alternate astatic and non-astatic coils. The actual inductance value of the halves of the astatic coils is much greater, of course, than the halves of the ordinary centre-tap coils, since the mutual inductance between the two is considerably less, and more inductance is required to enable all the anode circuits to be tuned to the same frequency.

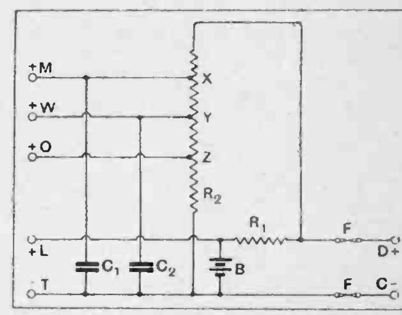


H.F. amplifier stabilised with the assistance of astatic coils. (No. 260,036.)

Mains Receiver.
(No. 258,931.)

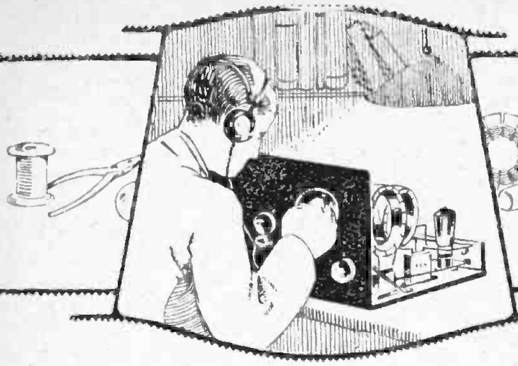
Appl. Date, June 29th, 1925.

A system of utilising the electric light supply is described in the above British Patent Specification by S. Iredale. The accompanying illustration shows a suitable circuit for the utilisation of direct-current supply. The supply mains shown at DC are taken through two protecting fuses F to a resistance R_1 which controls the filament current, and a floating battery B, which is connected across the filament supply at LT. The value of the resistance R_1, of course, is adjusted so that it delivers a suitable charging current to the accumulator, this current further being of the same order as that taken by the set. Another resistance R_2, from which the high tension supply is obtained, is connected across the supply mains, and is provided with tapping points X, Y, Z, from which alternative high-tension voltages can be obtained. The two tapping points X and Y are shunted by smoothing condensers C_1 and C_2, the alternative high-tension voltages being available at M, W, and O. In order to prevent a short-circuit occurring through the earth connection of the set, a high-insulation condenser is placed in series with the earth lead.



Circuit for supplying L.T. and H.T. current from D.C. mains. (No. 258,931.)

The specification also shows a similar circuit, in which the supply is obtained from A.C. mains, which are connected through the usual rectifying devices and smoothing circuits, both for filament and high tension supply.



Readers' Problems

"The Wireless World" Information Department
Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

A Simple Three-valve Broadcast Receiver.

Will you please give me a diagram of a three-valve receiver which is to include a tuning unit with reaction and two low-frequency transformers? V. ST. G.

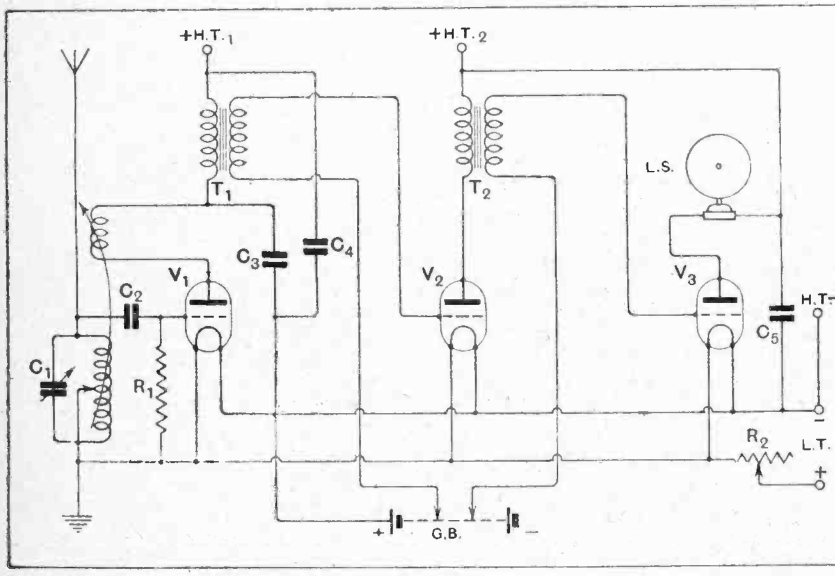
The diagram will be found on this page, and includes the components mentioned. An aerial tuning condenser C_1 of 0.0005 mfd. is used in parallel with the tapped aerial tuning coil. Valve V_1 is the detector, and has a grid condenser C_2 of 0.0002 mfd. and grid leak R_1 of 0.5 megohm. These values are used to eliminate detector distortion so far as is possible.

In the anode circuit of the detector is the reaction coil, the primary winding of T_1, by-pass condenser C_3 of 0.001 mfd., and a battery by-pass condenser C_4, of 2 mfds. Valve V_1 can be of the type having an amplification factor of 15 to 20, and T_1 should have a primary inductance of 50 henries or more; in other words, a low ratio transformer should be used. If the transformer is of the type which has a condenser connected across its primary terminals, fixed condenser C_3 will not be required.

Valve V_2 may be of the low or high impedance type, depending on the quality and amplification desired. For the best quality V_2 should be of the low impedance type and transformer T_2 be similar to transformer T_1. The largest valve that can be worked from the existing anode and filament batteries should be used at V_3; a suitable valve would be one having an amplification factor of about 3. Condenser C_5 should have a capacity of about 5 mfds.

The grid battery GB will have to be a large one to suit the last valve. It may be of 15 to 25 volts, depending on the valve and the anode voltage used. V_2 will require a smaller grid bias voltage, perhaps one-half or one-third of that applied to the last valve.

It will be seen that only one filament rheostat R_2 is required, and this may have a resistance of 2 to 5 ohms.



Circuit of a three-valve broadcast receiver with transformer coupled low-frequency stages.

Life of Grid Bias Batteries.

I am told that the normal life of a battery used for biasing the grids negatively is about one year. Is this correct or should I continue to use the battery until distortion begins? L. C. E.

The life of a battery used to apply a negative potential to the grids of amplifying valves is practically the shelf life of the battery; that is, the life the battery would have when stored, for instance, in a cupboard and not connected to a circuit. This depends a good deal on the construction of the battery, and a year is considered an average life, although sometimes the voltage falls appreciably in a shorter period.

It is not always satisfactory to judge the condition of the grid bias battery by the absence or otherwise of distortion, for the simple reason that the distortion introduced by a failing grid battery will take place so gradually that the ear will not detect it, until the grid bias has reached a value very different from normal.

The shelf life referred to above may not be very different from the life of a similar battery supplying current to a load; in fact, it is often beneficial to provide a small load in the form of a grid leak. Such a load having a value of, say, 1 megohm, will take only a minute current—1 microampere per volt to be exact—and is worth connecting when the grid battery is a large one. Sometimes it is said that the slight leakage of a paper dielectric by-pass condenser provides a useful load; but the magnitude of such a load is not known in the majority of instances.

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"Everyman-four" H.F. Transformers.

Is it absolutely essential to wind the high-frequency transformers recently described in this paper for use in the "Everyman" receivers with 27/42 silk covered Litz wire, or may I use 9/36 enamelled covered Litz? S.P.

The gauge of wire, number of strands, and to some extent their covering, is a matter of great importance. Litz wire, having 27 strands of No. 42 gauge wire, was used in the H.F. transformers referred to for a very definite reason. It has been found by calculation and by measurement that for a coil 3in. in diameter and having an inductance of between 200 and 300 microhenries there is one size of Litz wire which gives superior results, and that size is 27/42.

A cable having 81 strands is very slightly better but not in proportion to its cost.

No. 27/42 wire was therefore used because it is the best size that can be used, and a properly designed transformer employing this Litz gives an amplification greater than that which can be obtained when another size of Litz is used in the construction. The amplification is several times greater than when ordinary solid wire is used on the same size of former.

It only remains to be said that certain stranded cable, according to the gauge of the wire, and the number of strands, gives results inferior to solid wire. It is therefore of the utmost importance that Litz of the size specified should be used. To use Litz having a different gauge of wire or number of turns is to ask for trouble, for amplification is reduced and selectivity is greatly impaired. A silk insulation is recommended, as considerable difficulty is often experienced with enamel insulated Litz, particularly when the strands are of fine wire.

oooo

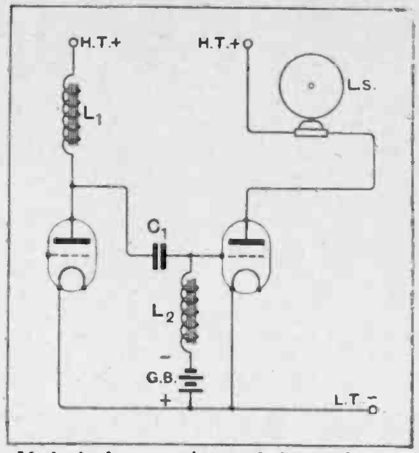
Choke-condenser Coupling.

I have a choke-condenser coupled low-frequency amplifier and am limited in my choice of output valves by the necessity for using a two-volt filament heating accumulator and a 120-volt anode battery. Loud passages in music are frequently badly distorted; is there a remedy for this? J. E.

If the grid bias applied to the output valve has the correct value, occasional loud signals are probably overloading it. As a result, the negative half waves of the signals sweep over the curved foot of the anode-grid characteristic of the valve, while the positive half waves make the grid positive and set up grid currents. The distortion produced by overloading such as this is very unpleasant. Steps should be taken to lower the input voltages to the last valve, and the general results will undoubtedly be improved by increasing the grid bias a little.

Of the two distortions—that due to bottom bend rectification and that due to the flow of grid current—occasional bottom bend rectification can usually be tolerated, as it will only occur during loud passages. Grid current produces a distortion lasting longer than the corresponding anode bend distortion, owing to the charging of the coupling condenser and the time required for the charge accumulated to pass to the filament through the grid leak. This is why it is wise to bias the grid a little more negatively than an inspection of the ordinary static characteristics will indicate.

Much can be done by reducing the size of the coupling condenser and grid leak,



Method of connecting a choke–condenser coupling to the output valve of a set. A choke L_2 is used instead of the more usual grid leak.

but naturally these values cannot be reduced too much or frequency distortion will become pronounced.

It is often distinctly beneficial to replace the grid leak by a low-frequency choke coil of high inductance and low self-capacity, as indicated in the diagram. Here L_1 is the anode choke coil, C_1 the coupling condenser, L_2 the grid choke, and GB the grid bias. Coupling condenser C_1 should preferably be of large capacity, such as 1 mfd.

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A Peculiar Fault.

I have a three-valve resistance-capacity coupled receiver, which is used for the reception of the local station and Daventry. A resistance-capacity coupled set is used because I thought that with it I should be sure of having the very best quality of reproduction. Instead of this I find the reception varies in a slow, periodic manner, and if I connect a milliammeter in the negative anode battery lead the needle swings to and fro all the time. How can I cure this, and what is the cause of the trouble? M. G.

The fault which you have described is not new by any means. The amplifier is designed to magnify the very low frequencies as well as the higher frequencies, with the result that a high-resistance anode battery provides a sufficient coupling between the stages to set up oscillations of very low frequency. This can usually be cured by connecting a large condenser, such as one of 10 mfds., across the anode battery if the anode circuits are all connected to the same voltage or across the anode battery joined to the last valve if different voltages are used for the various stages.

Another method of curing this is to remove the coupling condenser connecting the anode of the first valve and the grid of the second, and to connect another condenser having a mica dielectric and a much smaller capacity than the one now used. As the grid leaks used are of 0.5 megohm, the new coupling condenser can have a capacity of about 0.005 mfd. This will cut down the amplification of the very low frequencies somewhat and tend to stabilise the receiver. It is recommended that both methods be adopted.

A cure is usually effected by connecting a L.F. transformer between the detector and first L.F. valve in place of the resistance-capacity coupling. If a good transformer is used, quality will not suffer, and the amplification will be greater.

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Low Loss Lunacy.

It would appear that the low-loss craze which has held sway for some time is now being carried to the limits of absurdity since I have recently seen an advertisement of a low-loss loud-speaker. Would not an exposure of such humbug be of great benefit to the progress of wireless? J. A. S.

So far from the description of "humbug" being merited by the loud-speaker you mention, it is the very thing we want, and if its manufacturers have indeed produced a really low-loss loud-speaker they are worthy of the highest commendation. In view of the fact that the efficiency of the average loud-speaker is only about 1 per cent., or, in other words, its losses are 99 per cent., it is evident that the need for a "low-loss" loud-speaker is a very real one.

We think that you are confusing the real meaning of the expression "low-loss" and imagining that it is synonymous with the expression "air-spaced coils and skeleton condensers." In reality, of course, the expression is merely a "scrambled" method of saying "high-efficiency," and the advertisement which you mentioned would probably run much less risk of misunderstanding and ridicule if it advertised a high-efficiency loud-speaker.

Wireless users have become far too prone to think that low-loss applies only to air spacing of an inductance or skelton formation of a variable condenser.