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THE LISTENER

ILLUSTRATIONS

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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 LONDON-NEW YORK WIRELESS TELEPHONY SERVICE.

THE announcement that a Transatlantic telephony service is about to be started has been received by the public with some surprise. It has long been known that experiments were in progress, yet it was not expected that the system would so rapidly reach the state of perfection necessary for commercial service.

That Transatlantic telephony was only an afterthought when designing the great Rugby Station is evidenced by the layout of the masts. The original intention was to use the entire mast system for the telegraphy transmitter, but with the possibility that a Transatlantic telephony service might be developed led to the installation of the gear at the Rugby Station.

Secrecy.

Long-distance wireless telegraphy, however, as a commercial possibility dates back to December 1922, when the International Western Electric Company, in conjunction with the Telephone and Telegraph Company of America, demonstrated wireless telephony communication between Broadway, New York City, and their works at Southgate, near London. The distance was about 3,200 miles, and the transmission lasted for over two hours with perfect quality and without interruption or parasitic noise.

Many problems have had to be solved. The handling of high power, the need for secrecy, the use of only a limited wavelength band, and the provision of simultaneous two-way working without interference between the transmitting and receiving apparatus. The side band system which is employed has already been described in the pages of this journal, the interception of the signals being difficult and requiring elaborate equipment. It is significant to note, moreover, that, except during the first Transatlantic experiments from Rugby of nearly a year ago, amateurs have lost sight of the transmissions.

Duplex Working.

For duplex working the stations at Rugby and Rocky Point in the United States transmit the outgoing messages, the receiving sets being installed at Houlton, Maine, and at Wroughton, near Swindon. It is believed that the system is not strictly duplex telephony, but that the receiver is rendered inoperative when the transmitter is being modulated.

The effect that the new service will have on business and everyday life is likely to be far reaching, and full credit is due to the Post Office authorities for the enterprise they have shown in securing for England the first European link of what will probably become an inter-continental service with America.

It is to be hoped that the British Broadcasting Corporation will avail itself of the telephony link by providing for listeners at an early date a programme "relayed" from New York as a means of demonstrating the success of the new service.

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THE HEAVISIDE LAYER.

Experimental Proof of its Existence.

By PROF. E. V. APPLETON, M.A., D.Sc.

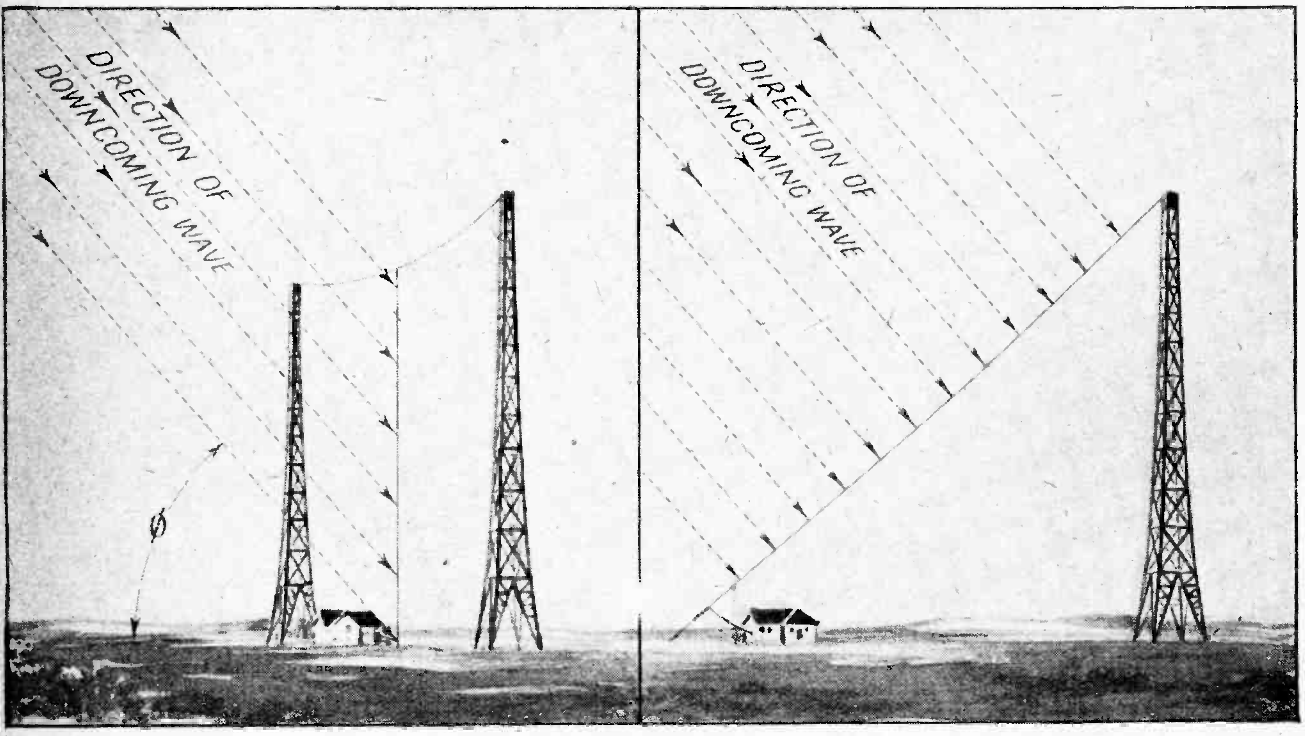
IN two earlier articles [1] I have outlined a simple method of studying fading on broadcasting wavelengths, and have also described the theory put forward by Mr. Barnett and the writer to account for this phenomenon. This theory is itself based on the well-known ionised layer theory of Heaviside and Kennelly, but differs from it in certain essential particulars. When the theory of fading was put forward in 1924 it met with much opposition, for two reasons. In the first place there were many physicists and engineers who completely denied the existence of the ionised layer in the upper atmosphere. They felt that there was no difficulty in accounting for long-distance transmission round the curvature of the earth. The line of argument of the opponents of the Heaviside layer theory may be put, in somewhat cruder language, as follows: By using an earthed transmitter the waves start off with their "feet" on the earth, and there seems no reason why they should ever step off it again. The waves cling, as it were, to the ground and are thus assisted round the protuberance of the earth. The chief exponents of this and similar theories have been Elihu Thompson, in America, and J. E. Taylor, in England. But such views are in complete disagreement with the results of many mathematicians, who find, from their calculations, that such guiding by the earth does not exist to a sufficient extent to account for long-distance transmission.

[1] *The Wireless World*, April 21st and August 11th, 1926.

Reflection at Right Angles.

But there was another difficulty in connection with the acceptance of the theory of short-distance fading. If we make the usual assumption that the layer lies above a height of 50 miles we must assume that the layer can "reflect" waves which arrive at its surface almost at right angles, since the signal variations which we suppose are due to "reflected" waves are detectable at a distance of 30 miles from a broadcasting station. Such an assumption was quite different from the older Heaviside layer theory, in which it had been necessary only to postulate "reflection" from the layer at grazing incidence, the effect of the layer not being considered appreciable at distances of less than 200-300 miles.

It was thus very desirable to prove as directly as possible the existence of the layer and also the existence of high-angle deviation of waves by the layer. It will be seen that what was required was to prove that waves



(a) (b)

Fig. 1.—If the downcoming wave were entirely absorbed as at (a), maximum results would be obtained by inclining the aerial at right angles to the beam as at (b).

The Heaviside Layer.—really did arrive at a receiver from the atmosphere in a downward direction, that is to say, in a direction inclined to the horizontal. Various writers have suggested that the presence of such waves might be detected by using tilted aerials and tilted loops. Very careful experiments were therefore made by Smith-Rose and Barfield to test if stronger signals could be obtained by tilting an aerial out of the vertical or by tilting the axis of a coil out of the horizontal. But (apart from a small forward tilt of the electric force, predicted many years ago by Zenneck, and due to the finite conductivity of the earth) no effect of the kind sought for was experienced even when fading and directional errors were present. This absence of tilt of the electric and magnetic forces therefore led Smith-Rose and Barfield to decide, as late as September, 1925,[1] that "experimental evidence on the existence of the Heaviside layer is still lacking."

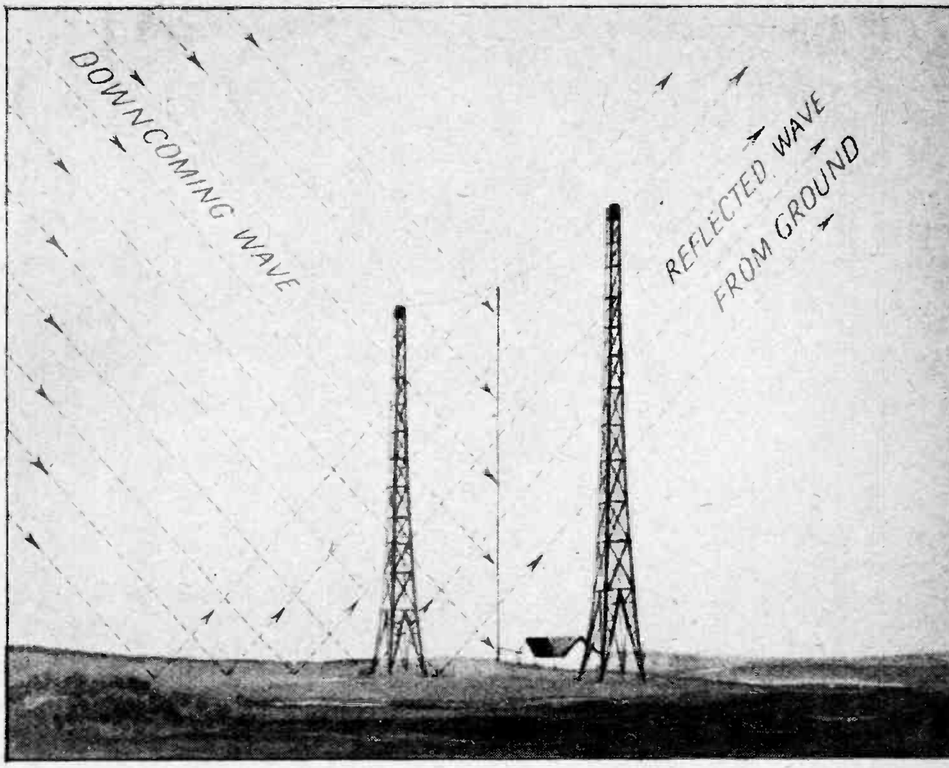


Fig. 2.—Due to the reflected wave from the ground best results in practice are obtained with a vertical aerial.

We can understand the failure of Smith-Rose and Barfield to detect downcoming waves by considering what happens when a downcoming wave meets the ground. Let us consider two examples. In the first case let us assume that the earth is perfectly absorbing, and in the second case perfectly reflecting. We have to consider the effect, in both cases, of a wave arriving at the ground in a direction making an angle ϕ with the horizontal. In the first case the incident wave is totally absorbed at the ground, and we have no reflected wave (see Fig. 1). In this case we should get maximum signals by tilting the aerial, which is normally in the position (*a*), to the inclined position (*b*), so that its length is parallel to the direction of the electric force of the wave. In such a case the angle ϕ would be equal to the angle between the vertical and inclined positions of the aerial.

Reflection from the Earth's Surface.

But in the second case we have to consider also the reflected wave from the ground, and it is easy to show that in this case the maximum signal is always obtained when the aerial is in the vertical position, no matter what may be the angle of descent of the wave. An examination of Fig. 2 shows that the horizontal components of the electric forces of the two waves cancel each other, so that the combined effect of the two waves is to produce a vertical electric force. We can thus understand why Smith-Rose and Barfield were unable to obtain any evidence of downcoming waves by the method of tilting aerials, for the comparatively high conductivity of the ground makes it approximate to a perfect conductor for wireless waves. It was thus obvious that quite different methods of attack must be devised for such cases.

The methods which were finally used for the detection of downcoming waves and for the proof of the existence of the Heaviside layer were developed at Cambridge, and were suggested by the fading measurements previously described. It will have been seen from the above discussion that what was required was a method of distinguishing between waves travelling horizontally and waves arriving in a downward direction at a receiver. By directional methods alone Smith-Rose and Barfield had been unable to distinguish between them.

Ratio of Electric and Magnetic Components.

But there is a very real difference between a ground wave and an atmospheric wave if we consider the magnetic force in the wave as well as the electric force. For a horizontally travelling ground wave, such as that which travels direct from transmitter to receiver, the electric force is equal to the magnetic force if we measure them respectively in a proper system of units. But in the case of waves arriving at an angle ϕ to the ground from the atmosphere this is not so. The wave coming down from the atmosphere, together with the reflected wave from the ground, make a horizontal magnetic force which is larger than the vertical electric force, the ratio of the two being

[1] *Experimental Wireless*, September, 1925.

The Heaviside Layer.—

the secant of the angle ϕ. Thus, if we can measure the ratio of magnetic force to electric force, we can find the angle at which the waves reach the ground. Also, if it can be shown that the magnetic force due to the downcoming wave is greater than the electric force, we have a definite proof of the existence of the ionised layer.

Now, it is possible to compare the electric and magnetic forces of a wave. If we use a vertical aerial we can measure the vertical electric force, while if a loop aerial is used the magnetic force may be measured. Thus, by comparing the fading on a loop set with that on an aerial set simultaneously, it is possible to make a crucial test of the ionised layer theory. But, in making experiments of this type, we must be quite certain that the two sets (loop and antenna) possess the same sensitivity for normal waves. In the Cambridge experiments this was done by making measurements during the day-time, when only the ground ray is present.

In this way the two amplifiers and detectors were adjusted so that the two galvanometers in the two sets registered the same deflection. The two sets were then ready for conducting the fading measurement tests at night.

Experimental Results.

The first tests that were carried out showed that when signal variations were present at night the departure of the galvanometer deflection from the mean was greater on the loop set than on the aerial set, thus proving that waves were arriving from the upper atmosphere. But, as mentioned above, if we know the ratio of the magnetic force to the electric force produced at the ground by the downcoming waves we can find the angle of descent. Now, the departure of the signal intensity from the mean on the loop set is a measure of the magnetic force of the downcoming wave, while the same quantity measured on the aerial set is a measure of the electric force. To find the angle of descent we therefore measure the ratio of these two quantities and find the angle the secant of which is equal to the ratio. For the case of the London signals measured at Cambridge the ratio of loop fading to aerial fading was found to vary round about the value 2.9, indicating that waves were being received in a direction making about 70° with the horizontal. In the case of the signals from Birmingham received at Cambridge the average value of the ratio was 1.5, indicating an angle of about 50°. These figures indicate that the height of the ionised layer for these wavelengths and distances of transmission is about 80-100 kilometres at night. This figure is in good agreement with the first determination[1] of the height of the layer made on December 11th, 1924, by Mr. Barnett and the writer, using an entirely different method. In the earlier experiments a height of 85 kilometres was obtained. We may thus draw a diagram (see Fig. 3), approximately to scale, illustrating the paths of the ground ray and the main atmospheric ray in the transmission of the London (2LO) signals to Cambridge.

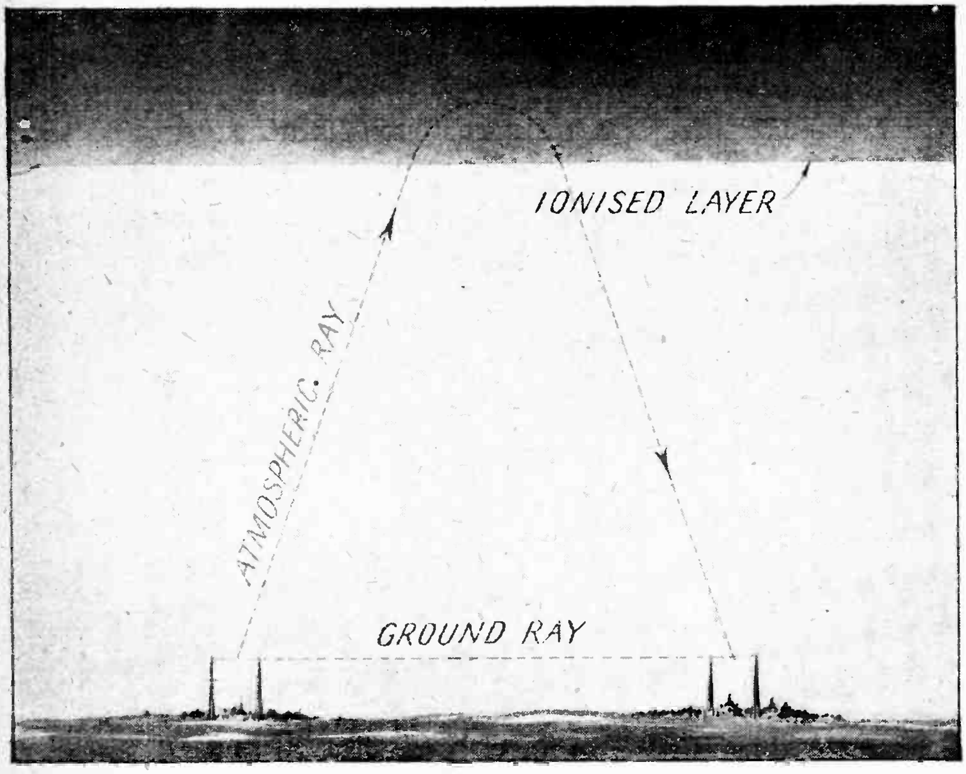


Fig. 3.—Drawing approximately to scale showing paths of ground and reflected rays between London and Cambridge. The angle of the atmospheric ray is 70 degrees.

[1] *Nature*, March 7th, 1925.

MEASUREMENTS OF SIGNAL FADING.

The importance of obtaining a complete and accurate knowledge of the behaviour of wireless transmissions under a variety of conditions on both the broadcast band and from 100 metres downwards is sufficiently obvious nowadays. In our next week's issue will be found an article on signal fading, in which practical details will be given for constructing and calibrating the necessary apparatus for making measurements of fading. Typical results will be given of the fading observed on broadcast transmissions.

A Receiver Giving the Maximum Useful Range and Selectivity.

By W. JAMES.

"THE Wireless World Five" has two stages of radio-frequency amplification, a valve detector, and two stages of low-frequency magnification. It is completely shielded. The receiver may be considered as an "Everyman's Four" with an additional stage of high-frequency amplification, but "The Wireless World Five" is not intended to compete with this set. Rather is it a receiver for those who require even greater sensitivity and better selectivity than is obtained from an "Everyman's Four" and for those who are forced by circumstances to employ a small aerial. "The Wireless World Five" will bring in at full loud-speaker strength, when used with an indoor aerial or a frame aerial, all those stations received on an "Everyman's Four" with an outdoor aerial.

The five-valve receiver cannot normally be used with a full outdoor aerial; the amplification is far too great. There may, of course, be places free from interference where an outdoor aerial could be used successfully on occasions, but the set was primarily designed to be connected to an indoor aerial, and its magnification and selectivity were arranged accordingly. American transmissions have often been heard when using such an aerial. It may be of interest to state that the set illustrated was designed and had been tested during the latter part of 1925. The only changes are in details; one of the reasons why its construction was not described earlier is connected with the screening box.

The Circuit Used.

From the illustrations it will be seen that there are three tuning dials, two rheostats, a jack, and a tapping switch. The three large dials operate the condensers tuning the high-frequency stages, and the high-frequency amplification is controlled by the upper rheostat, which is connected to the filaments of the two high-frequency amplifying valves. Low-frequency amplification is adjustable by the tapping switch connected to points on the intervalve transformer following the detector. Thus there are three tuning controls, two volume controls, a master filament rheostat, which is used as an "on" and "off" switch, and a jack connected to the fourth valve.

Referring to the circuit diagram, Fig. 1, the aerial is connected to terminals A or A_1, and the earth to E;

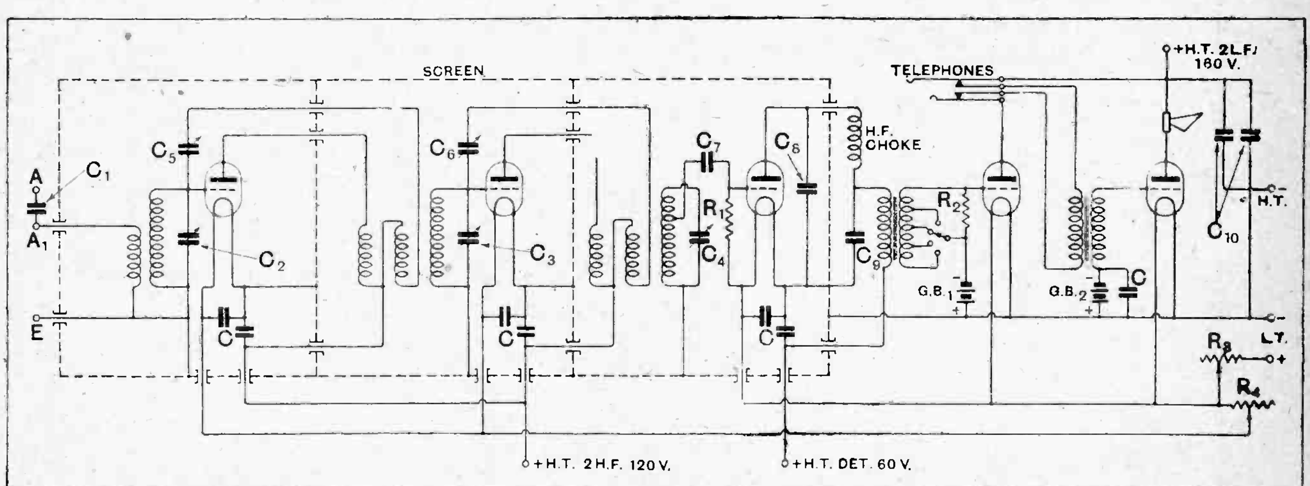


Fig. 1.—Connections of receiver: C, 1 mfd.; C_1, 0.00005 mfd.; C_2, C_3, C_4, 0.0003 mfd.; C_5, C_6, balancing condensers; C_7, 0.0002 mfd.; C_8, C_9, 0.0005 mfd.; C_{10}, 2 mfd.; R_1, 2 megohms; R_2, 0.5 megohm; R_3, 2 ohms; R_4, 30 ohms.

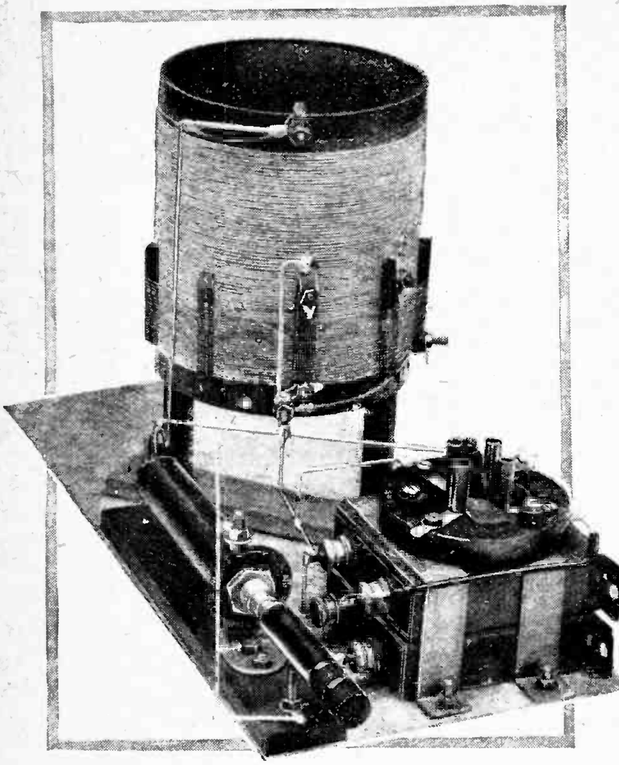


Fig. 2.—One of the high-frequency units removed from the copper box. The base is of sheet tin. On the left is the balancing condenser mounted on a piece of ebonite, while at the back is the H.F. transformer. The valve-holder is screwed to the two brass straps which hold the two 1-mfd. by-pass condensers in position. All the wiring shown is done before the unit is placed in the box.

when the aerial is connected to A, a fixed condenser, C_1, of 0.00005 mfd. is included in the aerial circuit to improve selectivity. The aerial circuit is completed through the primary winding of the aerial-grid transformer, which is in the first section of the copper box. This transformer is tuned by C_2, which is also in the first section of the box along with the valve, by-pass condensers C, and balancing condenser C_5.

Passing from the anode of the first valve is a wire leading into the centre section of the box to the primary winding of the second high-frequency transformers. This transformer has a balancing winding connected to C_5, and a secondary tuned by C_3. In this section is included the second valve, by-pass condensers C, tuning condenser C_3, and balancing condenser C_6.

From the anode of the second valve passes a wire to the primary of the third transformer in the third section of the box. In this box is a tuning condenser C_4, grid condenser and leak C_7, R_1, the detector valve, anode by-pass condenser C_8, and condensers C. The remaining components are not screened, and include the H.F. choke, L.F. transformers, valves, and by-pass condensers.

Effects of Shielding.

The high-frequency stage of the "Everyman's Four" receiver gives an amplification of practically 40, and the screening provided is of a simple nature, consisting of a sheet of metal placed between the aerial-grid transformer and its tuning condenser, and the first valve with its transformer. This screening prevents electrostatic couplings between the two circuits and so enables a good balance to be obtained which holds over the whole tuning range.

The screening does not make any measurable difference to the efficiency of the coils. If, now, a further stage of high-frequency amplification is connected to this receiver it is found impossible to stabilise the H.F. circuits by adjusting the balancing condensers. The receiver oscillates violently, due to stray magnetic and electrostatic couplings, and there appears to be no position for the coils in which the magnetic coupling of the circuits is negligible.

Of course, the receiver can be partially stabilised by reducing the amplification of the two stages, but this is undesirable, for the selectivity becomes too great, and adjustment is difficult. Remembering that the function of a stabilising condenser is to balance the valve capacity and that of its wiring, it is not hard to realise that satisfactory results will only be obtained by completely shielding each stage.

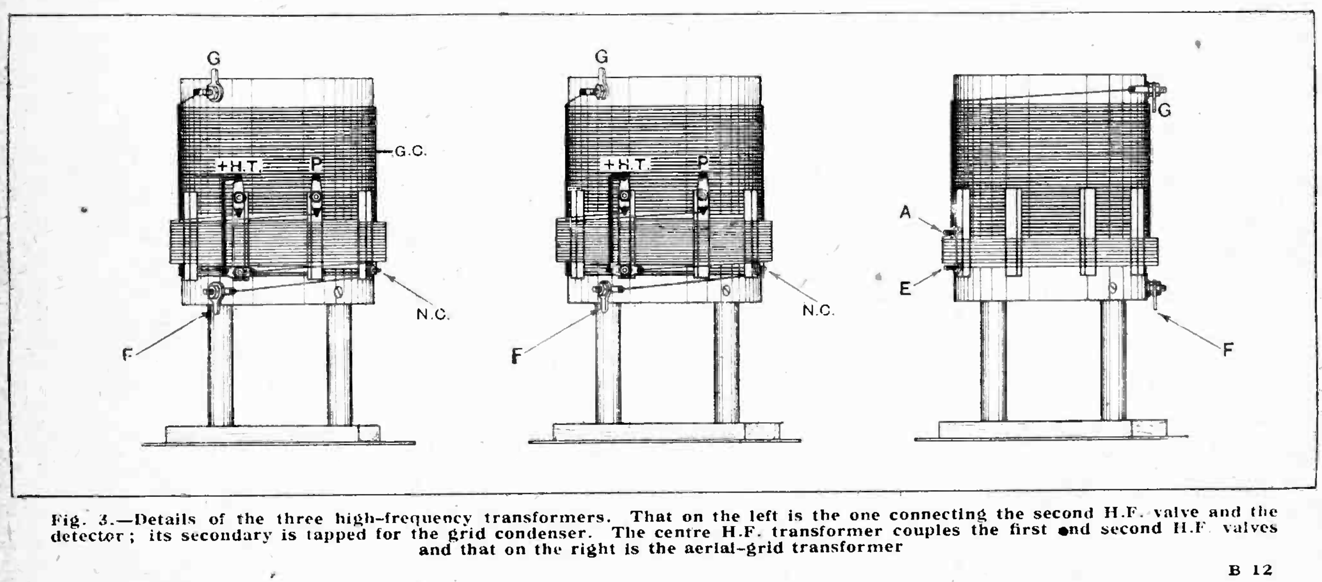


Fig. 3.—Details of the three high-frequency transformers. That on the left is the one connecting the second H.F. valve and the detector; its secondary is tapped for the grid condenser. The centre H.F. transformer couples the first and second H.F. valves and that on the right is the aerial-grid transformer

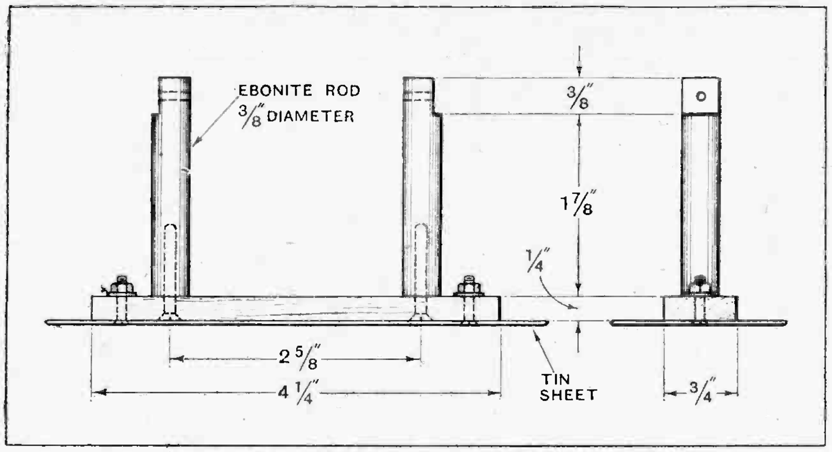


Fig. 4.—Construction of the base of the H.F. transformer. The two upright pieces are of ebonite, and the base is of wood. This is screwed, as shown, to the sheet tin. This drawing should be examined in conjunction with Figs. 2 and 3.

Nothing is gained by shielding the coils only. The screens, to be of reasonable size, have to fit closely round the coils, and this increases their resistance and so broadens the tuning. The result is that it is no easier to eliminate the local station than when the station is received directly by the unscreened coils, since the tuning of the coils is much sharper without the screens. In addition, couplings between valves, tuning condensers, and wiring still have to be eliminated before the set can be properly stabilised.

Having decided that complete screening is necessary, it is easy so to arrange the screen that not only is it effective, but that it introduces a minimum of resistance into the tuned circuits. This can be done without the use of bulky metal boxes; in fact, it can be said that the receiver illustrated, which measures only 24in. × 8½in. × 10in. deep, is remarkably compact.

H.F. Transformers.

The H.F. transformers are constructed in exactly the same style as those used in the "Everyman's Four," but it was found impossible to use the set with satisfactory results when the two transformers gave an amplification of about 35 each. Selectivity was good, and the set was quite stable over the whole tuning range, but the amplification was so great that noises were amplified to such an extent as to make reception difficult, if not impossible. The amplification of the first stage was, therefore, cut down by reducing the number of turns in the primary winding. This increases its selectivity. Fewer turns were also used in the primary of the aerial-grid transformer, and a series condenser was employed as an alternative aerial coupling. These changes have the effect of reducing the amplification to a more reasonable value and make the receiver really selective without unduly sharpening the tuning. The aerial-grid and the detector stages are more broadly tuned than the intermediate stage. Tuning is therefore quite easy, as the detector circuit can be tuned last of all.

The Detector Stage.

A further difference between this set and "Everyman's Four" is that a transformer coupling is used between the detector and first L.F. valve instead of a resistance-condenser coupling. The object is to allow adequate filtering of the high-frequency currents to be effected without impairing the quality of the low-frequency amplifier. The filter comprises two fixed condensers, C_8, C_9, of 0.0005 mfd. each and a high-frequency choke, connected between the anode of the detector and the primary winding of the tapped low-frequency transformer. As these condensers are shunted across the L.F. transformer, a low ratio instrument is employed to reduce the tendency to cut down the higher audio-frequencies. Resistance R_2 of 0.5 megohm is connected across the secondary to further level out the amplification-frequency curve. In the detector stage a valve

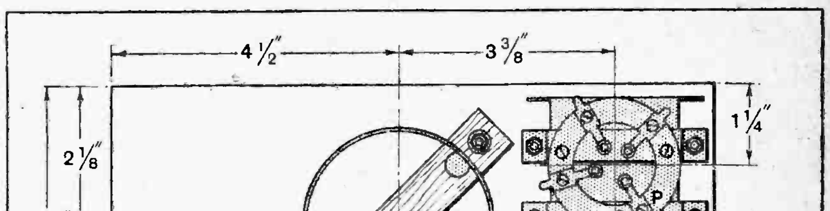


Fig. 5.—(A) Drawing showing the arrangement of the parts for the first and second sections. Fig. 2 is a photograph of the second section.
(B) The detector valve stage with its high-frequency transformer. A grid condenser and leak, C_7, R_1, and a by-pass condenser, C_8, are included in this section.

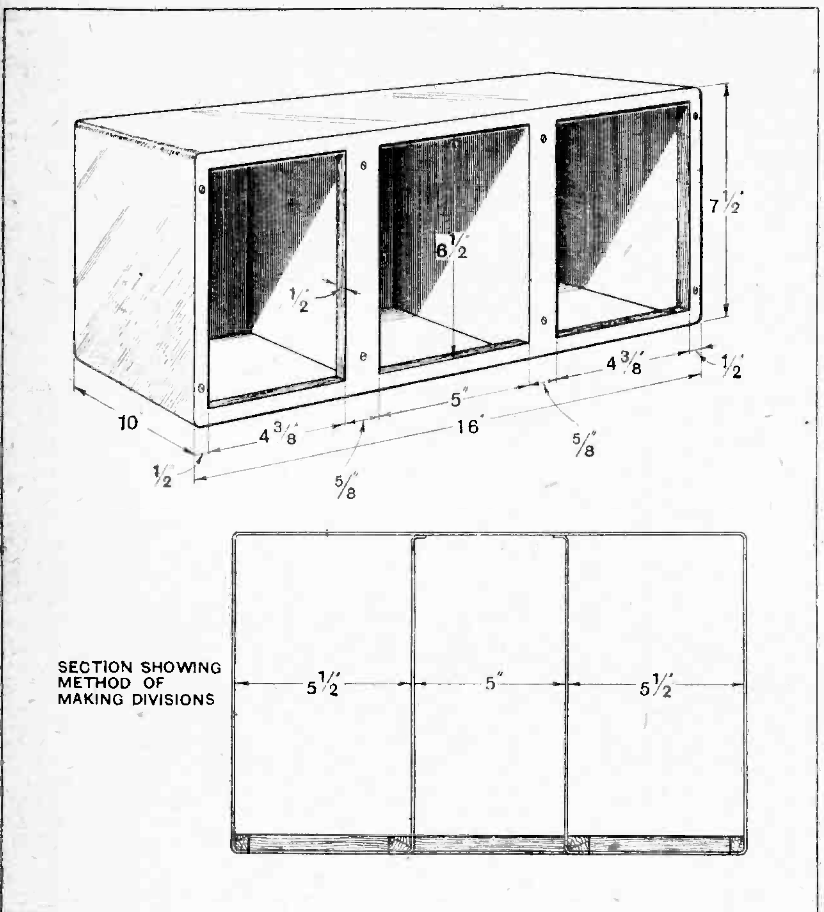


Fig. 6.—Details of the box, which is of No. 24 gauge. It is of copper, and the two partitions are soldered into position. Round the inside front edge is a framework of wood held by screws as shown. Further holes are drilled through the edges to take the screws holding the cover.

of high magnification factor can be used provided it has a low A.C. resistance. The A.C. resistance of a valve can be decreased by raising the anode voltage or by giving the grid a positive bias. For this reason grid circuit rectification was decided on and frequency distortion reduced to a minimum by using low values of grid condenser and leak.

From the combination of low-impedance valve, low-ratio transformer, and shunt resistance, high and uniform amplification is obtained.

Tapped L.F. Transformer.

To connect the whole of a tuned transformer to a grid rectifier would very seriously reduce the selectivity. Condenser C_7 is, therefore, connected nearly halfway down the grid coil to maintain selectivity at a reasonable value. Amplification is reduced by connecting the grid to a tap on the coil instead of to its end, but not to the extent which might be expected.

The transformer connected between the detector and first low-frequency amplifying valve has its secondary winding tapped, and connections are taken to a switch mounted on the panel. This is a very convenient means for varying the amount of low-frequency amplification, and enables one to strike the best balance between the amount of high-frequency amplification and the amount of low-frequency amplification. When the full selectivity of the set is required the low-frequency amplifier can be switched full on and the volume control rheostat R_4 connected to the high-frequency valves be turned down. This increases the selectivity by reducing valve damping.

Construction of H.F. Transformers.

The three secondary windings have 70 turns of 27/42 silk-covered Litzendraht, the ends being terminated at tags as indicated in Fig. 3. Paxolin tubes 3in. in diameter by 3½in. long are used. It will be seen that the end connections of the aerial-grid transformer are at the right-hand side, whilst those of the other two transformers are at the front.

A tap has to be made at the fortieth turn from the filament end of the first transformer for the grid connection; this tap is marked GC, Fig. 3, and it is sufficient to make contact with a few of the strands. A convenient means of doing this is to solder a fine wire to the strands and to wrap this wire round the cable several times to make a strong joint.

Each tube has a support comprising two ebonite rods screwed to a base of wood, Fig. 4, the wooden bases being 4¼in. × ¾in. × ¼in., and the rods 2¼in. long × ⅜in. diameter. The ends of the bases are drilled for No. 6 B.A. screws, as indicated.

Twenty-four pieces of ebonite ⅛in. thick by ¼in. wide are now required as spacers, and if possible should be grooved or threaded 32 per inch. Seven of these should be fitted with No. 10 B.A. screws and nuts, as indicated. It is advisable to countersink deeply on the under side of the spacers to make quite sure that the heads of the screws will not make contact with the Litzendraht wire.

Eight of the spacers should be arranged round the filament end of the aerial-grid coil, Fig. 3, rubber bands being used to hold them in position whilst the primary winding is being put on. Wind eight turns of No. 30 D.S.C. for this coil, terminating the ends at contacts A and E.

For the second high-frequency transformer, the centre one of Fig. 3, a double winding of 10 turns each of No. 40 is required; both windings are in the same direction as the secondary. Commence the winding at point +H.T., near terminal F, and wind 10 turns of No. 40 D.S.C., finishing this coil at point P. Commence the next winding at point NC and wind 10 turns between the turns of the primary already wound; terminate this coil at the top +H.T. terminal.

For the third high-frequency transformer a double winding of 15 turns each of No. 40 D.S.C. is required. These windings are wound in exactly the same manner

LIST OF PARTS.

Baseboard, 23¼in. × 10¼in. × ½in.
Ebonite panel, 24in. × 8½in. × ¼in.
Copper box, 16in. × 10in. × 7½in. of No. 24-gauge copper.
3 Variable condensers with micro-dials, 0.0003 mfd. (Utility).
1 Jack (Edison Bell).
1 Rheostat, 30 ohms (Burndept).
1 Rheostat, 2 ohms (Burndept).
1 4-stud switch (Burndept).
1 Fixed Condenser, No. 610 type, 0.0005 mfd. (Dubilier).
1 Tapped transformer, 2.7 to 1 (Pye).
1 Transformer, 3½ to 1, A.F.3 (Ferranti).
2 Valve holders (Benjamin).
1 Can't Cross connector, 7 contact.
5 Ebonite shrouded terminals (Belling and Lee).
3 Dial indicators (Belling and Lee).
2 Fixed condensers, 2 mfd. (T.C.C.).
1 Fixed condenser, 1 mfd. (T.C.C.).
8 lengths Sistoflex.
No. 22 tinned sheet.
2ft. strip brass, ½in., No. 20.
Screws, etc., etc.

H.F. UNIT.

1 Paxolin tube, 3½in. × 3in. (Micanite and Insulators, Ltd.).
20 yards Litzen wire (Ormiston and Sons, Ltd.).
5 yards No. 40 D.S.C. wire.
1 Neutrovernia (Gambrell).
1 Valve holder (Bowyer-Lowe).
2 Fixed condensers, 1 mfd. (T.C.C.).

DETECTOR UNIT.

1 Paxolin tube, 3½in. × 3in.
20 yards Litzen wire.
5 yards No. 40 D.S.C. wire.
2 Fixed condensers, 1 mfd. (T.C.C.).
1 Fixed condenser, 0.0002 mfd., No. 600A (Dubilier).
1 Fixed condenser, 0.0005 mfd., No. 600A (Dubilier).
1 Grid leak, 2 megohms, and holder (Dubilier).
1 Valve holder.

AERIAL UNIT.

1 Paxolin tube, 3½in. × 3in.
20 yards Litzen wire.
5 yards No. 30 D.S.C. wire.
1 Neutrovernia (Gambrell).
1 Valve holder (Bowyer-Lowe).
2 Fixed condensers, 1 mfd. (T.C.C.).

as for the second transformer. It should be noticed that the two + H.T. terminals on the second and third transformers are connected.

The primary windings described are suitable for valves of 20,000 to 30,000 ohms A.C. resistance; for valves having an A.C. resistance of 15,000 to 20,000 ohms it is necessary to reduce the number of turns, winding 8 + 8 instead of 10 + 10 and 12 + 12 instead of 15 + 15 respectively. For valves of 30,000 to 50,000 ohms both transformers should have 15 + 15 turns, the aerial-grid transformer having 8 turns in both instances.

Assembly of the Sections.

When the transformers are wound the metal bases can be prepared. These are of sheet tin measuring 9⅜in. × 4¼in., as indicated in Fig. 5. The coils are fixed to the base by screws passing through the sheet tin and the wooden base of the coils; countersunk headed screws should be used. On the right-hand side of the sheet tin two 1 mfd. Mansbridge condensers are fixed by means of two brass straps, and these straps are drilled at the top to take screws for the valve-holders. On the left-hand side of the second and third bases is mounted a balancing condenser; first the balancing condensers are fastened to the ebonite bases by means of a bracket, the screw holes being well countersunk to make sure that they will not make connection with the metal base. Then the ebonite bases are fastened to the sheet tin. One of the screws passing through the sheet tin and ebonite base has its head soldered to the tin. This is used as a negative L.T. connection. The ends of the knobs of the balancing condensers project over the edge of the sheet tin base, and when the sections are mounted in the screening box project about ½in. through holes in the cover.

Details of the copper box are given in Fig. 6, and a photograph of the back of the receiver showing the box in position, but with the centre H.F. transformer removed, appears as Fig. 7. The box is made of No. 24 gauge sheet copper and all joints are soldered. On the inside of the open face pieces of wood are fitted and held by means of countersunk headed screws passing through the edges of the box. This is to enable the cover to be screwed on with wood screws. Two holes are provided in the cover for the heads of the knobs of the balancing condensers, and a number of holes are drilled in the cover and in the metal edges of the box for the fixing screws.

(To be concluded.)

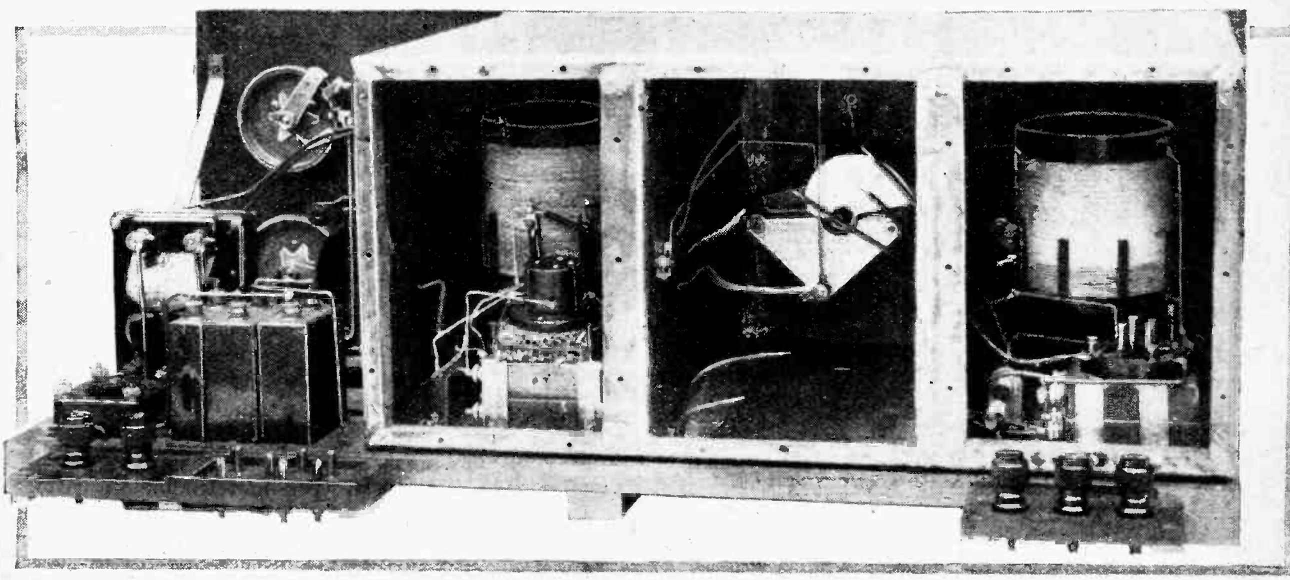
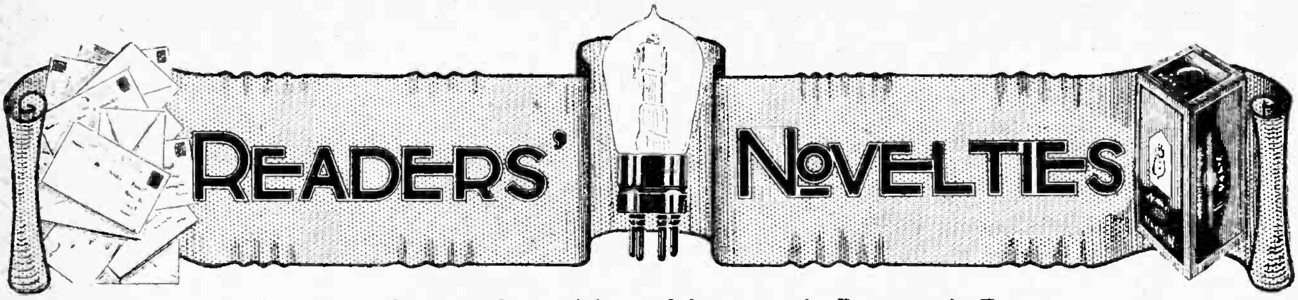


Fig. 7.—Rear view of the receiver with the cover removed from the copper box. The second H.F. transformer has been removed from its box to show the tuning condenser.



A Section Devoted to New Ideas and Practical Devices.

INSPECTION LAMP.

When wiring up a complicated receiver which may call for frequent inspection of the interior in the experimental stage, it is a good plan to screw to the baseboard a small screw batten holder, the terminals of which are permanently connected across the L.T. supply. A flash lamp bulb of suitable voltage may then be screwed into the holder wherever it is necessary to examine the interior of the set.—H. C. B.

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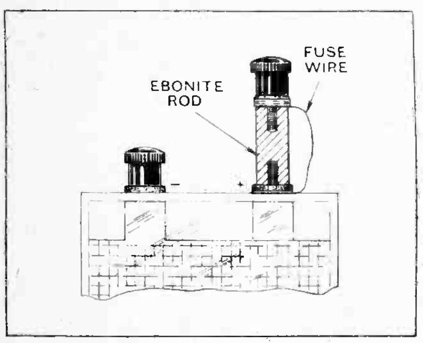
ACCUMULATOR FUSE.

To safeguard the accumulator from accidental short circuits in the apparatus to which it is connected, a fuse may be fitted to the accumulator itself, as indicated in the diagram.

One of the terminal tops is removed and replaced by a short ebonite pillar, drilled and tapped to fit the accumulator terminal at one end and to take a short length of screwed rod at the other. The terminal top is refitted as shown after clamping the fuse wire under a round lock-nut at the top of the pillar.—G. M.



Accumulator terminal pillar and fuse.

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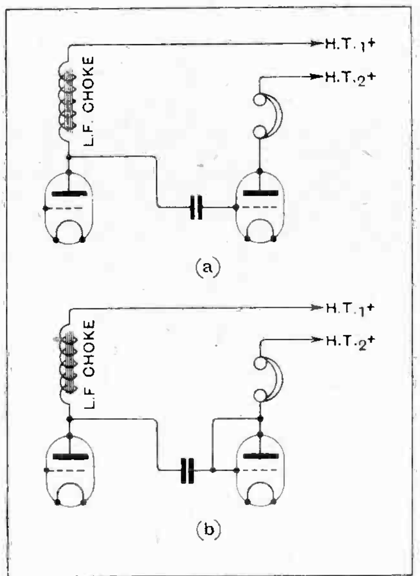
SIMPLE SWITCHING DEVICE.

The essentials of a choke-coupled amplifier are shown in circuit (*a*) in the diagram. In order to cut out the second valve it is necessary only to plug in a short-circuiting link between the grid and anode socket of the second valve holder, thus converting the choke and coupling condenser into a filter feed circuit.



Switch device for choke-coupled amplifier.

As valves designed for choke coupling are generally unsuitable for loud-speaker work, the scheme is only recommended when telephones are to be used instead of a loud-speaker.—H. L. T.

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."

FIXING A CONDENSER DIAL.

The knob and dial of a variable condenser are frequently secured to a threaded spindle with a shallow lock-nut. Even with a special spanner it is often difficult to tighten this nut satisfactorily.

A length of No. 18 S.W.G. tinned wire about equal to the diameter of the dial is straightened and a loop formed at one end to slip over the condenser spindle. Before fitting the dial the lock-nut is tightened down on to the single turn of wire, and the dial is then screwed down to the lock-nut. By pulling on the wire projecting from the edge of the dial the single turn of wire may be removed, thus leaving the dial firmly locked to the spindle.—O. K. W.

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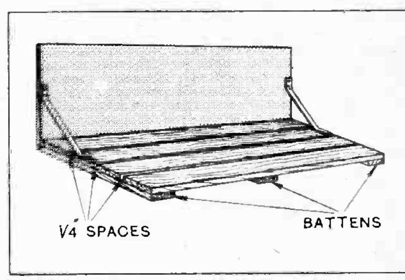
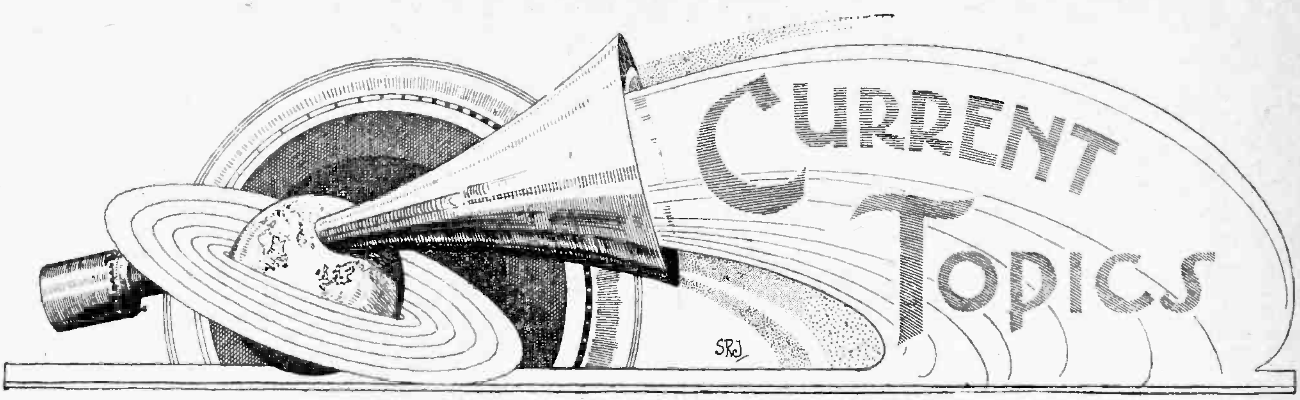
BASEBOARD IMPROVEMENT.

In the design of many receivers recently described in *The Wireless World* there has been a marked tendency to fix certain components such as Mansbridge condensers to the underside of the baseboard, wires being led through holes in the baseboard to high-frequency components above.



Built-up baseboard for use with components fixed on both sides.

Much time and trouble in wiring are saved if the baseboard is built up of parallel strips as shown in the diagram, as this obviates the necessity of drilling the base for wiring.—T. A. B.



News of the Week in Brief Review.

NOTHING DOING.

The Southend Borough Council has refused to allow wireless listeners to run aerials over public roads.

A GLOOMY YULE.

In Christmas week two Aberdeen residents, William Diack and William Brown, were each fined £2 by Sheriff Laing for having installed and operated a two-valve wireless receiver without a licence.

A WORD FOR THE SCHOOLBOY.

Apparently lured by the smart phrase "schoolboy howler," our daily Press is suggesting that the prevalence of oscillation is due to the clumsy handling of wireless receivers by boys at home on holiday. As a matter of fact, most schoolboys are more familiar with the correct control of a wireless set than many of their elders.

ARE THEY LICENSED?

The latest mystery disease is described as "radio rabies." Sufferers, we are told, imagine that they are human receiving sets.

D.F. SET FOR A LIGHTHOUSE.

The Board of Trade has suggested the installation of wireless direction finding apparatus on the Spurn Lighthouse at the mouth of the Humber.

LICENCES FOR THE BLIND.

The Ministry of Health has issued a circular to county and county borough councils drawing attention to the Wireless Telegraphy (Blind Persons Facilities) Act, 1926, and intimating that it is hoped that councils will do all in their power to facilitate the working of the Act by the prompt issue of certificates to applicants who are registered as blind persons in their area.

EIFFEL TOWER WIRELESS TRAGEDY.

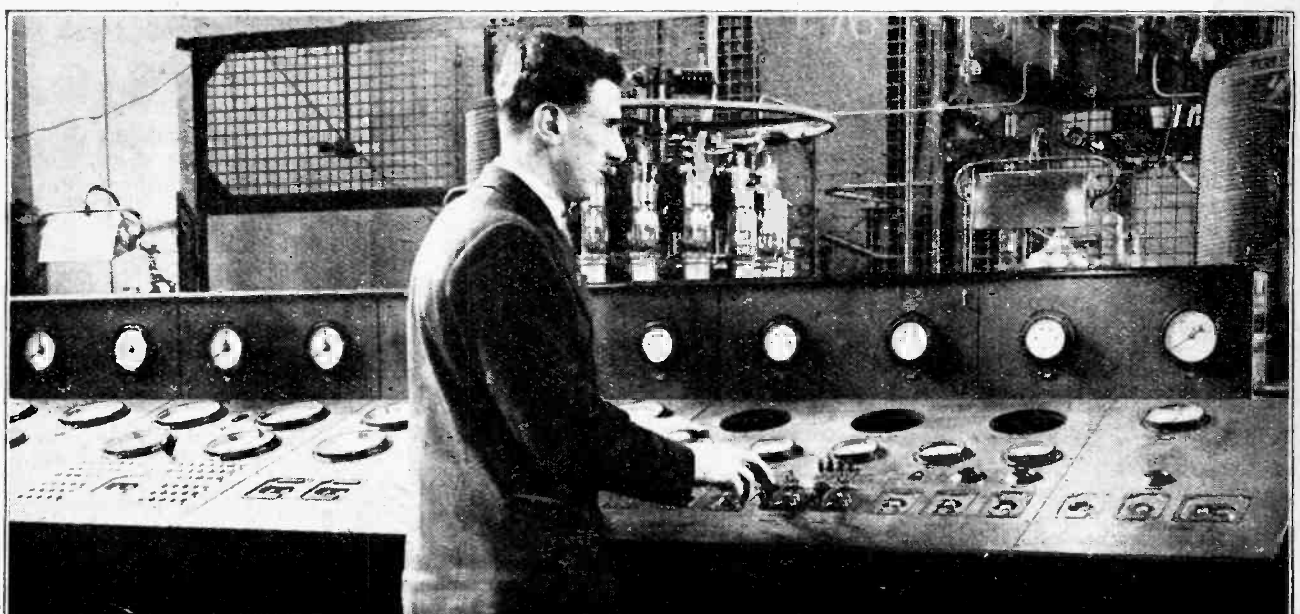
Two days before Christmas a wireless operator named Lavaud was accidentally electrocuted at the Eiffel Tower station in Paris.

CHINA BUILDS HER OWN STATION.

A wireless station has just been completed at Pehchikoh, Nanking, the capital of Kiang-su province, China. All the equipment at the station is of Chinese make, says *Engineering*, with the exception of the generator, which has been imported from America.

TRANSATLANTIC TELEPHONY SERVICE.

The Postmaster-General announces that, in view of the satisfactory progress being made in the experimental development of transatlantic telephony, it is hoped to open a preliminary public service with the New York telephone area early this



THE NEW TRANSATLANTIC TELEPHONY SERVICE. The control board at the Hillmorton station near Rugby. The telephony transmitter is installed at one end of the apparatus room which houses the telegraphy transmission equipment.

month. The charge will be £15 for a conversation of three minutes, and each additional minute above the first three will be charged at £5.

This interesting announcement, which was hardly expected at such an early stage, is commented upon in this week's Editorial.

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THIS YEAR'S WIRELESS EXHIBITION.

The Radio Manufacturers' Association announces that the next All-British Wireless Exhibition will be held at Olympia between September 21st and October 2nd, 1927.

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LIFE ON THE OCEAN WAVE.

Naval wireless men at sea will hardly relish the announcement that no further applications for transfer to the Royal Naval shore wireless service can be entertained at present. Apparently there is a long waiting list!

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MOSCOW TO TELL THE WORLD.

According to M. Smirnov, People's Commissar for Posts and Telegraphs of the Soviet Union, who has just paid a visit to London, a broadcasting station of 50 kilowatts will shortly be completed in Moscow. It is hoped that the new station will have an effective range of 2,000 miles.

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WIRELESS ON INDIA AIR ROUTE.

In connection with the establishment of the new air line to India by Imperial Airways, Ltd., a chain of wireless stations will shortly be inaugurated so that aeroplanes in flight can remain in constant communication with the ground. When completed the chain will comprise stations from Egypt to India at Heliopolis, Ismailia, Gaza, Rutbah Wells, Ramadi, Baghdad, Shiabah (Basra), Bushire, Bandar Abbas, Charbar, and Karachi.

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BROADCASTING BY THE LEAGUE OF NATIONS?

An international broadcasting station of high power, controlled by the League of Nations, is a project now under consideration by the League Council. While the technical difficulties of such a scheme are easily surmountable, the question of money is sufficiently formidable. Who would form the subscribers?

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WHAT RUGBY HAS ACCOMPLISHED.

An account of the successful activities of the Rugby wireless station since it began operating is given in the second report of the Wireless Telegraphy Commission, published by His Majesty's Stationery Office. The Commission was appointed in 1920 to decide upon the wireless plant most suitable for the execution of the Imperial wireless scheme. In Australia, South Africa, and India, says the report, work is well advanced on the stations corresponding with that at Rugby. With regard to the Rugby station, the telegraphy installation has so far only been worked on the eight-mast aerial and with about two-thirds power. Even so the signals have been heard all over the globe. Experiments will shortly be made to determine the possibility of the simultaneous operation of both the main telegraph transmitter and the Transatlantic telephony transmitter.

Future plans include the installation of a short-wave plant and a medium-wave plant utilising the existing masts for supporting the additional aerials. The development of this multi-way working of the Rugby station can, the report says, be confidently left in the hands of the Post Office wireless engineers.

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UP-TO-DATE JAPAN.

A new wireless station securing direct communication between Japan and Western Europe and utilising a power between 550 and 600 kilowatts is to be erected in Japan by a German firm to the order of the Japanese Wireless Telegraph Company, according to a message from the U.S. Department of Commerce. There will be eight separate braced steel towers, each about 820 feet high.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 5th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington Park School, Tetherdown. Informal evening.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Comparison of Loud-speakers.

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

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Monthly Business Meeting followed by talk and discussion.

THURSDAY, JANUARY 6th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way. Annual General Meeting. Lantern Lecture by Mr. Reeves.

Stretford and District Radio Society.—At the Café Imperial. Lecture, "2UF Calling," by Mr. H. Bailey.

FRIDAY, JANUARY 7th.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Lecture, "Valve Manufacture," by the Mullard Wireless Service Co., Ltd.

Sheffield and District Wireless Society.—Evening of Experimental Work.

Bristol and District Radio Society.—At 7.30 p.m. In the Physics Lecture Theatre, Bristol University. Lecture and Demonstration on the R.C. Threesome, by Edison Swan Electric Co., Ltd.

EXHIBITION OF PHYSICAL AND OPTICAL SOCIETIES.

The seventeenth annual exhibition of the Physical Society and the Optical Society opened yesterday (Tuesday) at the Imperial College of Science and Technology, Imperial Institute, South Kensington. The exhibition will be open to-day and to-morrow in the afternoon from 3 to 6 p.m. and in the evening from 7 to 10 p.m. The general public will be admitted without tickets to-morrow, when a feature of the exhibition will be a lecture at 8 p.m. by Mr. J. L. Baird on "Television." About 70 firms are exhibiting scientific apparatus, and in addition there is a group of non-commercial exhibits by Fellows of the societies and others, including demonstrations of famous historical experiments in physics, recent research, and effective lecture experiments.

NEWS FROM THE CLUBS.

Hackney Radio Week.

Under the auspices of the Hackney and District Radio Society a "Hackney Radio Week" will open on Monday next, January 10th, at the Electricity Demonstration Halls, 18-24, Lower Clapton Road, E.5, continuing until the 15th. A comprehensive range of apparatus constructed by members of the Society will be on view, and B.B.C. programmes will be reproduced on loud-speakers. It is hoped that the "Radio Week" will result in an extended popularity for broadcasting and wireless generally in the large area covered by the Society.

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Current from A.C. Mains.

"The Maintenance of a Receiver from A.C. Mains" was the title of a lecture given on December 17th by Mr. C. H. Handford, of Cardiff University, who was recently made a Life Member of the Society. Mr. Handford outlined the various methods in use for supplying both filaments and plates, and expressed the opinion that the only satisfactory solution at the moment of the filament supply for H.F. and Detector valves, is the "Trickle Charger." Mr. Handford also showed how the double wave, or, as he preferred to call it, 2-phase system of rectification, required less smoothing owing to the doubled frequency of the rectified current, and proceeded to outline a scheme which he is using of getting 3- or 6-phase currents from a 2- or 3-phase A.C. supply. The lecture was illustrated throughout by a splendid series of lantern slides.

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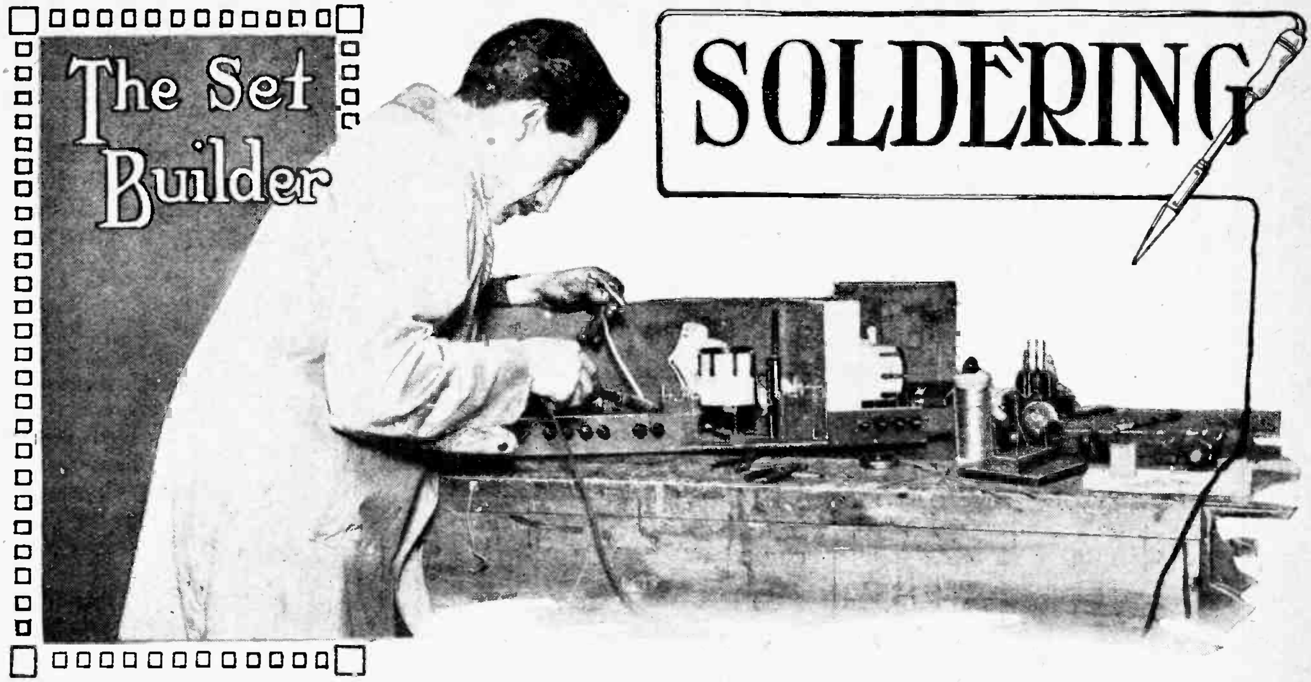
On the Subject of Sound.

A lecture of considerable interest was given at the last meeting of the Tottenham Wireless Society by Mr. J. F. Stanley, B.Sc., A.C.G.I., who took for his subject, "The Acoustics of a Room and its Effect on a Loud-speaker." It was noted that for several years past the Society has heard lectures on all sorts of subjects dealing with sound-producing apparatus, yet, until this occasion, a lecture had never been given dealing with Sound itself. The factors governing clear speech and good quality music were first discussed and investigated. Arising out of this came the questions of the absorbing properties of a room, its shape, liability to produce echo and the possibility of standing waves being produced. From this Mr. Stanley passed to a discussion on the development of the B.B.C. studios and remarks about the various halls used for outside broadcasts. A fascinating lecture was concluded with a discussion on orchestras and bands for broadcasting purposes.



Some Practical Soldering Hints for the Home Constructor.

ASSUMING that the circuit arrangement is a good one and the layout of the components has been carefully considered, then the value of a receiving set is assessed by the appearance of its wiring. The performance of a set is more easily marred by carelessness in soldering than by the use of inferior components, yet how rare are the receiving sets in which the soldering is really well carried out.

Soldering is regarded as such a simple job that few take the trouble to acquaint themselves with details of the process. There are, however, a few practical hints which it is folly to despise.

Solders.

Lead and tin will run together to form solder in almost any proportion, the properties of the resulting alloy depending upon a somewhat critical relationship in the quantities of the two metals. Much of the solder on the market, especially that which finds its way into the hands of the home constructor, is of uncertain composition. Poor quality solders contain too much lead, while on the other hand the amateur may be induced to buy certain low-melting-point solders which contain as a rule other metals than tin and lead.

Soft solder is produced by melting together 1 part of lead with 2 parts of tin. It is fairly bright when freshly cast and exhibits a cracking noise when bent. For hard solder 2 parts of lead are alloyed with 1 part of tin. It is the soft solder that is used in instrument wiring, for it has the lower melting point, flows easily over a clean surface and makes a sufficiently strong joint. Hard solder does not run well with an only moderately hot iron, and a large iron is needed to carry the necessary heat.

Solder should be purchased in the form of thin sticks. Thick sticks of solder take too much heat from the iron before the solder melts, and it is advisable to hammer out the end of a thick piece of solder to prevent the conducting away of heat to a large mass of metal before a sufficiently high temperature is obtained and the melting point reached.

Soldering Bits.

Except where the components of a set are well spaced out on a baseboard, it will be found advisable to possess at least a couple of irons. A large one with a copper head some 2½in. to 3in. in length, and about ⅝in. square, or ¾in. round section can be used for all easily accessible joints. For wiring switch contacts and getting behind other wiring, smaller irons are essential. The hatchet type, where the head is at right angles to its support, is generally more useful than the straight type in very small irons. The head should measure 1in. to 1½in. in length by about ⅜in. square, tapering to the point.

The iron is best heated by a gas flame. Special gas heating stoves are obtainable, though for home use there is little better than a small gas ring. The stove should be within reach of the work so that a lead when in position can be held with the left hand and the iron lifted from the stove and applied to the joint. It is advisable to provide an asbestos card about one foot square to prevent the stove and hot globules of solder from burning the surface of the bench. The iron should never be allowed to become red-hot, and the temperature of a small iron is best regulated by using only a very small flame. The heating effect of a gas flame is much greater at the top, and while a small iron may actually rest on the gas ring over the jets so that the heat is slowly applied to prevent

The Set Builder—Soldering.

a rapid temperature rise, large irons are best supported by an improvised wire rack.

For emergency work a small spirit stove is useful, though will be found to be very slow when much soldering is to be done.

The heating of an iron in a coal fire will, as a rule, be found troublesome. It is very difficult to regulate the temperature, sulphurous vapour corrodes the face of the copper head, and the iron is out of easy reach of the operator.

An electrically heated iron is well worth using when electric supply is available, and should consume about 150 watts. Some five to ten minutes are taken after switching on the current before the necessary temperature is reached, though on small work such as instrument wiring an electric iron can be used continuously without being set aside to recuperate. An electric iron rarely becomes overheated or "burnt," and does not cool off in use. After prolonged use, however, the heater element may cease to develop sufficient heat.

Cleaning the Iron.

Even a very thin film of oxide on the face of the iron will normally prevent the transference of sufficient heat to melt soft solder. Once melted, the solder will run off the iron, unless the copper is what might be described as being chemically clean. For the solder to cling to the face of the iron it is necessary for the tin to practically alloy with a surface film of the copper, and the presence of oxide, sulphide or burnt organic matter will prevent the metal running into close enough contact. The surface oxide, etc., will be removed by treatment with ammonium chloride (sal ammoniac). The tinning process is therefore simplified by rubbing the hot iron on a block of sal ammoniac. As an alternative the iron may be lightly dipped for a second into a solution of zinc chloride, which will not only clean the iron, but the zinc chloride while fusing on the hot surface will act as a flux for bringing about a combination between the metals.

The old process of working together resin and solder on a piece of tinned metal in order to "tin" the iron is to be deprecated. Too much heat will be taken from a small iron, and although the fused resin assists the combination of the solder with the face of the iron, resin is not effective in destroying a deposit of dirt in the same way as zinc chloride.

Before attempting to tin an iron the faces must be filed bright and free from "pits." It is not enough to clean up one working face only, and the four sides forming the point should be made bright with a clean file. A file should be set aside and used solely for cleaning the iron, for solder will fill the grooves of the file, while a file which has been used for ebonite will leave a thin film on the face of the iron and increase the difficulties of tinning. The iron should be heated after filing, then again very quickly brightened up and dipped for a brief interval in the zinc chloride solution. Tinning will then be found quite easy and the solder will flow freely over the entire point of the iron. Sal ammoniac as a saturated solution or a block of this salt may be used for cleaning the iron each time it is removed from the flame.

In general soldering work, such as the joining together of large surfaces of copper, brass, zinc, iron or tin plate, zinc chloride solution (killed spirit) is commonly used. It is prepared by dissolving zinc in commercial hydrochloric acid (spirits of salts) undiluted. The acid should be poured into a small earthenware jar to allow of easy escape for the hydrogen which is rapidly evolved, while a glass jar is apt to crack owing to the temperature rise. Zinc must continue to be added until no more will dissolve and the effervescence ceases.

Fluxes.

This solution is corrosive and should not be allowed to come into contact with the hands and clothing, whilst under no circumstances must it be applied to the surfaces of a joint to facilitate the soldering of connections. Although when used as a flux one is not troubled with soldering difficulties owing to dirty surfaces, the vapour which is evolved when zinc chloride is heated disperses over a wide area around the joint. Being deliquescent, it remains moist, and possessing acid properties completely breaks down the insulation.

A number of liquid fluxes are obtainable, some of which are claimed to be non-corrosive, and although very useful for cleaning the iron, must not be applied to instrument wiring.

There are several soldering pastes in general use, of which "Fluxite" is perhaps the best known. It should be very sparingly applied as it spreads when heated, and although practically non-corrosive, does not possess good insulating properties. Surplus paste can be removed with methylated spirits applied with a small soft brush, though it is a better plan to lay a small piece of white blotting paper alongside the joint, passing the wire through the paper, if necessary, so that any excess of flux is absorbed at the time of making the joint.

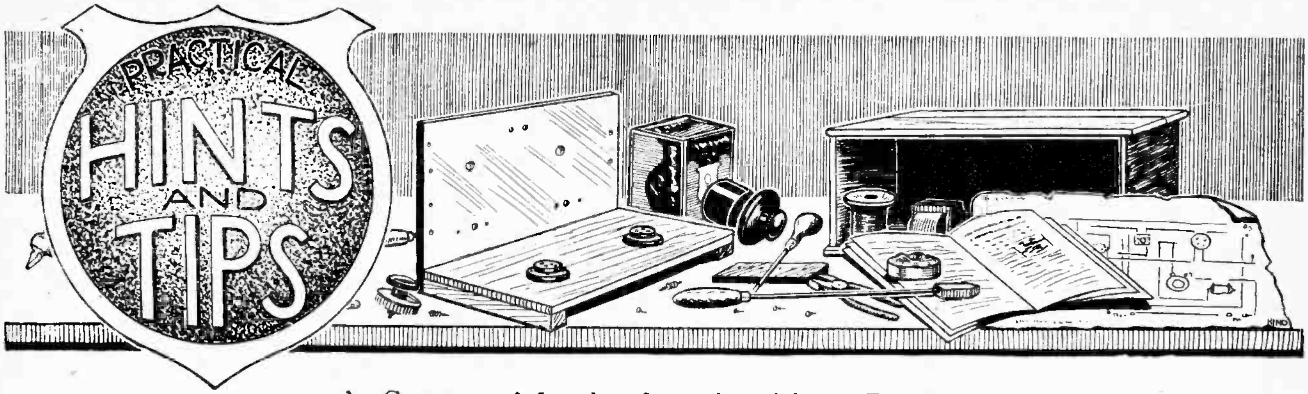
Resin-cored solder is the safest method of introducing flux right over the surface of the joint and without leaving an excess. If this is used in conjunction with the merest trace of "Fluxite" the solder will be found to flow without previously preparing the surfaces by scraping or filing.

Many instrument tags, instead of being supplied already tinned, will be found to be nickel-plated. Solder does not take well on nickel-plating and the surfaces should be made bright with a fine file and tinned before the components are finally assembled.

Soldering Paste.

Soldering pastes are often recommended, and can be used provided that just the requisite amount of paste is applied and the joint to be soldered is not too close to other surfaces on to which the fluid can splutter or condense, as acid fumes are usually evolved. The advantages of soldering paste are that the flux will remain in position on the joint, a surplus of solder or flux can be avoided, whilst the solder, being very finely divided, is very much more readily melted and runs spontaneously.

A requisite amount of solder should be left on the job, subsequently applying the iron, if necessary, after the joint is once made, so that the solder takes the form of a small bright globule. F. H. H.



A Section Mainly for the New Reader.

EXPERIMENTS WITH THE SUPERHETERODYNE.

The difference between the operation of a superheterodyne and the more conventional type of receiver is so considerable that the amateur constructor, although quite at home with ordinary apparatus, is apt to find himself in difficulties when called upon to make preliminary adjustments to a set in which three different frequencies (*i.e.*, fundamental H.F., intermediate, and audio) are being dealt with. In approaching this, as well as many other wireless problems, the beginner is advised "to make haste slowly," and it is a good plan to set up a preliminary experimental circuit with a total of four valves, on the general lines of that shown in Fig. 1, using the components which will later form part of the complete superheterodyne receiver. The oscillator valve has been omitted to avoid complication. Its connections may follow any standard design, preferably that to be adopted in the final set.

As a single stage of I.F. amplification only is suggested, a fairly strong incoming signal will be necessary, and it is recommended that an open aerial should be used in conjunction with the standard form of "untuned aerial" coupling transformer. The first valve operates as a beat frequency detector; impulses from the oscillator are usually fed into the tuned portion of its grid circuit rather than in the manner shown. This valve is coupled to the succeeding one (the I.F. amplifier) by means of an input transformer tuned to the same frequency as that which passes oscillations to the grid circuit of the third valve, which operates as the second detector.

It may be stated with some confidence that it is possible to gain a better insight into the working of the superheterodyne by manipulation of a simple set of this description than by embarking direct on the construction and operation of an elaborate instrument with two or more intermediate frequency amplifiers.

It is recommended that provision should be made for a variable coupling between the aerial and closed circuits, either by moving the coils in relation to each other, or by altering the number of turns in the primary winding, as it has been found, in practice, highly desirable to have some control over the amplitude of signal voltages applied to the first grid circuit when making preliminary experiments.

In the circuit diagram, the input transformer secondary is shunted by a fixed condenser; this coupling may therefore be considered as more sharply tuned than that following it, which is adjusted to resonance by the inductance of its windings in conjunction with their own self-capacity. In this, conventional practice has been followed; it should be added, however, that there is a distinct tendency nowadays to use similar transformers in each stage, thus distributing the overall selectivity equally between the various couplings.

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LOUD-SPEAKERS IN SERIES.

When connecting up two or more loud-speakers in different rooms of a house, the arrangement suggested in Fig. 2 has several advantages, notably that the wiring need have very little self-capacity associated with it. This difficulty may be overcome, when using the more conventional circuit with two leads, by spacing the separate conductors, but the amateur wire-man will find it much easier to do the work neatly when a single wire only is to be installed.

The method of connection will be recognised as an elaboration of that which has been recommended from

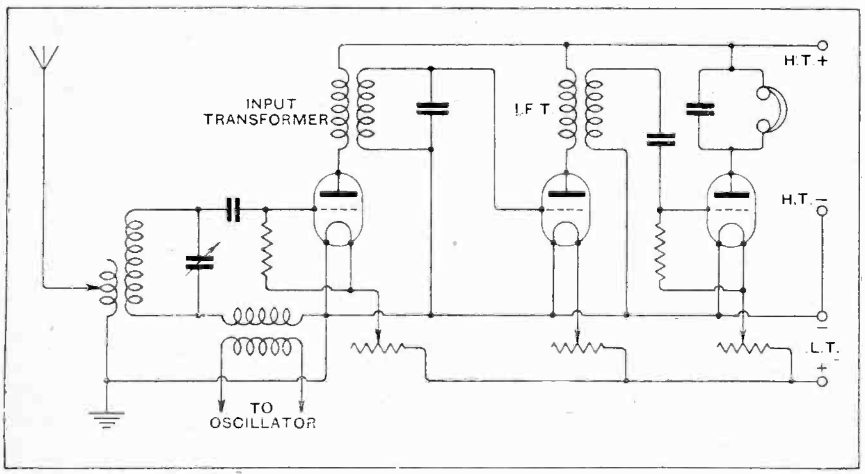


Fig. 1.—An experimental superheterodyne.

time to time in the pages of this journal as being particularly suitable when a loud-speaker is to be operated at a considerable distance from the receiving apparatus. An L.F. choke is inserted in series with the anode of the output valve; audio-frequency voltages set up across it are applied to the loud-speakers through a large blocking condenser, which should have a capacity of about 1 mfd. An "earth return" from the distant point completes the circuit; it is therefore essential that the negative side of the H.T. battery should be earthed at the receiver end

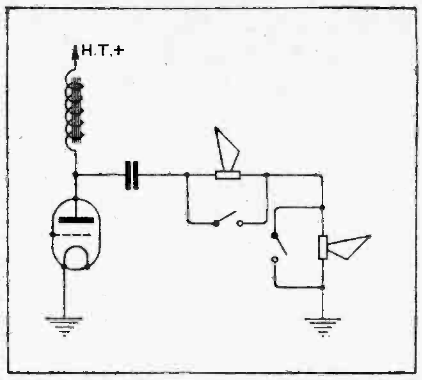


Fig. 2.—Wiring the house for loud-speakers.

—in practice it almost invariably is, except in frame-aerial sets.

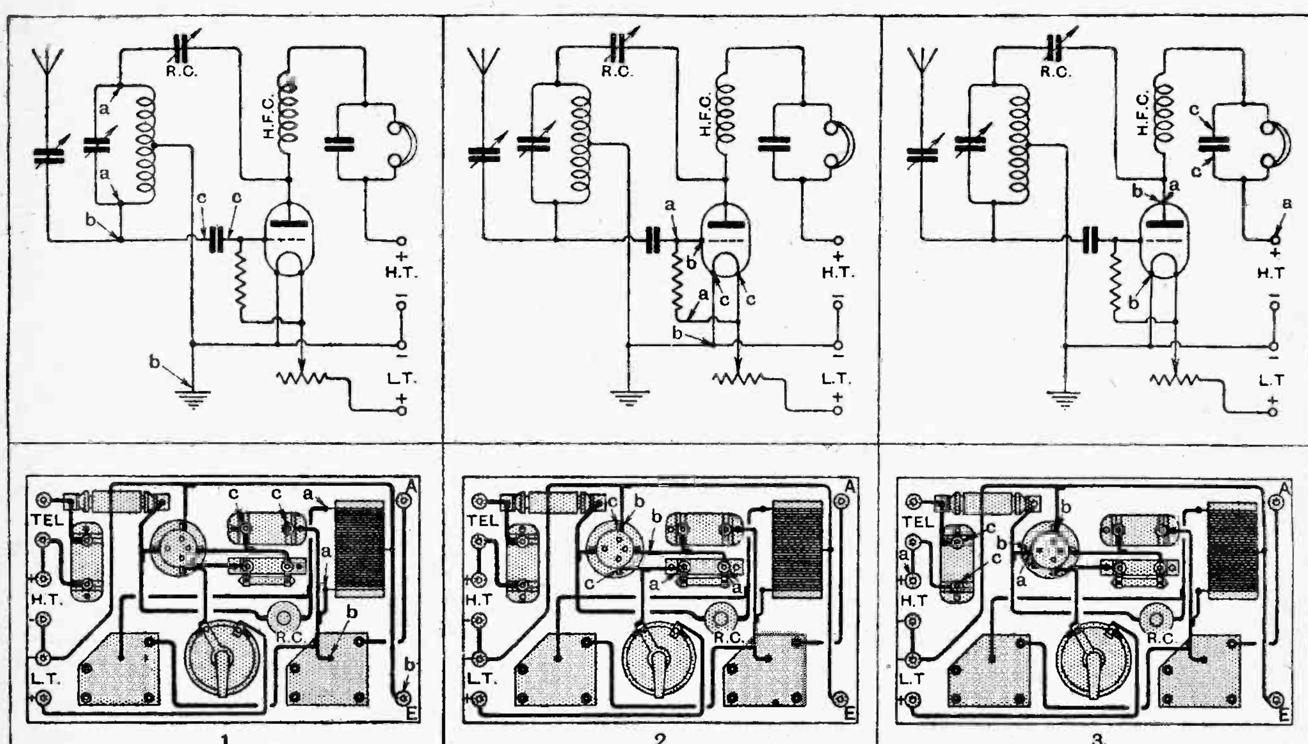
It is suggested that a switch should be connected across each loud-speaker in order that those not required may be short-circuited. If preferred, this switch may be replaced by a jack, which should be arranged to complete the circuit when the plug is withdrawn, as the loud-speakers are in series. Suitable jacks fitted with a protective covering and a base for screwing to the skirting board of a room are now available commercially. Being of small size they are quite inconspicuous.

DISSECTED DIAGRAMS.

Point-to-point Tests in Theory and Practice.

No. 54.—A Single-valve "Hartley" 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.



Continuity of the tuning coil as a whole is tested between *a* and *a*, and of the centre-tapped connection between b and *b*. The insulation of the aerial series condenser may be ascertained by a direct test, but the coil should be disconnected before testing the parallel condenser. Insulation of the grid condenser is shown between *c* and c.

The grid leak is tested between *a* and *a*, and the insulation of the grid circuit as a whole between *b* and *b*, with leak removed and tuning coil disconnected. If the valve is of a type which shows no visible glow, its filament may be tested between c and c, or the whole L.T. circuit, including filament, by applying a test across the L.T. terminals.

The continuity of the anode circuit as a whole is tested between *a* and *a* (with phones in position or their terminals short-circuited), and its insulation including that of the reaction condenser, which should be good, between *b* and *b*. Insulation of the by-pass condenser is shown between c and *c*. Several other continuity tests may be applied if necessary.

AMERICAN RADIO SHOWMANSHIP.

Entertainment Methods of American Station Directors.

By A. DINSDALE.

CHARLES B. POPENCE, manager of Station WJZ, describes broadcasting as "a performance given in a super-theatre before an audience that runs into millions and even tens of millions, including rich and poor, urban and rural, native and foreign born, aristocratic and plebeian—a universal gathering, indeed." Having thus quoted the man responsible for the programmes of America's greatest and most powerful station, let us enquire into his methods of showmanship.

Broadly speaking, radio broadcasting is a continuous performance, with ever-changing features. In marked contrast with the stage impressario who presents but one show a season, the radio impressario must put on a successful presentation every day, day after day, with all the necessary rehearsals and repetitions so essential for its polished performance.

To hold his vast and varied audience, the programme director must provide endless variety. He must studiously avoid duplication and the commonplace, for, unlike the theatrical audience, the radio audience remains virtually the same day after day.

The director of a radio programme must cater for the wide range of likes of a heterogeneous public, whilst carefully avoiding, or attempting to avoid, an equally wide range of dislikes. The programmes must be built up with some regard to sustained interest. Radio showmanship is necessary in the selection, arrangement, and rendition of programme features, so that they gradually work up to a climax, and then taper off until the closing-down time.

Pick-up Wires and their Rich Harvest.

Fortunately, the radio programme manager is not limited to what he can bring before the microphone in the studio. In America particularly he is usually in a position to go after whatever features are being presented to visible audiences, and, by means of microphones and pick-up wires, to bring those same features to an invisible audience as well.

Thus, in the case of WJZ, whose 50 kW. transmitter is situated at Bound Brook, New Jersey, some thirty-five miles from New York City, the main studio is in the heart of New York's theatre district. There are also pick-up wires to many hotels, clubs, churches, parks and other places where good features are waiting to be picked up at the discretion of the programme director.

Furthermore, WJZ is linked up by direct wire with WRC in Washington, WBZ in Springfield, Mass., as well as a studio in Boston, and with WGY in Schenectady, with the latter station's pick-up system extending the whole length of New York State to Buffalo, and including all the large cities.

Outside features play a most important part in the present-day radio programme in America. To illustrate, it is of interest to note that during the year 1925 there were 2,218 outside events on the programme of WJZ, occupying a space of 2,290 hours, as against 4,348 inside events occupying a space of 1,750 hours.

It is significant that, although there were not as many events from outside, yet the outside events filled in more programme time, being more in the nature of orchestra and band concerts, as well as banquets and public gatherings.

Music, of course, predominates in overwhelming proportions so far as the usual broadcasting programme is concerned. So far as musical features are concerned, orchestras lead by a comfortable margin. During 1925 station WJZ presented a total of 1,347 orchestra programmes, as against 77 band programmes. There were 806 talks, but, considered as time expended, they account for quite a small period only.

There were 285 concerts and 328 piano recitals. Turning to vocal items there were 365 soprano recitals, 169 tenors, 89 contraltos, 167 baritones, and 18 bassos. Of choirs, glee clubs, and singing groups there were 129, and organ recitals figured to the extent of 47; violin recitals, 159; 'cello recitals, 19; harp recitals, 8. Additional figures could be given, for the programme director records every event just as carefully as the mariner logs every variation in the weather. However, the foregoing will suffice to give the reader a general idea as to the structure of the present-day high-class American programme.

Only Aural Results Count.

The basis of broadcasting is the transmission of sound through an intangible medium—the ether. Some day we shall undoubtedly be able to broadcast vision also, and thus balance and complete the effect, greatly enhancing the entertainment value of the service.

But that is in the future. To-day we can only broadcast sound; hence the programme director is interested primarily and even exclusively in ear impressions. Appearances mean nothing in broadcasting. The artists are just as invisible to the audience as the audience is to them.

This situation has produced some startling results, not only in America, but in every other country which has taken up broadcasting. Musicians who have failed, for one reason or another, to gain proper recognition on concert platform and theatrical stage, have scored the most astonishing successes in broadcasting, where their musical ability and achievement have been judged by an impartial audience purely on a musical basis.

Singers whose voices lacked the necessary power to "get across" in the concert hall or theatre have come into their own before the microphone, where electrical amplification builds up the sound volume to any intensity required, thus relieving the vocalist of the added strain.

Then, too, there is the informality of a performance before the microphone. A studio, particularly in America,

American Radio Showmanship.—
greatly resembles a drawing-room, so that otherwise timid artists, who would suffer from stage fright if they appeared before a visible audience, have felt very much at ease in their work before the microphone.

Conversely, veterans of the concert and theatre stages have suffered acutely from nervousness before the microphone, owing to the lack of the customary visible audience.

Taken all round, however, the microphone performance is far more conducive to the best musical achievements. The noises and other distractions inseparable from a large auditorium full of people are absent, the acoustics of the studio can be made perfect, and the microphone, which is the ear of the audience, can be placed to the best advantage, so that not only do the various instruments blend properly with each other, but also with the acoustical characteristics of the studio, so as to give the correct effect of "atmosphere." The broadcast listener then gets the same impression that he would if he were seated in the "best seat in the house."

A very important phase of radio showmanship, therefore, is the correct placement of the microphone or microphones, and the proper arrangement of the various artists. Unless these matters receive very careful attention, the radio performance is incomplete.

Station WJZ, being the latest of America's super-power stations, has incorporated in the design of all the apparatus the results of the very latest researches. It is claimed that the tone or musical frequency range of the station extends from 50 cycles to above 6,000, exceeding the performance of the best receivers and loud-speakers.

On the subject of proper microphone placement, it is the outside broadcasts which present the real problems. For studio work it is seldom that more than one microphone is required, but outside events frequently call for a plurality of microphones so that the various effects may be gathered.

Thus, for concerts given by the New York Philharmonic Orchestra four microphones are employed, two being in use at a time. Church services, such as are regularly broadcast from St. Thomas' of St. George's, New York City, call for as many as nine microphones, which have to be installed in various parts of the church, with an elaborate switching system, so as to pick up the organ music, the choir, and various parts of the service.

Radio Reporters.

Relying to such a great extent, as they do, upon outside events to fill their programmes, the larger American broadcasting stations function very much like a newspaper, sending out announcers to act as news reporters and sport reporters as and when occasion arises.

It may be appreciated that such jobs are not always easy. Last year, for instance, WJZ wished to report the classic Poughkeepsie Regatta, held on the River Hudson some miles above New York, and in order to supply red-hot news a radio reporter was sent out to follow the competing boats in a motor boat.

On another occasion a radio reporter was sent to cover the thrilling race between a speed boat on the Hudson River and the Twentieth Century Limited, one of America's fastest trains, which runs daily between New York and Chicago. The train runs along the bank of the river for some distance, and it was over this stretch that the race was run.

The radio reporter on this occasion followed events in an aeroplane, with his microphone linked by short-wave first to a receiver at Poughkeepsie, and later to the Radio Corporation of America's laboratory at the northern end of New York, both points being connected by wire to the control room of WJZ. The present writer was fortunate enough to hear this broadcast, and can testify to its excellence as a thrill producer.

In reporting sporting events, plenty of microphones and wire are necessary. Not only has the news itself to be given to the audience, but also the cheering and general noise of the crowd, all so essential for a realistic background. It is quite the opposite to the studio performance, where, generally, no background is wanted.

The Radio Announcer.

Again quoting the manager of WJZ, "Announcing is no simple task. Everyone cannot make a good announcer, popular opinion to the contrary, notwithstanding. A radio announcer is born, not made. He—or she, for there are some very capable women announcers—is a rare person, to be sure."

What is a good radio announcer's best attribute? Put in a nutshell, it is voice personality. As with vocalists, so with the announcer, it is the voice, and the voice only, which becomes known to the radio audience. Hence the main asset of the announcer is his, or her, voice, provided that voice is properly and sensibly employed.

The radio announcer's voice must be friendly and cultivated. His diction must be flawless. He should know something of foreign languages, so that he can give a fair approximation of the correct pronunciation of foreign titles and composers. He must always be prepared to say enough, but not too much, and he must know what to say at the right time.

Whilst Mr. Popence has gone on record as saying that an announcer is born, not made, he has added that training perfects the born announcer. So far has broadcasting progressed as an art that the announcer of three years ago could hardly go before the present-day microphone. Some announcers are better for certain forms of presentation than for other forms.

The work of a station like WJZ is much more involved than that of an ordinary low-power local station. With its 50 kilowatts of power it easily covers a radius of 1,000 miles, and, under favourable conditions, can even be heard on the Pacific coast. By means of relays through other stations the area which it can be certain of serving can be still further extended.

Bound Brook is thus more of a national than a local station, and, in a country the size of the United States, the task of making the programmes as general as possible is no mean one. The radio showmanship required involves the possession on the part of the programme director of very considerable skill, for he must please the variegated tastes of urban listeners in scores of cities, and also of rural listeners scattered over hundreds of square miles of open country.

That WJZ has been so highly successful in pleasing such a varied and scattered audience is no mean tribute to the showmanship of its manager.

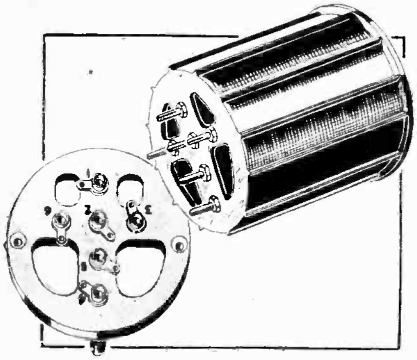
A Review of the Latest Products of the Manufacturers.

THE NEW COLVERN COIL FORMER.

Interchangeable inductances become essential when building a receiving set which will tune over a wider range of wavelengths than the 180 to 525 band.

A former with pin connectors for constructing interchangeable coils has recently been designed by the Precision Screw Co., Ltd., Provost Works, Macdonald Road, Walthamstow, London, E.17, embodying the requirements for really efficient coil construction.

The former is a moulding of genuine Bakelite, and the most noticeable feature is the extremely small wall thickness. Actually it is about $\frac{1}{64}$in. The wall of the cylinder gives support to twelve ribs which elevate the turns of wire at an average distance of $\frac{1}{16}$in. from the face of the former. The use of twelve ribs around a diameter of some $2\frac{3}{8}$in. gives a practically cylindrical coil as apart from the six- and eight-sided coils produced by the use of heavily ribbed ebonite tube. The ribbing together with a thickened ring at the top of the former render it perfectly strong and durable, while the amount of dielectric material in the neighbourhood of the turns is exceedingly small. The former is supplied with six silver-plated pin connectors and a Bakelite base, so that it can carry the windings required for stabilising, introducing capacity reaction, or may be used as an oscillation coupler in a superheterodyne receiver. The length of the winding space on the former is 3in.



The new Colvern Bakelite coil former. The winding space is approximately 3" × 3".

This coil former is well made and beautifully finished, the pin connectors being accurately machined, making an easy fit into the six sockets. It would appear to meet all the requirements for the construction of highly efficient tuning inductances.

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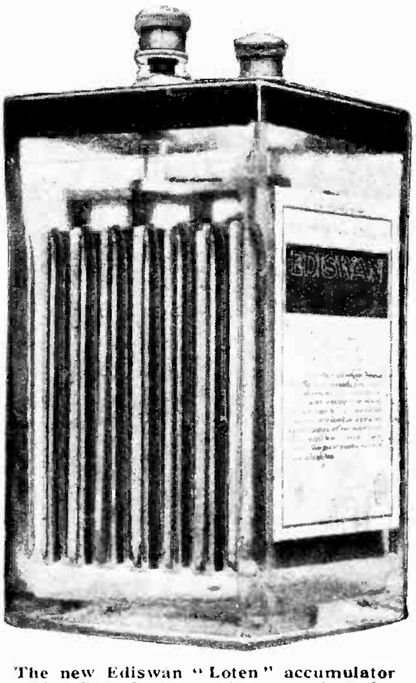
EDISWAN DRY CHARGING ACCUMULATOR.

A new type of filament heating battery has been recently introduced by the Edison Swan Electric Co., Ltd., Ponders End, Middlesex.



The new Ediswan "Loten" accumulator with glass box container. It is "dry charged" and is brought into use merely by the addition of acid.

The special feature of this battery is that although supplied in a dry condition it can be brought into service merely by the addition of acid, and the usual slow process of first charge is avoided. As the accumulator is in a charged state the gravity of the acid needed for filling must be higher than that used in the case of the ordinary type of accumulator. The specific gravity recommended by the manufacturers is 1.260. The duration of first discharge approaches very closely the full rated ampere-hour capacity. The charging rate for the 45 ampere size is given as 3 amperes.

The form of construction is particularly durable and robust. The plates are carried in a thick glass container, and are held in position in grooves in the side of the box, while the top is sealed by means of a glass lid which is dished towards the centre so that moisture will run back into the cell and obviate the usual trouble with regard to spraying. The glass top is drilled and fitted with rubber cork and vent. The terminal pillars pass through rubber collars in the glass top of the cell. Ample space is provided between the acid level and the sealed top, and a full ½in. is allowed beneath the plates for the collection of sediment.

The battery is marketed under the name of the "Loten" accumulator and the specimen examined was the type XG.543, having overall dimensions of 5×4½×9in., being a single 2-volt cell with an ampere-hour capacity of 45.

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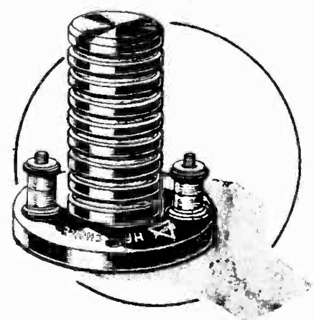
RADIAX H.F. CHOKE.

The high frequency choke of Radiax, Ltd., Palmer Place, Holloway Road, London, N.7, is designed for baseboard mounting, and consists of an ebonite pillar 2¼in. in height carrying eight grooves for the windings with a mean diameter of about ⅞in. The total number of turns is approximately 4,000, which is exceedingly high for a high frequency choke coil, and in view of the fact that an exceedingly fine wire is used, and that the choke is section built, the high inductance value which is obtained is not accompanied by an excessive value of self-capacity. The choke coil is suitable for use either on the broadcast band or with circuits tuned to much higher wavelengths, whilst it should be equally reliable in a short wave set.



Radiax high-frequency choke coil. The winding, which is in eight sections, consists of about 4,000 turns on an ebonite column 2¼" × 1". The illustration shows the sectioned windings, the protective covering having been removed.

TRANSMITTERS' NOTES AND QUERIES

General Notes.

Mr. C. F. Scruby, who, with Mr. D. T. Blunden, operates G 5LU at 8, Penrith Road, Basingstoke, tells us that this station was heard in Freeport, Pennsylvania, at 0630 B.S.T. on September 5th; signal strength was reported as R3. He was using an input of 2.9 watts to two Cossor P1 valves.

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Mr. G. L. Brownson (G 2BOW), Hale, Cheshire, writes that on October 24th he received U 2ADT, Mr. W. Swenson, Montclair, N.J., on 21.6 metres at 2130 G.M.T. Signals were about R3, good R.A.C. and steady. He learns that U 2ADT was using only 10 watts and that this was his first call on that wavelength.

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Mr. Frank R. Neill (GI 5NJ), whose station in Whitehead, Co. Antrim, is so well known, writes that on Sunday, December 19th, he was in communication with Z 3AR, D. W. Buchanan, Ashburton, New Zealand, for over two hours continuously between 11 a.m. and 1.15 p.m., when the call to dinner proved stronger.

Z 3AR replied immediately to Mr. Neill's call at 11 a.m., and the signal strength remained constant during the whole time. 5NJ was transmitting on a wavelength of 32.8 metres with an input of 80 watts to a DET1 valve, and his signals were reported R4, while those of Z 3AR were a steady R6. The receivers used at the respective stations are not stated.

This is probably the first time that two-way working between Northern Ireland and New Zealand has taken place at so late an hour. The weather was fine and bright in Antrim, and therefore not the kind of day on which a lengthy test with New Zealand might have been expected.

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We are asked to state that U 1AOF, Mr. H. C. Wing, 62, Pierce Street, Greenfield, Mass., will be testing every Sunday at 0500 G.M.T. on 85 metres, and will welcome reports. He will call GLB . . . . . GU 1AOF or Test G . . . . . GU 1AOF, in Morse, for several minutes, and will then try telephony. If any transmitter hears him during these tests he is asked to call up U 1AOF on the 45-metre waveband. Reports may be sent *via* Mr. G. L. Brownson (G 2BOW), "Bryning," Hale, Cheshire.

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Mr. A. J. Baker (G 6QH), 23, Third Avenue, Bush Hill Park, Enfield, writes that on December 27th at 2045 G.M.T. he was in communication with KFSX, the American steam yacht "Warrior" from New York, bound on a trip round the world. Her position at that time was in the Red Sea, 187 miles south of Suez. Mr. Baker was using 6 watts input, and the interchange of messages was carried out on 38 metres. The operator of KFSX will be glad if any British amateurs will watch for him on this wavelength and answer his calls after 2000 G.M.T. G 6QH reports that his tone was rather rough, like spark, and was received at about R5.

oooo

Mr. F. N. Baskerville and Mr. G. L. Brownson (G 2BOW), of Hale, Cheshire, have recently been carrying out reception tests with U 8DDL, Mr. E. W. Stratton, Jnr., Rochester, New York, but did not find the conditions as favourable as they were during similar tests last year. Their most successful receptions were on the 80-metre wavelength. They did not succeed in picking up any of U 8DDL's signals on 40 metres.

If any reader has head U 8DDL during the past ten weeks, Mr. Baskerville will be very grateful for any details which may enable him to check his own tests. His full address is 9, Arthog Drive, Hale, Cheshire.

oooo

Duplex Telephony with America.

Our correspondent's letter, of which we published an extract on page 807 of our issue of December 15th, has aroused considerable interest.

Another correspondent from South Shields writes that the station in question has been heard there a number of times, mostly on Sundays about noon and on Wednesdays after 5 p.m.; the wavelength was about 22.5 metres.

A correspondent in London also reports having picked up signals which he thinks must have come from the same station at about noon on October 28th. The wavelength then used was between 15 and 20 metres and speech was heard at fair loud-speaker strength with an 0-v-2 Reinartz receiver. Several people spoke from their homes on the ordinary telephone, and their speech was relayed from this station. One remarked that it was a raw, cold morning and that he had been dragged from his bed to speak.

oooo

Reception of American Broadcast Stations.

A correspondent at Hadlow, Kent, writes that U 2XAF came in at consistent strength until November 20th, when, at a demonstration, he was able to receive it at comfortable loud-speaker strength on two valves. After that date it steadily decreased in strength, and he did not hear it again until December 18th, when it was back at normal strength. It was practically inaudible again on December 20th, when the B.B.C. tried to relay it. By contrast, KDKA, which he first heard on November 20th (the night of abnormal reception), has remained at consistent strength and was very clear on December 20th. He finds that there is seldom any trouble with atmospherics on 2XAF's wavelength, but that on 63 metres they are generally a little troublesome. The receiver he uses is a modified Reinartz in conjunction with a two-valve transformer-coupled amplifier, the detector being a socket type "Weco" valve.

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Radio Jargon.

At the general meeting of the R.S.G.B. Mr. D. S. Richards said that he hoped the use of American jargon (otherwise known at "radiese" or "ham language") would be dropped in such publications as the *T. and R. Bulletin* as unworthy of the dignity of the R.S.G.B.

Our own sympathies are entirely in agreement with his remarks. As an instance of the absurdity of the excessive use of "radiese" in ordinary correspondence we give below a sample letter which recently appeared in a French contemporary :—

OM, HWRU? Y WRKD 1U, GES HW: Y THOT WRK WID 1 GUD INPT; 90m QRA ABT SPK: WEN SUM B4 2345 Y M CLD 4 WRK WID 1 HAM, WID ABT 0.6 amp. RDM GUD ANT, CP GND, HV HRD BY U.S.A. HWSAT? B4 TMRW Y RITE 1 LTR CRD Q.S.L. FB BEST DX. CUM PSE TMRW HR, WE WRK WID CUM HAMS ENAF DIF. CU TMRW? GG? 73's.

This was followed by a translation into courtly French which strongly emphasised the contrast between the two languages.

We also give an example from the "Personal" column of an Australian contemporary :—"—— is still too QRW with work to get on the air," and fail to see any subtle significance in the code letters which make them convey a fuller meaning than the plain English word "busy."

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New Call-Signs Allotted and Stations Identified.

G 5QR D. G. Bird, 273, Pershore Rd., Birmingham. (Change of address.)

G 5XH L. W. Hooke, 87a, Haverhill Rd., Balham, S.W.12. Transmits on 23, 44–46 and 90–200 metres.

G 6BG A. Rothschild, 1, Ashby Rd., Canonbury, N.1.

G 6PF F. M. Cooper, 120, Sandygate Rd., Crosspool, Sheffield. Transmits on 45 metres. (Change of address.)

G 2AWP (Art. A.) W. Huggins, 47, Kingswood Rd., Penge, S.E.20.

G 2AXI F. Inchley, 127, Holly Lane, Erdington, Birmingham.

G 2BRX (Ex 6ON) W. H. Felton, "Wiltonest," Arundel Rd., Durrington, Worthing.

G 5GN (Ex 2ALU) C. R. Green, 32, Aldridge Road Villas, W.11.

G 2AXG A. F. Horton, "Heather View," 51, Coval Road, East Sheen, S.W.14.

K 4YAA (Ex K Y4) Rolf Formis, Alexanderstr. 31, Stuttgart.

CH 2BJ T. Taylor, Casilla 868, Valparaiso, Chile.

LA 5B Bjarne Lindemann, Bjerndalen 31, Bergen.

Ö J1 L. Jenny and R. Haas, via Radio Zentrale, Salzburg. Austria.

SUPERSONIC TRANSFORMERS.

PART V

Influence of Input Impedance of Valves.

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

THE performance of an electrical impedance in a valve in circuit depends upon the inter-electrode capacities of the succeeding valve and upon the type and magnitude of the impedance in its anode circuit. For example, at frequencies below resonance a supersonic transformer behaves mainly as an inductance. At resonance it behaves substantially as a non-inductive resistance, whilst at frequencies above resonance it behaves mainly as a condenser. Hence, if we have a valve circuit where one iron-cored transformer follows another, *i.e.*, two units in cascade, the performance of the first is affected by the impedance of the second and by the inter-electrode capacities of the valve in the anode circuit of which the latter transformer functions. Similarly, valve circuits which succeed the second transformer will affect its performance. This, again, affects the first transformer. Under certain circumstances there is a—so to speak—vicious circle and the combination oscillates, a state of affairs which can be quelled by neutralisation of the anode to grid capacity.

In the experimental work associated with the measurement of amplification curves of the iron-cored transformers described in Parts I to IV, a valve V_2 is resistance coupled to a rectifier, as in Fig. 21. (This is reproduced from Fig. 5, Part II, November 17th issue.) The effect of this valve on the performance of the 1.5 mil iron transformers Nos. 1 and 2 will now be discussed. This course was pursued during the experiments to show the profound influence of inter-electrode capacity at supersonic frequencies, especially with transformers the natural self-capacity of which was small.

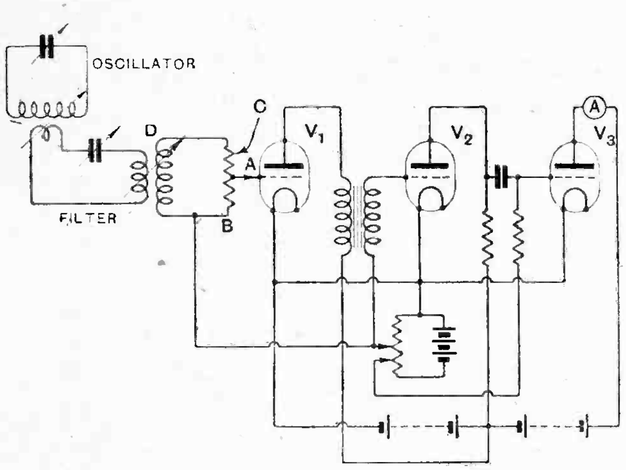


Fig. 21.—Circuit used to determine transformer curves.

Neglecting the filament to anode capacity, the equivalent circuit on the secondary of the transformer of Fig. 21 is shown in Figs. 22, 23. C_2 is the filament to grid capacity, including the capacity of the valve holder and leads. $(1 + \eta) C_3$ is $(1 + \eta)$ times the anode to grid capacity of the valve, which again includes stray capacities. η is the effective amplification of the valve, and is less than m the magnification co-efficient.

In this case it is equal to $\frac{mR}{\rho + R}$ where m is the magnification co-efficient, ρ the A.C. resistance of the valve, and R the equivalent resistance in its anode circuit.

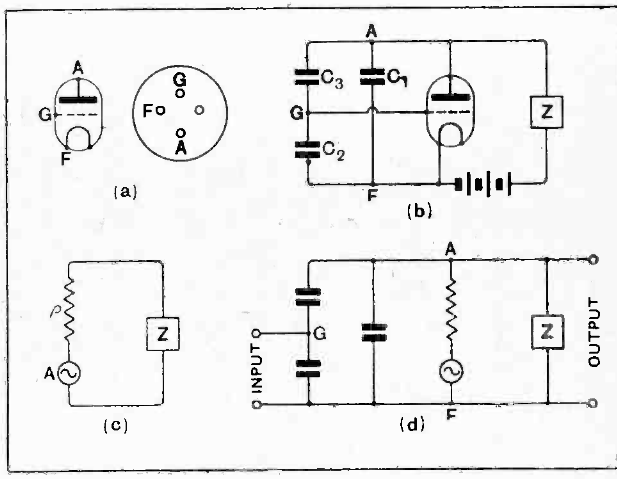


Fig. 22.—Circuits illustrating input impedance of a valve. Capacities are as follow: F to A = C_1; F to G = C_2; G to A = C_3. Circuit (b) shows inter-electrode capacities and Z = impedance in anode circuit. Circuit (c) shows equivalent circuit of valve where A = fictitious alternator. Circuit (d) is a combination of (b) and (c).

Thus, if the coupling condenser between V_2 and V_3 is of relatively low impedance, the value of R is practically equal to that of the anode resistance and the grid leak in parallel. The measured value of η was about 3.9. The reason for $(\eta + 1)$ times the anode to grid voltage is as follows: The anode voltage variations are η times those between the grid and filament, and in a resistance-coupled amplifier are of opposite sign (180° out of phase). Thus the voltage between grid and anode is $(\eta Vg + Vg) = (\eta + 1) Vg$, *i.e.*, $\eta + 1$ times that of the grid.[1] This causes a condenser current equal to $\omega C_3 (\eta + 1) Vg$. If, however, we consider the condenser to be across the grid-filament circuit where the voltage is only Vg, its value must be $C_3 (\eta + 1)$, so that the current is unaltered. There is also a resistance r in series with the condenser $(\eta + 1) C_3$. In this case its value is about + 7,000 ohms, but it can be neglected in comparison with the impedance of the condenser, which is of the order 10^5 ohms at 4×10^4 cycles. Thus in our particular case the circuit of Fig. 23 can be replaced by that of Fig. 24, where a condenser of value $(\eta + 1)$

[1] Vg is the voltage variation of the grid with reference to the filament.

Supersonic Transformers, Part V.—

$C_3 + C_2$ is placed across the secondary of the transformer. The measured values of C_1, C_2, C_3 for valve V_2 of Fig. 21 taken in the valve holder are given in Table XI.

TABLE XI.—INTER-ELECTRODE CAPACITIES OF VALVE V_2 OF FIG. 21.

Position.	Capacity, $\mu\mu F$.
F to A = C_1	9.5
F to G = C_2	12.5
G to A = C_3	5.0

The value of C_4 in Fig. 24 is found from the relationship $C_4 = (3.9 + 1)\ 5 + 12.5 = 37$ micromicrofarads. From Table V, Part 3 (page 715 of *The Wireless World* of November 28th), the total equivalent secondary capacity of transformers Nos. 1 and 2 was 62 micromicrofarads. The above calculation shows that a capacity of

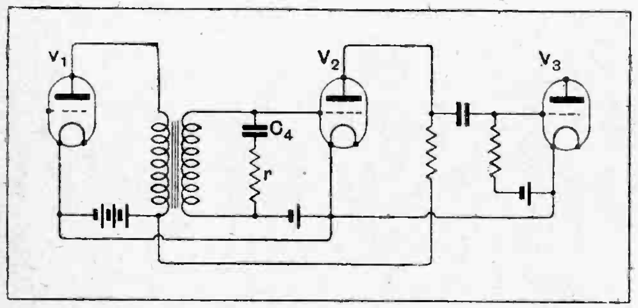


Fig. 23.—Equivalent circuit to input impedance of valve V_2 of Fig. 21. $C_1=(\eta+1)C_3+C_2$ where C_2=F to G capacity of V_2, C_3=A to G capacity of V_2, r=resistance which is positive in value. The self-capacities of the windings have been omitted.

37 micromicrofarads was due to the valve V_2 of Fig. 21. Hence the equivalent secondary capacity of each transformer *when the winding is quite free* is $C=62-37=25$ micromicrofarads. The various data associated with the transformers under the two conditions, (1) the secondary winding "loaded" by the input impedance of V_2 of Fig. 21, (2) the secondary winding free or unloaded, are arranged in Table XII.

TABLE XII.—EFFECT OF INPUT IMPEDANCE OF V_2 ON TRANSFORMERS.

Transformer.	Optimum Wavelength (Metres).		Effective Primary Capacity, C_s $\mu\mu F$.		Equivalent Secondary Capacity, C $\mu\mu F$.	
	Secondary loaded by V_2.	Secondary Free.	Loaded.	Unloaded.	Loaded.	Unloaded.
1	7,000	4,400	560	225	62	26
2	9,000	5,700	1,000	400	62	25

The natural wavelengths with the secondary windings unloaded were calculated on the assumption that the differential permeability of the iron was constant. This probably has little effect on the wavelength of transformer No. 2, but that of No. 1 may be on the high side. The results in Table XII are rather remarkable, for we see that resistance-coupled valve V_2 following the transformer adds a capacity 1.5 times that of the equivalent secondary capacity of the transformer, and the operating wavelength is augmented several thousand metres (59 per cent.), which is rather alarming. Moreover, an amplification curve of the "unloaded" transformer is of little value when the instrument is used in a valve circuit, *i.e.*, with a valve or a series of valves following it.

Under the heading "Transformer Design" in Part III, November 24th issue, we quoted results obtained with a transformer having staggered primary and secondary windings. This construction was tried to see whether the effective primary capacity could be minimised by reducing the mutual capacity between the primary and secondary windings. Using a 3/1 transformer with the same core and turns as No. 1[1], and with six sections on each winding, the effective primary capacity was 480 micromicrofarads, as compared with 560 micromicrofarads for the normal construction. Now, the inter-electrode capacities of V_2 in Fig. 21 accounted for 335 micromicrofarads (the difference between row 1, columns 4, 5, Table XII), so that the effective primary capacity of the staggered windings is $470-335=135$ micromicrofarads. Dividing this by the square of the ratio, we obtain the equivalent secondary capacity $C=15$ micromicrofarads, as against 25 micromicrofarads for the normal construction, a reduction of 40 per cent. Unfortunately, this transformer has been mislaid, and I am unable to check the foregoing result experimentally. The difference seems rather larger than one would expect, but, as we have already seen from Table VI, Part III, page 716, of the November 24th issue, the mutual capacity of the standard or normal transformers is large compared with the self-capacity. In making measurements on the effective primary capacity, the conditions should be such that the capacity added due to the valve (in this case V_2) is relatively small. In practice, unless the valve capacity is neutralised, the advantage of reduced capacity due to staggered windings will not be utilised to any degree.

When dealing with receivers there will, in general, be two transformers in cascade, as shown in Fig. 25. The input impedance of the valve V_2 will be shunted across the secondary winding of transformer T_1. This impedance is due not only to the inter-electrode capacities but to the electrical nature and magnitude of the impedance of transformer T_2. This impedance varies with the frequency, as explained above, so that the phase of the anode voltage with reference to the grid will also depend upon the frequency. Also, the factor η varies with frequency, since the amplification curve is peaked; η in this case is given by

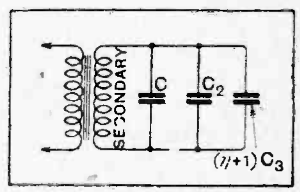


Fig. 24. — Approximate equivalent circuit for Fig. 23 where C= equivalent secondary capacity of transformer, C_2=F to G capacity of V_2, C_3=A to G capacity of V_2, η=magnification due to V_2.

$$\frac{\text{Magnification}}{\text{Turns ratio}} = \frac{M}{S}.$$

Since the impedance varies in magnitude and phase with frequency, the input impedance of V_2 also varies. It is still represented by a condenser in series with a

[1] No. 44 D.S.C. was used in this case, No. 42 D.S.C. in the normal construction.

Supersonic Transformers, Part V.—
resistance, both of which vary with the frequency. The inductance of the transformer makes it possible for this resistance to be negative. If the negative value is adequate and other conditions suitable, self-oscillation will occur. In the amplifier shown in Fig. 19 (page 777 of the December 8th issue), where the grid resistances R_2 are omitted, an increase in anode potential of V_3, V_4 (the valves associated with the transformers), from 50 to 100 volts was sufficient to make the set oscillate.

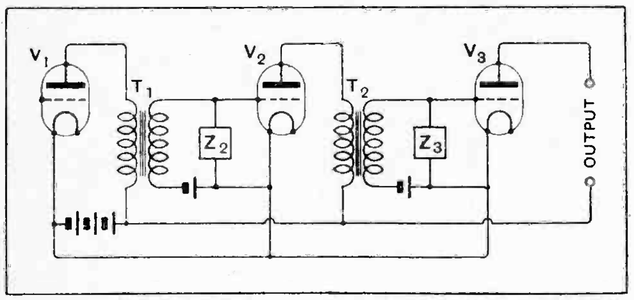


Fig. 25.—Diagram showing double transformer coupled amplifier and input impedances to valves.

Since the series capacity and resistance representing the input impedance of V_2 in Fig. 25 vary with the frequency, the amplification curve of transformer T_1 will be affected accordingly. Moreover, apart from oscillation, unless the input impedances of V_4 and V_5 are the same, the amplification curves of T_1 and T_2, as obtained in this circuit, will be different. Hence the combined amplification curve for the two transformers in cascade will be quite unlike that obtained by squaring the ordinates of one of the curves. The above argument and the experimental data seem to indicate that, with the transformers under discussion, at any rate, capacity neutralisation is desirable. Self-oscillation would be suppressed, and the input impedance would be substantially the grid-filament capacity of the valve. It would then be easier to get the two input impedances equal.

Effect of Resistance of Windings.

Owing to the high effective resistance of the American supersonic transformers and the flatter amplification curve, the above effects are not so pronounced. The higher resistance makes for stability, whilst the flatter curve and the larger leakage mean that the capacity component of the input impedance of a valve succeeding the transformer is of less importance. Although the amplification of a 1.5 mil iron transformer at its maximum exceeds that of the American appreciably, the superiority is not evinced to the same extent when the transformers are cascaded, as shown in Fig. 19 in Part IV. In other words, the inter-electrode capacities have less effect on the American than on the 1.5 mil iron transformers. Despite the advantage of the American type in this respect, the reduction of resistance and the neutralisation of capacity is the more scientific way of dealing with the problem. There is no one who doubts the veracity of this statement in connection with H.F. amplifiers for broadcast wavelengths, and there seems every reason to believe that it would be sound practice in the design of iron-cored supersonic transformers. The designer then uses his iron and copper to the best advantage. So far as neutralisation is concerned, the reader will see from the photograph in Part I, page 634, November 10th issue, that there is ample room for additional winding.

One of the two transformers under discussion (No. 2) operates down to a frequency of 25,000 cycles. Now, audio frequencies are not so far removed from this figure, and we naturally wonder what effect inter-electrode capacities have in speech amplifiers. We can take the simple case of a condenser-resistance amplifier shown in Fig. 26 and ascertain the effect of V_2 on the resistances R_1, R_2, and the coupling condenser C_1. Assuming V_2 to be a valve having $C_1 = C_2 = C_3 = 10$ micromicrofarads, $\rho = 3 \times 10^4$ ohms, $m = 30$, and that $R_1 = 10^5$ ohms, $R_2 = 5 \times 10^5$ ohms, we get at frequencies above 1,000 cycles (since the impedance of the coupling condenser is negligible). The effective anode resistance is R_1 and R_2 in parallel $= 8.3 \times 10^4$ ohms. Thus $\eta = 22$. Also $C_4 = (\eta + 1)\ C_3 + C_2 = 23 \times 10 + 10 = 240$ micromicrofarads. Impedance of 240 micromicrofarads at $f = 5{,}000$ cycles is $\frac{10^{12}}{240 \times 2\pi \times 5{,}000} = 1.32 \times 10^5$ ohms, so that the total impedance of the grid-filament path is the vector sum of these values in parallel. The vector diagram is shown in Fig. 27, the current into the condenser and that through the resistance being at right angles to one another. I_T, the total current, is greater than i_2 by the amount shunted through the equivalent condenser,

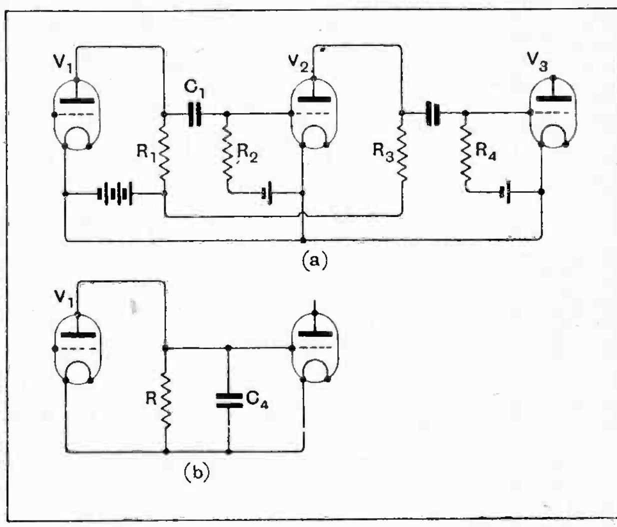


Fig. 26.—Resistance-capacity coupled amplifier circuit (a) and equivalent circuit for V_1 (b). $C_4 = (\eta + 1)C_3 + C_2$ and $R = R_1R_2/R_1 + R_2$.

i.e., due to the input impedance of V_2. The impedance in the anode circuit of the valve V_1 is now 7×10^4 ohms instead of 8.3×10^4 ohms, so that there is a reduction of 15 per cent. in the amplification at 5,000 cycles and of 29 per cent. at 10,000 cycles. When an additional stage of resistance coupling is added the above figures are respectively 35 per cent. and 58 per cent. Where a valve of lower magnification factor is used the reduction in amplification would not be so great.

Another case arises when the valves of the speech

Supersonic Transformers, Part V.—

amplifier are transformer coupled. Here, of course, the input impedance varies with the frequency. With a good transformer in which the amplification is sensibly constant over a wide range of frequency, the magnitudes of η and the input condenser would be sensibly constant, but the resistance r would vary with the frequency. Under certain conditions—according to the coefficients of the transformer and the internal resistance of the valve—the resistance might be negative. Since the positive resistance in the valve circuit preceding the transformer—we assume a circuit in which a resistance-coupled detector is followed by a transformer—is large, this negative resistance does not, in general, cause oscillation, but it may influence the amplification-frequency curve, especially if the magnification per stage were relatively high and the internal resistance of the valve low.

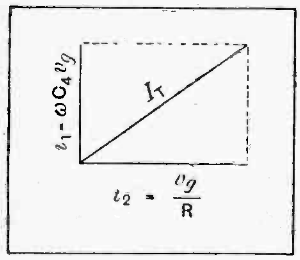


Fig. 27.—Vector diagram of current in Fig. 26 (b). i_1= current through C_4; i_2= current through R; I_T= total current=alternating current through valve V_1.

When *two* transformers are coupled in cascade in the well-known manner the second influences the performance of the first, since it causes an input impedance on the grid of the valve with which it is associated. This input impedance varies with the frequency, as indicated above. Furthermore, the first transformer causes an input impedance on its valve grid-filament circuit, which influences the action of the circuit (whether high- or low-frequency) preceding it. If this valve be the detector, the high-frequency input impedance, so far as the transformer is concerned, can be considered as a condenser $C_2 + C_3$, because there is usually a by-pass condenser, and the H.F. is well above the resonance of the transformer (low reactance).

Overall Amplification.

The preceding argument points to an important issue which I introduced in this journal[1] some time ago, namely, that the overall amplification characteristic of a complete receiver is wanted. Isolated curves of one "unloaded" L.F. transformer are of little value where another L.F. transformer and a selective high-frequency unit are used in conjunction with it.

The input impedance of a thermionic valve was first treated theoretically by Miller in the *Bulletin Bureau of Standards*, Vol. 15, page 367, 1919. Readers wishing to study the subject more intimately should consult Miller's analysis and the experimental curves which support it. They will, of course, have to apply the analysis to their own particular cases, for the paper deals merely with the input impedance of a single valve, the anode circuit of which contains some form of impedance.

The theory of transformer design and the calculation of characteristic curves have not been given because they are beyond the scope of this journal. Readers, however, who desire to probe the matter further can refer to an article in *Experimental Wireless* dealing with the neutrodyned tuned anode.[2] Barring leakage between primary and secondary windings and the effect of the input impedance of the succeeding valve, the theory follows the same lines as those given there. Care must be exercised, however, about the approximations used, because the argument referred to much higher frequencies. For example, in a supersonic transformer zero reactance does not occur precisely when $\omega^2LC = 1$, as it would for a short-wave circuit.

Harmonics due to Hysteresis.

There is the question of distortion due to harmonic frequencies caused by hysteresis in the iron. If the main or carrier frequency is 30,000 cycles there will be the usual side bands 30,000 ± 8,000. Hysteresis will give a series of treble frequencies 90,000 ± 24,000, etc. The importance of these will depend upon the selectivity or peakiness of the amplification curve. The same kind of effect is obtained in any high-frequency circuit when grid current flows, but there is in general a double frequency also. Whether there is any audible result or not is a question to be settled by experiment. In any case, the auxiliary frequencies in a supersonic transformer will be of less account than those in a sonic (low-frequency) transformer.

In conclusion, the author would like to draw attention to one or two errors in previous articles in the series. In Fig. 1, page 631 of the November 10th issue, the subsidiary loops should be wholly to the left of the B-H curve as shown in Fig. 28. In the footnote to Table IV on page 684 of the November 17th issue the value of C_s should be in micromicrofarads. The values of B_{max} in Fig. 18, page 718 of the November 24th issue, should read 1.0×10^3, etc., instead of 10×10^3.

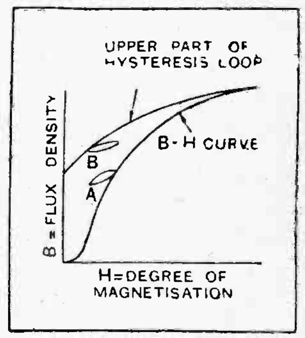


Fig. 28.—Subsidiary loops (A, B) formed when A.C. magnetisation is superposed on D.C. magnetisation in an intervalve transformer core.

BOOSTING UP THE CHORUS.

A NEW use has been found for the valve amplifier, this time on the theatre stage. The innovation was recently introduced by Paul England's "Revellers," appearing at the Alhambra, London.

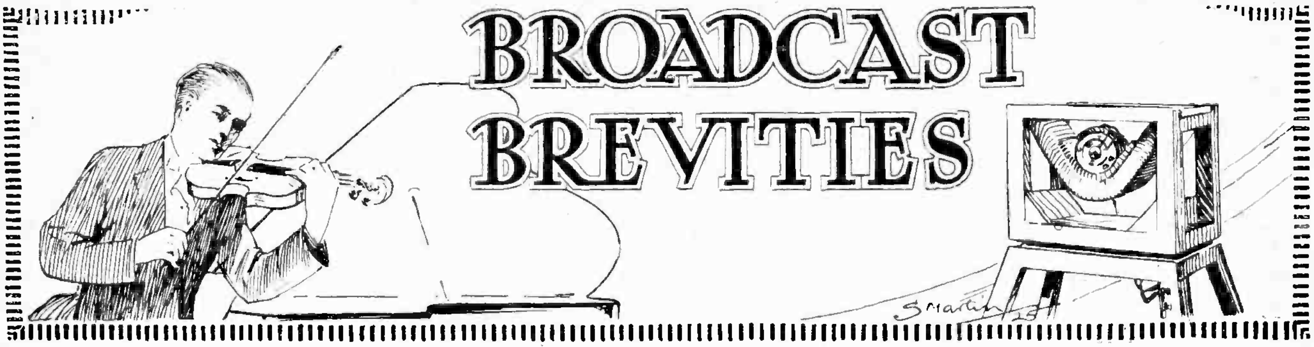
After their opening "Froth-Blowers' Chorus," the Revellers were discovered sitting at a dining table, on which reposed the remains of their feast. They sang one or two numbers and then broke into "Cuckoo," a new song by Leslie Sarony. The first verse was sung, and then suddenly the chorus was heard, amplified ten times by means of concealed microphones and amplifiers.

The Marconi-Reisz microphones were concealed amongst the debris of the meal, and a Marconiphone "E" amplifier, placed beneath the stage, supplied four loud-speakers. These were placed in pairs at the sides of the proscenium, and played diagonally across the house, covering the whole auditorium.

The result was an instant success at the first performance, the song being encored no fewer than five times!

[1] *The Wireless World*, p. 90, January 20th; p. 744, June 2nd, 1926.

[2] Amplification and Selectivity of Neutralised Tuned Anode.—*Experimental Wireless*, p. 545, September, 1926.



NEWS FROM ALL QUARTERS.

By OUR SPECIAL CORRESPONDENT.

Enter the Corporation.—Savoy Hill's Holiday.—Observations on Finance.—Alternative Programmes for All.—Foreign Relays.—Broadcasting and the Newspapers.

A Little Sentiment.

Many loyal souls who heard the last strokes of Big Ben on Friday night may have said, with lumps in their throats: "The B.B. Company is dead; long live the Corporation!" With which sentiment most of us will concur, though with the important little proviso that, if it is to live long, the Corporation must give us our money's worth.

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The Silence of Lord Clarendon.

Lord Clarendon's message to listeners in the current issue of the B.B.C.'s official organ is not lacking in inspiration. Credit is given to the old company for the progress already achieved, and the impression is imparted that the new Corporation is fully alive to the responsibilities which it is now called upon to shoulder.

This is Lord Clarendon's first official pronouncement. No doubt his reticence in the past has been chiefly due to the fact that, until the governors had actually taken the reins, "silence was golden." But when will his lordship make use of the medium which is almost literally "at his elbow," and give listeners a chat from the microphone? The personal element of a broadcast talk would enlist more public sympathy for the new board than many columns in *The Radio Times*.

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Holiday at 2LO.

An unwonted hush enshrouded No. 2 Savoy Hill on New Year's Day, reminding one of the oft-remembered monastery garden. The reason was not far to seek. With the exception of the officials necessary to run the programmes, the whole staff was holding high holiday, presumably as a mark of special respect to the new governors. Apart from this "day off," however, the accession of the new Corporation has been practically unmarked at headquarters, only one or two of the highest officials appearing to be affected by the transfer. The "other ranks" are hardly aware of any change, while the vast army of listeners is not yet affected at all.

No Change.

On the first day of the transfer the London and Daventry programme was on precisely the same lines as those given at New Year seasons in the past. Moreover, the programmes for the next four or five weeks are already mapped out, and we need expect nothing of a startling nature.

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Dividing the Shekels.

As far as the immediate financial position is concerned the revenue will be sufficient to meet current expenditure involving the costs of liquidation, but little will be left over for ambitious experiments in the arrangement of programmes.

In the year ended last March the company received £500,000; in the current financial year £732,000 will be divided as between the Company for nine months and the Corporation for three months.

If the estimate of 2,200,000 licences in force on April 1st next is accurate, the Corporation will receive in its first financial year £805,000.

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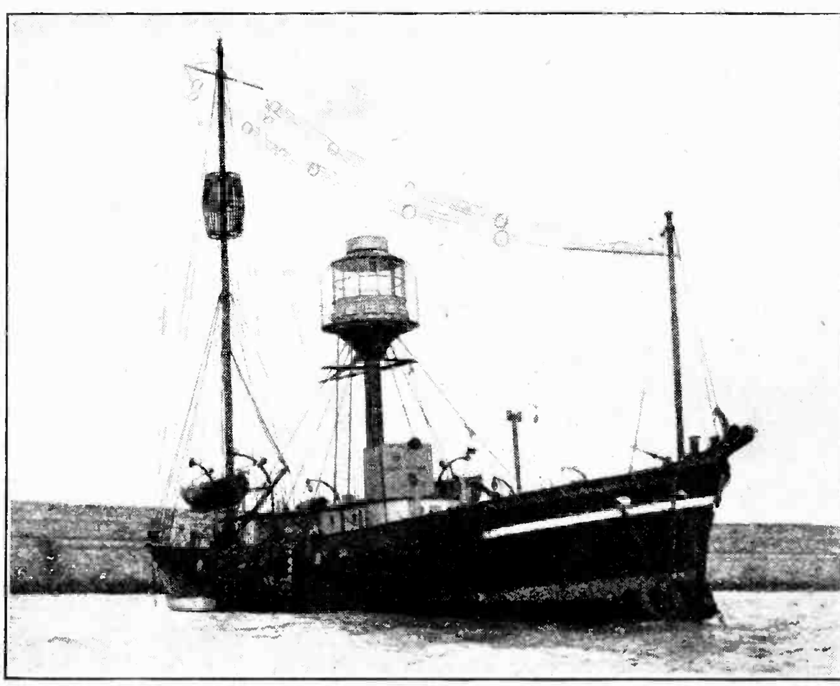
Spending the Money.

The joyful assumption that we are to have more expensive programmes as a result of this increase in revenue is



THE COMPLETE LIGHTSHIP. Stationed outside Dublin Bay, this lightship, the "Albatross," has been equipped with a synchronising wireless beacon and submarine oscillator, and should prove of immense value to shipping in time of fog. A fund for equipping lightships with broadcast receivers has been initiated by "The Daily News."

purely speculative. I understand that the first concern of the Corporation will be the regional scheme, for which the new body is likely to set aside some proportion of its income for 1927-28. No doubt the Corporation will add to this reserve a portion of its income for the financial year 1928-29, the total of which is expected to reach £866,000, and it is probable that the regional stations will be in operation by 1929.

oooo

Alternative Programmes for All.

With the regional scheme changing from a romantic dream to something near a certainty it is interesting to speculate on the altered aspect of broadcasting in two years' time. According to the plan, each high power station may specialise in a certain type of programme. Three or four programmes will be available to valve users, while even the crystal manipulators, now a diminishing quantity, will have at least two programmes.

oooo

Placing the High Power Stations.

The scheme provides for about ten stations in Britain, five or six of which will be of "super power" like 5XX, the remainder being relays with the power of the present main stations. The high power stations will each be situated at a minimum distance of ten miles from the nearest large town, and I should not be surprised if the "London" station finds a site twenty-five miles out from the Metropolis.

oooo

A Relay Freak.

The B.B.C.s recent relay of Hilversum's programme aroused considerable enthusiasm in Holland. In a letter to Savoy Hill the announcer, Mr. W. Vogt, states that he has received many interesting communications both from Britishers and his own countrymen. One came from a Dutch listener who heard the first syllable of a word from Hilversum and, by rapidly turning his condenser, picked up the second syllable from Daventry!

oooo

Uncomplimentary.

I have not heard it contradicted that a Wigan listener tried the same experiment on the word "useful," but the condenser was stiff and he missed the sibilant.

oooo

A "Remote Microphone."

A new term, "remote microphone," has been adopted by the engineers at WJZ, New York, to describe the microphone arrangement used in broadcasting the carillon of the Park Avenue Baptist Church.

In the preliminary tests it was found that the sound of the bells was so shattering that the microphone would blast when within fifty feet. On the other hand, when the microphone was placed farther away, street noises caused serious interference. The riddle was solved by an engineer who conceived the idea of muffling the microphone; the instrument now faces a brick wall quite close to the carillon, street noises are excluded, and the chimes are just sufficiently softened to prevent blasting.

FUTURE FEATURES.

Sunday, January 9th.

LONDON.—Little Plays of St. Francis acted by the University College A.D.C.

GLASGOW.—Religious Service relayed from Hyndland Parish Church.

ABERDEEN. — Organ Recital and Service relayed from Cowdray Hall.

Monday, January 10th.

LONDON.—Sir Martin Harvey.

BIRMINGHAM. — Chamber Music—Winifred Small and Maurice Cole.

BOURNEMOUTH.—A Dip Into the Past.

CARDIFF.—A Double Bass Recital by Victor Watson.

MANCHESTER.—A Lancashire Concert.

Tuesday, January 11th.

LONDON.—The Band of H.M. Royal Air Force.

MANCHESTER.—British Composers—Henry Bishop.

NEWCASTLE. — "Voices," Light Comedy in one act played by the Station Repertory Company.

GLASGOW.—Wish Wynne in Character Studies.

ABERDEEN.—"The Treasure Hunt," played by Aberdeen Radio Players.

BELFAST.—"A Sharp Attack," by Herbert C. Sargent, played by the London Radio Repertory Players.

Wednesday, January 12th.

LONDON.—"My Programme," by a committee of members of the National Institute for the Blind.

MANCHESTER. — Lancashire Play Series—"Independent Means."

Thursday, January 13th.

LONDON.—Mendelssohn's "Hymn of Praise" relayed from Norwich Cathedral.

BIRMINGHAM.—Military Band Concert.

CARDIFF.—Welsh Programme.

ABERDEEN.—Instrumental and Ballad Concert.

BELFAST. — "The Jarvey," a Comedy of Ulster Life by Ruddick Miller.

Friday, January 14th.

LONDON. — Chamber Music — Brahms.

GLASGOW.—A Studio Raid by the students of Glasgow University.

Saturday, January 15th.

LONDON. — The Cathedral Male Voice Quartet.

MANCHESTER.—Revusical Moments of 1927.

That Neglected Earth Switch.

An event, highly improbable but not impossible, which would cause more universal anxiety at the present time among the male population of this land than almost anything else, would be a midday thunderstorm. In the winter months a large percentage of listeners pay little attention to the "earthing" of their aerials, the risk of thunderstorms being exceedingly remote. But if a thunderstorm did come along one of these January days, say, at 11.30 a.m., when most men-folk are far from their homes . . . but the thought is too harrowing.

oooo

Foreign Relays to Continue.

The lying jade has been active again with a story that the B.B.C. proposes to discontinue the relaying of foreign programmes. I am assured at Savoy Hill that there is no truth in the rumour. So that's that.

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Broadcasting News.

At the moment of writing an agreement is being framed between the broadcasting authorities and the Newspaper Proprietors' Association under which the Corporation will enjoy greater freedom than did the Company in the matter of news collection and distribution.

I understand that the First News Bulletin will in future be given earlier in the evening, viz., 6.30, with the Second Bulletin at about the usual hour. More interesting, however, is the indication that the B.B.C. will give descriptions of important events as they occur, these transmissions being relayed from the spot. 2LO will, I hear, be restricted to 104 per annum of these "running commentaries," which will be S.B. throughout the country. The provincial stations will be allowed to deal in a similar manner with purely local events.

oooo

Talks on Distortion.

Many listeners have only vague ideas of the steps taken in the broadcasting studio and control room to ensure adequate and faithful reproduction. Mr. Colin Gardner, who is giving two talks on "Reality in Broadcast Reception" this month from the Birmingham station, will deal fully with this subject, and will introduce demonstrations showing the effect of various forms of distortion, such as may result from undesirable resonances in parts of the apparatus.

oooo

R.A. String Band Concert.

The Royal Artillery String Band is to broadcast from 2LO on Saturday next, January 8th, with Captain E. C. Stretton, M.V.O., Director of Music, R.A., as conductor. Syncopated songs by Grace Ivell and Vivian Worth will be interpolated.

oooo

A Night of Dancing.

January 29th is to be a wireless dance night, the appropriate items being broadcast from 9.30 p.m. to midnight from 2LO.

APERIODIC H.F. AMPLIFICATION.

Further Notes on the Work of von Ardenne and Heinert.

By Dr. H. KRÖNCKE.

I RECENTLY gave an account of how M. von Ardenne has been endeavouring to use aperiodic high-frequency amplification with resistance coupling even for relatively short-waves, and in the issue of *The Wireless World* of Dec. 16th, 1925, a description was given of a new "multiple-valve" which had been elaborated by Dr. S. Loewe, and which is suitable both for low-frequency amplification and high-frequency amplification. Recently the scientific principles upon which high-frequency amplification with resistance coupling is based have been the subject of more precise investigation, and it will probably be of interest therefore to summarise briefly the most important points underlying the development of the aperiodic high-frequency amplifier.

Effect of Valve Capacities.

Fig. 1 represents one stage of a resistance-coupled amplifier. The resistance R_a is used as coupling, the condenser C_1 serves to transfer the alternating potential established across the ends of this resistance to the grid of the succeeding valve; the resistance R_1 acts as grid leak. With high-frequency oscillations, the internal capacities of the valves, shown in Fig. 1, are quite as important as the resistances and the capacity C_1, and the higher the frequency, the more is this the case. With such capacities account must be taken of:

(1) The capacity C_{ak} between anode and filament of the first valve.

(2) The capacity C_{gk} between grid and filament of the second valve.

(3) The capacity C_{ga} between anode and grid of the second valve.

To these capacities we will revert later.

According to the formula for resistance coupling the amplification in one stage of a valve amplifier, *i.e.*, the ratio of the fluctuations of potential in the anode circuit and the variation of potential in the grid circuit is:

$$A = K\frac{R_a}{R_a + R_i},$$

in which K is the valve amplification factor and R_i the internal resistance of the valve. For this reason it is well known that in order to attain high amplification the valve amplification factor K must be made as large as possible, and the external resistance R_a must be large as compared with the internal resistance of the valve R_i. The formula will be still clearer if, instead of the potential amplification factor K, we introduce the steepness of the valve characteristic S, *i.e.*, the inclination of the grid characteristic to the horizontal axis. As will be easily appreciated:

$$\frac{R_i S}{K} = 1, \text{ or } S = \frac{K}{R_i}.$$

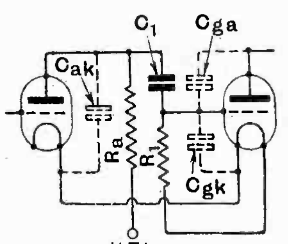


Fig. 1.—Schematic circuit of resistance-coupled valves showing inter-electrode capacities.

Now, M. von Ardenne has introduced the idea of *working* steepness, *i.e.*, the steepness of the characteristic, which results with a noticeable external resistance R_a, and to which we will refer again later. If we designate this working steepness as S_a we get

$$S_a = \frac{K}{R_a + R_i}, \text{ therefore } A = S_a \cdot R_a.$$

In order first of all to comprehend better the influence of the external resistance, there is represented in Fig. 2 by the curve A the grid volts—anode current characteristic of a valve. It is assumed that this characteristic is taken without noticeable external resistance in the anode circuit. By the insertion of a large external resistance, for example of 500,000 ohms, the characteristic will assume an essentially different form. The curves in Fig. 2 are drawn on the supposition of an anode potential of 100 volts and for a valve with a potential amplification factor of 25. With an external resistance of 500,000 ohms, therefore, the saturation current is 0.2 milliamperes, and the "working characteristic" for this resistance is as shown by curve B. With an external resistance of 1 megohm, the working characteristic assumes the form of curve C, and for $R_a = 3$ megohms the form of curve D. The upper angles of these working characteristics lie in a curve which has the same form as the characteristic A, but with its origin passing almost through zero.

Working Characteristics.

The curves show several important points. On the one hand, the working steepness S_a decreases with an increasing external resistance. As, however, the amplification is equal to the product $S_a \cdot R_a$, the total amplification actually increases to a certain extent with increasing resistance, until, finally, with a very high internal resistance, the steepness S_a becomes so small that the amplification also again decreases. It will further be recognised that with an increasing resistance R_a the ascending portion of the characteristic falls increasingly within the scope of the negative grid potential, where no grid current flows, and where, therefore, the overall power consumption of the valve has the smallest conceivable value. Finally, it will be recognised that the greater the external resistance the straighter runs the working characteristic. From these considerations it is apparent that an external resistance R_a of about 3 megohms is the most favourable for the coupling of the resistance amplifier.

The above conditions regarding the choice of the external resistance apply for low-frequency amplification, as one may convince oneself easily by the practical construction of amplifiers. With the amplification of high-frequency oscillations on the other hand, the con-

Aperiodic H.F. Amplification.

ditions are somewhat more complicated. We shall see that there are two limiting conditions, one of which calls for a large external resistance, whilst the other requires a small external resistance; hence it follows that a compromise must be effected.

The alteration of the conditions with high-frequency amplification is to be chiefly attributed to the influence of the internal capacities shown in Fig. 1, which are in parallel with the coupling resistance R_a. The effective resistance is diminished by these capacities, and the amplification is lowered thereby. First of all let us calculate the value of R_a, giving an amplification of 1 in order to establish a lower limit, which in practice must be considerably exceeded if the amplification is to be of any use at all. If we write

$$A = K \cdot \frac{R^1_a}{R^1_a + R_i} = 1,$$

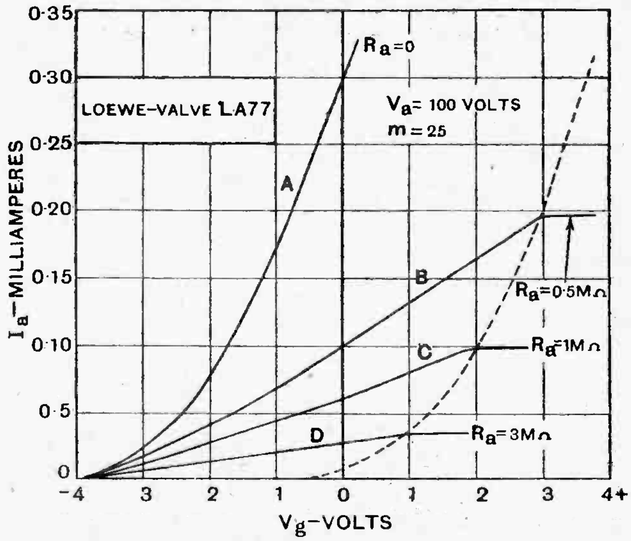


Fig. 2.—Working characteristics for anode resistances of different value

in which R^1_a is to be that critical value of the coupling resistance, the latter results in

$$R^1_a = \frac{R_i}{K - 1}.$$

It must be generally assumed that with this state of things the resistance R^1_a is principally brought about by the resistance of the capacities, therefore

$$R^1_a = \frac{1}{\omega C} = 477 \cdot \frac{\lambda}{C},$$ where λ is measured in metres and C in cm. If we insert this in the formula for R^1_a we get $\lambda = \frac{R_i}{K - 1} \cdot \frac{C}{477}$.

This formula gives the *limiting value of the wavelength* in metres, for which, with a definite value C of the harmful capacities, with a definite internal resistance of the valve R_i and with a potential amplification factor K, the amplification 1 can be obtained.

Valve Capacities under Working Conditions.

We shall see further that the magnitude of the harmful capacities is, on an average, about 50 cm. Furthermore, for the more usual valves it can be reckoned that the factor $\frac{R_i}{477\ (K-1)}$ is about 10. The wavelength with which the high-frequency amplification ratio 1 can be obtained with resistance coupling is therefore about 500 m. It may be assumed as a general rule that good high-frequency amplification is only possible for a wavelength which exceeds that limit wavelength by about three-fold.

It appears surprising at first sight perhaps that the harmful capacities should have an average value of about 50 cm. In fact the sum of the internal capacities $C_{ak} + C_{gk} + C_{ga}$ is very much smaller, namely, about 10 cm., if these capacities are measured "statically," or if the valves are not in operation. If the second valve especially is switched on the capacity C_{ga} is apparently increased considerably in consequence of the effect of the grid on the anode current. This *apparent* increase of the capacity plays a specially important part; it is the chief reason why aperiodic high-frequency amplification with resistance coupling has hitherto caused so many difficulties, since all means for lessening the internal capacity and the capacity of the leads are of little avail, because the apparent capacity C_{ga}, which cannot be influenced, gives by far the greatest amount.

As the result of fresh investigations, especially those of Schrader, it has been shown that the apparent capacity C_{ga} is greatest when a small resistance R_a is placed in the anode circuit of the previous valve. But the greater the resistance R_a, the smaller is the apparent capacity C_{ga}, and with a large value of R_a this apparent capacity drops to a fifth or tenth of the value it has with a large anode current. For this reason it is advisable to make R_a as large as possible.

As shown by the formula for the limiting wavelength of aperiodic high-frequency amplification, it is advantageous to make the internal resistance R_i small and the potential amplification factor K large. In other words, the internal resistance of the valve must be small and the steepness of the characteristic must be as great as possible. As will be seen from Fig. 2, one must not on this account choose too great an external resistance, since with an increasing external resistance the steepness of the working characteristic decreases more and more. It has been found in practice that the anode current should not be less than about 0.2 milliamperes; should it be so the working steepness would become too small, with a consequent loss of amplification. In practice, therefore, one should work with an anode potential of 100 volts and with an external resistance of about 200,000 ohms. In order to make the internal resistance as small as possible, the most favourable course is to work with double-grid or four-electrode valves in which the external grid is used as a modulating grid.

In order to lessen as much as possible the capacities of the leads and thereby to reduce the harmful capacities, Dr. S. Loewe has constructed two four-electrode valves with all other parts of the amplifying circuit in a single glass bulb. The grids of the valves are connected by the well-known circuit used to reduce the space charge, and it has now been possible to reduce the limiting wavelength to about 70 metres, so that effective high-frequency amplification can be obtained for wavelengths ranging from about 250 metres upwards.

Brain Waves of the Wireless Engineer.

Mains Supply.

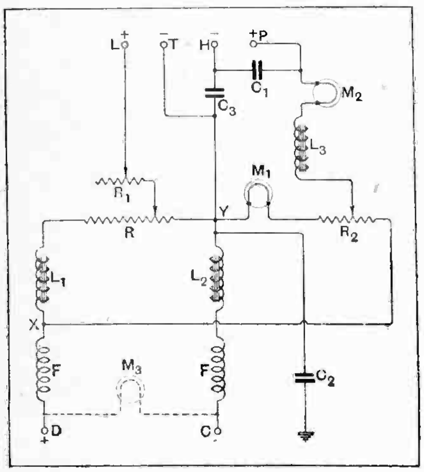
(No. 259,260.)

Application Date, April 30th, 1925.

(No. 259,262.)

Application Date, May 8th, 1925.

Various circuital arrangements for mains supply are described by G. G. Blake and L. Russell-Wood in the above two specifications, the chief point of novelty in the invention, perhaps, being the inclusion of radio-frequency chokes.



Circuit for obtaining H.T. and L.T. supply from mains. (No. 259,262.)

In the accompanying illustration the mains supply is shown at D.C. and may be either leads from a continuous-current supply or from rectified A.C. current. These leads are taken through two iron-cored chokes L_1 and L_2 shunted by a resistance R. The filament current is then drawn from L.T., and is regulated by another variable resistance R_1. The high-tension supply is taken across the points X and Y, *i.e.*, through both radio-frequency chokes and one low-frequency choke L_3. The high-tension supply is shunted by a resistance comprising a lamp M_1 and a resistance R_2, the H.T. supply finally being drawn through a choke L_3, and another lamp M_2 shunted by a large condenser C_1. A safety protection condenser is included in the earth lead at C_2, while a similar condenser is shown at C_3. Another feature of the inventions which is dealt with in the former specification is the use of series resistances in the main positive high-tension lead P for the purpose of obtaining different high-tension voltage tappings. Yet another feature of the invention is the use of a lamp M_3 connected across the input serving to indicate when the system is live.

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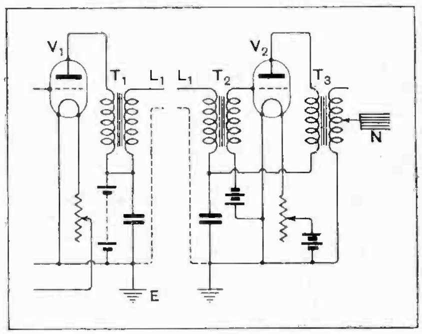
Inductive Reproduction.

(No. 260,061.)

Application date, August 6th, 1925.

Instead of connecting telephone receivers directly to the output of an amplifier, it has been proposed to energise them by low-frequency induction. A modification of this scheme is described by C. W. Hale and R. Lyle in the above British Patent Specification, the accompanying drawing illustrating the invention. The arrangement really consists in using a powerful low-frequency amplifier, the output of which is connected to an overhead frame, or system of insulated wires, and earth, a strong low-frequency field existing, of course, between the two. The headphones are provided with leads of appreciable length, and when these are placed in the field, *i.e.*, between the overhead wires and earth, sufficiently strong currents will be induced in them to energise the receiver quite powerfully. A modification of this system lies in energising several overhead systems from subsidiary amplifiers, the anode supply of which is taken directly through the network system. Thus, in the accompanying illustration the last valve of the main amplifier is shown at V_1, and the



Loud-speaker distribution system. (No. 260,061.)

anode circuit contains a transformer T_1, which is connected to a line L_1 and earth, the line L_1 also being connected, if desired, to one of the distributing networks. The continuation of this line is connected to an input transformer, the secondary of which controls the grid-filament circuit of another valve V_2. The anode circuit of this valve contains another output transformer T_3, serving to energise another frame or network N located, of course, in another building. The anode supply to the valve V_2, it will be seen, is taken through the line L_1, which may form part of the main network.

Valves at Sea.

The valves used in ocean liners are similar in all respects to those used on land, both in the case of transmission and reception, but it is obvious that only extremely reliable types can be expected to stand up to the exacting conditions of such a service. The *Berengaria*, the *Aquitania*, and the *Mauretania*, all of which maintain a regular schedule of Atlantic crossings, are equipped with Osram valves.

Two types are used for transmission, Types V24 and QX, the former an amplifier and the latter a low self-capacity rectifier, are used as direction finders. In the lifeboat sets, valves of the D.E.V type are used.

TRADE NOTES.

Post Office Triumph.

A tribute to the growing popularity of the Ediswan R.C. Threesome valve has been received by Messrs. Edison Swan Electric Co., Ltd., 123-125, Queen Victoria Street, E.C.4, in the shape of a letter bearing as the sole address "Edison Swan Electric Company's R.C. Threesome." In spite of the scant address, the letter was duly delivered to the Edison Swan branch in Newcastle, the nearest depot to Sunderland from which the letter was sent.

Alkaline Battery Service in London.

Increased facilities for charging batteries in the West Central area of London are available with the opening of the new London Showroom and Service Depot of Messrs. Batteries, Ltd., of Redditch.

The new premises, which are situated at 220, Shaftesbury Avenue, W.C.2, are provided with every facility for recharging and refilling batteries. A technical staff gives advice to users and intending purchasers of the "Nife" Nickel Steel Alkaline Accumulator.

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Change of Address.

Messrs. Radio Presse, Paris, notify us that their new address is 129, rue du Faubourg Poissonnière, Paris (IXe).

Readers' Problems

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

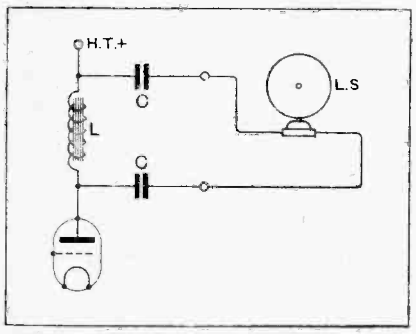
Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

A Loud-speaker Filter Circuit.

It is often said that a filter circuit connected between the output valve of a receiver and the loud-speaker will improve the clarity of reproduction, and that there are other reasons why such a circuit is desirable. What are your views on this matter?

M. N.

When the output valve is one of the so-called super-power valves, the steady anode current for a grid bias of, say, −18 and an anode voltage of 160 is of the order of 15 milliamperes. If this current is passed through the windings of an ordinary loud-speaker there is no doubt that it is overloaded, and will not give good reproduction. In addition there is a danger that the windings may be damaged, and the magnets may in time be weakened. To avoid this a transformer or a choke-condenser filter should be fitted.



A loud-speaker filter circuit.

If a transformer is used it is possible by careful design to arrange that the most efficient impedance is connected in the output circuit of the valve. A transformer will, therefore, in many instances enable a better adaptation of the impedance of the loud-speaker to that of the valve, with the result that louder signals are obtained. In addition, the steady anode current passes through the primary winding of a transformer; this can be made of ample size.

The use of an output transformer in this way is to be recommended, not only because of the improvement in the quality of reproduction and increase in loudness, but because it is easier to run extension wires between the set and points where the loud-speaker is occasionally required without upsetting the tuning of the set.

When it is not possible to obtain a properly designed transformer, the simple filter circuit can be used with excellent results. A suitable circuit is given here and will be seen to comprise an iron cored choke coil and two fixed condensers. The inductance which the choke should have will depend entirely on the A.C. resistance of the valve, the loud-speaker, and the lowest notes it is desired to pass without reduction in amplitude. If a loud-speaker having a D.C. resistance of 750 to 1,000 ohms is used, and the output valve has an A.C. resistance of 3,000 to 4,000 ohms, a choke of 15 to 20 henries is ample. The two condensers should be large ones, or the lower tones may be reduced in strength. If they are of 2 mfds. each the results should be satisfactory, although when certain loud-speakers are used a reduction in the strength of the lower tones is noticed. Larger condensers should then be used.

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Testing Valves.

I appreciate the valve test reports published from time to time, and wonder whether you would give me an idea as to the method of conducting the tests, as I would like to be able to measure the characteristics of my own valves. It seems to me that it is of considerable importance to know the characteristics of individual valves, as then the effect of differences in operation is more readily noted.

G. E. M. J.

The valve characteristics can be obtained with the circuit arrangement shown on this page. The filament of the valve to be tested is heated by a battery connected to the L.T. terminals, and the voltage across the filament is adjusted by a rheostat R_1, and is indicated by a voltmeter V_1. This instrument should be of a type reading 0 to 6, and need not be a very accurate one.

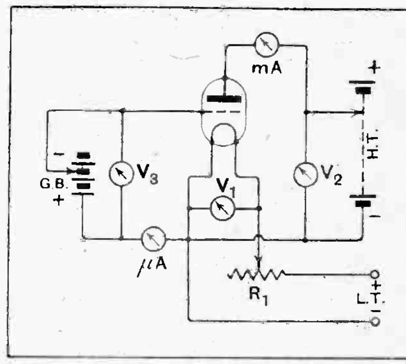
In the grid circuit is an adjustable grid battery which biasses the grid V_3 volts; grid current, if any, is indicated by the microammeter μA, which may read 0 to 100 microamperes. A useful range for V_3 is 0 to 25 or 30 volts, but it should be capable of reading small voltages accurately, because certain valves have a working grid bias of about 1 volt, and a change in voltage of .1 should be easily readable. A two-range instrument is useful.

Connected in the anode circuit is a milliammeter mA for indicating the anode current; this instrument should be an accurate one reading 0 to 5 and 0 to 50 milliamperes, or thereabouts. Anode voltage is indicated by a voltmeter V_2, which should read 0 to 120 and 0 to 240, or cover a similar range of voltages in two or three steps.

So far as the ordinary anode grid characteristics are concerned, the procedure is quite simple. Set the filament voltage at the required value, adjust the H.T. voltage to, say, 120 and the grid bias to zero. Now with the anode voltage constant at 120 read off the anode current at mA for grid voltages V_3 of −1, −2, etc., volts. Repeat the readings for other anode voltages.

If a sheet of squared paper is now marked off in volts and milliamperes in the usual manner, a curve can be drawn through the points obtained by plotting the results of the test. These curves are extremely interesting, and we ourselves test every valve in this way before using it in a set.

From the curves it is an easy matter to estimate to a suitable grid bias for various anode voltages. Let us suppose that at 120 volts a suitable grid bias is −6 volts. The anode current is, say, 4 milliamperes. Increase the anode voltage to 130 and read the anode current, say 5 milliamperes. Now increase the grid bias to reduce the anode current to



Circuit arrangement for measuring valve characteristics.

its original value of 4 milliamperes; the new grid bias might be 7 volts. Then from the figures obtained the voltage amplification factor is 10÷1, that is, the change of anode voltage divided by the change of grid voltage. The anode A.C. resistance is given by the change of anode voltage divided by the change of anode current, in this case 10÷0.001, or 10,000 ohms. Similar measurements can be made at other points, and when the results are worked out an accurate table of values is obtained. From these values the suitability of a valve for use in the various positions in a set may be judged.

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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.

A PROGRAMME SUGGESTION.

THE popularity and utility of broadcasting must always be governed by the nature and quality of the programmes. The programmes, in fact, are the very heart of broadcasting. But the programme maker's is no ordinary task of entertainment, for whereas the theatre may repeat the same performance for perhaps a whole season with scarcely any change, the broadcast programme is never repeated, and even individual items of the programme reappear but seldom.

It must be that in this system the cost of programme production is very high, and perhaps so high that the quality of the daily programmes must suffer in order that the best of broadcasting may be averaged out over the year which has to be budgeted for according to the funds available for the programme side.

It is not our purpose here to criticise; we realise too well the enormity of the task which the B.B.C. has to carry through, but some views on the method of dividing the programme time may be worth putting forward in the spirit of suggestion, and our readers' views on these points would be gladly welcomed.

The present policy of the B.B.C. programme directors appears to be to endeavour to put on such a variety of items that the tastes of every section of the community are met by at least one item each evening. This endeavour is a very courageous and well-intentioned attempt, but we must stop to ask if it is really the best way of meeting the wishes of the public. In the early days of broadcasting it was practically impossible to arrange the programme ahead. Under such circumstances the necessity for great variety was fully apparent because the public could not choose, but now that details are arranged for so long in advance, is it not perhaps time that a change in policy took effect? We have made it our business lately to make enquiries amongst our friends, and we are told that listening to broadcasting cannot be indulged in every evening because of other engagements, and that with the present construction of the programmes it seldom happens that more than one or, at the most, two items in the evening make a strong appeal. On this account the decision must be made as to whether the whole evening can be given up in order to listen to one or two items which may last only, perhaps, for half-an-hour in the middle of the evening. We are told that if, on the other hand, the programme authorities divided up the public into groups and catered for each group, say, one night in the week, then broadcasting would assume a much more attractive character, because we could settle down to an evening's entertainment without experiencing the disappointment which would result from our favourite music being sandwiched in between items not at all to our taste.

Is it not better to announce programmes well in advance and please some section of the public all the evening each in turn, and so allow freedom for other engagements when other sections of the public are being catered for?

CONTENTS.

SIGNAL FADING MEASUREMENTS.

Practical Details for Constructing and Calibrating the Necessary Apparatus.

By R. L. SMITH ROSE, Ph.D., D.Sc., A.M.I.E.E.

EVER since the year 1902, when Marconi discovered that under certain conditions the range of a wireless transmitting station was greater at night than in the daytime, a section of those engaged in wireless science, whether from an amateur or professional standpoint, have given their attention to the measurement of signal strength and the study of the variations in the results obtained. This subject has two very important aspects both of which should attract the interest of the experimenter. First of all, in order that communication may be carried on at all under any given conditions it is necessary that the transmitting station shall produce at the receiver a signal of sufficient strength for comfortable reception on head-telephones or for the operation of recording apparatus: further, in circumstances in which atmospheric or other interference is very pronounced it is necessary that the ratio of the desired to the undesired signal shall be above a certain minimum value. Thus, in order that the design of a new wireless communication scheme may be carried out in a satisfactory manner, it is desirable to have as much knowledge as it is possible to obtain from the stations and schemes already in existence. In the second place, the study of the variations of signal strength from given transmitting stations under different conditions has a most important scientific bearing on the problem of the manner of the propagation of wireless waves over the earth's surface.

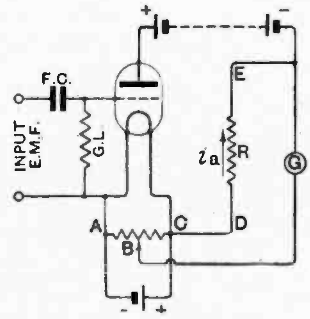


Fig. 1.—Connections of rectifying valve showing method of balancing out the steady anode current from the galvanometer.

The importance of obtaining a complete and accurate knowledge of the behaviour of wireless transmissions under a large variety of conditions using wavelengths similar to those now employed for broadcasting purposes is, of course, sufficiently obvious nowadays; while the experiments already carried out on various wavelengths from 100 metres downwards have adequately demonstrated the important part which these wavelengths are likely to play in the future of wireless communication. On these two bands of wavelengths the variations in signal strength take place much more rapidly than on the longer waves, and these variations are now generally referred to by the term "fading," implying that a signal which is at one instant strong and easily audible may decrease in strength or fade, until at a few seconds or minutes later it is very much weaker or even inaudible. After another period of time the signal may return to its former strength, and this cycle of operations is repeated in a manner which may be very regular or very erratic, depending upon a large number of conditions. The study of such fading variations is in itself very fascinating, and the object of the present article is to describe a simple method by which the experimenter may himself make systematic measurements in this direction and so obtain added interest from his receiver, as an alternative to the logging of broadcasting stations or ordinary DX reception.

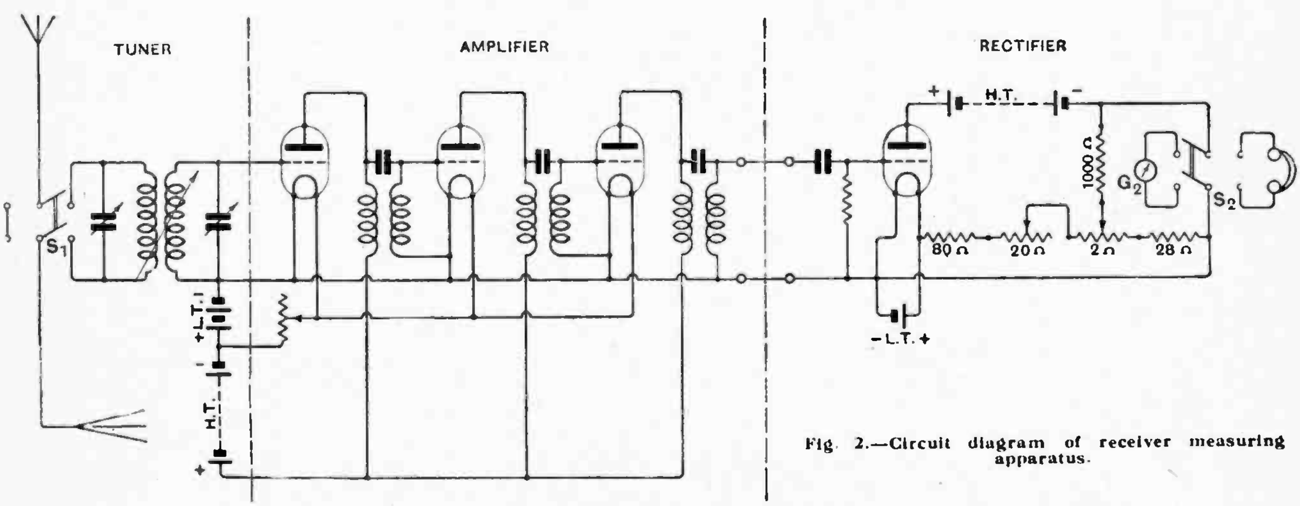


Fig. 2.—Circuit diagram of receiver measuring apparatus.

In recent years this subject has gained an enormous added interest on account of the rapid development of the use of wavelengths below 600 metres, particularly those lying within the broadcast band and those below 100 metres.

In the earliest stages of the obtaining of information on signal strength under any new conditions it is perhaps sufficient to record the estimated strength of the signal heard in the telephones, employing the well-known R

Signal Fading Measurements.—

scale. While much useful data can be obtained in this manner, the absence of any standard of reference and the inherent dependence of the results upon physiological and other factors over which the observer has little or no control, make it necessary to classify it as a qualitative rather than a quantitative method of measurement, and it is to be regarded merely as a preliminary to the carrying out of more accurate measurements. An improvement on the above, which was introduced in the early days of signal measurements, is the well-known shunted telephone method, in which the telephone receivers are shunted by a known resistance until the received signal is just audible or just not audible, care being taken to maintain the total impedance of the circuit containing the telephones constant. On a steady signal this method of measurement has some small application, but it is practically useless for a series of measurements owing to the falling off in sensitivity of the ear due to fatigue. It is also unsuitable for making rapid observations of fading owing to the appreciable time necessary in making the adjustments of the shunt resistance. When considering the application of a method of measurement to the reception of broadcast transmission, it is to be remembered that any audibility method relying upon the use of telephones is almost impossible owing to the difficulty of distinguishing between real variations in the wireless signal strength and variations in the intensity of the audible modulation comprising the broadcasting programme. This difficulty will, of course, vary in its extent with the type of programme being transmitted.

From several points of view, therefore, it is highly desirable to eliminate as far as possible the telephone receiver from wireless measurements and so avoid the vagaries of the human ear. By the use of a sensitive moving-coil galvanometer in conjunction with a valve receiver most of the above difficulties are removed, and while it is not easy to make absolute measurements of the field intensity in the arriving waves, relative signal strength measurements can be made fairly simply to a high order of accuracy and with ample reliability for the study of fading

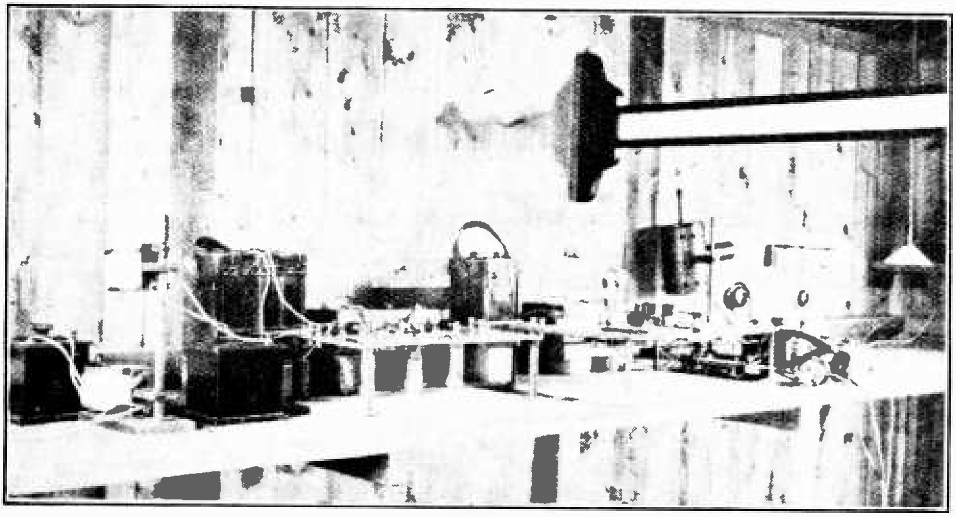


Fig. 3.—General view of receiving and measuring apparatus. From left to right may be seen the loose-coupled tuner, amplifying and detecting panels, and galvanometer lamp and scale.

Principle of Galvanometer Method.

The method of measurement employed is based upon the fact that when a sine-wave alternating voltage of any frequency is applied between the grid and filament terminals of an ordinary rectifying valve there is a change, usually a decrease, in the mean value of the anode current flowing through the valve. The valve can be used under the conditions for either grid or anode rectification; but as the former gives a greater sensitivity for the present purpose, it is assumed that it will be used in this manner employing the usual condenser and grid leak. Since the change in the anode current due to the arrival of the signal E.M.F. is only a small fraction of the steady current which normally flows from anode to filament through the valve, it is evidently desirable to eliminate this steady current and only record the change on the galvanometer, which can then be used in a much more sensitive condition. For example, the steady anode current through a rectifying valve may be of the order of half a milliampere or 500 microamperes, whereas it will be necessary to record changes in this current of a fraction of a microampere if reasonable sensitivity to incoming signals is to be obtained. In order to avoid the steady current passing through the galvanometer, this instrument is connected in a shunt circuit with a simple potentiometer arrangement by means of which the anode current may be "backed-off" from the galvanometer. The schematic circuit-diagram of the arrangement to be described is shown in Fig. 1. The input side of the valve is seen to be similar to that usually employed for rectification: comprising the fixed condenser (F.C.) and grid leak (G.L.), the input E.M.F. being applied to the condenser and negative filament terminals respectively. A potentiometer, AC, is connected across the valve filament, and the anode circuit is formed by the resistance R and the high-tension battery. The galvanometer G, is connected, as shown, between the negative H.T. terminal and the slider, B, of the potentiometer. Now suppose that i_a is the steady current flowing in the anode circuit, before the application of any input E.M.F., then the potential difference between the ends DE of the resistance R will be equal to i_aR, the point D being at a positive potential with respect to E. Along the potentiometer ABC, it is evident that the point is positive with respect to C. Therefore since points C and D are connected together, the point B can be brought to the same potential as E by adjustment of the slider, and this balance position will be indicated by the current

Signal Fading Measurements.—

through the galvanometer G, falling to zero. If now an alternating E.M.F. is applied to the input terminals of the rectifier the anode current will alter, and the current change will divide between the resistance R and the galvanometer G. A definite fraction of the change in current will therefore flow through the galvanometer and a corresponding deflection will be produced. In actual practice the resistance R can be made large compared with that of the galvanometer, so that the greater part of the change in current passes through the instrument.

To give a more concrete idea of the various dimensions to be employed in such a circuit the following particulars are given of a rectifier unit employing an ordinary dull-emitter valve operated direct from a 2-volt filament battery, and employing a H.T. battery of about 24 volts. The steady anode current i_a was about 0.5 milliampere, so that with the value of R of 1,000 ohms, the steady P.D. between D and E was about 0.5 volt. Since the total voltage drop along the potentiometer AC was 2 volts, it is evident that the tapping point B had to be adjusted so that BC was a quarter of AC, in order to get zero current in the galvanometer. The galvanometer employed had a resistance of 12 ohms, and as it was shunted by the resistance R (1,000 Ω) plus the portion BC of the potentiometer (about 100 ohms), it is clear that about 99 per cent. of the change in anode current passed through the galvanometer.

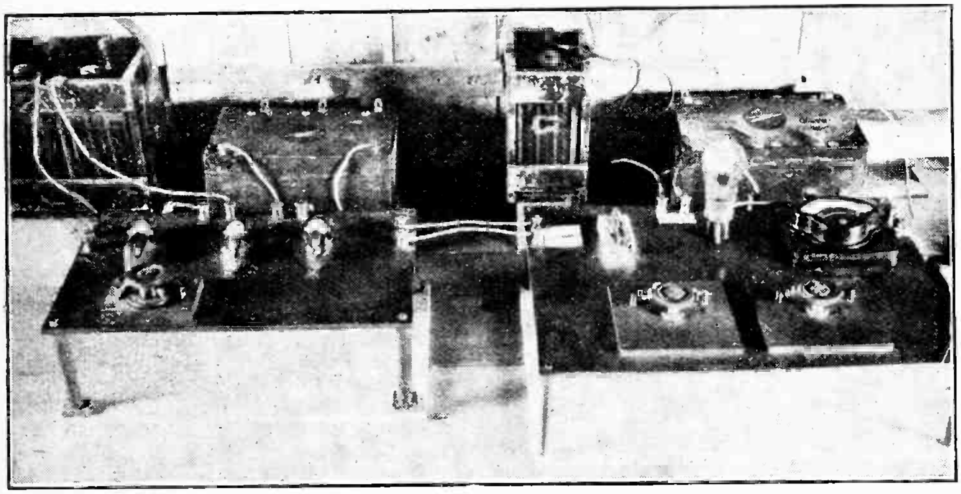


Fig. 4.—Amplifying panel (left) and rectifier (right) showing stud switches of balancing potentiometer.

The circuit shown in Fig. 1 is, of course, not novel, and it is employed in many forms of wireless recording instruments, while the use of a rectifying valve for measuring A.C. voltages is employed as a portable instrument in the well-known Moullin voltmeter.

Details of Apparatus.

The above-described method of recording wireless signals should appeal to the experimenter, particularly on account of its simplicity and the low cost of the apparatus which is necessary as an addition to the ordinary receiver. To get the greatest sensitivity a reflecting galvanometer of the moving coil type is desirable, and a suitable form of this instrument can be purchased new at less than four pounds. The average experimenter will have little difficulty in fitting up a suitable lamp and scale for this galvanometer at a low cost, and the addition of the necessary resistances and potentiometer to the rectifier unit is a comparatively minor matter. It is seen, therefore, that all the apparatus necessary to turn a wireless receiver into a visual recording instrument can be added at no more cost than that of a good loud-speaker, and it is to be remembered that no low-frequency amplification is required for this method of measurement.

The following description of apparatus utilising the above principles which has been employed for the study of signal fading on the broadcast band of wavelengths is given more as a guide to the experimenter than with the recommendation that strict adherence to the details given is necessary. The circuit arrangement of the complete receiver is given in Fig. 2, from which it is seen that the simplest form of a coupled circuit and high-frequency amplifier is employed. The aerial is a straight vertical wire, 70ft. high, and is used with an earth screen constructed in the form of a simple star-shaped network with its centre directly beneath the aerial. The leads from the aerial and earth screen to the tuning circuit are made as short as possible, and are run horizontally and parallel at about one foot apart. Such an arrangement of the aerial system ensures some definiteness as to the actual quantity being measured. In the first place, the vertical component only of the electric force of the arriving waves is operative, since the total E.M.F. induced by the horizontal component is zero. This point is of great importance in a complete study of fading, particularly on the shorter wavelengths; for, with the changing plane of polarisation of the arriving waves, the horizontal component of the electric force becomes appreciable, and an aerial system with unbalanced horizonal components would be acted on by both components of the force in a proportion which is not easily determined. The chief advantage of the use of the earth screen is that the resistance of the aerial circuit is thereby kept reasonably constant and is independent of the mois-

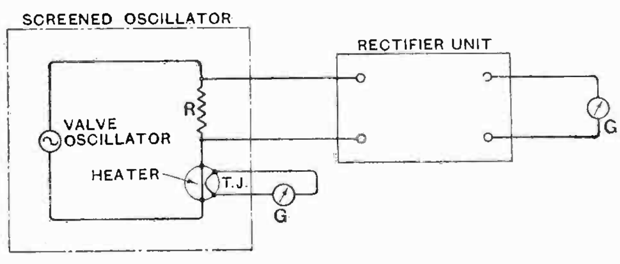


Fig. 5.—Circuit arrangement for calibrating the rectifying valve from a local oscillator.

Signal Fading Measurements.—

ture conditions of the earth's surface. The coils used in the primary and secondary tuned circuits are formed of single-layer solenoids and are very loosely coupled together. They are arranged with their axes vertical so that no E.M.F. is induced in them directly by the incoming waves. While it is desirable to have reasonably good selectivity in these tuned circuits it should not be so high that slight variations in wavelength of the transmitter cause a decrease in received signal strength and so artificial fading effects. For the same reason, and also to ensure perfect stability of the whole arrangement, the radio-frequency amplifier comprises a perfectly straight three-stage system using a combination of transformer and capacity coupling. This is an old and well-known arrangement which gives moderately uniform amplification over a range of from 300 to 600 metres.

In regard to the rectifying panel the chief point is the arrangement of the potentiometer. This can, of course, be made with the adjustable tapping covering the whole range, but it must be remembered that with a sensitive galvanometer a very fine adjustment is required for the balance position; but that the range of this adjustment covers only a limited portion of the potentiometer. Consequently an arrangement such as that shown in the diagram, Fig. 2, can be employed with advantage. Here it is seen that the shunt resistance to the filament battery comprises two fixed resistances of 80 and 28 ohms respectively, a variable resistance of 20 ohms, while the actual potentiometer is formed of only a 2-ohm series resistance. The variable resistance and the potentiometer are arranged in sections on ten-stud switches, and it will be appreciated that they form coarse and fine adjustments respectively of the balancing E.M.F. applied to the galvanometer. For example, suppose the variable resistance is set at 16 ohms; the total resistance of the circuit will be 116 ohms and, with a 2-volt filament battery, the range of the potentiometer will be from 0.48 to 0.52 volt in ten steps. This, it will be noted, is suitable for the case assumed above, in which a balancing E.M.F. of about 0.5 volt was required from the potentiometer. The actual quantities concerned will, of course, depend very much upon the valve and the H.T. voltage employed, and the resistances must be arranged accordingly. In place of the tappings to the 10-stud switch, a continuously adjustable potentiometer of a few ohms resistance can, of course, be employed. Unless the contact on this is of very good design, however, a stud switch is to be preferred. The disadvantage that adjustment cannot be obtained between the studs is not serious, since when an approximate balance has been found, the deflections due to the signals can always be read from the false zero thereby obtained. In the set under consideration the balance is obtained to within about 10 mm on the galvanometer scale, which is then moved to bring the spot of light on to the zero line. During the balancing operation, the aerial system is cut off by means of the double-pole switch S_1 shown in Fig. 2, so that no external E.M.F. is received. When the balance is obtained the aerial is switched in and the circuits are tuned until the galvanometer deflection is at its maximum. To assist in the identification of the transmission it is convenient to be able to switch out the galvanometer and substitute a pair of telephones (as at S_2, Fig. 2) for audible reception of the signals. When using a sensitive galvanometer, as in the present case, it is found that a readable deflection can be obtained on the carrier-wave of a broadcasting station while the modulation is barely audible in the telephones. It is therefore an advantage to insert an audio-frequency amplifier in front of these telephones.

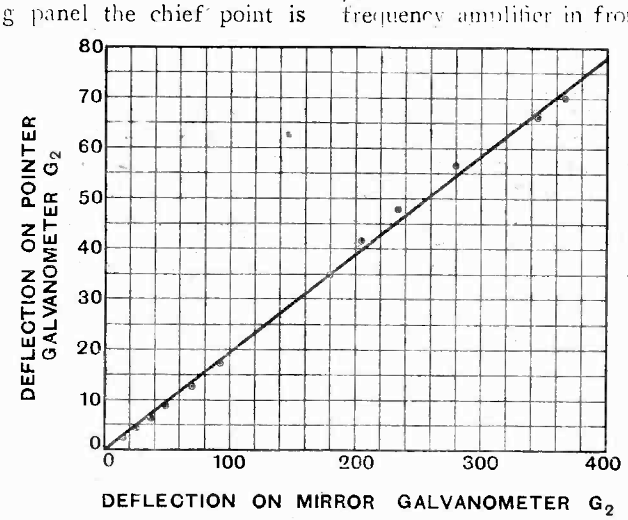


Fig. 6.—Calibration of rectifying valve and reflecting galvanometer G_2 against thermo-junction and pointer-galvanometer G_1 supplied from local oscillator.

The lay-out of the apparatus being described is shown in the photographs in Figs. 3 and 4. The installation is contained in a wooden hut in a field in such a position that it is well clear of such obstacles as trees, buildings and overhead wires, which might cause local distortion of the arriving waves. The set is completely self-contained and is operated from portable accumulators for the valve filaments and galvanometer lamp, and large size dry cells for the high-tension batteries. All batteries used for the valves should be of ample capacity, in order to ensure constancy of amplification and rectification throughout a continuous test of several hours' duration. For the galvanometer lamp a 6-volt 12 watt motor-car headlight bulb is found to give a comfortable spot of light when the hut is darkened. A small reading lamp can be operated from the same battery to assist in recording observations.

Calibration of the Rectifier Unit.

The first point to be decided in the use of a measuring set of the type described above is to ascertain what interpretation is to be placed upon the galvanometer reading. In the second place, some means must be provided of determining that the overall sensitiveness of the receiver is remaining constant during a test so that any variations in the galvanometer deflection may be attributed to the incoming signals. Now it is known that when a valve is used for grid rectification the change in anode current is proportional to the square of the alternating E.M.F. applied to its input circuit when this is below a certain limiting amplitude. In order to verify that this law held in the case under consideration the rectifier unit was calibrated by the aid of a local oscillator. The circuit diagram of the arrangement is shown in Fig. 5. A simple

Signal Fading Measurements.—
valve oscillator was arranged in a suitably screened box, and the oscillatory current was measured by means of a non-contact heater-thermojunction (T.J.) reading on a direct-current pointer galvanometer G_1. By this means a known current could be passed through the resistance, R, and thus a known potential difference applied to the input circuit of the rectifier After the steady anode current from the rectifying valve had been balanced out from the galvanometer, G_2, the local oscillator was switched on and the current adjusted to produce approximately full scale deflection of G_2. The oscillatory current was then reduced in successive stages at which the readings on both galvanometers were recorded. The result of such a test is given in Fig. 6, which shows that the deflections on the two galvanometers are proportional to one another. Now it is known from calibration that the thermojunction produces a reading on G_1 proportional to the square of the current passed through the heater. It is thus evident that the deflection on the rectifier galvanometer is proportional to the square of the input E.M.F. over the full range of the scale employed. Since the radio-frequency amplifier will give an amplification which is largely independent of the amplitude of the signal E.M.F., it follows that when used for the recording of signals the deflection of the galvanometer G_2 will be proportional to the square of the potential difference across the secondary tuning condenser, *i.e.*, proportional to the square of the received aerial current. For making periodical tests of the overall sensitivity of the apparatus during measurements on received signals it is convenient to replace the resistance R by a small coil which is placed with a fixed coupling to the secondary tuning coil. By this means an E.M.F. can be injected directly into the secondary circuit, and thus the galvanometer deflection for a given current in the local oscillator can be checked when desired.

When all the measuring apparatus has been set up in the manner described, the procedure to be adopted in the carrying-out of fading tests may be briefly described as follows. The rectifying valve should be switched on at least half-an-hour before it is desired to make observations in order to allow the conditions to become quite steady. During this and the whole of the tests, the apparatus should be carefully shielded from draughts, for it is to be remembered that the galvanometer is of relatively great sensitivity and that the minutest changes in anode current will cause erratic variations of the deflection and detract considerably from the accuracy of the results.

Measurements on Broadcast Transmissions.

At the beginning of a test the receiver is tuned in to the desired wavelength, and then with the aerial and earth switched off, the steady anode current is carefully balanced on the galvanometer, and the scale of this instrument adjusted to give a reading at zero. The local oscillator is then switched on, brought into tune with the receiver, and the strength of the current adjusted to give about half scale deflection on the galvanometer. After recording the steady deflection so obtained, the oscillator is switched off and the aerial and earth circuit completed. The galvanometer deflection due to the incoming signals is then observed at intervals of, say, 15 seconds for a period of about ten minutes. At the end of this time the aerial and earth are switched off and the "zero" deflection of the galvanometer is observed and recorded. Under the most satisfactory conditions it is usual to find that a steady drift of the anode current has taken place which results in the "zero" of the galvanometer charging by a few millimetres over such a period of ten minutes. While this drift may be negligible when dealing with large deflections of 300 or 400 mms., at smaller readings it becomes important, and it is then necessary to apply proportionate corrections to the scale readings taken during the previous ten minutes. After noting this altered zero, the rectifier may be rebalanced, and then the local oscillator is switched and its current adjusted to the same value previously used. From the resulting deflection, a comparison of the overall sensitivity of the receiver with its initial value is obtained. If this is satisfactory the oscillator may be switched off and the observation of the incoming signals continued. If it is found that with a given input from the local oscillator the resulting deflection does not remain reasonably constant, the cause of the variation must be sought and eliminated. Under the best conditions, and with careful attention, this apparatus can be made to repeat results to within 5 to 10 per cent., and when it is considered that the fading of signals very frequently gives changes of 100 per cent. or more, such an accuracy is sufficient for

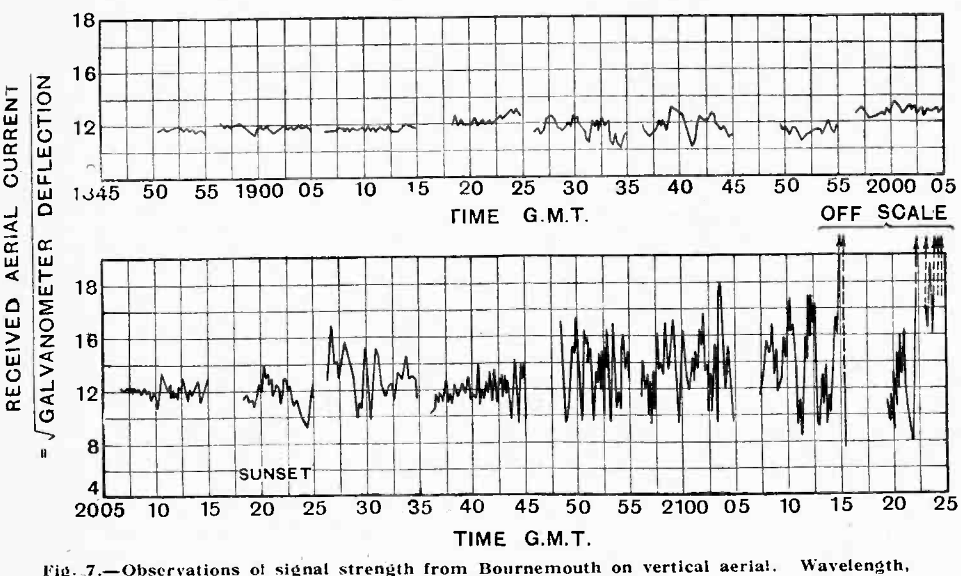


Fig. 7.—Observations of signal strength from Bournemouth on vertical aerial. Wavelength, 386 metres; sunset 2021 G.M.T.

Signal Fading Measurements.—

much useful work on this subject. It will, of course, be appreciated that when once a period of systematic observations has been begun no changes must be made in the tuning of any of the circuits or in the adjustments of the amplifier.

Local Station Check.

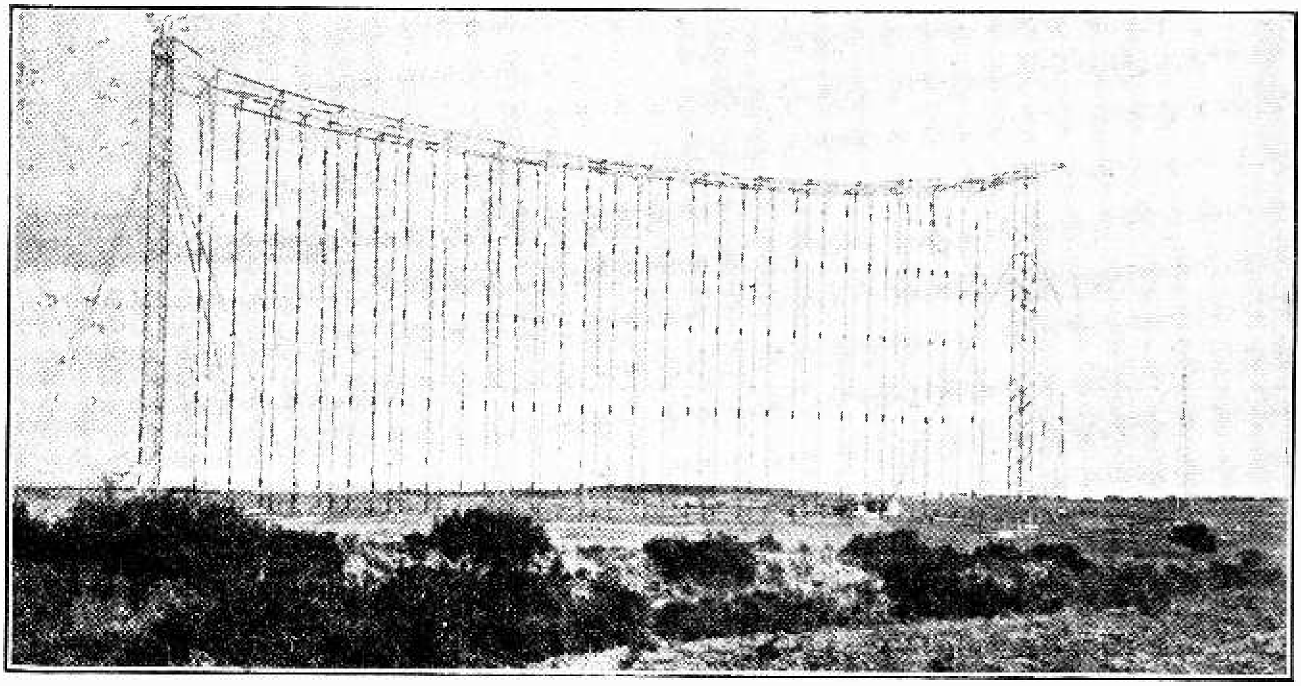
The overall reliability of the apparatus can also be checked by making a continuous series of observations on a nearby broadcasting station. For example, on the set described above, observations taken on the transmissions from 2LO at a distance of 18 miles show a maximum variation of only a few per cent. over a three or four hour run by day or night. Incidentally this is a tribute to the constancy of the radiated carrier wave from the broadcasting station. When observing at longer distances it is usual to find that the resulting signals are equally constant in the daytime only, and that when the time of observation approaches or follows sunset, erratic variations in the received signal intensity take place. In Fig. 7 is shown the result of observations made on transmissions from Bournemouth at a distance of nearly 80 miles, and over a period of nearly three hours in the neighbourhood of sunset. The graphs given in this diagram show the relation between the time of observation and the square root of the galvanometer deflection, which is proportional to the received aerial current.

The readings were taken at half-minute intervals, and the gaps between the groups of observations indicate the times at which the galvanometer zero and the amplification of the receiver were tested. In this case the observations were commenced at about one hour and a half before sunset, and the signal strength is seen to be fairly constant for about the first half hour. At about an hour before sunset the strength of signal begins to vary by an amount which is well outside the limiting experimental error. After sunset the variations continue to increase in magnitude, and towards the end of the run they become very large, the strength varying between two-thirds and twice the approximate day value. It will be observed that in some cases the fading appears to pass through periodic cycles of one to three minutes' duration; but in other cases the variations are very erratic in their nature.

Application of Results.

This graph is typical of many that are obtained with such measuring apparatus, and it is now known that the effects are due to the combination of a direct wave sent along the earth's surface, and a second wave which has been deflected from the upper parts of the atmosphere. This second wave may have a varying amplitude, phase or plane of polarisation relative to the first, which give a resultant effect at the receiver greater or less than, or equal to that of, the direct wave, which is usually received alone in the daytime. By the systematic study of these fading processes under different conditions a great deal can be learnt about the behaviour of these waves and their mode of propagation generally.

LISBON BEAM RECEIVING STATION.



The aerial system of the Vendas Novas receiving station near Lisbon. This station was opened on December 15th, 1926, with a high-speed service to London and is part of a new scheme for linking Portugal with its colonies and with the principal capitals of Europe.

NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

AN EFFECTIVE INSULATOR.

The chief qualities that an insulator should possess are a long leakage path during wet weather, ample strength to withstand the strain of a strong wind, low capacity, and, if possible, a dry spot somewhere along its surface.

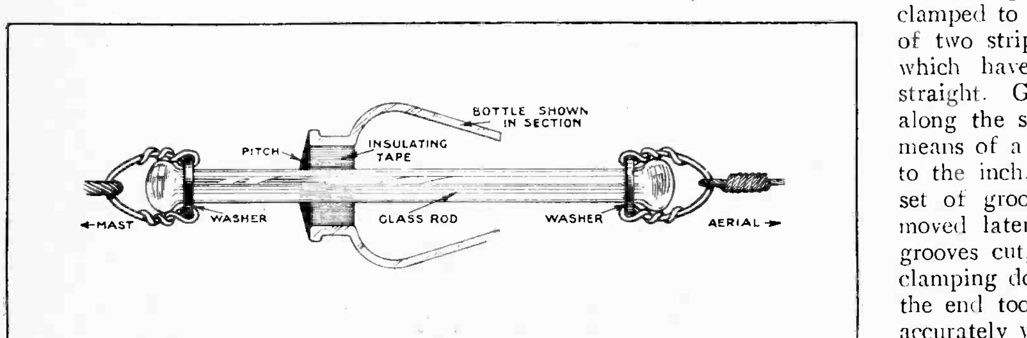
The insulator shown in the sketch may fairly be claimed to possess the qualities enumerated above.

The glass rod is 9in. long and ½in. in diameter (as the strain is a longitudinal one, this diameter is ample). Next procure a small bottle the neck of which is a little less than twice the size of the glass rod. The shape of the bottle need not, of course, exactly follow that shown in the sketch, but something like it is preferable. The bottom of the bottle must be removed and the bottle chosen should have, if possible, a small rim round it; by marking round it with a three-square file and then gently tapping all round the bottom will come clean away. You may spoil a bottle or two at first, but it is not really hard to do.

Having prepared the bottle, next find two brass washers which will easily slide on the glass rod, with about $\frac{1}{16}$in. clearance all round, and at the same time be smaller than the bottle neck. Now insert one end of the rod in a clear, bright fire; as soon as it starts to melt withdraw it and press the heated end against a bar of the grate. This will give a "dubbed up" shape, as shown in the sketch, When it has cooled sufficiently to handle slip on both the washers and insert the other end of the rod in the fire; shape this as the first and let it cool off.

If you have obtained the correct shape it will be found impossible to remove either of the washers. Next slide the bottle over the glass rod and, marking the correct position, slip off the bottle and wind tightly round the rod insulationg tape, which should be about ⅝in. When you have reached the inside diameter of the bottle neck cut the tape and wedge the bottle over it. Make sure it is a good tight fit, and then seal finally with pitch (from a dry cell) run round hot.

All that remains is to fashion the loops of wire at each end, and the job is finished. The insulator will stand all the strain it is likely to get in ordinary use, but of course care must be taken, when lowering the aerial, not to fracture it. L. T. F.



Aerial insulator of low self-capacity and long leakage path.

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 Street, London, E.C.4, and marked "Ideas."

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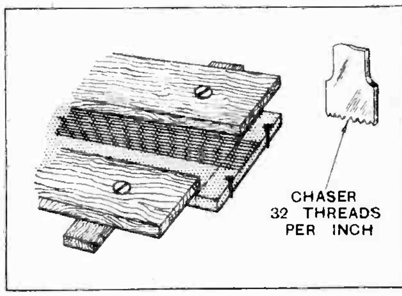
EBONITE SPACERS FOR "EVERYMAN" COILS.

A convenient method of constructing the ebonite spacing strips supporting the primary windings of the H.F. transformers used in the "Everyman Four" and other receivers is illustrated in the diagram.



Grooving ebonite for "Everyman" transformer spacing strips.

A strip of ebonite ⅛in. in thickness, and having a width equal to the length of the spacing strip required, is clamped to the work-bench by means of two strips of wood the edges of which have been planed perfectly straight. Grooves are then drawn along the surface of the ebonite by means of a chaser having 32 threads to the inch. Having completed one set of grooves, the ebonite strip is moved laterally and a fresh set of grooves cut, care being taken, when clamping down the guide strips, that the end tooth of the chaser engages accurately with the outside groove of the previous set. R. W.

Construction and Operating Notes.

By W. JAMES.

(Concluded from page 9 of previous issue.)

IN the first part of this article, published in last week's issue, the circuit and the method adopted to provide effective screening was fully discussed, and the construction of the three high-frequency units was described. The illustration of the back of the receiver, Fig. 7 (see illustration on page 9 of previous issue), shows a special mounting for the detector valve. This valve has a solid type of holder, which is glued to a piece of sponge rubber fastened to the upper surface of the top 1-mfd. by-pass condenser. A holder and mounting of this type is very satisfactory and is probably better than many of the anti-noise holders marketed. Naturally, such a holder is not tightly fixed in position, but, provided a little care is exercised when inserting or withdrawing the valve, it will be found sufficiently robust in practice and really anti-microphonic.

With the three units assembled we can turn our attention to the arrangement of the remaining components. On the ebonite front panel, which measures 24in. × $8\frac{1}{2}$in. × $\frac{1}{4}$in., are mounted the two rheostats, jack, four-point stud switch, and the three tuning condensers, in the positions indicated in Fig. 8. The lower row of holes marked C are for the No. 4 wood screws, which are screwed into the baseboard, and the three holes marked A are for the tuning condensers. These are of the one-hole fixing type, and if dial indicators are to be used holes for them will have to be drilled.

Front Panel and Baseboard.

The parts fitted to the baseboard, which measures $23\frac{3}{4}$in. × $10\frac{1}{4}$in. × $\frac{1}{2}$in., are shown in Fig. 9, from which it will be seen that the screening box is on the right-hand side, with the low-frequency parts on the left. Three $\frac{1}{2}$in. battens are fitted to the underside of the baseboard, as is shown by the illustrations, and one brass bracket is provided at the extreme left-hand end. This bracket,

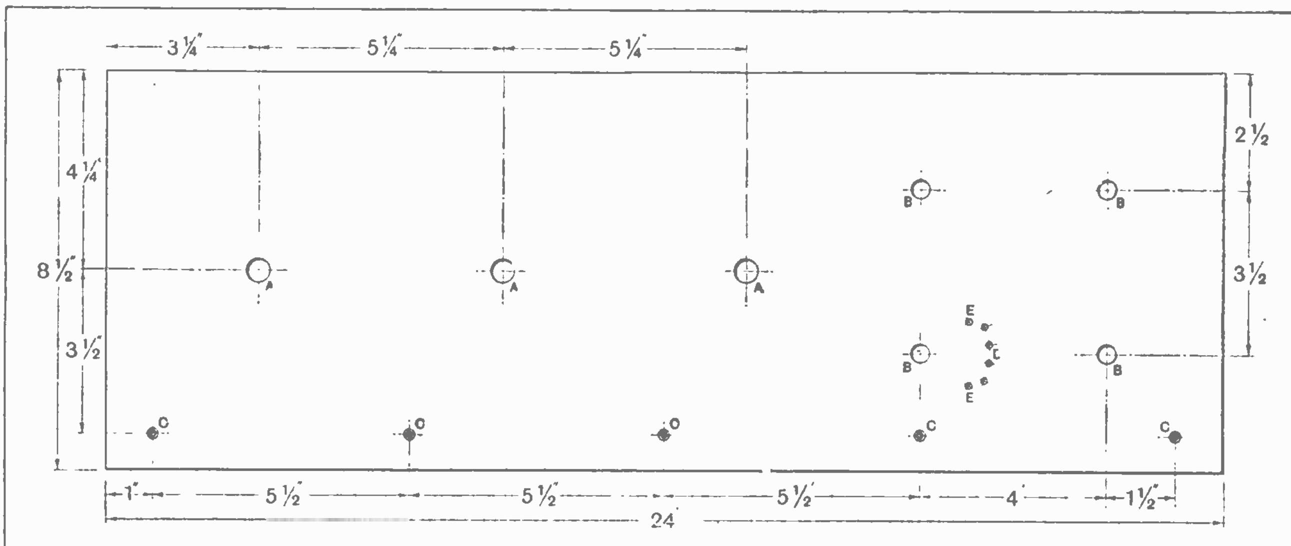


Fig. 8.—Details of the ebonite front panel: A, $\frac{1}{2}$in. diameter; B, [illegible]in. diameter; C, $\frac{3}{8}$in. diameter and countersunk for No. 4 wood screws; D, [illegible]in. diameter; E, drilled and tapped No. 6BA.

The Wireless World Five.—

of $\frac{1}{8}$in. strip brass, has one foot screwed to the panel, and the other to the baseboard.

There are two terminal strips, one for the aerial and earth, and the second for the loud-speaker, and a battery connector. The two terminal strips, of the dimensions given in Fig. 10, are fastened to the baseboard by lengths of $\frac{1}{2}$in. brass strip, which are screwed to the underside of the baseboard and the ebonite strips. The battery connection strip is fastened in a similar fashion.

contact with the copper box; the condensers also hold the box firmly against the front panel.

It is now easy to drill a few holes through the baseboard and the bottom of the box and to fit countersunk headed screws further to secure the box, baseboard, and panel.

We have now assembled the three tuning units shown in Figs. 2, 3, and 5, and fitted the parts on the panel and baseboard, except for the fixed condenser C_1, Fig. 11, which is screwed to the underside of the baseboard near

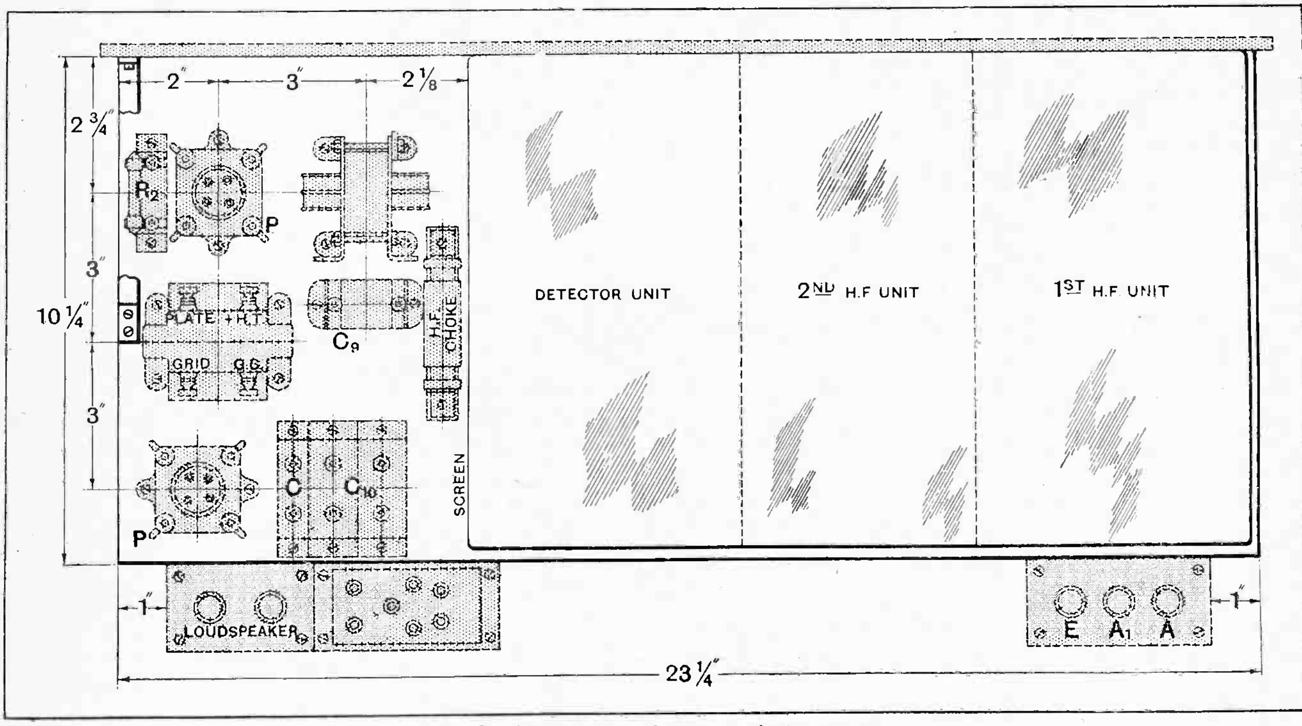


Fig. 9.—Arrangement of parts on the baseboard.

the aerial and earth terminals. We have now to drill holes in the baseboard and screening box for the connecting wires.

With the baseboard cut to size and the connection and battery strips mounted, arrange the parts of the low-frequency amplifier as shown in Fig. 9; then screw the panel to the baseboard and fix the brass bracket. Finally, place the screening box in position, holding it tightly against the back of the panel, and mark the holes for the spindles of the tuning condensers.

When these holes have been cut in the back of the box, the box can be put in position and the three tuning condensers mounted. The tuning condensers used have a metal end plate, which makes a fairly good electrical

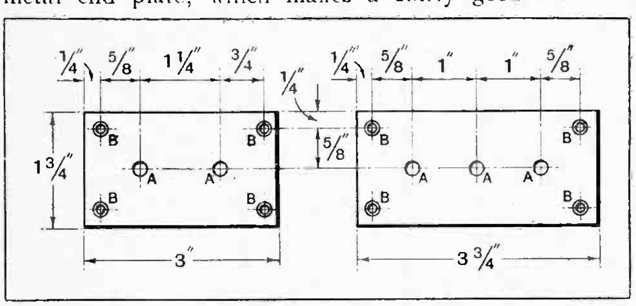


Fig. 10.—Ebonite connection strips for loud-speaker, aerial and earth terminals. A, 7/32in. diameter; B, $\frac{1}{8}$in. diameter, and countersunk for No. 6BA screws.

Wiring the Set.

If the wiring diagram is examined, it will be noticed that one wire passes through the left-hand side of the box looking at the open face. This is the wire connecting the plate terminal of the detector valve to the H.F. choke coil. There is also another wire connecting the metal end plate of the tuning condenser, a screw on the end of the shield, and a screw used to hold fixed condenser C_8 to the tinned sheet base. It will also be seen that a wire passes from +H.T. Det. to the lower 1-mfd. by-pass condenser; this wire has an arrow-head to indicate that it is connected to the lower condenser; it passes through the baseboard and the bottom of the screening box. A further wire which passes through the baseboard and the bottom of the screening box is for the positive side of the valve holder. Two small holes have therefore to be drilled in the left-hand end of the box, and two through the base and baseboard; the latter holes can be drilled to one side so as to clear the base of the unit when this is in position. One of the holes in the end

The Wireless World Five.—can be drilled opposite the H.F. choke, and the second near the opening, so that a screw and nut with soldering tags can easily be fitted.

Turning now to the centre section, the two partitions each have three holes for wires, which connect the points circuit and the first H.F. valve, two additional holes are required for the aerial and earth wires. These holes pass through the baseboard, copper box, and sheet tin base in such a position as to provide a direct connection between the aerial and earth terminals and the respective contacts on the tuning coil.

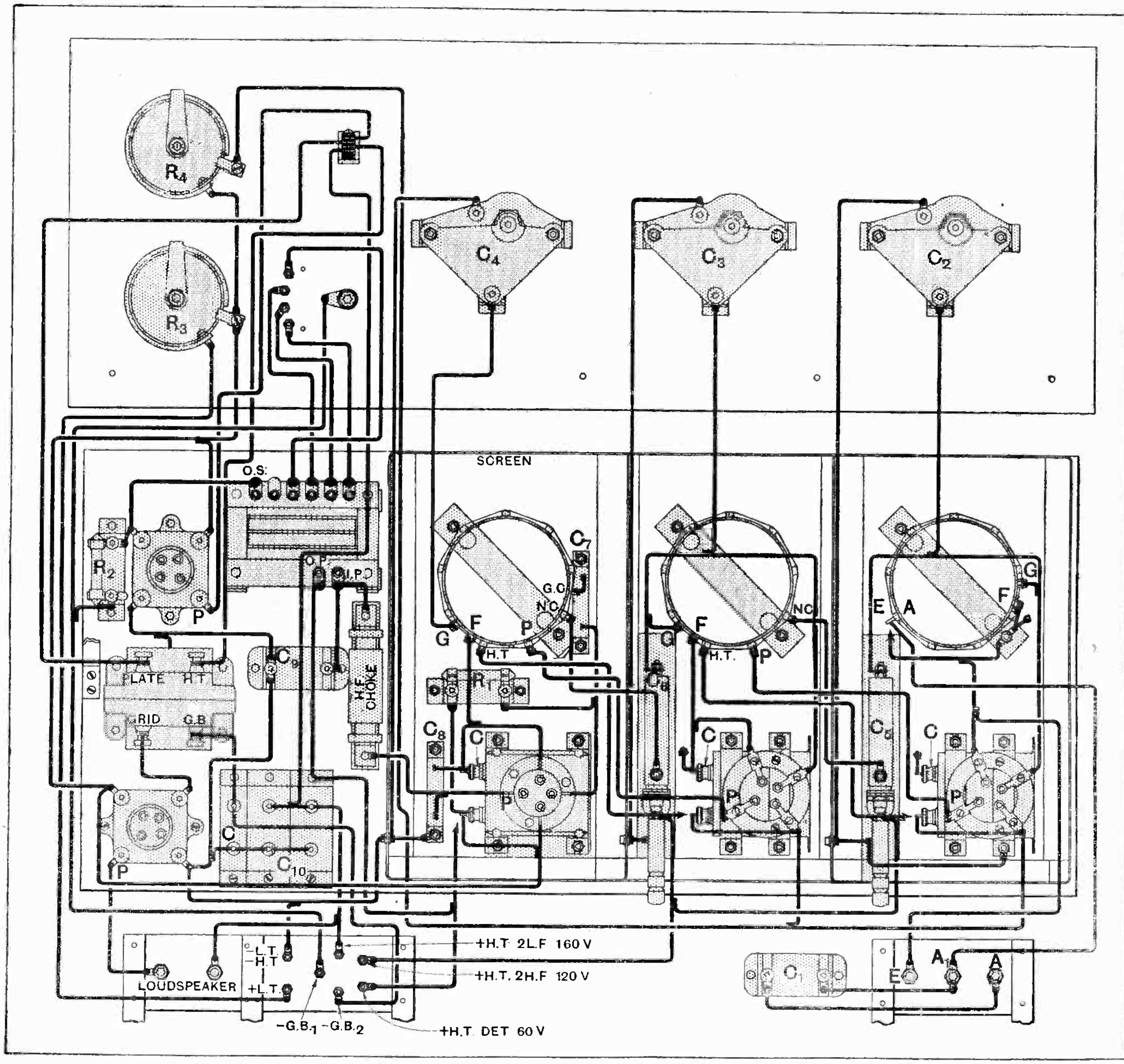


Fig. 11.—Wiring diagram. The connecting wires with arrow heads are joined to the lower 1 mfd. condenser in the three sections respectively.

marked P, NC, and +H.T. These wires can be seen in Fig. 7 and are arranged in such a position that they are reasonably short and direct. Two holes have also to be provided in the centre section for the +H.T. and +L.T. battery wires, and two more for screws and soldering tags. The holes for the battery wires are made through the baseboard.

In the right-hand section, which is for the aerial-grid

Wiring can now be commenced in earnest, and it is better to begin by wiring the three H.F. units. Before the first H.F. unit is placed in the screening box, wire the grid connection of the valve holder to the G terminal of the coil and one side of the balancing condenser, Fig. 11. Also connect the positive contact of the valve holder to the top front contact of the 1-mfd. condenser and the negative side to the E terminal of the

The Wireless World Five.—
tuning coil, to the F terminal, and to the screw holding the coil to the tinned sheet base. Finally, solder this wire to the base and connect the two 1-mfd. condensers to the tinned sheet base.

Now deal with the second H.F. unit and with the detector unit. In the latter unit is included a grid condenser and leak, GC, R_1, and a by-pass condenser, C_8. These can be wired as shown in Fig. 11.

Before putting the three units in the sections of the screening box, run the three wires between the earth side of the tuning condensers and the screws provided; also put in three grid wires to the tuning condensers of approximately correct length, leaving them free for the time being.

If now the units are placed in their respective positions, the three grid wires can be soldered to the grid wires already on the units; three insulating wires for the P, NC, and +H.T. connections can also be run between the first and second and the second and third sections. Finally, a pair of insulated wires is run beneath the baseboard, one for +H.T., and the second for +L.T., and insulated wires are passed through the baseboard and soldered according to the diagram.

Wiring is not such a difficult matter as one might think when first looking at the wiring diagram. In fact, the units can be removed or connected in a few minutes. On the low-frequency side there is no difficult wiring, but insulated wires are used and are run beneath the baseboard in many instances to avoid crowding.

Balancing and Testing.

With the set wired, put a Mullard PM5A valve in the two H.F. stages, a PM5 in the detector and first L.F. stages, and a PM256 in the output stage. These valves are for a 6-volt filament heating accumulator, and will give the highest amplification, for a given selectivity, than it is possible to get with present-day valves.

If other valves are used, choose those having an A.C. resistance of 20,000 to 30,000 ohms for the first four positions, and a power valve for the output stage. With the above valves the total filament current is 0.65 ampere.

Another useful valve for the H.F. positions, if a quiet one can be obtained, is the Cosmos SP55 Blue Spot.

Slightly better quality will be obtained by employing a valve of lower A.C. resistance, such as a PM6 (approximately 6,000 ohms), in the detector stage, but a valve of this type should not be used in the first L.F. position unless a big grid bias is used to keep the steady anode current to about 3 milliamperes. It should be expected that no improvement in quality will be heard by using a low-impedance detector valve if a horn type of loud-speaker is employed; with a cone type of loud-speaker the quality is perceptibly improved. The receiver is so flexible and the L.F. amplifier is so designed that the quality of the signals received from the local station is above the average.

To balance the receiver, connect the batteries, etc., screw on the back of the case, connect the aerial and earth, and tune in the local station. Now unsolder the +H.T. battery wire to the first valve. Probably the local station will still be heard at good strength, and it should be reduced in strength by adjusting the first balancing condenser. The condenser will have to be adjusted very carefully indeed, and it might not be possible to find a position where the local station is not heard at all.

Now connect the +H.T. battery wire and disconnect

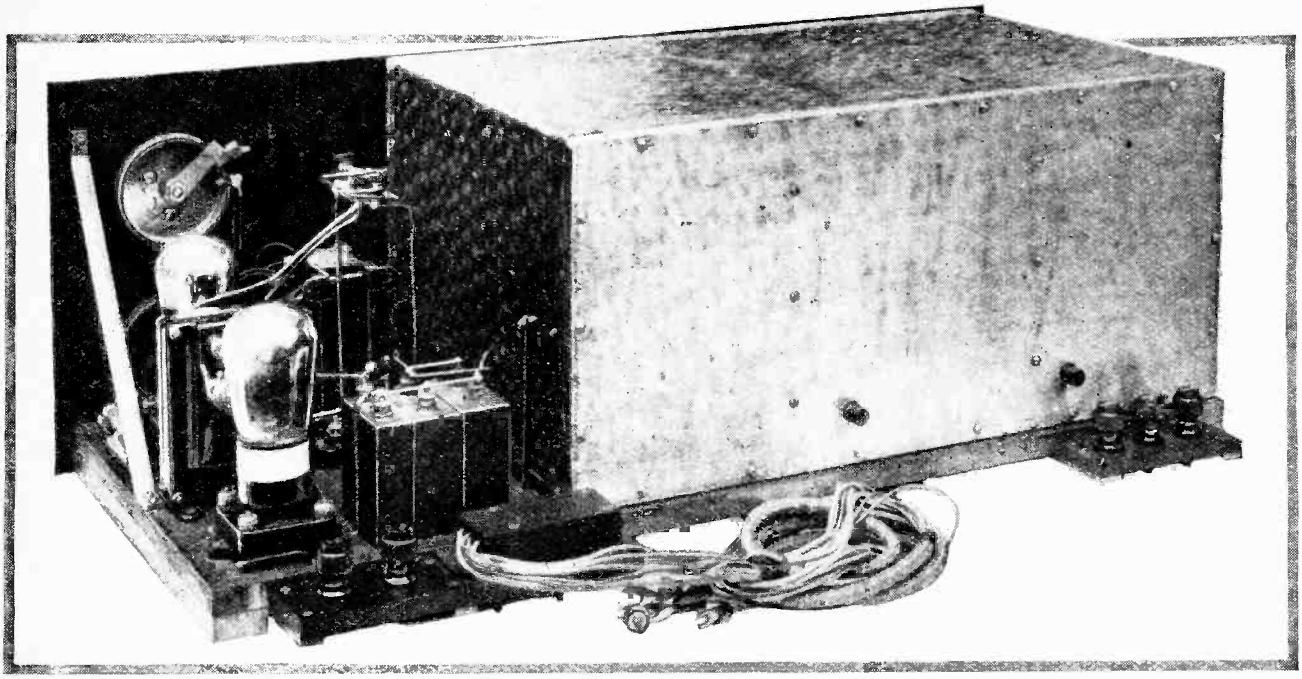


Fig. 12.—Rear view of the completed receiver with the cover of the screening box in position. The ends of the knobs of the two balancing condensers can be seen projecting through holes in the cover.

The Wireless World Five.—

the + H.T. wire to the second stage; this stage is adjusted in exactly the same manner, but it will probably be found possible to find a silent point. The adjustment of the balancing condensers must be done very slowly; a fraction of a turn of the knob is sufficient to pass through the best position.

When the balancing condensers have been properly set and the + H.T. wires reconnected, try tuning a station at the top end of the tuning condenser dials. Commence by turning the amplifier full on, and when a station is heard adjust the low-frequency amplification by the stud switch, and the high-frequency amplification by the rheostat volume control. The latter control affects the selectivity, which is better when the amplification is reduced. Also tune in a station working on a fairly short wavelength. Dial settings should be noted, and if necessary the dials be reset to make them read more nearly alike. The receiver will *not oscillate* at any wavelength, and the amplification is sufficient for all practical purposes.

TRANSMITTERS' NOTES AND QUERIES

Transatlantic Telephony.

A considerable number of our readers have written to us during the past month on the subject of duplex telephony between the United States and England, which they have picked up. A correspondent at Hampstead tells us that at 1430 G.M.T. on Sunday, January 2nd, he heard a Canadian station sending gramophone records and speech on about 20 metres. At intervals it announced "Canada calling England" and "Canada calling U.S.A." He will be glad to hear if any other listener picked up this station and what is its QRA.

o o o o

Apropos the general interest shown by listeners in the recent Transatlantic tests, we understand that the Post Office is adopting means for ensuring secrecy in their transmission and reception of wireless telephony between England and the United States, so that subscribers on either side of the Atlantic need not fear that their conversations will be overheard by any listener who can tune his set to the official wavelengths.

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QRA's Wanted.

We give below a list of the QRA's which have recently been asked for by various correspondents, and shall be glad if any of our readers can supply us with the required information.

In some cases the owners of experimental call-signs do not wish their names and addresses to be published, and we would, therefore, ask those who kindly send us QRA's to indicate any which should be regarded as confidential.

From recent experience we find it necessary to point out that it is mistaken kindness to send in QRA's taken from the "Wireless Annual for 1926," "The Wireless World Diary," or any other of our own lists, as, obviously, we should not include any call-signs under "QRA's wanted" if we were satisfied that we already had the information accurately recorded.

G 2BL, G 2BN, G 2DL, G 2WS, G 5AL, G 5NF, G 6YB, G 6YL, G 6ZL, G 6ZM, G 6ZZ, GC 6ID, DRN, D 7FJ, FOPM, GHDH, HW DX8, I 1CM, JM, 2PZ, K 4MC, K 4XY, LA 1K, R 1KA, RTRL, SS 8MAX, TY.

International Prefixes.

The International prefixes used by experimental transmitting stations have, since they were first adopted, suffered from a lack of method and general agreement. The effort of the American Radio Relay League to revise and re-arrange them in accordance with a regular system, of which particulars are given on page 56, deserves general support, though we foresee several obstacles to its immediate adoption in Europe, where the prefixes LA, GI and GW have already become firmly established, and the authorised Swedish and Italian call-signs are not altogether adaptable to the new proposals. There might also be some difficulty in persuading Brazilian and Chilean amateurs to alter their well-known prefixes BZ and CH.

The system adopted in the U.S.A., Australia, the Argentine, Portugal, and other countries, of indicating the district in which a station is situated by the initial figure or letter of the call-sign, has undoubted advantages, and we think that any similar system for indicating the Continent by International prefixes should be generally welcomed.

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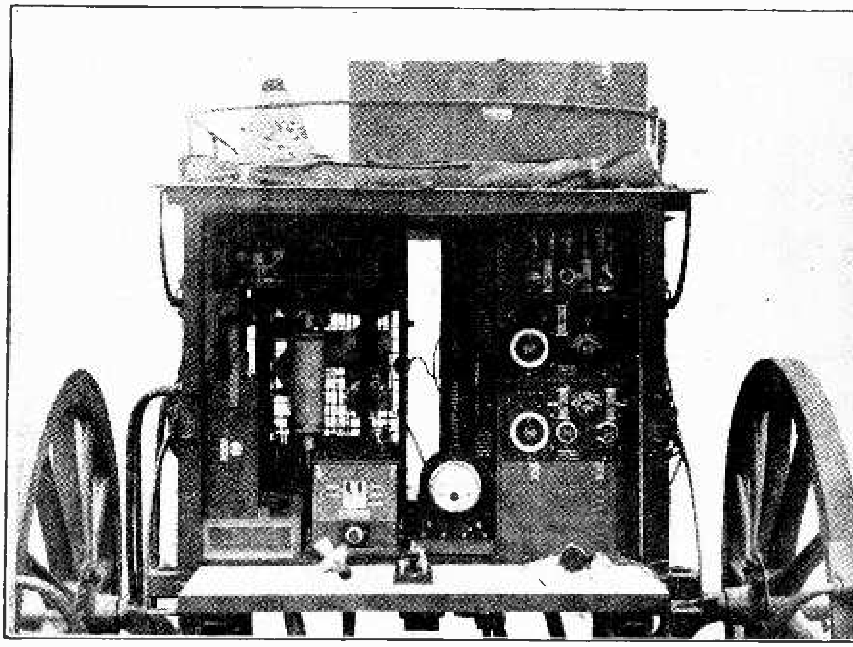
New Call-signs Allotted and Stations Identified.

G 6HN (ex 2BON), H. Needs, 69, Manor Road, Brockley, S.E.4.
G 6LR L. A. C. Lawler, 67, Lucien Road, S.W.17.
G 2AFJ W. Lindow, 36, Hutton Lane, Deane, Bolton, Lancs. (Change of address.)
G 2ASY T. Wright, 147, Darwen Road, Bromley Cross, Bolton, Lancs.



COMPLETE TRANSMITTER FOR FIELD USE. Telegraphy and telephony are both possible with the Marconi UC1 ½kW transmitter which is here seen mounted on a field wagon. The five valve receiver with two tuning units can be seen on the right. The range for telephony is 70 miles, using 30-ft. masts, while for telegraphy (C.W.) the range is 200 miles.

SIR JOHN C. W. REITH, KT.

Some Landmarks in a Striking Career.

THE career of Sir John Charles Walsham Reith, Kt., M.Sc., whose knighthood was announced on New Year's Day, has many of those meteoric qualities which figure in American business fiction, but rarely in actual life. Still on the glorious side of forty (he is only 37), Sir John finds himself, in 1927, the executive head of all broadcasting conducted in Great Britain.

Educated at the Glasgow Academy, Gresham's School, Norfolk, and at the Royal Technical College, Glasgow, Sir John Reith began his career as an apprentice in the North British Locomotive Works, obtaining his first business berth as an engineer with S. Pearson and Son, Ltd. Then came the war, and he entered the Royal Engineers. His term of fighting was brief, for, early in 1915, when holding the rank of major, he was so badly wounded at Loos as to be incapacitated for further active service. In 1916 he had recovered sufficiently to take up an important commission in America, where he was placed in charge of munitions contracts on behalf of the British Government. While in America the staff under his control numbered 600 inspectors. Returning to England in 1917 Sir John was for a short period engaged on special constructional work, and at the time of the Armistice he was holding an Admiralty appointment. He then undertook the difficult and delicate task of liquidating armament and engineering contracts until 1920, when, at the age of thirty, he became general manager of the Beardmore Works at Coatbridge, near Glasgow.

First Association with Broadcasting.

When, in 1922, the vast enterprise of broadcasting was just emerging from the experimental chrysalis, an extraordinarily happy choice on the part of the powers that were placed Sir (then Mr.) John C. W. Reith in the managerial chair of the British Broadcasting Company.

Sir John Reith is "a son of the Manse," his father being the Rev. Dr. George Reith, who for fifty years was Minister of the College Church, Glasgow. His grandfather was general manager of the Grand Trunk Railway of Canada, and subsequently for thirty years head of the Clyde Navigation Company.

During his tenure of office as managing director of the British Broadcasting Company, Sir John Reith's forceful personality has largely dominated the policy pursued at Savoy Hill; and if that policy has not entirely escaped criticism (what constructive policy ever does?), at least it can be said that British broadcasting has erred on the side of a healthy conservatism.

Replying to the accusation that the B.B.C. has been reluctant to consider the views of listeners, Sir John Reith himself said: "If it be arbitrary to decline to broadcast anything which in our opinion might be injurious morally and intellectually then we are open to this charge." This, in a nutshell, expresses an attitude of mind, courageous and (be it whispered) rare, which has given Britain a broadcasting prestige and dignity unexcelled in any other country.

Sir John Reith's present post is that of Director-General of the British Broadcasting Corporation.

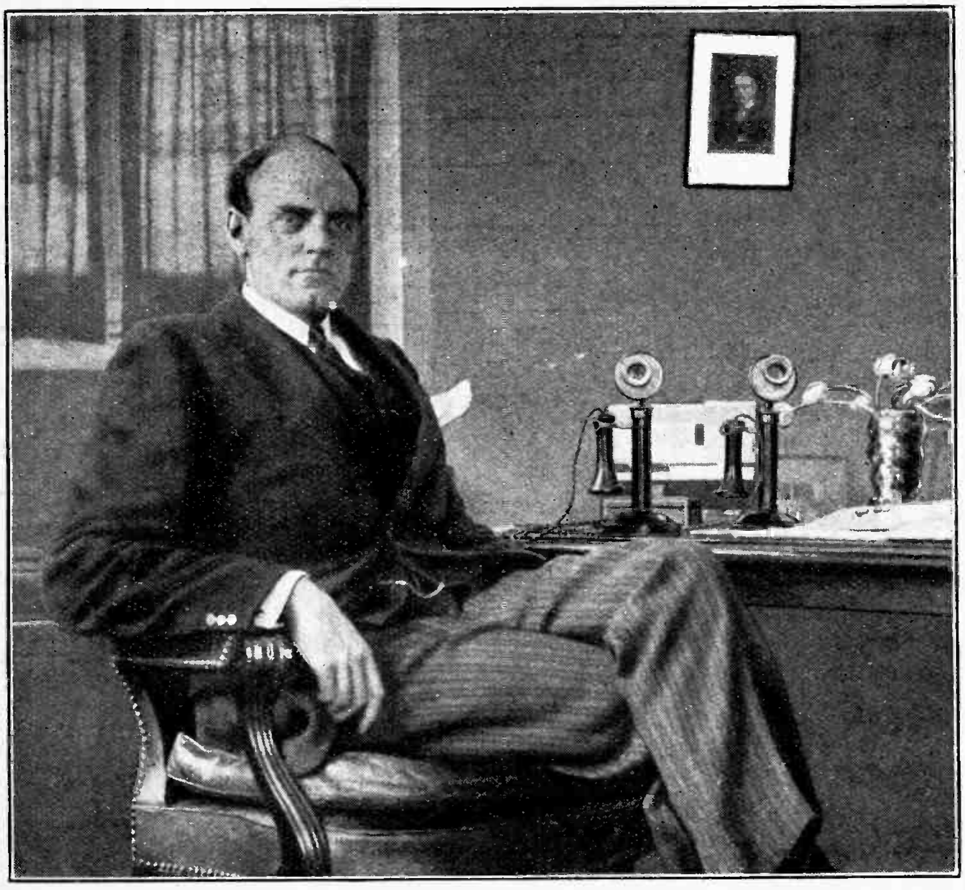


Photo.: "Wireless World" copyright.

DIRECTOR-GENERAL OF THE B.B.C. A recent portrait of Sir John C. W. Reith, whose Knighthood, announced on New Year's Day, coincided with his accession to the important office of Director-General of the British Broadcasting Corporation.

CURRENT TOPICS

News of the Week —in Brief Review

OUR HAPPY WORKHOUSES.

During the Christmas season wireless sets were installed in the workhouses at Newmarket, Ampthill and East Grinstead.

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AUSTRALIAN BROADCASTING MOVE.

The Australian Commonwealth has appointed a Royal Commission to investigate the present position of broadcasting with a view to moulding future policy.

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A GRIEVANCE IN CORK.

Declaring that the import duty on wireless goods is preventing an increase in the number of wireless licences in the Irish Free State, the Radio Association of Cork City has passed a resolution calling for the abolition of the duty. It was described as a non-productive tax.

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WIRELESS IN THE WARDS.

Through the efforts of the students of Armstrong College and the College of Medicine, Newcastle, a wireless installation has been provided for the patients of the Royal Victoria Infirmary. A nine-valve super-heterodyne receiver has been installed in the Stanley Hospital, Liverpool.

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A QUIETER PARIS.

A decree has been issued by the Prefect of Police in Paris forbidding the use of loud-speakers for advertising purposes, either in the streets or in buildings where they can be heard in the streets. A Paris correspondent of *The Wireless World* states that the quality of reproduction on many loud-speakers in that city is so execrable that it is surprising that the decree was not issued months ago!

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AERIALS FOR ALL.

The Hull City Architect has reported to the Hull Corporation that it would be good policy to provide wireless poles, brackets, and pulleys during the erection of Council houses. He suggests one pole to every four tenants. The present conglomeration of poles and different methods of fixing are, he says, very unsightly, and in many cases result in damage to the properties.

The Housing Committee recommend that poles as suggested be provided for 20 houses, and that a charge of 10s. be made to the tenants.

PIANISSIMO IN EASTBOURNE.

Eastbourne Town Council has passed a bylaw making it punishable by a fine of £5 to use a noisy loud-speaker or gramophone in a public place.

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BEAMS OF GREETING.

Nearly 20,000 greetings, it is estimated, passed over the Imperial cables and the beam services between Great Britain and Australia, Canada and the West Indies during the New Year season.

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"AMERICAN SERVICE, PLEASE."

On Friday last, January 7th, the Postmaster-General opened a preliminary public transatlantic telephone service.

The service is available daily between 1.30 and 6 p.m. (G.M.T.), and at the moment is restricted to conversations between subscribers in the London telephone area and those in New York and its suburban area. The charge is £15 for a conversation of three minutes and £5 for each additional minute or fraction thereof. Calls can be booked on any ordinary telephone by asking the local exchange for "American Service."

Experiments are being conducted to secure greater privacy than is at present possible.

TELEPHONING TO NEW YORK. Mr. E. H. Shaughnessy, O.B.E., the well-known assistant engineer of the Post Office, who has been intimately associated with the development of Transatlantic telephony and is now in control of the official service.

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LECTURES ON BROADCASTING.

A course of four lectures, entitled "Sidelights on Broadcasting," will be given by Capt. Jack Frost (late of the B.B.C.) on Friday evenings from 6 to 7.30, beginning on January 21st, at the Regent Street Polytechnic, London, W.

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WIRELESS AND THE MUSICIAN.

"Any opinion or action based on the superficial and naturally unthinking first impression that ether and air for musical purposes are in opposition is untimely and unserviceable."—Sir Walford Davies, before the Incorporated Society of Musicians.

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I.E.E. ANNUAL DINNER.

H.R.H. the Prince of Wales has kindly consented to honour the Institution of Electrical Engineers by his presence at the Annual Dinner and Reunion of the Institution to be held at the Hotel Cecil, Strand, W.C., on Thursday, February 10th.

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CAPTAIN ECKERSLEY ON "MICROPHONES AND LOUD-SPEAKERS."

The Radio Society of Great Britain will hold an informal meeting, with members of the Transmitter and Relay Section, on Friday next, January 14th, at 6 p.m., at the Institution of Electrical Engineers, Savoy Place, W.C.2. Captain P. P. Eckersley will give a talk on "Problems of Microphones and Loud-speakers." Light refreshments will be available at 5.30 p.m.

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WEATHER FORECASTS FOR SHIPS.

A firm of Cardiff shipbrokers, Messrs. Lambert Bros., Ltd., have installed a broadcast receiver in their offices for the special purpose of receiving the Daventry weather forecast. The 10.30 bulletin is typed by a clerk and displayed daily for the benefit of ships' captains.

LONG WAVE RECEIVER WITH 2 H.F. STAGES.

There has been a considerable demand, especially amongst those troubled by shipping interference, for a long-wave receiver. Such a set with two H.F. stages is described by Mr. W. James in the current issue of our sister journal, *Experimental Wireless*, now on sale, price 1s.

Amongst other features of the January number should be mentioned "Quartz Crystals and their Practical Application to Wireless Circuits," by A. Hinderlich; "Delineation of Alternating Current Wave Forms," by H. A. Thomas; and "Telephone Transmitter Modulation Measured at the Receiving Station," by L. B. Turner.

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THE ETHOPHONE-THREE RECEIVER.

Messrs. Burndept, Ltd., write to point out that the normal arrangement of plug-in coils in this receiver for the reception of the lower B.B.C. band is as follows:—Aerial (fixed coil), 50; reaction (moving coil), 35. In reporting on this set in the issue for December 29th, 1926, the wavelength range of 200 to 490 metres was given for the reverse arrangement of coils. By using the coils in their normal positions wavelengths up to 650 metres are available.

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SHEFFIELD AND DISTRICT RADIO SOCIETY.

Under the title "Current from A.C. Mains," an account appeared on page 12 of our last issue of an interesting lecture on this topic given by Mr. C. H. Handford. Through an unfortunate oversight it was not stated that the lecture in question was delivered before the Sheffield and District Radio Society.

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FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 12th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Demonstration by the President, Capt. H. J. Round, M.C., A.M.I.E.E.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street, Barnsley. Lecture: "Simple Mathematics of the Thermionic Valve," by Mr. D. W. Milner, B.Sc.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Two-valve Night.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "Leclanche Batteries for H.T. and L.T. Supply," by Messrs. Siemens Bros.

Preston and District Radio Research Society.—Lecture on "Valves," by the Mullard Wireless Service Co., Ltd.

THURSDAY, JANUARY 13th.

Stretford and District Radio Society.—At Primitive Methodist Schoolroom, King Street. Lecture: "Exide Batteries," by Mr. C. P. Lockton, M.Sc.

FRIDAY JANUARY 14th.

Radio Society of Great Britain.—At the Institution of Electrical Engineers, Savoy Place, W.C.2. Informal Meeting with T. and R. Section.

Leeds Radio Society.—At 8 p.m. At Collinson's Cafe, Wellington Street, Leeds. Lecture: "Valves," by Mr. A. H. Fisher.

Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square. The Month's Wireless News.

MONDAY, JANUARY 17th.

Croydon Wireless and Physical Society.—At 8 p.m. At 128a, George Street. Lantern lecture: "The Manufacture and Construction of Loud Speakers," by Mr. Ricketts, of the Amplion Co.

SIGNALS FROM THE "RENOWN."

The Admiralty hopes to maintain daily communication with the "Renown" throughout her passage to Australia with the Duke and Duchess of York and on her return.

Amateurs and others who may intercept signals passing between the vessel and the naval authorities in this country and Australia are asked to refrain from making any attempt to call up the "Renown," as it will be impossible for such calls to be answered.

The "Renown" is fitted with a standard Admiralty short-wave set.

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1,000 WORDS PER MINUTE.

Transmission experiments carried out during the past year between the Nauen wireless station, near Berlin, and Rio de Janeiro, have shown that it is not impossible to transmit 1,000 words per minute by dispensing with the ordinary Morse signs and utilising the principles of photo-telegraphy. The tests have been conducted on 40 and 25 metres.

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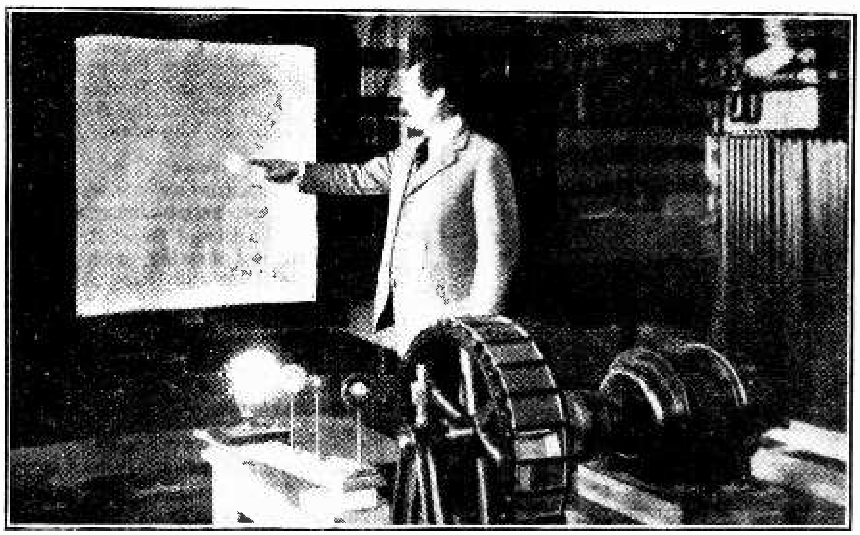
LIGHTING "MIRACLE" BY WIRELESS.

The lighting of 3,579 electric lights by a mere spoken command was achieved with apparent ease by the Mayor of St. Louis (Missouri), when he recently opened the city's new £1,600,000 lighting scheme.

Actually the Mayor addressed his command into a microphone connected with the KOKA transmitter, from which it was broadcast on a very short wavelength through five relays to a station set up at the Westinghouse plant in St. Louis. Here the current pulse set up completed the lighting circuit and the "miracle" was performed.

TELEVISION IN AMERICA.

THE famous American engineer, Mr. E. F. W. Alexanderson, has set up an apparatus for television, about which he is extremely optimistic. His theory, it is interesting to note, is based on the same principle as that of M. Edouard Belin, and seems somewhat different from that of the English inventor, Baird, whose experiments have aroused so much attention.

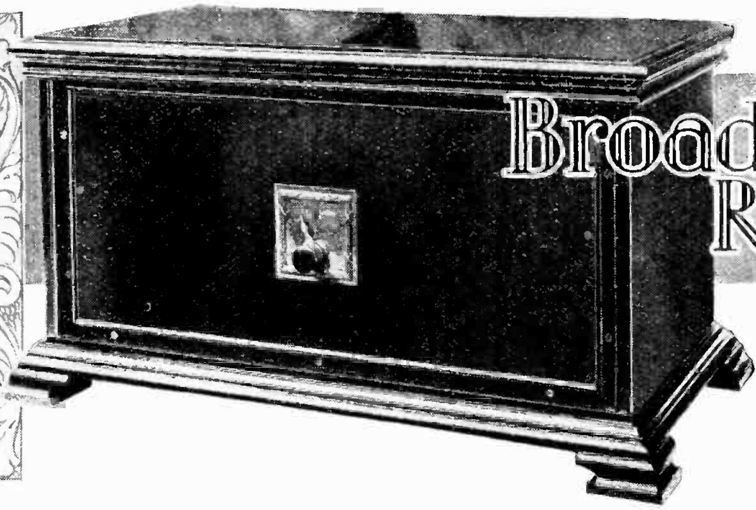


AN AMERICAN TELEVISION DEVICE. Dr. E. F. W. Alexanderson, the well-known engineer, is seen pointing to the cluster of seven lights which make up an important feature of his television system. The drum in the foreground, which is made to revolve at very high speed, is fitted with 24 mirrors at slightly differing angles, with the result that the entire screen is covered with reflected light in a fraction of a second.

Dr. Alexanderson's apparatus consists of the usual light beam thrown on to a rotating series of mirrors, which reflect this beam on to a screen in a little moving spot of light. But, where Belin used only one light source, and had only one light beam, Alexanderson has used seven. In this manner he develops a useful illumination of 49 times that of Belin. This was the great difficulty with Belin's work—he had to cover a screen with this one light spot about (according to Dr. Alexanderson's figures) 300,000 times in one second—a thing which is physically impossible with any clarity of detail. With the seven light sources this can be reduced to only 43,000 strokes per light beam—a modulation not beyond the bounds of reason, as it is only ten times as fast as that of radio telephone broadcasting.

For distance transmission of pictures, telegraphic signals can be used, as they come in independent of signal strength, and thus are not affected by fading, according to Dr. Alexanderson. He adds that the short wave would, of course, be used in this work. Dr. Alexanderson considers that actual television for the ordinary broadcast listener is quite a logical possibility, despite the difficulties to be overcome.

N. C. McL.



Broadcast Receivers

GECOPHONE "L and D" MODEL

Single Control Loud-speaker Set for the Local Station and Daventry.

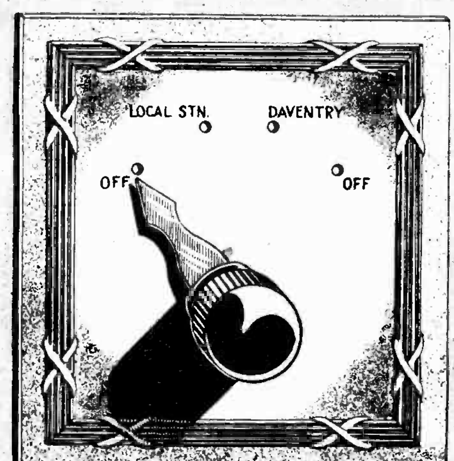
THE outstanding feature of the Gecophone "L and D" receiver is the extreme simplicity of the controls. A single knob mounted on a small bronze panel on the front of the cabinet serves not only to switch the set on and off, but also to effect a rapid change-over from the local station to Daventry. There are in all four positions of the switch, two "Off" positions having been provided to left and right of the "On" positions in the centre for the two alternative stations.

The change-over from one station to the other is instantaneous, no retuning being necessary. This is a very good feature, and is brought about by duplicating the aerial tuning condenser; there are two distinct aerial circuits, each complete with aerial coil, reaction coil, and tuning condenser. These duplicate sets of components are mounted on a sub-panel inside the cabinet, and, having been carefully adjusted when installing the set, require no further attention.

The aerial and reaction coils are built up in pairs in the form of a unit, with four-pin connections arranged to fit into standard valve-holder sockets. Each coil is boxed in an ebonite moulding, the reaction coil being hinged in order that the coupling with the aerial coil may be varied. The weight of the reaction coil is supported by friction in the two pivots, through which electrical connection is made between the ends of the reaction coil and the appropriate pins in the base.

The directions for tuning in the instruction book are rather brief, having regard to the fact that the set is intended to appeal to the non-technical listener. One is told to tune in the station on the condenser with the reaction coil set at an angle of 90° and then to "move the hinged portion of reaction unit towards the fixed portion until satisfactory volume is obtained." There is no mention of the limiting condition of self-oscillation or of the possible necessity of retuning after each movement of the reaction coil.

Aerial, earth, loud-speaker, and battery connections are made to terminals on an ebonite panel let into the back of the receiver. The terminals are of special construction and will accommodate ordinary wire or special plug connectors supplied by the manufacturers. The spacing of the terminals and the proximity of the wood of the cabinet make the insertion of wires rather difficult, and on this account the use of the special plugs is recommended. A rather unusual arrangement of the H.T. terminals also demands the use of the special plug if mistakes in connecting up are to be avoided.



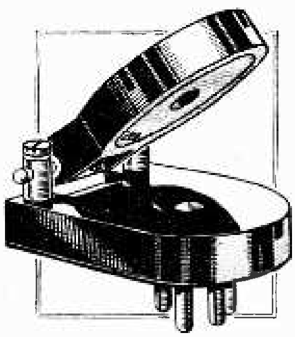
Four-way control switch on the front panel. All subsidiary tuning controls are situated inside the cabinet.

There are two aerial terminals, "A" and "B." Normally terminal "B" should be used; the aerial should be connected to "A" only if difficulty is experienced in getting down to the required wavelength. Two pairs of output terminals are provided, but if only one loud-speaker is in use it should be connected to "Phones 1 and 2." The newcomer to wireless will no doubt be puzzled that

Broadcast Receivers.—
loud-speaker terminals should be marked "Phones." This is a survival from the early days of the art when loud-speakers were non-existent and phones were connected to the output terminals of all receivers as a matter of course.

The three valves are employed as follows: First valve, detector with grid rectification (grid leak returned to −L.T.); second valve, L.F. amplifier transformer coupled; third valve, power output valve transformer coupled. D.E.5 type valves are used throughout on account of the Gecophone transformers, which have a ratio of 1 to 4. The detector valve is supplied from a separate H.T. tapping, a common tapping being provided for the two remaining valves. Grid bias for the amplifying valves is obtained from a 9-volt battery supported in clips inside the cabinet.

The wavelength ranges of the receiver measured on a standard aerial were as follows:—


Plug-in coil unit with adjustable reaction coupling.

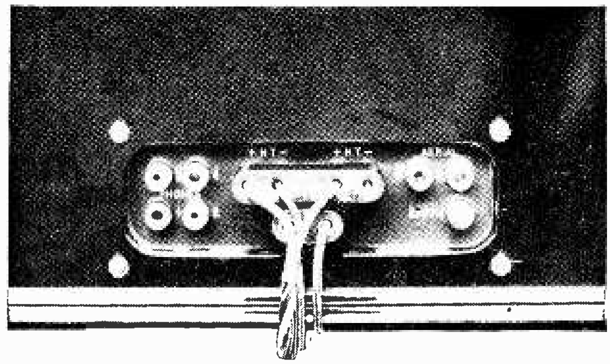
Aerial terminal.	Local tuner. Metres.	Daventry tuner. Metres.
A	265-455	—
B	325-495	1,300-2.150

The range for the Daventry tuner on the "A" terminal was not measured, as the change-over switch automatically cuts out the series condenser on the long range.

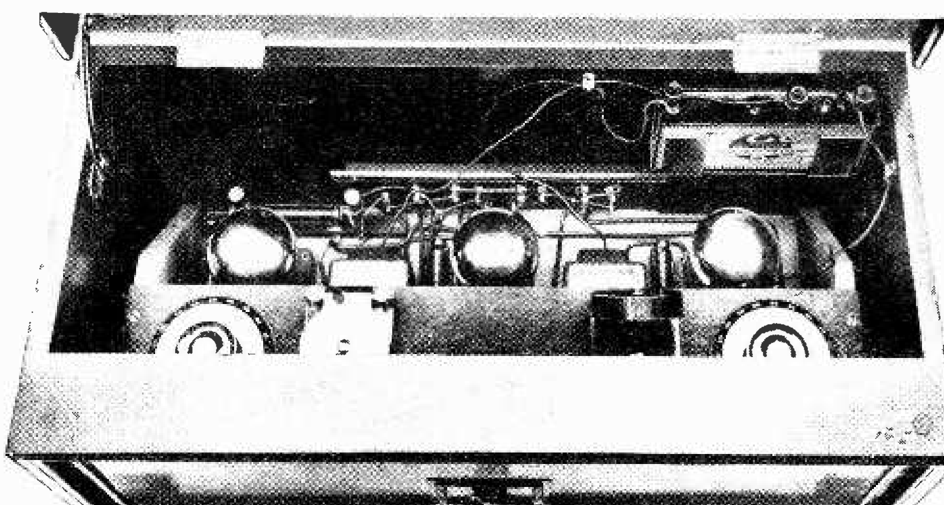
The overall efficiency as measured with the modulated oscillator was very good, and the ranges claimed by the manufacturers would be easily obtained on a standard P.M.G. aerial.

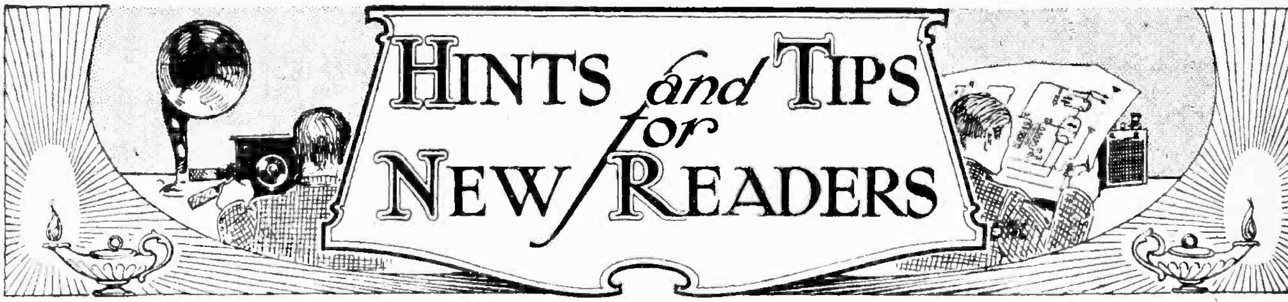
The set was again connected to an outdoor aerial for test on the B.B.C. transmissions. It was then discovered that with 45 volts on the detector, as recommended in the instruction book, the set oscillated over the whole of the Daventry range at all settings of the reaction coil, and the H.T. had to be reduced to 36 volts before proper control would be obtained. The necessity for this change was partly attributable to the high efficiency of the aerial with which the set was tested, special care having been taken to ensure a low-resistance earth. However, the aerial system is in no way exceptional, and there must be many aerials of less than 100ft. in use with which the trouble would be still further aggravated. A warning note should have appeared in the instruction book or fewer turns wound on the reaction coil to give greater latitude for aerials of low resistance.

Three representative loud-speakers by well-known makers were tested with the set, and all gave ample volume both on the local station and Daventry. Unfortunately, the full volume of which the set is capable could not be used without producing harshness, and considerable detuning was necessary to obtain reasonable quality. Incidentally, detuning is the only form of volume control available.


Terminal panel at back of cabinet. The terminals are designed to accommodate ordinary wire connections or special plugs supplied with the set.

The conclusion to be drawn from the foregoing tests is that, in the absence of a volume control, a two-valve set from the Gecophone range would probably produce the same results more economically at distances of 25 and 75 miles of a main station or Daventry, but outside these ranges the "L and D" model would undoubtedly be required. The set is manufactured by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, and the price, including valves and royalty, is £18 17s. 6d. Complete with batteries and connecting plugs and cords the price is £25 5s.


Interior view of the set showing sub-panel with coil units and tuning condensers.



A Section Devoted to the Practical Assistance of the Beginner.

SPACERS FOR H.F. TRANSFORMERS.

Several ingenious ideas for facilitating the construction of the H.F. transformers used in the "Everyman" receivers have been contributed to the "Readers' Novelties" section of this journal. It seems, when workshop facilities are lacking, that it is the making of the grooved ebonite spacing strips which presents the greatest difficulty, and perhaps an alternative method of preparing them may be of interest to prospective constructors who have not access to a lathe.

Eight strips in all are required, each with a thickness of $\frac{1}{8}$in., a width of $\frac{1}{4}$in., and a length of slightly over 1in., depending on the actual type of transformer under construction. It will be found almost essential to cut shallow grooves for supporting the fine wire used in the primary and neutralising winding; unless these are provided, the correct spacing of the turns becomes a very tedious matter indeed. The method of making the grooves, which is shown in Fig. 1, will be found convenient; it has the advantage that no special appliances are required.

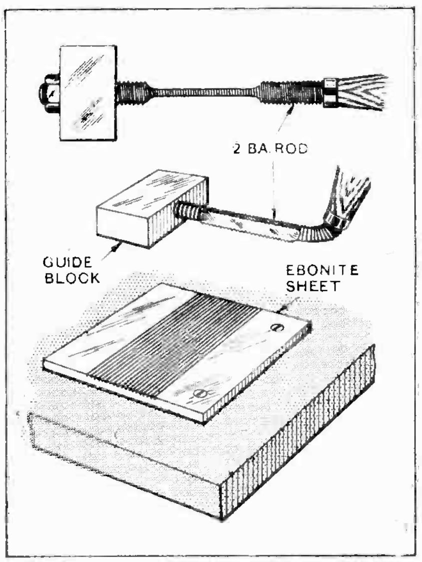


Fig. 1.—A cutter for grooving spacing strips.

A short length of brass or steel 2BA threaded rod, the pitch of which is suitable (thirty-two threads to the inch), is filed as indicated in the upper drawing, in order to provide a cutting edge. A bend is made in one of the ends, which is then pointed for insertion into a tool handle. The other end is fitted with a rectangular guide block, which may be of metal, ebonite, or even hard wood. The tool is now complete, except that it is necessary to file away the threads on the underside of the rod, except where the "flats" have been made.

A small sheet of $\frac{1}{8}$in. ebonite, measuring, say, 3in. by $2\frac{1}{2}$in., to leave a good margin, is now secured to the bench with a couple of countersunk screws, and the guide block of the cutter is pressed firmly against one edge. The tool is drawn sharply across the surface two or three times or until the grooves are of sufficient depth. The best angle for the cutter can easily be found by trial. As many strips as are necessary may now be cut from the sheet, after which they may be finished off by rubbing their edges on a sheet of emery paper tacked to the bench.

It is recommended that the actual cutting edge of the tool should be a little longer than the finished spacers, which can easily be cut from the sheet to the exact length required.

Strips for the aerial-grid transformers generally recommended in conjunction with these coils may be prepared in exactly the same manner; the spacing of $\frac{1}{16}$in. between turns is, of course, obtained by winding in alternate grooves.

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A RESISTANCE CAPACITY L.F. UNIT.

In the issue of this journal for December 1st, 1926, it was shown that the porcelain bases supplied as supports for valve holders could be used for mounting the fixed condenser and anode resistance of an intervalve L.F. coupling. There is no reason why an extremely compact and well-insulated unit should not be mounted on a base of the type specified, as the holes provided will accommodate fixing screws for clips to support both grid and anode resistances as well as the coupling condenser.

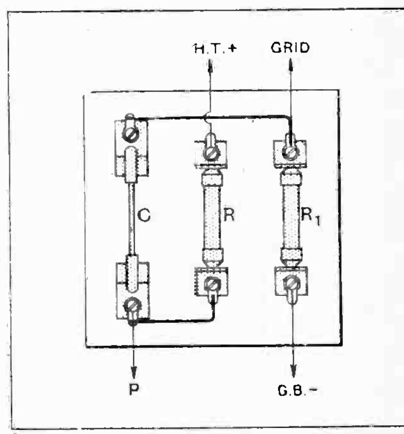

Fig. 2.—Resistance-capacity components mounted on a base.

Where components of considerably larger size than those discussed in the article referred to are used, the parts may be assembled on a rectangular block of ebonite as shown in Fig. 2, and wired ready for connection to the external circuit. In this diagram, C represents the condenser, R the anode resistance, and R_1 the grid leak. The connection to the anode of the preceding valve is marked P.

MECHANICAL REACTION.

Direct interaction between sound-waves from the loud-speaker and the valves is frequently responsible for low-frequency howling; in exceptional cases the effect is so marked that it is almost impossible to operate the set without substituting valves which are less microphonic. The use of shock-absorbing valve holders will not always effect a cure; when this fails it is recommended that a light card-board cylinder with an internal diameter of about an inch greater than that of the glass bulb should be lightly packed with cotton-wool and slipped over the valve.

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THROTTLE CONTROL

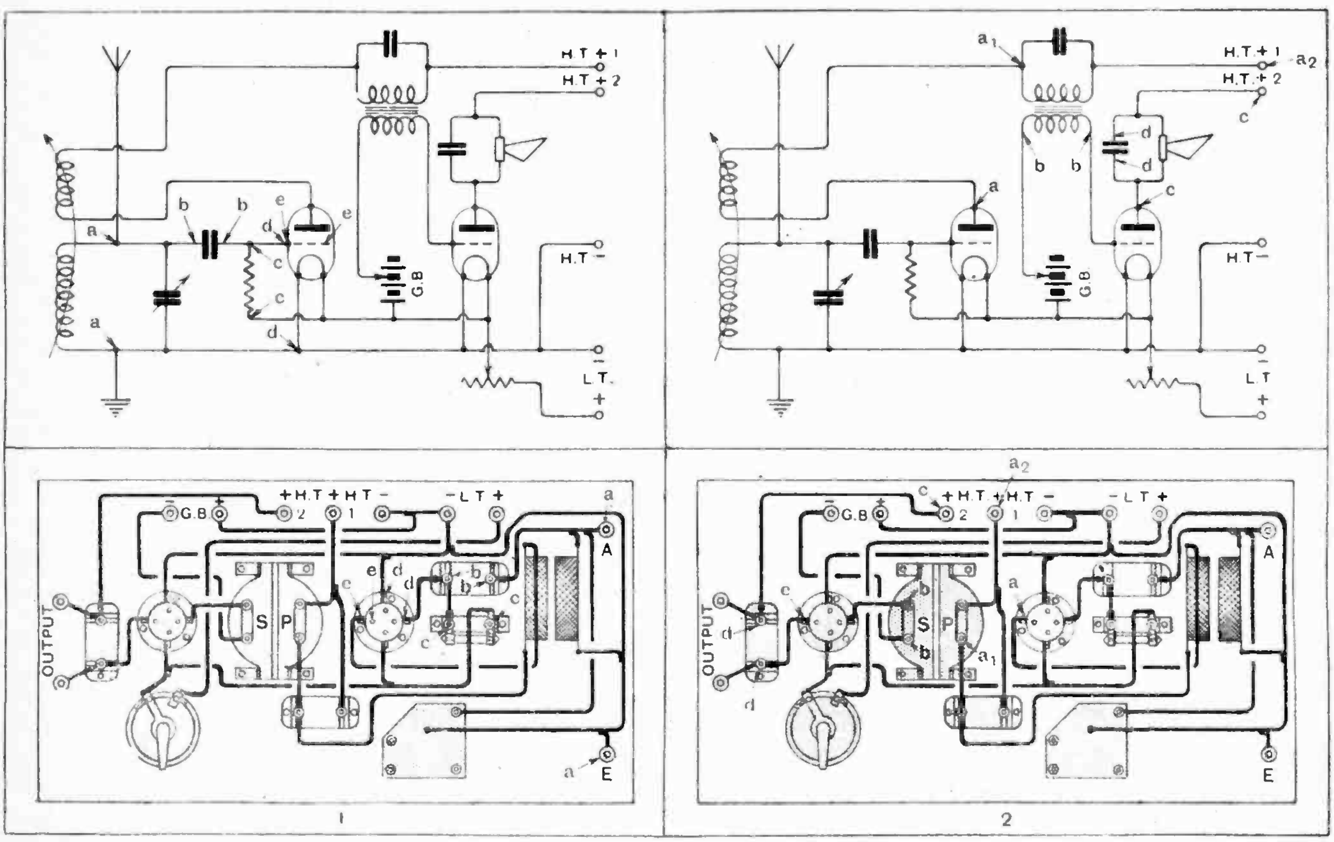
In regenerative detector circuits of the "Schnell" type, and others in which an increase in reaction is obtained by reducing the capacity of the controlling condenser, it will be found that operation is made considerably easier if the dial is set on its spindle in such a way that, when the scale reading is increased, the capacity of the condenser is reduced. In other words, the zero mark of the dial should be set to correspond with the datum line when the fixed and moving vanes are completely engaged; this departure from the usual practice is particularly helpful when the user has been accustomed to the more generally adopted form of reaction control, in which an increase of capacity results in an increased feed-back of energy.

DISSECTED DIAGRAMS.

Point-to-point Tests in Theory and Practice.

No. 55.—A Two-valve Detector-L.F. 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.



A test between *a* and *a* will show continuity through the aerial coil and its connections. Before doing this, it is as well to disconnect the tuning condenser, as a short-circuit in it would nullify the test. Insulation of the grid condenser is shown between *b* and *b*, and continuity of the leak between *c* and *c*. The insulation of the grid circuit as a whole is shown between *d* and *d* (with aerial coil disconnected and grid leak removed). The connections between the external terminal points on the valve holder and the sockets may be tested between *e* and *e*.

Continuity of the detector anode circuit as a whole is shown between *a* and a_2, of the reaction coil and its connections between *a* and a_1, and of the L.F. transformer and its connections between a_1 and a_2. The transformer secondary is tested between *b* and *b*. Continuity of the L.F. valve anode circuit is shown between *c* and *c* (with output terminals "shorted" or L.S. connected). Insulation of the by-pass condenser is tested between *d* and *d*. Several other fairly obvious tests may be applied if those mentioned above fail to reveal the source of trouble.

The Set Builder

WIRING.

Useful Advice on the Connecting up of Components.

IT is almost a too-obvious remark to make that the method of wiring directly governs the performance of a set, and it occasions some surprise that so many otherwise well-planned instruments should display such indifferent connecting up. Of the two general systems of wiring up—bare wire and wire in sleeving—rigid bare wiring is now more commonly used.

Stiff Wire v. Sleeving.

The layout of the components of a set is always considered bearing in mind the route to be taken by the connecting wires, and assuming that all leads are to be short and reasonably direct. Stiff wiring, making use of a "self-supporting" tinned copper wire, was shown in the pages of this journal before the advent of broadcasting in this country, though in many of the first broadcast receivers were to be found dozens of yards of interlaced sleeving, and it is only comparatively recently that stiff wiring has been universally adopted.

The running of wires by the shortest route in sleeving must not be completely condemned on the grounds of impairing the electrical efficiency of a set, but principally because of its unworkmanlike appearance. A receiving set consisting of an oscillating detector valve followed by two L.F. amplifying stages would probably give exactly the same results when connected up with well-spaced bare leads as when wired with leads in sleeving, but it is when an endeavour is made to improve the appearance of the entwined sleeving by carefully bunching the leads together to form cables that imperfections in the performance of the set appear.

By adopting stiff wiring a minimum of stray capacity is presented between the leads, and inductive coupling is practically avoided, while low insulation is prevented by virtue of the air spacing.

The gauge of the wire is fixed by consideration of the mechanical strength required, though it may be stipulated that wire of smaller gauge than No. 16 S.W.G. should not be employed for the filament circuit wiring of a multi-valve set. Both No. 18 and No. 20 S.W.G. tinned wire may be used for short leads, and the finer wires look well where a large number of leads come close together. More care is needed in accurately shaping No. 20 wire, as compared with No. 16.

Wire rolled to a square section is often supplied for wiring purposes, though it is difficult to appreciate the particular merit possessed by this form of wiring in preference to the usual round No. 16, while one is faced with the additional difficulty of avoiding twists, more care is needed in bending, and leads cannot be subsequently adjusted without leaving kink marks. The square wire is, of course, a little stiffer than the round, though this additional strength is not required.

Parallel Wires.

Wiring has a very much better appearance if only right-angle bends are used, as compared with branching wires in several directions so as to take the shortest path. The former method is just as good, electrically, as the latter, and its good appearance probably arises from the fact that the leads are easy to trace.

In a set where the components are carefully laid out there are comparatively few branching leads necessitating the use of "T" joints, and it is always advisable to make junctions on the terminals and other points of distribution. If, for instance, a common H.T. potential is to be applied to several valves, it is advisable to run separate leads from the H.T. bridging condensers or other points of distribution in preference to branching from what might be termed an H.T. bus bar, as the part of the lead which is common

Wiring.—to the several circuits will create some small degree of inter-stage coupling. Valve filament circuits must of necessity take connection from a common pair.

Jointing.

There are three ways by which T joints are usually made. A strong mechanical joint is produced by bending one wire at its end to form an "L" and arranging it to lie along the straight lead to which it joins, though this method has an ugly appearance, particularly if a number of joints are to be made. Another method consists of looping the branching wire around the main lead. A strong and compact joint is thus made, though this method is a little difficult, and is often impracticable owing to the junction point being inaccessible.

The neatest form of joint is made by adjusting the branching lead to merely touch the main lead, strengthening the joint by a slight excess of solder. This form of joint is usually strong enough, although the leads should be supported or terminated not far from such a joint. For the shaping of wires a pair of square-jawed pliers should be used, and to avoid the risk of fracture at an acute bend it is advisable to file away the sharp edges of the square jaws. A pair of round-nosed pliers will be found useful, while wires are best snipped off to length and odd ends removed with a pair of side cutters.

The path to be taken by every lead should be carefully considered, with a view to limiting the number of bends. It is the bends in instrument wiring that make it look complicated. Although, after some experience, leads can be correctly bent merely by estimating the distances between the points of bending, it will be helpful at first to use a 6in. steel rule and actually measure off the distances. The leads for shaping should not be appreciably longer than required, so that they can be easily placed into position as each right angle bend is made.

Tags for Terminating.

In cutting off where the wire is to enter the hole in a tag, the end of the wire should be pointed by using the side cutters with their edges lying obliquely across the wire. Never attempt to solder leads on to the stems of terminals. The amount of heat taken by the brass terminal may cause it to become loose in the ebonite, while the terminal is practically spoilt as to withdrawal or future use.

It is better to use tinned soldering tags than to endeavour to clamp down a loop of wire under a nut.

Preparation of Straight Lengths.

Although connecting-up wire is often purchased in straight lengths ready for use, it will require straightening by stretching if supplied on a reel or in a hank. One end of the wire should be tied off firmly, preferably near the ground, so that the wire does not acquire a curvature by sagging after straightening, and pulled taut until it can be felt to appreciably stretch. It should then be cut off in lengths of about 2ft. 6in.

If the wire is dull it should be polished with a clean cloth, avoiding any trace of grease, which would, of course, render soldering difficult. Where appearance is of first importance the wiring of the set may be treated with cold transparent lacquer applied with a small camel hair brush, to prevent leads from becoming tarnished.

Colour Scheme.

The leads may, for purposes of identification, be enamelled in various colours. According to the amount of wiring to be done and the space in which it is to be accommodated, so must the method of wiring be adapted, though probably the best practice is to distribute valve filament leads, as well as the various connections to the high tension battery, in the form of No. 16 tinned copper wire carried in sleeving beneath a raised baseboard, wire all grid, plate, and tuned oscillating circuits with bare No. 16 tinned wire, making use of right-angle bends and supporting long leads with small ebonite cleats or pillars.

Stiff Wire in Sleeving.

When sleeving is used with stiff wire it must be threaded on to the wire before the bends are made, and the ends are made bare by trimming round the sleeving with a razor edge, taking care not to "nick" the lead. A small quantity of No. 20 tinned wire may be introduced where the wiring is likely to appear too conspicuous or congested.

BROADCASTING ON A COMMON WAVELENGTH.

WITH the change of wavelengths following the general adoption in Europe of the Geneva Scheme has come a new problem for wireless engineers. This has arisen through the necessity of working more than one station on a given wavelength; unless these stations are adjusted to exactly the same frequency a low-pitched heterodyne note will be heard which will considerably add to the difficulties of listeners not in the immediate vicinity of one of the stations.

Not only must the frequencies be synchronised, but the adjustment must be held. Herein lies the broadcasting engineer's chief difficulty. Hitherto "swinging" of the frequency up to 150 cycles on either side of the normal value has not been regarded as serious, but for the purpose of transmission on a single wavelength differences higher than 10 cycles cannot be tolerated.

In Germany a solution is being sought with the aid of crystal controlled transmitters. It is impossible, of course, to grind quartz crystals with sufficient accuracy for this purpose, and so advantage is being taken of the temperature coefficient of the quartz for making the final adjustment. According to figures published by Dr. Meissner a change of temperature from 15° to 60° Centigrade is accompanied, on the short wavelengths used for broadcasting, by a change of frequency of approximately 100 cycles, which gives an ample margin for adjustment. A further variation of frequency is obtainable by varying the distance between the crystal electrodes.

Experiments are now being carried out by the Telefunken Company at the suggestion of Dr. Bredow of the Telegraphentechnisches Reichsamt, Berlin, and the results so far obtained indicate that a considerable extension of the broadcasting system in Germany along these lines will shortly be possible. H. K.

News from All Quarters: By Our Special Correspondent.

Daventry to Experiment—Too Much "S.B."?—Those Sunday Programmes—Clearing the French Ether—Glasgow's Triumph—Somerset Night.

Shorter Waves from 5XX.

In a few weeks time listeners will have an opportunity of hearing the Daventry station conducting experimental transmissions on a wavelength within the ordinary broadcast band, probably in the neighbourhood of 400 metres. The tests will be the first to be carried out in connection with the projected regional scheme, and will go a long way towards proving its feasibility.

The idea of conducting these transmissions is not new. They were referred to by Lord Gainford in his speech at the annual general meeting of the old company in July last.

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High Power Maintained.

During the tests Daventry will maintain its high power, so it is probable that the transmissions will be heard over a very wide area—possibly farther than with the ordinary wavelength of 1,600 metres. I gather that the time chosen will be outside the ordinary broadcasting hours, to avoid Continental weeping and gnashing of teeth.

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Too Much "S.B."?

"I think it is about time something was done to stop 2LO from interfering with 2ZY. What about our own orchestra and our own talent and choir? I, personally, am completely 'fed-up' with London programmes."

In this terse unequivocal jeremiad a Manchester listener clears his chest.

The same feeling is becoming noticeable in other parts of the provinces, but I fail to fathom just where the grouse lies.

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Is Merit Dependent on Locality?

A certain amount of local talent will always be desirable, but, assuming that transmission is faultless, is a *good* London programme likely to lose its savour by the time it reaches Manchester? A rose by any other name would smell as sweet, and a saxophone from any other station sounds equally seductive, or equally revolting, according to the viewpoint of the listener.

A Point for Criticism.

Where criticism is called for is in regard to Daventry's programmes. On several evenings of late the London programme has been S.B. to all stations, *including* 5XX. Surely these are occasions when the high-power station might with advantage offer an alternative programme? If this course were followed we should hear fewer complaints from those who object to spoon-feeding from London.

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Do You Hear Dublin?

Curiosity exists in Dublin as to the strength and volume with which 2RN is heard over here. In order that statistics may be obtained the Editor of the *Irish Radio and Musical Review*, 179, Great Brunswick Street, Dublin, would welcome reports from British listeners who have picked up Dublin's programme since the station changed its wavelength to 319.1 metres.

Old Bore's Wireless Almanac.

Old Bore is a little late this year with his predictions. No doubt the general stir over the advent of the new Corporation temporarily upset his delicate instruments.

January.—Pudsey listener inadvertently oscillates. Post Office wireless van starts Pudseywards, but suffers puncture and returns to St. Martin's-le-Grand.

February.—Famous musician denounces broadcasting and packs trunk.

March.—B.B.C. criticised.

April.—Famous musician again denounces broadcasting and re-packs trunk.

May.—B.B.C. criticised.

June.—Post Office wireless van starts for Pudsey.

July.—Announcer drops aspirate.

August.—Famous musician makes no statement.

September.—Old Bore sees crowd bound for Olympia. B.B.C. criticised.

October.—High Court Judge asks:

WIRELESS ON THE "RENOWN." Navy operators conducting final tests last week with the wireless receiver installed in one of the Royal staterooms for the voyage of the Duke and Duchess of York to Australasia.

"What is broadcasting?" Famous musician explains and packs trunk.

November.—B.B.C. criticised.

December.—Post Office wireless van returns from Pudsey.

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Those Sunday Programmes.

More than two hundred Sundays have passed into history since broadcasting was begun in this country, yet the problem of providing the ideal Sunday programme remains unsolved. Too often the listener's Sabbath is synonymous with gloom, particularly from a musical point of view. The majority of listeners are not averse to a little light music on Sunday, and the fact that such music exists in abundance has been proved again and again by De Groot, Sandler, and Colombo.

Few people would clamour for jazz on Sundays, but many are resorting to it (the French stations specialise in Sabbath jazz) to escape from the esoteric profusions which make up the average Sunday programme at home.

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An Organ for Broadcasting.

A new organ, specially adapted for broadcasting, is being opened at Lozell's Picture House, Birmingham, on February 7th. This unique instrument contains the ordinary features of a church organ combined with numerous effects in imitation of a symphony orchestra. The action is electric, and the instrument embodies about 150 miles of wiring.

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Order out of French Chaos.

The French ether, at present the most chaotic in Europe, will come under State control in five years' time, according to a Decree which has been drafted by the Minister of Commerce. Under this Decree all broadcasting stations will become nationalised by 1932. During the intervening five years licences to broadcast may be granted by the Ministry of Posts and Telegraphs to existing stations and to new ones, but with a view to their ultimate incorporation in the Government system.

Under State control the programmes are to be arranged by a National Board, on which will be represented the public services, the chief national associations (including those of authors, composers, and artists), the wireless trade, and the general public.

The scheme appears to be a more or less faithful imitation of our own system.

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Not What It Seemed.

The experiences of an Alfreton (Derbyshire) correspondent in picking up what he first thought was KDKA go to show that all is not America that comes through in the wee sma' hours.

My correspondent had been listening to KDKA on 63 metres, but at 2.30 a.m. he changed over to the higher wavelengths in the hope of getting other American stations. A transmission which purported to be a "Football Banquet" programme from KDKA then came hurtling through at terrific strength on about 340 metres. Ten minutes later the transmission was interrupted by a speech in French followed by an explanation in English that KDKA had just been relayed by "Petit Parisien." Apparently the direct reception of the American station was much clearer than the reception *via* Paris.

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FUTURE FEATURES.

Sunday, January 16th.

LONDON.—Military Band Programme.

BOURNEMOUTH.—Full Church Service relayed from Christchurch Priory.

ABERDEEN.—Concert relayed from the Cowdray Hall.

Monday, January 17th.

LONDON.—Spanish Programme conducted by Percy Pitt.

DAVENTRY.—Musical Plays of Older Days.

BOURNEMOUTH.—"The Blue Penguin," played by London Radio Repertory Players.

CARDIFF.—"Emperor II.," Radio Drama by John Cooper.

MANCHESTER.—Foden's Motor Works Band.

NEWCASTLE.—"Admiral Peters," Comedy by W. W. Jacobs and Horace Mills.

GLASGOW.—"The Gentle Shepherd," Pastoral Play by Allan Ramsay.

ABERDEEN.—Ballad Concert.

BELFAST.—Request Programme.

Tuesday, January 18th.

LONDON.—R. A. Roberts in "Dick Turpin."

BIRMINGHAM.—Ballad Concert.

CARDIFF.—Beethoven Sonatas.

MANCHESTER.—Four short recitals.

ABERDEEN.—"Cosi Fan Tutte," Comic Opera by Mozart.

BELFAST.—"The Shadow of the Glen," a one act comedy.

Wednesday, January 19th.

LONDON.—"Through Another's Eyes." by Adolphe Hallis (piano).

BIRMINGHAM.—"Mary Stuart," played by the Station Players.

BOURNEMOUTH.—Shakespeare Programme.

CARDIFF.—"A Sharp Attack," by London Radio Repertory Players.

MANCHESTER.—"Playing with Fire," an event in two acts.

ABERDEEN.—Community Concert relayed from Wesleyan Hall, Inverness.

Thursday, January 20th.

LONDON.—National Concert.

MANCHESTER.—Voice and Personality Test.

Friday, January 21st.

LONDON.—Farewell Recital by Stuart Robertson (bass).

BIRMINGHAM.—Chamber Music.

CARDIFF.—"My Favourite Songs," Recital by Kenneth Ellis.

ABERDEEN.—The Radio Concert Party present "Bon-Accord Nights."

Saturday, January 22nd.

LONDON.—"Fire," a play by A. J. Alan.

BIRMINGHAM.—Shakespearean Hour.

BELFAST.—Ulster Provincial Series—Lisburn.

Flotsam and Jetsam Again.

Mr. Flotsam and Mr. Jetsam, two clever artists who recently broadcast a musical news bulletin each evening during the week, have been re-engaged by the B.B.C. for the week beginning February 7th.

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Two-Hundred-Year-Old Opera.

A shortened version of "The Beggar's Opera," which was first produced in the year 1727, will be broadcast from 2LO on January 24th. The Wireless Chorus and the original orchestra from the Lyric Theatre, Hammersmith, will take part. The production will be undertaken by Mr. R. E. Jeffrey.

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Glasgow Tells the World.

The Glasgow station officials are glowing with righteous pride over a letter which they have received from a resident in Tula Vista, California. The writer reports that at 9.20 p.m. (G.M.T.) on November 19th, he heard an orchestra playing "I Pagliacci," and that, despite continuous fading, he identified the station as 5SC.

On referring to the programme the station officials found that on the night in question the orchestra in the Glasgow studio was playing excerpts from "I Pagliacci" from 9.16 to 9.30 p.m.

The distance covered is approximately 5,000 miles.

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Somerset Night.

An outside broadcast worth hearing will be a Somerset night, arranged by the Portishead Literary and Debating Society for broadcasting, from Cardiff, this evening (Wednesday). W. Irving Goss and his brother Dan'l Grainger, the well-known dialect reciters, will give a typical Somerset evening in song and story.

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A Difficult Recipe.

A distressing story reaches me from America concerning a young bride who asked her husband to take down a radio recipe. The poor fellow inadvertently tuned in two stations at once, and what he wrote was as follows:—

"Hands on hips, place one cup of flour on the shoulders, raise knees and depress toes and mix thoroughly in one-half cupful of milk.

"Lie flat on the floor and roll the white of an egg backward and forward until it comes to a boil. In ten minutes remove from the fire and rub smartly with a rough towel. Breathe naturally, dress in warm flannels and serve with fish soup."

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.

An Active Session.

Signs are not wanting that the second half of the winter session, *i.e.*, from January onwards, promises to be an active period for the majority of wireless clubs. From a perusal of the many interesting programmes already prepared it becomes increasingly evident that all wireless amateurs who desire to make the maximum progress with their hobby would be well advised to associate themselves with their local wireless society.

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A Night of Troubles.

December 29th was "Problem Night" for the Tottenham Wireless Society. Each member was supplied with paper on which he was invited to write a question on any radio matter, preserving his anonimity if he so desired. As each question was read volunteers were asked to reply in detail or to supply a solution to the particular problem. Finally a short discussion took place, when questions and answers received a full measure of constructive criticism.

The success of the meeting was such that the Tottenham Wireless Society is making arrangements to hold a similar event at a later date. Other societies would be well advised to adopt a scheme on the same lines, experience having shown that question and answer constitute an ideal method of solving difficulties which otherwise would never see the light of day.

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Whist and Whistles.

The social side of club life has been well developed by the Golders Green and Hendon Radio Society, under whose auspices a most successful dance and whist drive, attended by 120 members and friends, was held in Christmas week. The guests included Messrs. Kirke and Whitehouse, representing the B.B.C., Mr. J. L. Baird, of television fame, and numerous celebrities in North London wireless circles. After Mr. Maurice Child had distinguished himself by winning the Challenge Cup for the Radio Derby, a most amusing demonstration was given on "a perfect wireless set," designed and constructed by the Society's experts. This piece of apparatus proved to be somewhat intractable, emitting mephistophelian whistles and finally exploding. Details of the design perished in the explosion!

Full particulars of the Society's activities during the coming weeks can be obtained from the Hon. Secretary: Lt.-Col. H. A. Scarlett, D.S.O., 357a, Finchley Rd., N.W.3.

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Wireless Production Difficulties.

"Its moral effect is terrific," said Capt. L. W. Davis, in a racy description of a certain lightning arrester in the course of his lecture before the Bristol and District Radio Society on Friday, Dec. 31st. The lecturer, representing Messrs. Automobile Accessories (Bristol), Ltd., dealt specially with the interesting range of wireless components produced by that firm, including sixteen types of receiver. An interesting account was given of the difficulties encountered in the quantity production of radio apparatus, and the lecturer followed this with a graphic description of his experiences when touring the West of England with a radio demonstration van. The van contained several receivers together with a large power amplifier adapted both for speech amplification and gramophone reproduction.

The Secretary, Mr. S. J. Hurley, 46, Cotswold Rd., Bedminster, Bristol, wishes to remind members that subscriptions for 1927 are now due.

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Have Loud-speakers Improved?

At the last meeting of the Nelson and District Radio Society, Mr. H. Diggle of Southport had many interesting things to say regarding loud-speakers of yesterday and to-day. He contended that in general principles the modern instrument was essentially the same as that in existence 20 years ago, though he cited as an exception the case of the Rice-Kellog loud-speaker. Mr. Diggle also drew attention to the important question of acoustics, showing the numerous problems likely to arise in connection with the use of rooms of varying shapes and sizes. The Hon. Secretary of the Society is Mr. Harry Stow, 30, Swaine St., Nelson, Lancs.

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[*Notices of Forthcoming Events will be found on page* 46.]

A GALA NIGHT AT GOLDERS GREEN. The gathering of members and friends of the Golders Green and Hendon Radio Society at a successful dance and whist drive held during Christmas week. The evening's novelties included a radio "Derby" and an explosive wireless set.

AMATEUR INTERNATIONAL PREFIXES.

Proposed Revision of Prefixes and Intermediates.

THE International Amateur Radio Union is to be congratulated on its attempt to revise the international prefixes which have in many cases grown up promiscuously without any official or semi-official sanction, and are often ambiguous. We have received from Mr. K. B. Warner, the Secretary of the I.A.R.U., at Hartford, Conn., a list which it is proposed to adopt on February 1st, 1927.

If this system is adopted there will no longer be any doubt whether the station calling is in India or Uruguay. At the same time, any sudden change is likely to cause considerable inconvenience at first, and in some cases may be opposed by the licensing authorities. For example, transmitters in Spain who have already been formally allotted the call-signs EAR 1, etc., may experience difficulty in getting these altered to EE — —, and those in Norway will not readily give up the LA to which they are accustomed.

In his covering letter Mr. Warner says:—

"A system has been in use in recent years under which, if United States 1AW wanted to call French 8GO, the call would be '8GO fu 1AW,' the letters 'fu' being the 'international intermediate' and indicating a U.S.A. station calling a French station. Similarly, the combination in the reply would be '1AW uf 8GO.' In recent months the number of countries 'on the air' has grown to proportions that exhausted the aphabet, thus involving two-letter combinations, many of them unofficial and without co-ordination. The Union now announces a new and carefully considered uniform plan of two-letter intermediates for all the countries of the world, to be employed in the same fashion as hitherto, and it is that list which is attached. Under this plan the first letter of the intermediate indicates the continent, the second the nation. Whereas under the old procedure it was necessary to assign and announce an intermediate for each new country coming on the air, the present plan provides for every country in existence, and only a re-partitioning of the nations of the world will make further revision necessary."

EUROPE.

EA	Austria.
EB	Belgium.
EC	Czecho Slovakia.
ED	Denmark and Faroe Islands.
EE	Spain and Andorra.
EF	France and Monaco.
EG	Great Britain and Northern Ireland.
EH	Switzerland.
EI	Italy.
EJ	Jugo-Slavia.
EK	Germany.
EL	Norway, Spitzbergen and Franz Josef Land.
EM	Sweden.
EN	The Netherlands.
EO	Irish Free State.
EP	Portugal, Madeira Islands, and the Azores.
EQ	Bulgaria.
ER	Rumania.
ES	Suomi (Finland).
ET	Poland, Esthonia, Latvia, Courland and Lithuania.
EU	U. S. S. R. ("Russia"), including Ukraine.
EV	Albania.
EW	Hungary.
EX	Luxemburg.
EY	Greece.
EZ	Zone of the Straits.

ASIA.

AA	Arabia.
AB	Afghanistan.
AC	China (including Treaty Ports), including Manchuria, Mongolia, and Tibet.
AD	Aden.
AE	Siam.
AF	French Indo-China.
AG	Georgia, Armenia and Azerbaijan.
AH	Hedjaz.
AI	India (and Baluchistan) and Goa.
AJ	Japan and Chosen (Korea).
AK	(Unassigned).
AL	(Unassigned).
AM	Federated Malay States (with Straits Settlements).
AN	Nepal.
AO	Oman.
AP	Palestine.
AQ	Iraq (Mesopotamia).
AR	Syria.
AS	Siberia, including "Central Asia."
AT	Turkey.
AU	(Unassigned).
AV	(Unassigned).
AW	(Unassigned).
AX	(Unassigned).
AY	Cyprus.
AZ	Persia.

NORTH AMERICA.

NA	Alaska.
NB	Bermuda Island.
NC	Canada, Newfoundland and Labrador.
ND	Dominican Republic.
NE	(Unassigned).
NF	Bahama Islands.
NG	Guatemala.
NH	Honduras.
NI	Iceland.
NJ	Jamaica.
NK	(Unassigned).
NL	Lesser Antilles.
NM	Mexico.
NN	Nicaragua.
NO	British Honduras.
NP	Porto Rico and Virgin Islands.
NQ	Cuba and Isle of Pines.
NR	Costa Rica.
NS	Salvador.
NT	Haiti.
NU	United States of America.
NV	(Unassigned).
NW	(Unassigned).
NX	Greenland.
NY	Panama.
NZ	Canal Zone.

SOUTH AMERICA.

SA	Argentina.
SB	Brazil, Trinidad Island and St. Paul Island.
SC	Chile.
SD	Dutch Guiana.
SE	Ecuador and Galapagos Archipelago.
SF	French Guiana.
SG	Paraguay.
SH	British Guiana.
SI	(Unassigned).
SJ	(Unassigned).
SK	Falkland Islands and Falkland Dependencies.
SL	Colombia.
SM	(Unassigned).
SN	Ascension Island.
SO	Bolivia.
SP	Peru.
SQ	(Unassigned).
SR	(Unassigned).
SS	(Unassigned).
ST	(Unassigned).
SU	Uruguay.
SV	Venezuela and Trinidad.
SW	(Unassigned).
SX	(Unassigned).
SY	(Unassigned).
SZ	(Unassigned).

AFRICA.

FA	Abyssinia.
FB	Madagascar, Reunion Island, Comoro Island, etc.
FC	Belgian Congo, Ruanda, Urundi.
FD	Angola and Kabinda.
FE	Egypt.
FF	French West Africa, including French Sudan, Mauritania, Senegal, French Guinea, Ivory Coast, Upper Volta, Dahomey, Civil Ter. of the Niger, French Togoland, etc.
FG	Gambia.
FH	Italian Somaliland.
FI	Italian Libya (Tripolitania and Cyrenaica).
FJ	Somaliland Protectorate and Socotra.
FK	Kenya, Zanzibar, Protectorate, Uganda, Anglo-Egyptian Sudan, and Tanganyika Territory.
FL	Liberia.
FM	Tunisia, Algeria, Morocco (including the Spanish Zone), Tangier.
FN	Nigeria.
FO	Union of South Africa, Northern and Southern Rhodesia, Bechuanaland Protectorate, and South-west Africa.
FP	Portuguese Guinea and Cape Verde Islands.
FQ	French Equatorial Africa and Cameroons.
FR	Rio de Oro and adjacent Spanish Zones, Ifni, and Canary Islands.
FS	Sierra Leone.
FT	Eritrea.
FU	Rio Muni (Spanish Guinea) and Fernando Po.
FV	French Somaliland.
FW	Gold Coast Colony, Ashanti, Northern Territories and British Togoland.
FX	Seychelle Dependencies.
FY	(Unassigned).
FZ	Mozambique.

OCEANIA.

OA	Australia (and Tasmania).
OD	Dutch East Indies.*
OE	Melanesia.*
OH	Hawaiian Islands.
OI	Micronesia.*
OO	Polynesia.*
OP	Philippine Islands.
OZ	New Zealand.

* To be further partitioned when activity warrants.

SHIP STATIONS.

Ships stations with amateur calls will place an X before their usual intermediate. E. g. Australian. 3AA at sea, calling U.S. 1AW, would send "1AW NU XOA 3AA." The reply would be "3AA XOA NU 1AW."

As regards Great Britain, however, we understand that the Post Office authorities will not sanction any variation from the established rule of giving the call of the station required thrice, the word DE once, and the call of the transmitting station thrice, so that the proposed system will not be entirely applicable in this country. It is hoped, however, that the international prefixes will be generally adopted and thereby obviate the confusion so often experienced in determining the nationality of some stations (*e.g.*, Uruguay and India both use the letter "Y," Argentine and Russia the letter "R," and many other prefixes are adopted promiscuously to suit the convenience of small groups of amateur transmitters). A British station wishing to communicate with the United States would, therefore, call up (say) NU 8ZZ, NU 8ZZ, NU 8ZZ, DE EG 2AB, EG2AB, EG 2AB, whereas an American transmitter would adopt the system outlined above and dispense with the connecting DE.

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.

MANUFACTURERS AND THE RADIO SOCIETIES.

Sir,—I note that in your issue of December 15th, under the heading, "Manufacturers and the Radio Societies," the correspondence on this subject continues, and that a further letter appears from the hon. sec. of the Thornton Heath Radio Society, complaining of lack of attention from manufacturers.

Immediately on reading the original complaint of this gentleman, I wrote to him in the terms of the following letter. Hitherto, I have received no acknowledgment of any kind. Under these circumstances his continued complaint against manufacturers seems hardly just. P. K. TURNER.

Blackheath, December 16th, 1926.

[COPY.]

Aerial Works, Blackheath, S.E.3.
November 23rd, 1926.

The Hon. Secretary,
The Thornton Heath Radio Society,
72, Corridge Road, Thornton Heath.

Dear Sir,—I note your letter in *The Wireless World* of November 17th.

You should have asked us. If you had done so, you would have found that we, at any rate, would willingly have co-operated in the way you suggest.

Please note that this letter is a personal one on my part; any such request should, of course, be addressed officially to the Research Department here.

Yours faithfully,
BURNDEPT WIRELESS, LIMITED.
P. K. Turner,
Head of Research Department.

DISTORTION IN LAND LINES.

Sir,—In an article appearing in the issue of *The Wireless World* for December 29th, 1926, Mr. Paul D. Tyers makes some rather sweeping assertions against the B.B.C. engineers which cannot be allowed to pass unchallenged.

Firstly, he appears to think that if he takes the curve of his correction filters, he can draw the inverse of this and that this inverse curve is a "first approximation to the characteristic of the B.B.C.'s line and amplifiers." What about Mr. Tyers' own amplifier? I think we should like to see the amplification—frequency curve of this and to know the exact method by which it was arrived at. Also the source of his input and what assurance he had that this input was a pure sine wave. I feel sure the B.B.C. engineers would like to see one of Mr. Tyers' "inverse first approximation" curves in order to compare it with the actual curves which Mr. Tyers may be sure they very frequently take on all their land lines and amplifiers. I should think that if Mr. Tyers were to see one of these curves he might obtain rather a shock, and, no doubt, by applying his own "law" he would be able to obtain in this manner the actual curve for his own receiver, and at the same time a good many restless hours rectifying it and straightening it out.

Mr. Tyers mentions woolliness. Does this mean that he has made his curves by some means after the sound has passed through the loud-speaker, or does he take them from the amplifier output terminals? If the former case, then again, many of us would like to hear details as to how these curves were taken and what precautions were taken to ensure the curve really did represent the loudness-frequency ratio of his final reproduction. If the method was employed, can he assure us that his loud-speaker is accurate, or possibly is it the case that his filters are correcting his amplifier but are unsuitable for his loud-speaker loudness-frequency characteristic?

Here at any rate are a few of the factors that want looking into before Mr. Tyers accuses the B.B.C. of not correcting its land lines.

The statements are the more difficult to understand because Mr. Tyers himself states that he has not the characteristics of his loud-speaker.

There is no doubt that on some outside broadcasts the Post Office do provide a very bad line for the B.B.C., and it is understandable that this may take place at the last moment and that the B.B.C. engineers have insufficient time to correct it to the pitch of perfection that we might wish. It is equally certain that the frequency amplification curves of the various stations are not all the same, and that some are distinctly better than others. After all it must be remembered that the B.B.C. had to divide their orders for equipment amongst various companies (I believe this was part of the original agreement between the B.B.C. and the Post Office), and some of the systems do show up better than others.

The fact that once in a while the B.B.C. obtain a bad line and have insufficient time to correct it, and that every station is not quite so perfect as the one almost perfect (although I am open to wager that there are few receivers in use which can reproduce accurately the most imperfect of the B.B.C. transmissions), are scarcely sufficient to warrant the statements that

1. The variation of transmission characteristic is due chiefly to the introduction of land line between the London and Daventry stations.
2. The B.B.C. only correct the Daventry land line.
3. The frequency-amplification curves of the B.B.C. can be obtained by means of inverse correction curves taken at the end of a receiving set.

I consider these statements are very damaging to the B.B.C. and unfair to their engineers. As one who has no interest in the B.B.C. other than an interested listener and an occasional "Broadcaster," but who has at various times had the privilege of coming into contact with the engineers of that company and has heard and seen a little of the tremendous trouble that is taken to perfect all types of transmission, I can assure Mr. Tyers that his criticisms are, in the main, unmerited, and that if apparatus is utilised for reception which even nearly approaches in perfection that of the apparatus used by the B.B.C. for transmission, then it will only be for a minute percentage of listening time that he will feel justified in complaining about the quality and accuracy.

Finally, I do not desire Mr. Tyers to think that I have not appreciated the remainder of his interesting article (he probably does not mind much either way, as he will be confident with justification that scores of your readers have found it of very real value), but I feel sure he will forgive me for taking up the cudgels on behalf of the B.B.C., solely as an appreciative listener, and will perhaps appreciate that parts of his contribution might be taken by the inexpert listener as evidence that the B.B.C. engineers either do not know their job or cannot carry it out correctly, both of which suggestions I think he will agree with me are quite false.

May I apologise for taking up so much of your space, but in these enlightened days when so many people are working on the betterment of reproduction, it would, I am sure you will agree, be dangerous to start with the supposition that the B.B.C. transmissions are themselves very far from accurate.

Brierley Hill. COLIN H. GARDNER.

December 29th, 1926.

Sir,—Since, in Mr. Gardner's trenchant criticism of my article on "Distortion in Land Lines," he alleges that I have made statements damaging to the B.B.C. engineers, I must of necessity in my reply elaborate one or two points, but even this, I fear, will present some difficulty, since Mr. Gardner does not appear to have understood my article correctly. First of all, let me remind him that my article was a simple explanation of the attenuation equaliser, *i.e.* a specific type of filter. I was not discussing the subject of correcting land lines in general, nor was I discussing the methods the B.B.C. employ. I proceeded to show how an attenuation equaliser could be added to a receiving system. The type of system which I had in mind was one, of course, which gives perfect reproduction from a direct studio transmission. However, let me endeavour to deal in turn with the various points which Mr. Gardner raises in his letter.

Mr. Gardner seems to doubt that the inverse of the frequency characteristic of an attenuation equaliser connected to a receiver is a first approximation of the characteristic of the B.B.C. line and amplifier system. I can only say that it requires very little mathematical consideration to see that this is the condition necessary for distortionless reproduction. (It is assumed that one is using a distortionless receiving system.)

Mr. Gardner next suggests that I should be shocked to see the curve of my amplifier, and that it would cause me hours of work trying to straighten it out. I can assure Mr. Gardner that I am not in the habit of using apparatus in my laboratory the nature of which I am ignorant; neither do I have to spend "restless hours" designing an amplifier to function in any desired manner. Space does not permit me to detail the method, but I would refer Mr. Gardner to any elementary text book. I regret I do not follow the next remarks referring to "woolliness" and my "curves." I can find no reference in my article to any curves which I have taken. Mr. Gardner seems to lay great emphasis on the point that he has come into contact with the B.B.C. engineers, and hints, perhaps, that he is in possession of a little more information concerning their methods than myself. I do assure him, however, that I have a most intimate knowledge of their methods, what type of correction devices they employ, and on what lines. I may also mention in passing that the frequency characteristic of one of the B.B.C. stations is very far from a straight line function, but this is intentional, and is made like this for certain technical reasons, which are too complicated to enter into in these columns.

If Mr. Gardner reads my article carefully I think he must agree that I have not criticised the B.B.C. methods, neither have I said that the B.B.C. do not correct their lines. I suggested that attenuation equalisers were only used on a permanent line such as that to Daventry. This I believe to be true. When the B.B.C. take over a line from the Post Office they "squeak" it, and correct it according to formulæ. The correction obtained is by no means perfect. For this reason the defects of a relayed transmission are immediately apparent on a good receiver. The B.B.C. engineers would be the first to admit this fact, and the suggestion that this is not so would be contrary to scientific reason, mathematical, and, finally, audible proof. It is interesting to note, however, that they are now using better correction devices than they had some months ago at the time my article was written.

Mr. Gardner next seems to have very great doubts about the accuracy of my apparatus, and hints that if my receivers were as good as those of the B.B.C. I should find only "a minute percentage of listening time in which I should feel justified in complaining about the quality and accuracy." I can again assure Mr. Gardner that I can design a receiving system quite as accurately as the B.B.C. engineers. What I actually use is a system substantially identical with that used by the B.B.C. themselves. The quaint part about this suggestion of Mr. Gardner's is that he fails to realise that the defects which I find are due to the fact that my receiving system is good enough to show them up. PAUL D. TYERS.

Watford.

January 3rd, 1927.

MODERN AMPLIFIER PERFORMANCE.

Sir,—Mr. Turner and Messrs. Burndept are to be thanked for giving publicity in the issue for December 29th, 1926, to such interesting measurements on amplifiers; they are valuable in that they approach the ideal of giving to the public overall response curves, not curves taken on single stages under conditions widely different from those in the actual amplifier. The overall response curves are by no means the product of several stages taken separately, and it would be interesting and valuable if the addition of one transformer and one resistance-coupled stage were made to each type of amplifier, the input being reduced accordingly to give the same conditions for the last valve.

It is generally assumed that the ear is not sensitive to phase shift of the harmonics associated with a fundamental, provided that each is presented with original amplitude. I do not know whether this assumption is made on the basis of any scientific evidence or not, and it would be very interesting if your readers would give their views. My own view is that the correct phase relationship is essential to true reproduction, and that even if the ear cannot detect the difference caused by phase shift instantaneously, it might work up a cumulative appreciation of the difference in the course of time. If this is true, then the r.c.c. method has another advantage over any reactive form of valve coupling.

Now that Messrs. Burndept have published overall response curves, is it too much to ask that loud-speaker manufacturers should break their discreet silence and publish similar information concerning loud-speakers? The gramophone manufacturers in the States have published such response curves; the transformer manufacturers in this country have been doing it for some time. There is scarcely a horn type loud-speaker on the market which reproduces notes below 250 cycles at anything like full strength, and refinement of amplifiers is quite useless with strangely peaked response curves given by the loud-speaker over the higher frequencies. So far as I am aware, no loud-speaker manufacturer, including those making the latest cone types, have been good enough to take the public into their confidence, and it is quite time that something more than the figure for the D.C. resistance of the windings should be given as the basis for choosing a loud-speaker. The present position is that the majority of listeners use a valve of too high impedance relative to the L.S. impedance, and those who require something better use two power valves in parallel, hope for the best, and pay exorbitantly for H.T. batteries as a result. W. SYMES.

Manchester,

December 29th, 1926.

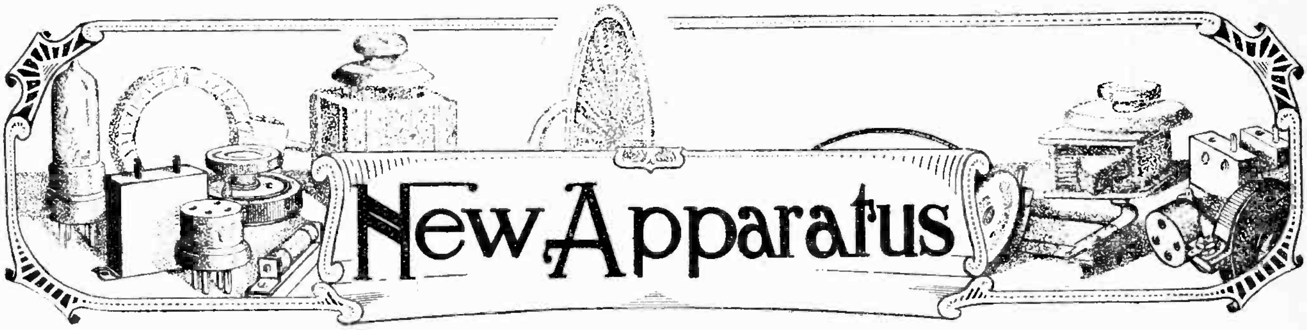
VALVE PRICES.

Sir,—I am constrained to congratulate you upon the leader in your issue of December 8th. You are obviously restrained, and know the shortcomings of the public, which so often gets what it asks for, i.e., something cheap; which turns out to be nasty.

The question of price is not inseparable. Manufacturers cannot live on losses, nor should the price of an article always be "what it will fetch," but abuse of the price-maintenance policy is seriously retarding the expansion of the industry and suppressing the desire of many listeners for the acquisition of apparatus which would improve their quality.

A certain wonderful valve, at one time retailing at 12s. 6d., is now sold at 14s., the increase in price being apparently a gesture of conciliation to the members of the valve ring, who say it *must* be sold at 18s. 6d. because it is a power valve. If that valve could be profitably sold at 12s. 6d., which it undoubtedly was, why may it not continue to be, and why may not all the 18s. 6d. valves be sold at 12s. 6d.? The answer is that short-sighted and false economies prevail. The trade in general prefers to subsist off a limited total output instead of an unlimited output with less extravagant profit margin, and increased employment and happiness all round.

Fleetwood. JOHN BUNTING.



A Review of the Latest Products of the Manufacturers.

MARTINPHONE REACTANCE UNIT.

One of the simplest forms of aerial circuit tuning for use with a single valve regenerative receiving circuit consists of a tapped inductance and an adjustable coupled coil for reaction. The majority of valve receiving sets employ this arrangement either in the form of swinging plug-in coils or as a tapped cylindrical inductance.

There is very little need, however, to employ low resistance tuning coils of special design for aerial circuit tuning, as the saving in coil resistance is small compared with other losses present in a tuned aerial circuit, while the reaction coil largely compensates for the resistances present. Very little difference can, therefore, be observed by using compactly wound coils with tappings as compared with other methods of tuning when direct aerial coupling is employed.

A useful tapped unit with adjustable reaction coupling is manufactured by Hill & Boll, Kingston, and Park Road, Yeovil. When connected to an aerial of normal dimensions the tuning range covers both the normal broadcast band as well as Daventry, the maximum wavelength being about 2,600 metres when using a parallel connected 0.0005 mfd. tuning condenser.

The Martinphone tapped inductance with reaction coupling.

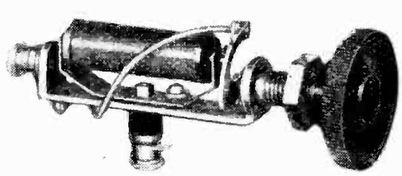
The aerial tuning coil has seven tappings, the switch contacts being carried on a platform beneath the main instrument panel. The windings are arranged in a series of slots in an ebonite former, and the reaction coil, which is wound in a groove on an ebonite disc, swings across the end of the aerial coil.

This tuning unit can be easily incorporated in a set, five holes only being required to give support to the sub-panel and clearance to the two spindles.

oooo

AN INGENIOUS FILAMENT RHEOSTAT.

A stiff spiral wire is made use of as the contact in the C.A.V. variable rheostat. The wire is curved so that when moved by an arm attached to the operating spindle the contact is driven firmly along the turns of resistance wire. The resistance winding is carried on an insulating spool, and is suspended between spring clips to permit of easily interchanging spools wound to various maximum resistance values. The rheostat is attached to the instrument panel by one hole fixing.



The C.A.V. variable filament resistance.

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LITZENDRAHT WIRE.

The increasing demand for this wire has induced many manufacturers to produce specially stranded wires for the construction of coils specified in recent articles in this journal.

Messrs. Ward and Goldstone, Ltd., Frederick Road, Pendleton, Manchester, now manufacture a Litzendraht wire consisting of 27 strands of No. 42 enamel and silk covered wire. The use of enamelled wire without a silk covering between the strands is, in general, not recommended, though when the strands are spaced with a silk covering the enamelling affords additional protection.

A difficulty may be experienced when soldering Litzendraht in which an enamel covering is used, as the enamel cannot be readily removed. It is inadvisable to scrape the wire owing to the danger of breaking off a few of the strands. The end of the wire is, however, easily tinned by binding round with copper wire of about No. 36 gauge, heating in a clean flame and several times immersing it in a solution of resin in methylated spirits. Resin cored solder should be used with perhaps just a trace of "Fluxite."

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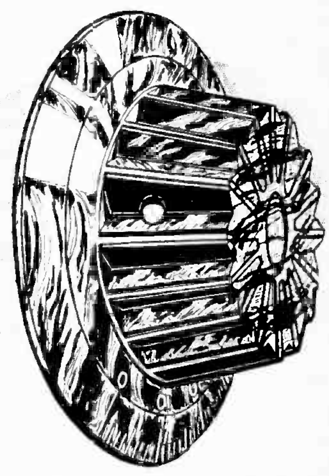
RADION PANELS.

Many readers are probably not aware that the American Hard Rubber Co. (Britain), Ltd., 13a, Fore Street, London, E.C.2, the manufacturers of Radion panels, also supply tuning dials moulded in Radion.

A new design has recently been introduced incorporating a large diameter operating knob, shaped with sharply marked grooves of suitable size for engaging with the tips of the fingers. The bevelled dial carries a scale of one hundred divisions, being marked in white on the black dial and in gold on the Mahoganite dial.

These dials are particularly well moulded, the operating knob having a clean machined appearance. The centre hole carries a large brass bush with ¼in. hole, and a sleeve adaptor is also supplied for use with $\frac{3}{16}$in. spindles.



The new type radion dial obtainable in either black or mahoganite radion.

"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 Volume Control.

I have a three valve receiver with a detector and two transformer coupled low frequency stages, and I find that when the three valves are used my loud-speaker is overloaded, whilst signals are not quite loud enough when two valves are used. Can you suggest a suitable form of volume control so that the strength when using three valves is cut down to a more agreeable value? J. P.

The distortion to which you refer is due to overloading the third valve as well as to overloading the loud-speaker, and results will be much more pleasant if an adjustable volume control is fitted to enable you to reduce the volume to the desired strength. A simple but effective volume control consists of a variable high resistance joined across the secondary of the first L.F. transformer. If this has a maximum value of about 500,000 ohms a very fine control of volume is obtained without impairing the quality in any way.

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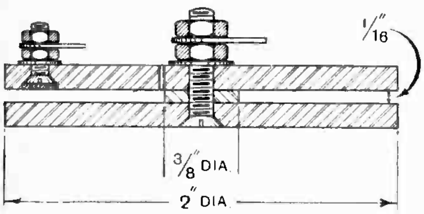
A High-frequency Choke.

In "The Wireless World" of December 15th, 1926, Mr. Minter refers on page 794 to a high-frequency choke coil, which he says was described in "Hints and Tips," February 24th, 1926. As this issue is now out of print I should be obliged if you would give me the details referred to. C. F. S.

The high-frequency choke coil consists of a winding of very fine wire on a disc type of former. Details of the former, which is of ebonite, are given in the diagram below. Two discs 2in. in diameter, ⅛in. thick, spaced with an ebonite washer



Dimensions of former of H.F. choke coil

1/16in. thick and ⅜in. in diameter, are held by a screw and nut passing through a clearance hole drilled through their centres. The beginning of the coil is soldered to a tag held by a second nut. A terminal for the end of the winding is provided by drilling another hole as near as possible to the edge of one of the discs. This hole should be countersunk deeply on the inside and the screwhead be covered with wax or similar insulating material. The centre screw should project sufficiently to allow it to be held in the chuck of a lathe or hand drill, and No. 45 or No. 47 D.S.C. copper wire is wound on until the slot is nearly full.

Too much tension should not be applied when winding as there is a risk that the extremely fine wire will be broken. A high-frequency choke of this type can be used in broadcast receivers. For instance, it may be used in the anode circuit of the detector when the condenser method of controlling reaction is employed.

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The Use of a Balancing Condenser.

I have constructed the popular "Everyman's Four-valve" receiver and feel very satisfied with the results I obtain, many distant stations being received at full loud-speaker strength, but I have a friend who persists in using the balancing condenser as a sort of reaction control when searching for distant stations, with the result that he frequently oscillates and never seems to get the results that I get from my receiver which is properly balanced. Surely it was not intended that the balancing condenser be used for this purpose. L. McK.

This is a very important question. Many people seem to think that a balancing condenser is merely an anode reaction device and that by adjusting it a certain amount of reaction is cancelled, leaving the remainder free to strengthen the incoming signals. They use the balancing condenser to increase or decrease the amount of the reaction effects. This is quite wrong, as is well known, even by those whose knowledge of balanced high-frequency circuits is of an elementary nature. The function of a balancing condenser is to balance the circuit. If the amplification obtained when the circuit is properly balanced is not sufficient, add another stage, or improve the aerial and earth, and find out which type of valve is the best for the particular circuit.

A receiver which is not properly balanced cannot give good results. It will tune broadly, howl and squeal, and behave in that erratic manner common to receivers suffering from chronic instability.

The "Everyman's Four-valve" receiver is very easily balanced. To balance it, the first valve is switched off by turning the volume control rheostat to the "off" position, after the local station has been received. When the valve is turned off the local station will probably still be heard; the balancing condenser should then be turned very slowly until the local station is reduced in strength to a minimum or is not heard at all. At first the signals may be fairly loud; as the balancing condenser is turned they become weaker until they fade away. If the balancing condenser is turned further the signals increase in strength again. The correct setting for the balancing condenser is that which reduces the signals to zero. Sometimes, especially when the receiver is used at a place quite close to a main station, it is not possible to find a point where the signals are not heard at all, but there is always a well defined minimum position.

When the correct position for the balancing condenser has been found it should never be touched again unless the H.F. valve is changed for one of a different type. The balancing condenser was mounted inside the set for this reason.

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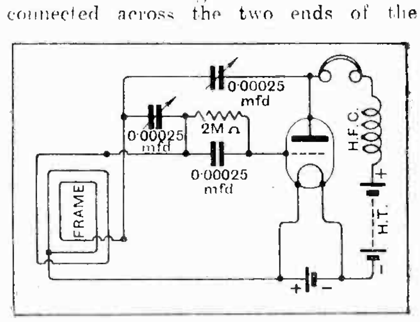
A Correction.

In THE WIRELESS WORLD of December 8th, 1926, on page 788, is given a diagram of a single-valve receiver with frame aerial. This diagram is not correct. The 0.00025 mfd. tuning condenser should be connected across the two ends of the



frame aerial, but the centre point of the frame should be connected to the filament circuit as shown in the diagram above. Reaction is controlled by the 0.00025 mfd. condenser.

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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.

TRANSATLANTIC TELEPHONY.

THE success of the transatlantic telephony service recently inaugurated by the Post Office is hailed all over the world as a remarkable achievement which promises with its development between other countries to have far-reaching effects in assisting not only commercial progress but in bringing together the nations of the world into closer touch. Following on the success of the new service we have the promise made to us that beam stations now in course of completion can be utilised for long-distance telephony with every prospect of complete success.

We are sorry to see that, in the daily Press particularly, so much is being made of the question of secrecy in communication, and, in our opinion, the disadvantages resulting from the fact that these telephony conversations can be tapped by listeners have been vastly exaggerated. The fact that broadcasting is available to all and is intended to be received by anyone having a wireless receiving licence may, perhaps, tend to imply to the public not acquainted with the facts that this receiving licence also entitles them to treat commercial or private wireless traffic which they may hear in the same way, but this is decidedly not the case, and anyone who repeats or communicates to another party the text of any message other than that received from a broadcasting station is liable to prosecution and severe penalties. Very little harm can, however, be done by an ordinary member of the public listening in to scraps of telephony conversations between here and America. It would only be when advantage was taken of any information so obtained that the position would become serious, and any member of the public who deliberately sets out to glean information of advantage to himself is just as easily able to tap the messages in Morse code as those transmitted by telephony, because the mastery of the Morse code, or even the installation of an automatic receiver, is a simple matter.

The view has been expressed recently that the wireless telephony public service will never be of much value until some method of ensuring secrecy is devised. We admit that to be able to conduct these conversations in a way which would ensure secrecy would be a very great advantage, but to suggest that without secrecy the service is of little value is, to our mind, a gross exaggeration of the position. A shopkeeper does not secure his goods to the counter because he fears that the public may pick them up and depart without paying for them; he relies for protection on the fact that stealing is an offence against the laws of this country, and there is, in our opinion, little difference between stealing tangible articles and stealing information obtained by wireless eavesdropping.

We sincerely hope that the scare which has been raised over the matter of the absence of secrecy in the long-distance telephony services will not influence the public to accept an exaggerated view of this disadvantage which is, after all, unimportant in comparison with the greatness of the scientific achievement of Trans-Atlantic wireless telephony.

CONTENTS.

WIDE RANGE BROADCAST SET

Simple Control — **Rejector for Local Station**

An Efficient Four-valve Circuit of Unusual Design.

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

THE set to be described in this article is the direct outcome of the tests on another single tuning circuit set—The Motorists' Four [1]—on a good outside aerial at a place under two miles from 2LO's aerial.

The ideas aimed at in designing the wide-range set were as follows :—

(1) Single knob control as far as possible.

(2) Simple provision for long- or short-wave reception.

(3) Other stations must be receivable at good strength on the loud-speaker, using a good outdoor aerial of the maximum length permissible at points within two miles from 2LO (or other local broadcast station).

(4) Searching for distant stations must cause no heterodyne interference on local station wavelength.

[1] *The Wireless World*, September 15th, 1926.

(5) And last, but not least, in the writer's opinion, the set shall look, as well as be, simple to control.

These five conditions represent rather a tall order, but they have been satisfactorily dealt with in the wide range set—as will be seen.

The Circuit.

Fig. 1 shows the complete circuit of the receiver, which is in principle the same circuit as used in the Motorists' Four. The first valve, V_1, is an anode bend detector, with 0.5 megohm in its plate circuit and $1\frac{1}{2}$ volts negative grid bias supplied by a single dry cell. The third and fourth valves, V_3 and V_4, are perfectly straightforward choke-coupled L.F. and output valves respectively, but the second valve, V_2, has two functions. First of all, V_2 is a transformer-coupled

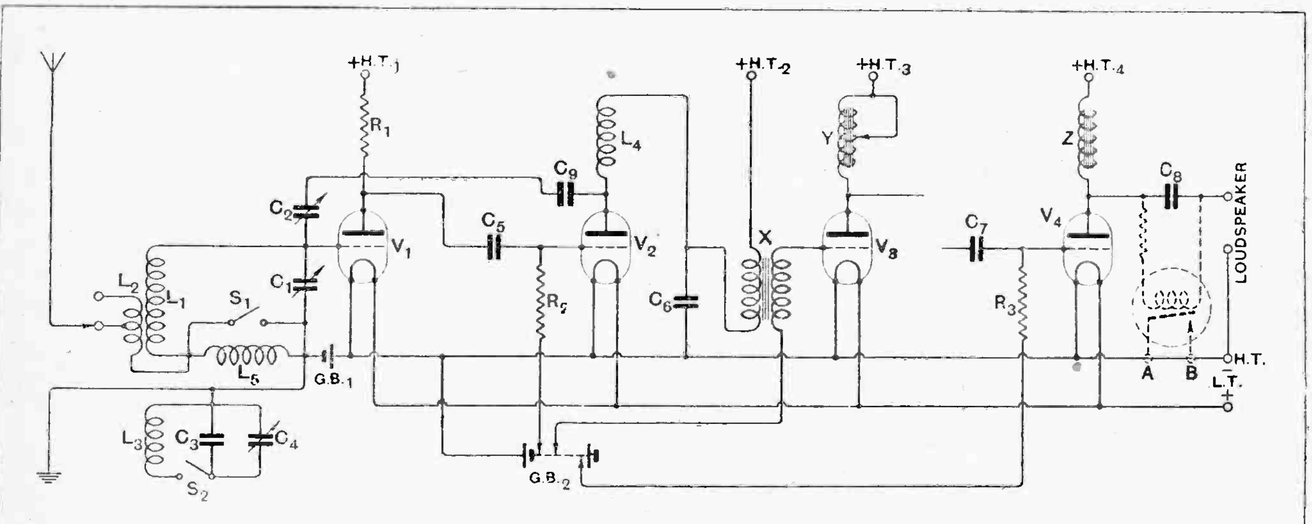


Fig. 1.—Showing the circuit, which is of unusual type. L_1=60 turns; L_2=17 turns; L_3=23 turns for 2LO; L_4=Cosmos H.F. Choke. C_1 and C_4=0.0005 mfd.; C_2=Gambrell Neutrovernier. C_3=air dielectric 0.0006 mfd.; C_5=0.001 mfd.; C_6=0.0005 mfd. C_7=0.01 mfd.; C_8=2 mfd.; C_9=0.0002 mfd. X=Marconi Ideal 4 : 1 transformer; Y=Pye tapped or 110-henry choke. Z=Pye 32-henry choke. R=0.5 megohm. R_2=3 or 5 megohms. R_3=1 megohm. The dotted lines show the connections for the relay control unit.

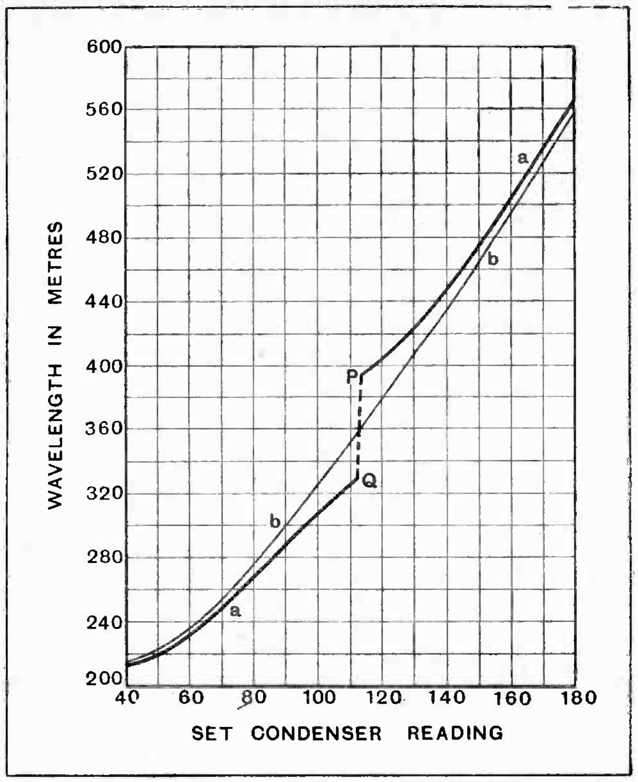


Fig. 2.—Showing the effect of using the rejector circuit on the wavelength calibration of the set. a=calibration with rejector in use, and b=calibration with rejector open-circuited. Notice the waveband or "gap" PQ wiped out when the rejector is used.

L.F. amplifier, but it is also used as a reaction valve for the detector V_1; thus the circuit is exactly equivalent to a five-valve arrangement of detector with three L.F. stages and a separate reaction valve.

It should be noted that, for short waves at any rate, this circuit does *not* embody a high-frequency stage, and yet the results obtained show that the circuit is extremely sensitive when used with the average outdoor aerial.

It is interesting to see how it is that the second valve is made to function as a reaction valve. Starting with the aerial tuning coil, we have alternating voltage of high frequency across the coil, and this voltage is varying in magnitude at audible frequency according to the speech and music being transmitted.

The current through the resistance R_1 in the plate circuit of V_1 consists of rectified half waves of high frequency having a mean value varying at audible frequency—in other words, it may be regarded as consisting of an H.F. part and an L.F. part. Due to the L.F. part, there is an L.F. voltage across R_1, which is passed on through the condenser C_5 to V_2, which further amplifies and passes on the voltage through transformer X to V_3, where it is again amplified and dealt with by V_4 in the usual way. On the short-wave range, at any rate, there is only quite a small H.F. voltage across the resistance R_1, somewhere about 0.3 to 0.7 of the voltage across the grid coil, according to the frequency, and this is due to the shunting effect of the unavoidable stray capacities across R_1, which naturally include the grid filament capacity of V_2.

In effect, then, part of the H.F. voltage across the grid coil is passed on *via* the stray capacities to the grid and filament of V_2. Owing to the H.F. choke in the plate circuit of V_2, there is a considerable H.F. potential on the plate of V_2 when there is any H.F. input to this valve, and it is of the right phase to feed back through a condenser to the grid end of the grid coil, thus giving a reaction effect.

This feed-back capacity needs to be only the same order as the stray capacities referred to, and, therefore, may conveniently consist of a neutralising or balancing condenser. As the wavelength increases, so the shunting effect of the stray capacities on the resistance R_1 falls off, and larger proportions of the H.F. voltage across the grid coil are passed on to V_2, until in the region of Daventry wavelengths there is actually an amplification of the H.F. voltage.

For this reason this type of reaction will tend to become more and more unstable as the wavelength gets longer, as the value of capacity feed-back required for oscillation gets less and less.

Another practical point that comes in is that the H.F. choke used for wavelengths up to 2,000 metres will self-tune probably in the region of 4,000 or 5,000 metres, so that this latter wavelength represents the upper limit of stable control with the choke used. It was found in the actual set here described that reaction was controllable up to about 4,300 metres using good plug-in coils. By using high-resistance longer wave coils it is, of course, possible to increase this range if desired.

The main point that should be noted here is that the same reaction arrangement will do for the long-wave range (up to, say, 2,600 m.) as for the short-wave range

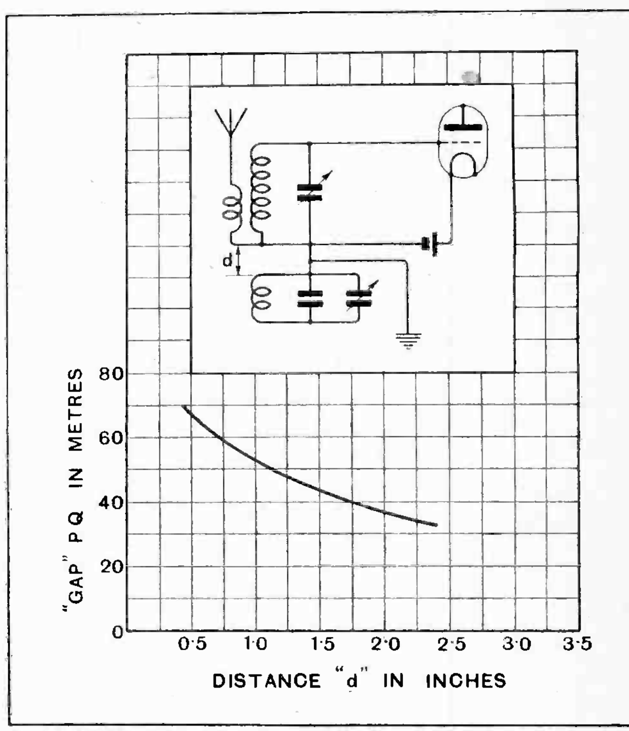


Fig. 3.—Showing the effect of altering the coupling distance "d" between the rejector coil and the grid coil.

Wide Range Broadcast Set.—
(say, from 220-560 m.). In practice it is found that the reaction control is not quite constant, but nearly enough so to comply with the condition (1) already referred to above.

Short- or Long-wave Reception.

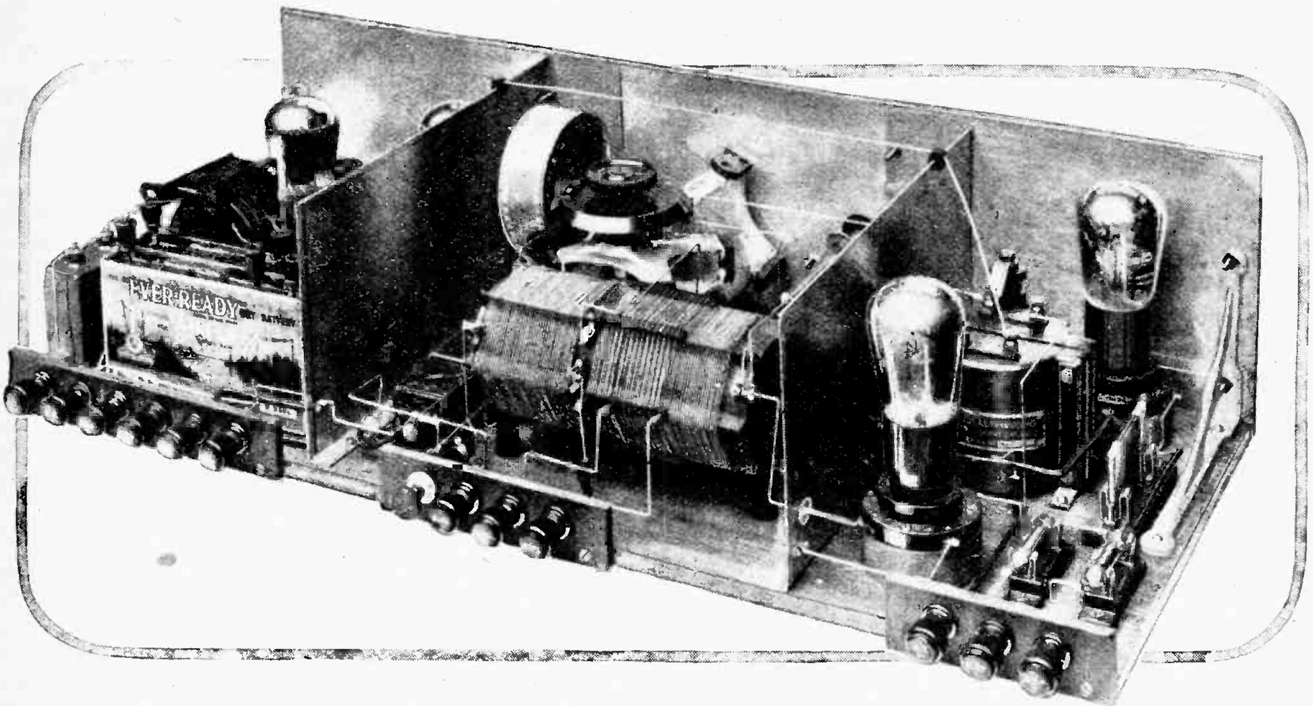
On referring to the circuit (Fig. 1) it will be seen that the grid coil consists of two main parts, L_1, L_2 and L_5. L_1, L_2 are the short-wave coil with the loose-coupled aerial winding, and L_5 is the long-wave coil. For receiving short waves, the coil L_5 is short-circuited by means of the single-pole switch S, so that the earth connection is effectively brought to the junction of L_1 and L_2, thus loose-coupling the aerial for the short waves. For the long waves the aerial is practically directly coupled to the whole of the grid coil, since the long-wave coil L_5 has many times the inductance of the short-wave coil L_1.

This arrangement is suitable for readers living in London or at similar distances from Daventry, as Radio-Paris may be received in London sufficiently clear from Daventry by this means to be worth listening to. Readers who live nearer to Daventry are advised to loose-couple the long-wave coil also, and details of a suitable arrangement for this will be given in a future article when the writer's experiments in this line are completed. So much for the first two conditions.

Cutting Out the Local Station.

Condition (3) involves the use of what is known as a rejector or absorption circuit—that is, an extra circuit comprising a coil and a condenser, which removes the unwanted signal from the grid coil. The chief function required of a rejector circuit is that it shall completely remove the unwanted transmission without also completely removing transmissions of all other stations, as is rather liable to happen if care is not taken in the design of the rejector.

The reader no doubt knows that, for a set to be selective, the tuning circuit, or circuits, must be of low resistance and that this low resistance may be obtained by suitable construction of coils and condensers and also by the use of reaction by means of valves. If a rejector circuit is not selective and is effective in wiping out the signals from the local station, then it will also wipe out signals over quite a large waveband of perhaps two or three hundred metres and so will be worse than useless. Thus the first essential of a rejector circuit is low resistance, so that it may be selective. Perhaps the easiest way to obtain a very low resistance circuit is to use the principle of reaction by means of a valve, but there is usually one very large snag in connection with the use of a valve rejector, namely, that of local interference. The writer does not mean to infer that it is impossible to use a reaction rejector quite successfully, but merely wishes to point out a snag which must be got over before the arrangement can be used.



A general view of the interior of the set. On the right are the first two valves, and on the left the third and fourth, with the tuning arrangements in the centre.

Suppose that we have a rejector circuit with a valve so connected (with reaction coil) as to reduce its effective resistance, and that the complete rejector circuit is coupled to the grid coil of the set. The set is tuned in to the local station in the usual way and then the rejector circuit is tuned so that the local signal is removed, the rejector reaction being pushed nearly up to the limit, so as to make the rejector circuit very selective. So

LIST OF PARTS.

- *1 Ideal Transformer 4 to 1 (Marconiphone).*
- *1 H.F. Choke (Cosmos).*
- *1 Tapped L.F. Choke (Pye) or 110-henry Choke.*
- *1 Output Choke (32 henry) (Pye).*
- *1 Neutrovernia (Gambrell).*
- *1 Fixed Condenser and Clips. 0.001 mfd. (McMichael).*
- *1 Fixed Condenser and Clips. 0.01 mfd. (McMichael).*
- *1 Fixed Condenser and Clips. 0.0002 No. 600a (Dubilier).*
- *1 Fixed Condenser and Clips. 0.0005 No. 600a (Dubilier).*
- *1 Fixed Condenser 2 mfd. (T.C.C.).*
- *2 Fixed Condensers (air dielectric) 0.0003 type R145 (Ormond).*
- *4 Valve Holders WB (Whiteley, Boneham & Co. Ltd., Mansfield).*
- *2 "On" and "Off" switches (Lissen).*
- *1 Five-stud Switch (Bowyer Lowe).*
- *3 Grid Leaks, 0.5, 1 and 5 megohms (Dumetohm) and Holders.*
- *1 Single Coil Holder.*
- *2 Grid Batteries (Ever Ready) 9 volt (Portable Elec. Light Co.).*
- *1 "T" type Cell (Siemens).*
- *1 pr. "Camco" Brackets (Carrington Man. Co., Ltd.).*
- *1 "Camco" cabinet 24×6×10in. deep.*
- *1 Baseboard 24×9¾×⅜in.*
- *1 Aluminium Panel 21×6×⅛in. and screens (Smith & Sons, 50, St. John's Square, E.C.1).*
- *1 "Utility" Variable Condenser 0.0005 mfd. (Wilkins & Wright).*
- *1 "Utility" Variable Condenser with Micro-Dial. (Wilkins & Wright).*
- *12 Ebonite Shrouded Terminals (Belling & Lee).*
- *2 ozs. No. 24 D.S.C. Wire.*
- *1 "Becol" Former 3×6in. long (British Ebonite Co., Ltd., Hanwell, W.7).*
- *B.G.B. Relay unit (Baily, Grundy & Barrett, Ltd., 2, St. Mary's Passage, Cambridge).*

Cost approx. £11 10s.

far, so good! The local station signal is completely wiped out, and we know that the rejector is selective, *but* as soon as the set condenser is altered to bring in other stations it is practically certain to allow the rejector valve to oscillate and thus cause serious local interference. The reason why the rejector valve will probably oscillate is because when the grid circuit in the set is tuned to the same wavelength as the rejector it acts as an extra load on the latter so that more reaction will be required for the valve to oscillate under this condition than when the grid coil is tuned to another wavelength. If the rejector reaction is adjusted so that the rejector valve does *not* oscillate, then the slight extra selectivity obtained by the use of the valve is, in general, not worth the extra complication involved, especially in view of the success of the simple type of rejector used in the wide-range set.

Principle of the Rejector Circuit.

In a rejector circuit we are not concerned with getting large *voltages* to pass on to valves, but we want a low-resistance circuit in which large *currents* may be induced.

One way of looking at the function of the rejector is as follows: Due to the currents induced in the grid coil of the set from the aerial circuit, there is a definite magnetic field associated with the coil. The rejector circuit, being coupled to the grid coil, is also in part of this field and, therefore, has currents induced in it due to the field; also due to these induced currents there is an opposing field set up by the rejector circuit proportional to the value of the current. These currents in the rejector will only be appreciable when the frequency of the currents in the grid coil induced from the aerial is the same as the frequency to which the rejector is tuned, so that the opposing field will only be appreciable in this case.

The value of the induced rejector currents naturally depends on the resistance of the rejector circuit, and if the latter is zero the opposing field set up by these induced rejector currents will *just exactly equal* the field producing those currents, so that the resultant field will be zero—in other words, there will be no field corresponding to rejector frequency and, therefore, no signal of this frequency in the grid circuit.

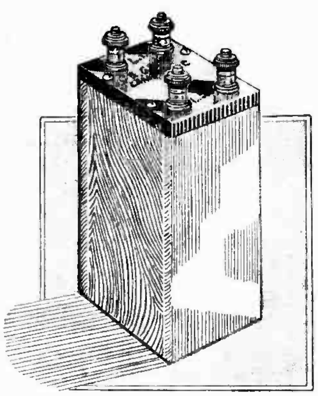


Fig. 4.—A sketch of the relay control unit.

Now the modern air condenser of even moderate price has got an extremely low resistance, so that it is the coil part of the circuit which is likely to have the greatest effect on the resistance. For this reason a small coil with comparatively large value of condenser in parallel is used as a means of cutting down the circuit resistance. The coil should be of the best shape for minimum H.F. resistance and the turns spaced for the same reason. A practical point which arises here is the limit to the size of the condenser; obviously, if a very large capacity is required, it will have to consist of fixed and variable air condensers in parallel, and space considerations will probably fix one limit, while the maximum capacity of the usual variable condenser limits the tuning range of the rejector and hence necessitates careful experimenting with the number of turns to the coil to ensure covering the local station wavelength.

The value of capacity finally chosen as being of the most general application to short-wave rejectors was 0.0006 mfd. fixed with 0.0005 mfd. variable in parallel. For 2LO the coil consists of 23 turns on a 3in. dia. "Becol" former, and the total capacity is about 0.001 mfd., while for Birmingham about 38 to 40 turns will be required with the same capacity. Full constructional details are given later in the article.

The Rejector in Practice.

The writer does not propose to go into the mathematical theory of rejector circuits, interesting though it is, but intends to deal with the actual effect of the rejector on the calibration of the set.

In Fig. 2 the thin curve (*b*) gives the wavelength calibration of the set with the rejector open-circuited (by means of S_2 in Fig. 1), and the full curve (*a*) shows the calibration with the rejector in operation and set for 2LO. It will be noticed that the curve (*a*) has a sudden sharp break in it at PQ, occurring at one particular con-

Wide Range Broadcast Set.—
denser reading—the one corresponding to 2LO's wavelength, in fact—and that the effect of the rejector is to wipe out a waveband corresponding to the length of the line PQ. In Fig. 3 the value of this "gap" PQ in metres is plotted against coupling distance "*d*" between rejector and grid circuits. Fig. 2 is a calibration of the actual set, and Fig. 3 was obtained by rewinding the rejector coil at different distances from the grid coil. The "gap" was found by making the set just oscillate round about 100°-120° on the condenser, and calibrating for every degree between these values by means of a heterodyne wavemeter.

In actual practice there is no noticeable gap—*i.e.*, there need be no cessation of oscillation as the set condenser is turned through the critical value; the waveband PQ is simply missed out, that is all. It was found that for satisfactory elimination of 2LO at two miles it was necessary to make the distance "*d*" (Fig. 3) not more than one inch and so that about 52 metres would be lost. However, this is not so bad as it sounds; there are plenty of other stations left which come in at good strength.

Where the set is to be used farther out from the local station, then the rejector need not be so tightly coupled, and thus the gap lost will be smaller. It was also found that at 30 miles south-west of 2LO no rejector was required, since London and Cardiff both came in well on the speaker quite clear of each other, as, in fact, did the rest of the British stations except Plymouth, which seemed to be using A.C. that night and was rather weak.

Condition (4), previously mentioned, is very conveniently looked after by the presence of the "gaps" when the rejector is in use, so that in this case it is impossible to oscillate and cause interference on the local wavelength, and as for condition (5) there are only three knobs on the panel—the main tuning dial, the reaction control, and the long-short wave push-pull switch.

Distant Control for the Set.

An extremely useful accessory for the set, though not a strictly necessary one, is the little relay control unit sketched in Fig. 4, made by Messrs. Baily, Grundy, and Barrett, Ltd.

With the aid of this unit the set may be switched off from the loud-speaker wherever the latter happens to be, and only the *existing* wires to the loud-speaker are utilised, so that the unit is very simple to install. The circuit arrangement is shown in dotted lines on Fig. 1, and when the unit is installed the connection between "A" and "B" should be broken and the two ends of wire connected to the two terminals marked L.T. on the unit. The current consumption of the relay is 2 milliamps per 120 volts H.T. used, and this current only flows when the set is in use, so that the power taken for the control is absurdly small. Although the relay winding and loud-speaker are in parallel with the last valve, the impedance of the former is so high in comparison with the A.C. resistance of the valve that there is no effect at all on the quality of reproduction by the use of the control unit.

Constructional Details.

A general view of the set in its cabinet is given in the title-block at the head of this article and also in the photograph on the cover of this issue, while a back view of the receiver out of its case is shown on page 64.

It will be seen that the set is built in three compartments separated by two metal screens. The centre compartment contains all the tuning arrangements, including the rejector circuit and the long-wave coil; on the right-hand side are the detector valve and the first L.F., and on the other side the remaining two L.F. valves. As it has already been said, the H.F. currents pass through the first valve on to the grid of the second and are then passed back to the grid coil *via* the reaction condenser, so that only the first two valves deal with any H.F. at all. For this reason the H.F. currents are kept to one valve compartment, and the last two valves, which deal with L.F. only, may be kept in a separate compartment.

The main reason why the tuning unit was put in the centre was to get the main tuning condenser into the centre of the panel, so as to give a symmetrical and pleasing layout of the controls on the front of the set.

It can be seen, even in the photograph of the exposed set, that the wires carrying H.F. currents to the first two valves are quite short and direct, owing to the arrangement of components adopted. In the front of the photograph can be seen the grid-leak type resistances R_1 and R_2 on the right of the detector valve, and behind them the clip-in condenser C_5 and the Marconi transformer. C_5 is made of the clip-in type for a definite reason, connected with quality or tone variation, and this reason will be gone into more fully when the method of operating the set is discussed.

(To be continued.)

The R.S.G.B. Diary and Log Book.

The Radio Society of Great Britain has issued an invaluable reference book which, we understand, is to be distributed to all members of the Transmitter and Relay Section, and should also be in the hands of every other amateur transmitter and those listeners who make a practice of receiving and reporting on the signals of distant stations.

The aims, objects and uses of the society are plainly set forth. Admiral Sir Henry B. Jackson indicates the help that amateur wireless experimenters may afford to the Radio Research Board, and various articles on subjects of interest are contributed by well-known writers, including speculations as to the future distribution of a broadcast service by Capt. P. P. Eckersley, "Radio Nomenclature," by J. F. Stanley, "Wireless in the School," by R. J. Hibberd, and the "Supersonic Era," by W. K. Alford.

These articles are followed by a comprehensive table of all standard valves arranged in four sections, viz.: (A) Detector and General Purposes; (B) High-frequency; (C) Low-frequency and Power; (D) Transmitting; and by an international list of amateur transmitting stations, giving the call-signs, names and addresses of all known amateur transmitters, with the exception of those in the United States, who would require a volume to themselves and of whom an official list is already issued by the Department of Commerce at Washington.

The editorial matter of the book closes with a list of the broadcasting stations of the world in order of wavelength, and the remaining 108 pages comprise a carefully considerd log book allowing two foolscap sheets for each week.

The very modest price of 3s. 6d. (4s. post free) should ensure its ready sale.

RESISTANCE-COUPLED RELAY CIRCUIT.

High-resistance Units of Special Construction.

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

IN this article it is proposed to describe a certain form of valve circuit suitable for actuating a relatively slow operating relay for remote control work. The mode of operation of the circuit can be studied by starting with a well-known valve arrangement. We are all familiar with a resistance-coupled valve circuit using a condenser between the anode of one valve and the grid of the next. If the coupling condenser is omitted it is essential to insert a battery between the anode and grid to give the necessary negative bias to the latter. Referring to Fig. 1 (*a*), the feed current to valve V_1 will cause a drop of, say, 40 volts in the resistance AB. This means that the grid of V_2 is $100 - 40 = +60$ volts above the negative end of its filament. Thus if the proper negative bias for V_2 were -5 volts, it would be necessary to insert a battery of -65 volts between A and C, as shown in Fig. 1 (*b*). Now suppose we interchange the positions of the high-tension battery and the resistance AB. The diagram will then appear as shown in Fig. 2 (*a*). Obviously A is at zero potential with regard to the negative pole of the battery. The feed current through AB causes at B a drop of 40 volts above A, and the grid of A will be at -40 volts relative to B. Hence to bring V_2 to its proper working point a battery of $+35$ volts must be inserted between A and C. Suppose valve V_1 is set to its lower rectifying point, as in Fig. 2 (*b*). The current through AB will then be reduced to a very small value, so that the points B and C will be almost at the same potential. Thus valve V_2 will pass an anode current corresponding to zero potential of the grid with reference to its filament. When a signal is applied to the grid of V_1 the mean current through AB increases,

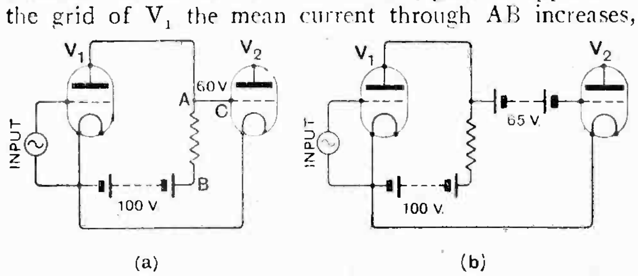


Fig. 1.—Circuits showing necessity for large grid battery when using pure resistance coupling.

and the potential of C falls with reference to B. Thus the anode current of V_2 falls. If a relay is situated in the anode circuit of V_2 it will be actuated as a result of this reduction in current. This is the resistance-coupled circuit it is proposed to describe for operating a relay. It looks very simple, but to attain absolute reliability there are a number of points which require to be carefully investigated.

Importance of High Insulation.

Let us consider another aspect of Fig. 2 (*b*) relating to surface leakage. Suppose we remove R and leave a leaky surface to do its duty. Then the resistance of the surface leak may be hundreds or thousands of megohms. If it is the latter its value will probably exceed that of the valve, and the major portion of the volt drop round the circuit will occur across the filament-grid path. This means that the grid of V_2 will be at a certain *negative* potential with regard to its filament. Thus the anode current of V_2 will fall. In practice, with a clean, dry

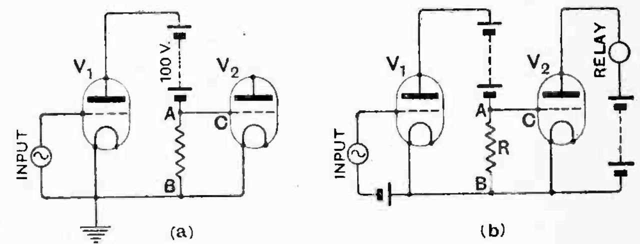


Fig. 2.—Pure resistance coupling with the H.T. battery so placed that a negative potential is applied to the grid of V_2. In circuit (b) V_1 is set to its lower rectifying point, thereby adjusting the grid of V_2 to zero potential.

panel and valve holder, this actually occurs, and the anode current of V_2 remains permanently at a very low value. By breathing on the panel the leak is reduced and the anode current rises. We know that Fig. 2 (*b*) consists of a resistance-coupled detector, V_1, and an additional relay valve, V_2, also that the anode battery is placed next to the anode of V_1 in order to avoid putting a positive bias on the grid of V_2. For appreciable sensitivity in a resistance-coupled amplifier it is essential that the coupling resistance should be large. In the present case V_1 is set to its rectifying point, and to get a fair degree of sensitivity R must be of the order of 10 megohms or more. By a special process, which will now be described, I have been able to construct leaks of reasonable constancy exceeding 100 megohms.

Construction of Super Leaks.

In order to stabilise and sensitise the circuit of Fig. 2 (*b*) for prolonged remote control work it was essential to find a reliable leak of about 50 megohms. This was done in the following way: One of the long faces of a piece of ebonite was rubbed over with graphite and then burnished by means of a polished steel surface. Two large square nickelled brass washers were placed at each end, so that the contact area was large. These were securely held in place by nuts and screws with leads soldered on. The value of the leak as measured by a 500-volt megger was about 1 to 2 megohms. The whole arrangement was then dipped in fluid bakelite and heat-treated until the surface was glass-hard. It was allowed to cool, and the resistance when measured after the bakelising process was

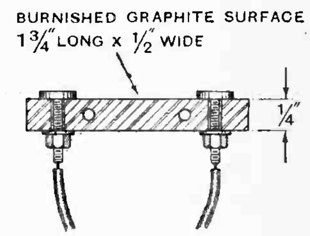


Fig. 3.—Construction of the experimental high resistance. The graphite is treated with fluid varnish, heat-treated and dipped in paraffin wax.

Resistance-coupled Relay Circuit.—
40 megohms or more according to conditions. The final treatment was to dip the whole product in good paraffin wax, thereby avoiding surface leakage on the resistance.

The actual resistance depends upon the applied voltage and decreases with increase in voltage. For example, a leak showing 40 megohms on a 500-volt D.C. megger would register about 80 megohms when measured with 6 volts. The latter voltage is more in keeping with the operating conditions. If the leak, after manufacture, is too low, it is easy to scrape off a portion of the bakelised material, thereby narrowing the width until the required value is secured. This is done prior to dipping in paraffin wax. A representation of one form of the high-resistance leak is given in Fig. 3.

Effect of Leakage.

Having manufactured a leak of substantially constant performance, the next step is to consider what happens when the leakage on the valve panel and valve holders exceeds a certain value, and to discover means to prevent its occurrence.

In Fig. 4 we have the picture of a circuit equivalent to that of Fig. 2. The valve V_1 is represented by a variable resistance r_1, the leakage across the valve holder, panel, or both, by r_2, which is equivalent to a partial short-circuit across the anode circuit of V_1. The leak on the grid circuit of this valve is unimportant. Where V_2 is concerned the only leakage of importance is across the valve holder or the panel from filament negative to grid. This is represented by r_3. It should be carefully noted that, although the leakage resistance may be of the order of megohms, its value may be low compared with

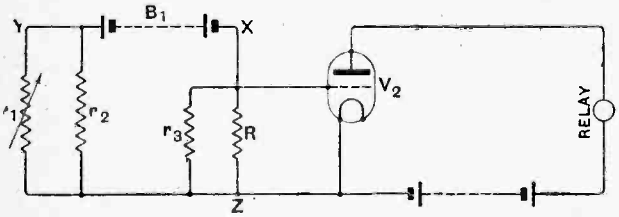


Fig. 4.—Equivalent electrical circuit to Fig. 2 (b): r_1=resistance of V_1 which is varied by signals; r_2=leakage across valve holder or panel; R=special resistance of the order of 80 megohms; r_3=leakage across panel or second valve holder.

the internal resistance (D.C.) of the valve V_1, which is set to its lower rectifying point, and the 80-megohm leak R. Having got a circuit equivalent to that used in practice, we can readily see what leakage faults may develop which are likely to affect the operation. It is evident that the points XY must be well insulated from the point Z. This means that all the leads associated with these points must be carefully dealt with. Also battery B_1 must be highly insulated. Since B_1 is only of the order of 9 volts and supplies little or no current, it is conveniently composed of six Siemens "T" type cells in a wooden box thoroughly soaked with paraffin wax. Both the leads from the positive and negative terminals to the points Y and X respectively are run in tubes of insulating material filled with paraffin wax. With these precautions, the smearing of the panel with paraffin wax or a varnish known as *Formapex* and the liberal use of quicklime trays, the circuit will function without trace of leakage. Now let us look at the other side of the picture, when these precautions are omitted and the atmospheric conditions play havoc with the insulation.

Turning, again, to Fig. 4, we see that there are two main leaks, viz., r_2 and r_3. Treating each separately, suppose the valve r_1 = 1,800 megohms, r_2 = infinite, r_3 = infinite, R = 80 megohms, B_1 = 9 volts. Then, in the absence of a signal, the battery B_1 sends a current of value

$$\frac{9}{r_1+R}=\frac{9}{1880\times 10^6} \doteqdot 5\times 10^{-9} \text{ ampere}$$

($\frac{1}{200}$ microampere) through the valve resistance r_1 and R in series.

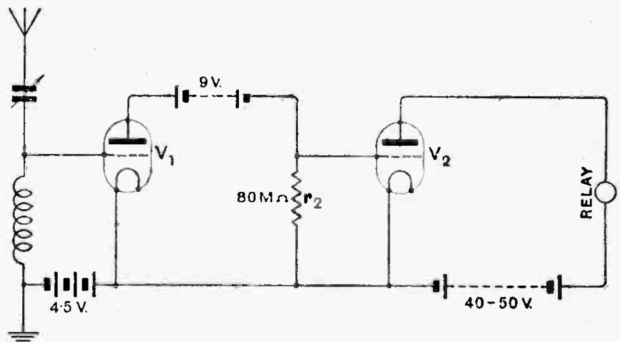


Fig. 5.—Resistance coupled relay connected direct to the aerial circuit for strong signals. Values are for 0.06 valves.

The volt drop across R is $5\times10^{-9}\times80\times10^6=0.4$ volt. Thus the potential on the grid of V_2 is -0.4 volt, and with the aid of the 50-volt battery gives rise to a steady anode feed of about 1 milliampere when V_2 is one of the 0.06 ampere class of valve. When a signal arrives the resistance of the valve r_1 may be reduced to 200 megohms. Thus the volt drop on R will now be $-\frac{80}{200}\times9=-3.6$ volts, and this will cause the anode current of V_2 to be reduced to zero.

Now assume the leak r_3 is sufficient to reduce the combined resistance r_3 and R to a value of 20 megohms. The volt drop across R in the absence of signals is $\frac{20}{1820}\times9=0.1$, and with signals is $\frac{20}{220}\times9=0.8$ volt, which would fail to cause sufficient variation in anode current to operate the relay *under normal setting*. In general, a low leak of this order should not arise unless the panel design is very poor.

Taking now the leak r_2 across r_1, imagine r_2 to be 200 megohms. Then from the previous calculation there is a permanent negative bias of -3.6 volts on V_2, which means zero anode current. Thus the device is rendered inoperative. Clearly the need for high surface insulation cannot be underestimated.

Time Lag.

So far the circuit has been shown as a detector V_1 resistance-coupled to a relay valve V_2. But there is another property which we have yet to explore. Referring to Fig. 2 (*b*), imagine a condenser to be placed across the resistance R. When signalling occurs, this condenser becomes charged up to a definite voltage. At the cessation of the signal the condenser does not discharge immediately. Its discharge current passes through R, and since R is 80 megohms, there is an appreciable lag in

Resistance-coupled Relay Circuit.—

the anode current of V_2 returning to normal value. The lag increases with the size of the condenser. Now in our case there is no actual condenser, but merely the capacity of the leads, etc. This, however, in combination with R, is sufficient to produce a time lag amounting to a fraction of a second. Hence the device is only applicable (unless R is reduced, thereby decreasing the sensitivity) to comparatively slow-speed work. By connecting a good mica condenser of 0.2 mfd. across R, the anode current of V_2 will, after the application of a strong signal, remain at zero for several minutes.

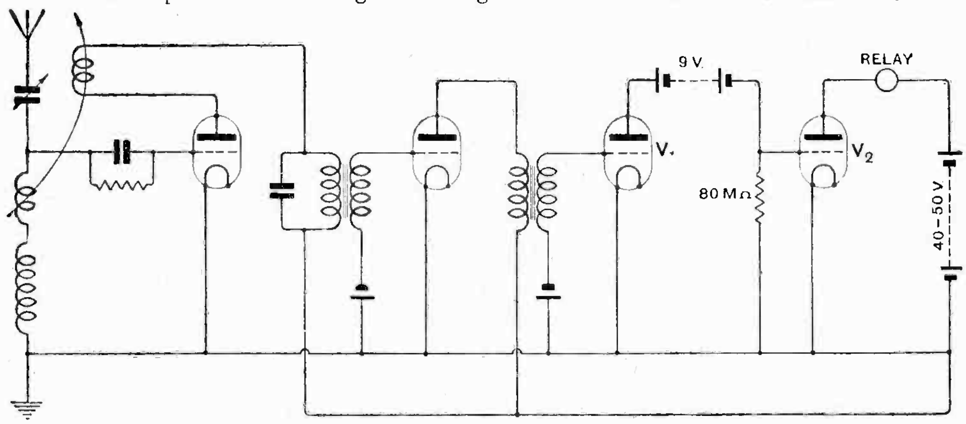


Fig. 6.—Relay connections for weak signals with reaction and L.F. amplification.

Two simple applications of the circuit (without condenser across R) are given in Figs. 5 and 6. In Fig. 5 valve V_1 the detector is connected direct to a high frequency circuit. When a strong unmodulated carrier wave is applied between the grid and filament the anode current in V_2 ceases. The carrier may be modulated by a series of dots and dashes and the relay in V_2 will respond. The speed of sending must not be too high or the condenser effect mentioned previously will make itself felt.

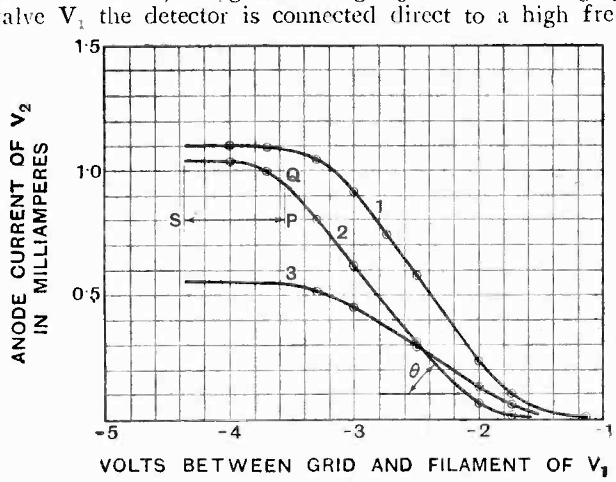


Fig. 7.—Characteristic curves for the circuit of Fig. 5.
Curve (1) : r_2 = 80 MΩ with no resistance in anode of V_2.
,, (2) : r_2 = 300 MΩ ,, ,, ,, ,, ,, ,,
,, (3) : r_2 = 80 MΩ with 12,000 ohms in anode of V_2.
SP represents the gain by using potentiometer adjustment of first grid potential as shown in Fig 8.

The second arrangement of Fig. 6 is for use with weak signals. Here we have a conventional detector and note magnifier prior to the valve V_1. The signals applied to V_1 are now rectified at note frequency, for the carrier wave must be modulated by a musical note. The relay corresponds in the usual way to dots and dashes of the modulated carrier. In practice the easiest way to get the modulated carrier is to feed the oscillating transmitter valves with A.C. instead of D.C. (anode supply). The dots and dashes are obtained by suppressing the oscillation, by some means, usually by interrupting the H.T., A.C. supply or reducing it to a low value.

It will be seen that the V_1 V_2 portion of the circuit functions on either high- or low-frequency. The sensitivity depends in a large measure upon the grid potential of V_1. If the adjustment is effected by a potentiometer the sensitivity can be made much greater for weak signals.[1] In fact, with a biassing battery on the grid of V_1 the correct voltage may be -3.5, whereas the battery may give 4.2. Thus a voltage of $4.2-3.5=0.7$, would have to be applied to V_1 before the anode current of V_2 was appreciably affected.

Effect of Relay Resistance.

Hitherto we have said nothing regarding the resistance of the relay in the anode circuit of V_2. Suppose the normal anode current in the absence of signals is 1 milliampere (H.T. about 50 volts) without the relay. If the resistance of the relay is 250 to 500 ohms, its inclusion in the circuit would not mean any perceptible decrease in current. With a relay of 10,000 ohms the standing current would be perceptibly reduced, probably to about 0.65 mA. Thus the variation in current during signalling would now be 0.65 mA, as against 1 mA, with a relay of lower resistance. Some curves illustrating these remarks are given in Fig. 7, and the influence of a resistance of 12,000 ohms in reducing the standing current will be evident. The curves for the two values of grid leak are interesting. The sensitivity with potentiometer adjustment is governed by the steepness of the straight portion of the curve, and this is almost the same for both leaks. The disadvantage of the higher leak is the increased time lag arising from the capacity of the leads, etc. If, however, a 5-megohm leak had been used the sensitivity would have been reduced, the straight portion being less steep, *i.e.*, the

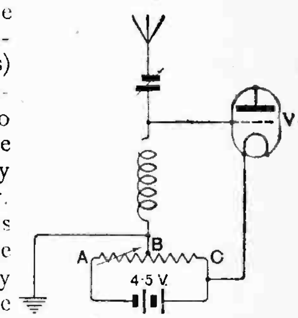


Fig. 8.—High resistance potentiometer method of adjusting grid bias of V_1. AB is a variable leak, while BC may be fixed.

[1] Adjustment can also be made on the anode battery of valve V_1 by varying the number of cells. This, however, may be too coarse to get sensitivity.

Resistance-coupled Relay Circuit.

angle θ would have been less. For optimum sensitivity the adjustment should be at the upper bend as indicated by the letter Q. If cells are used on the grid of V_1, giving an adjustment at Q, then a voltage equivalent to PS must be applied to the grid of V_1 before there is any change in current in V_2. The potentiometer arrangement may consist of two high resistance leaks (about 1 megohm), one of which is variable, as shown in Fig. 8. This avoids wastage of the biassing battery, since the current supplied to the leaks is very small.

So far as the construction of very high resistance leaks is concerned, it is probable that a form of varnish other than bakelite would be satisfactory. The heat treatment should not be done over an open flame, but in an oven.

TRANSMITTERS' NOTES AND QUERIES.

International List of Call-signs.

We are often asked by listeners where they can obtain a full and up-to-date list of amateur transmitters, with their call-signs and addresses.

The Radio Society of Great Britain has incorporated an International List in their Diary and Log Book, which may be obtained upon application to the Secretary at 53, Victoria Street, Westminster, S.W.1, for the modest sum of 3s. 6d. This list does not include amateur stations in the United States, as these are so numerous that they would require a volume to themselves. The official list of American amateur radio stations may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., for 25 cents, *plus* postage.

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General Notes.

Mr. A. M. Houston Fergus (G 2ZC) is investigating some partial blind-spotting, and will be grateful if residents in Ireland, North and South, and in Sweden, will communicate with him or report on his signals when heard.

He is co-operating with G 6HZ, Mr. L. Kane, 3, Barrard Street, Jersey, and though these stations are within five miles of each other some really interesting observations have been obtained. Districts that are dumb for one appear excellent for the other, and *vice versa*. G 2ZC is working on 45 metres, D.C., and on low power. His address is La Cotte, La Moye, Jersey, Channel Islands.

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The wireless operator at Walvis Bay Station, VNV, in South West Africa, writes that he picked up signals from s.s. *Carinthia*, GLKY, on December 24th, which were transmitted on 43 metres with an input of 5 watts. The receiver used was a crude experimental set with one detector and one L.F. valve, no earth, and a single-wire indoor aerial 10 ft. in length. The signals were R6 and steady. VNV also reports hearing PCRR, AND, ANF, FUT, FUA, and BZ 2AS, all between R6 and R9. He wishes further to test this experimental receiver, and will therefore welcome any transmitters who will call up VNV. He will forward QSL cards giving necessary details, but cannot reply by wireless, as there is no short-wave set available for his use.

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Mr. G. Hume, 124, Eversleigh Road, Battersea, writes that on November 20th he received Revista Radio Sport, of Madrid, on 43 metres, at 0025 a.m., the signal strength being about R7. A QSL card affords the information that the Madrid station was using only 1 watt input from 100 volt mains. Mr. Hume does not state what type of receiver he was using, but asks if any other of our readers who heard this station will exchange experiences with him.

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Mr. A. G. Burgess, 26, Gunnersbury Park Gardens, Acton, W.3, asks if anyone can give him the QRA of a German station heard on Saturday, January 8th, transmissing records, etc., on approximately 43 metres between 1330 and 1400 G.M.T., and a French station transmitting similar tests on 42.7 metres at about 1335 G.M.T. on the same date.

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Mr. F. N. Baskerville, 9, Arthog Drive, Hale, Cheshire, states that on Sunday, January 2nd, he heard good strong signals from three Australian and two New Zealand stations between 1420 and 1520 G.M.T., Z 3AR being audible at R5-6 at intervals all day until 1830 G.M.T. He observed several interesting phenomena on that date, the nature of which he does not state, and will be glad to hear from any other of our readers who may have noted any peculiarities of conditions, with a view to comparing notes.

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Mr. R. J. Denny (G 6NK), Waverley Road, Weybridge, succeeded in working with U 3XK, the experimental short-wave station of the Jenkin Laboratories at Washington, D.C., on Sunday, January 2nd, at 2245 G.M.T. His input was 12 watts, and 3XK reported his signal strength as R3.

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New Call-signs Allotted and Stations Identified.

G 2ABK R. C. Horsnell, The Anchorage, Crouch Rd., Burnham-on-Crouch, Essex.
G 2BXM F. C. Mason, 80, Forburg Rd., N.16.
GC 2WL A. T. Wilson, 206, Newlands Road, Cathcart, Glasgow.
GI 6MK J. A. McKee, Parkville, Antrim Road, Belfast; transmits on 45 and 90 metres. (This call-sign was formerly held by R. Wilby, Leeds.)
GI 2AXO C. B. Cleeland, 31, Dufferin Avenue, Bangor, Northern Ireland.
U ABI U.S. Army Station, Fort Sheridan, Illinois.

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QRA's Wanted.

G 2MN, G 5AP, F 8ESP, F 8ZET, SPR, U 1QU, Y 2HP.

Calls Heard.

Extracts from Readers' Logs.

Bangor, N. Ireland.

Great Britain :—G 2AS, 2BZ, 2II, 2NM, 2NS, 2OL, 2SR, 2SW, 2QV, 2OQ, 2TS, 2WL, 2VJ, 2XY, 5BU, 5CS, 5DC, 5GQ, 5IS, 5JW, 5XO, 5LI, 5NW, 5KU, 5NN, 5PM, 5TZ, 5XQ, 5RO, 5UW, 5WC, 5WQ, 5OW, 5US, 6AF, 6GB, 6HS, 6HY, 6JV, 6UU, 6IA, 6KO, 6WG, 6NX, 6OH, 6RW, 6RY, 6RD, 6UZ, 6TD, 6TY. Northern Ireland :—GI 2BX, 5NJ, 5GH, 5WD, 5MV, 6YM, 6WG, 6SQ, 6MU. Irish Free State :—GW 18B, 11C, 14C, 11B, 11Z. France :—F 8AR, 8AP, 8CI, 8CA, 8CL, 8GI, 8MO, 8MU, 8SP, 8TKR, 8UD, 8UR, 8UT, 8IP, 8UU, 8RO, 8RD, 8RV, 8KM, 8ZB, 8FK. Belgium :—B 4WV, V33, 4AR, 4UK, 4KM, 4RU, A2, 4AA, BP8. Germany :—K 4SR, 4LS, 4YZ, 4NCA, 4EDT, 2DO. United States :—U 1AR, 1AXX, 1AHE, 2AMJ, 2XG, 2XAF, 2XAD, WIZ. Miscellaneous :—SS W8, O 8MC, 4ED, BA 2A, N 9PM, 9GEA, D 7UU, D 7ZM, P 9AA, A 7CS, PCMM.

(0-v-1.) On 20 to 60 metres.

C. B. Cleeland (GI 2AXO).

Hale, Cheshire.

(December, 1926.)

Philippines :—PI 1BD, 1HR, 1LJ, 1AU, 3AA. South Africa :—O A3B, A3E, A5X, A4Z, A6N. New Zealand :—Z 2AR, 2AK, 2AX, 2BX, 3AI, 3AR, 4AA. Australia :—A 2VI, 3XO, 5HG. Chile :—CH 2AB, 2AS, 2BL, 2LD, 3LJ. Honolulu :—HU 6AFF, 6BUC. Canada :—C 1AK, 1DD, 2BE, 2BG, 3FC, 3XI, 4DQ. 20-metre European :—SMTN, LA IE, D 7ZG, F 8BF, F 8GI, I ACD, G 5HS, G 5HX.

F. N. Baskerville.

London, N.W.2.

(November 25th to December 31st, 1926.)

U.S.A. :—U 1AZR, 1BKE, 1CKP, 1CNP, 1CTM, 1CUE, 1QC, 1RD, 2ATH, 2BAD, 2BIR, 2CUQ, 2CUZ, 2FO, 2TP, 3BWT, 3CAB, 3DS, 3SJ, 4AK, 4CV, 8AKV, 8BRC, 9BBJ, 9BPD. Brazil :—BZ 1AD, 1AI, 1AK, 1AL, 1AO, 1AP, 1AW, 1AX, 1BK, 1IA, 1IB, 2AG, 2AS, 5AA, 5AB, SNNI. Uruguay :—Y 1CD, 2AK. Algeria :—FA 8VX. Miscellaneous :—Ö AK, Ö PY, ANF, SNF.

(0-v-1.) 20 to 50 metres.

M. W. Pilpel (G 2BZC).

PRACTICAL HINTS AND TIPS

Aids to Better Reception. Theoretical Diagrams Simplified.

A FRAME AERIAL RECEIVER.

There is still a general, but erroneous, impression that a receiver intended for operation with a frame aerial must be either of the super-heterodyne type, or must include several stages of high-frequency amplification. In point of fact, a single valve regenerative detector is capable, under good conditions, of giving clear signals up to a distance of some ten miles, or even more, from a main transmitting station, when used in this manner. The addition of two low-frequency amplifying valves will generally give sufficiently loud signals for loud-speaker reproduction, although it should be realised that, if this volume is only attainable by forcing the reaction control up to the verge of oscillation, quality will be poor. Except under favourable circumstances, and in skilled hands, a set of this description may very possibly prove unsatisfactory, except at a very short range.

For distances up to some thirty or forty miles, and even more, the combination of a really good H.F. amplifier, a valve detector, and two stages of L.F. amplification can generally be relied upon for signals of adequate loud-speaker strength. The circuit of a suitable arrangement is given in Fig. 1 This will be recognised as embodying the essentials of the "Everyman Four" receiver, described in *The Wireless World* for October 13th, 1926; the reader is referred for constructional details and values of components to the article which appeared in that issue. It is strongly recommended that the specification of the H.F. transformer should be followed exactly; this component may justly be called the heart of a receiver which depends for its operation on the efficient amplification of the feeble impulses collected by a frame aerial. It will be noticed that separate rheostats are shown for each valve; these may or may not be necessary; indeed, in a self-contained set, it will probably be found convenient to fit only one resistance for the three amplifying valves and another for the detector.

If a two- or four-volt L.T. battery is used, it may no longer be possible to take grid bias for the detector from the drop in voltage across a fixed resistor inserted in the negative filament lead, as in the original receiver. Under these circumstances the resistance for this valve should be connected on the positive side of the low tension circuit, and bias applied by joining the lower end of the transformer secondary to a suitable negative point on the common grid battery. A by-pass condenser C may be provided in order to restrict the circulation of H.F. currents. Its value is by no means critical; anything from 0.002 mfd. upwards will be found suitable.

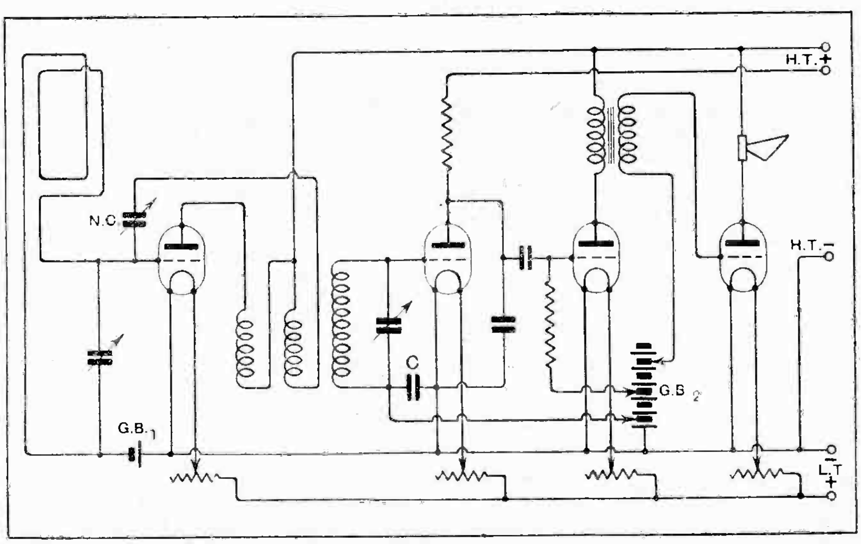


Fig. 1.—A sensitive frame aerial receiver.

If an attempt is made to construct the set under discussion as a self-contained unit, with a frame aerial built into the containing case, trouble will almost certainly be caused by interaction between frame and H.F. transformer; in all probability it will be found impossible to balance (or neutralise) the H.F. amplifier. This difficulty can only be overcome by enclosing the transformer, preferably with its tuning condenser and the H.F. valve, in a metal screening case. An idea of the size of a suitable container may be obtained by referring to page 8 of the issue of this journal dated January 5th, 1927. Screening will not be necessary if the frame aerial is mounted a few feet away from the receiver.

The frame aerial should be as large as is convenient, particularly when receiving at a considerable distance

REDUCING ANODE CURRENT.

It is now being generally realised that the best quality reproduction, combined with ample volume, is only obtainable when a valve of very low impedance—in other words, one of the so-called "super power" class—is used in the last stage of L.F. amplification. It should be borne in mind that these valves pass a very considerable anode current with some 100 to 120 volts applied to the plate; this can only be reduced by applying a comparatively high value of negative grid-bias voltage.

Users of these valves are recommended to devote as much attention to their grid batteries as to the L.T. accumulators or H.T. supply. If a valve is allowed to run for any length of time with a "zero" or even an insufficiently negative grid, it is quite probable that harm will be done. In the first place, the life of a dry-cell H.T. battery is certainly reduced when a large current is taken from it, while the emission of the valve itself is likely to suffer. Moreover, the fine wire windings of any choke, transformer, or loud-speaker connected directly in the anode circuit may possibly be injured.

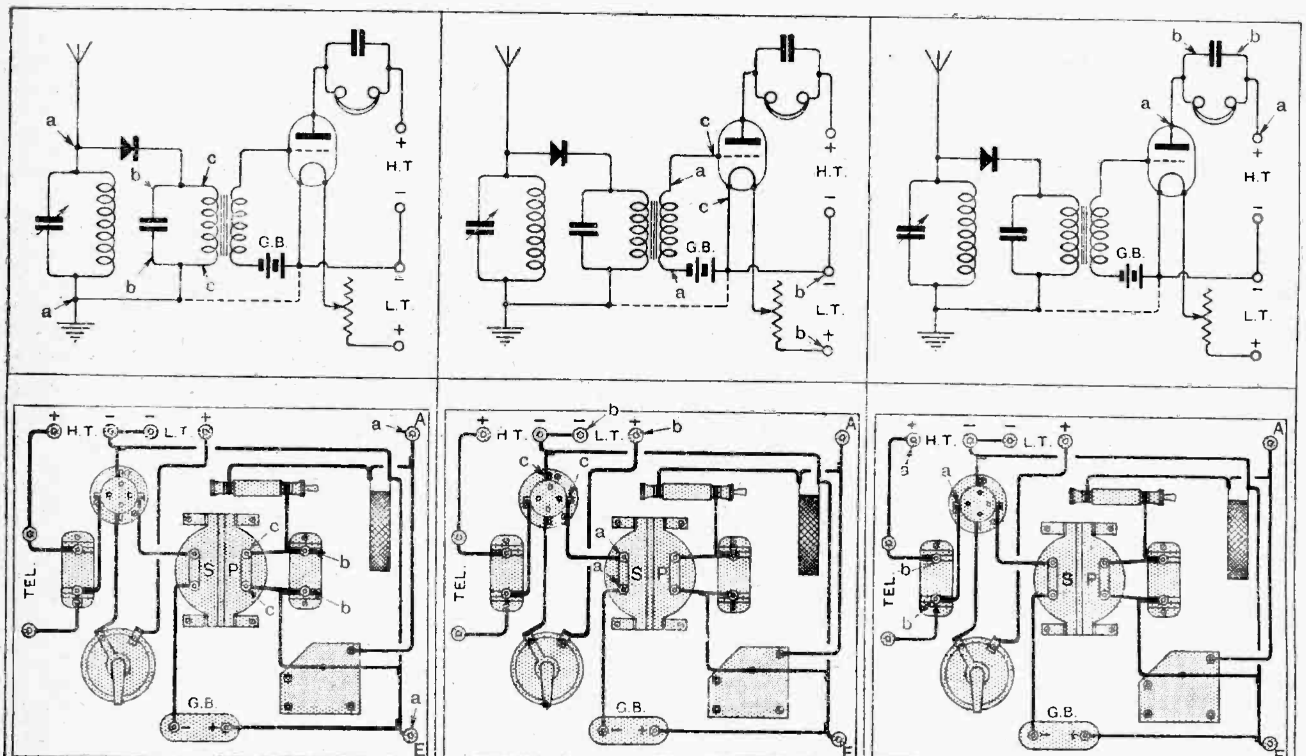
When dealing with any power valve functioning as a low-frequency amplifier, it is always a good rule, from the point of view of economy (and often of quality as well), to apply the maximum negative grid voltage possible—generally a little more than that indicated by the manufacturer's "static" curves. As already suggested in these notes, it is wise to extinguish the filament before breaking the grid circuit, even momentarily.

DISSECTED DIAGRAMS.

Point-to-point Tests in Theory and Practice.

No. 56.—A Crystal Detector with L.F. Amplifier.

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.

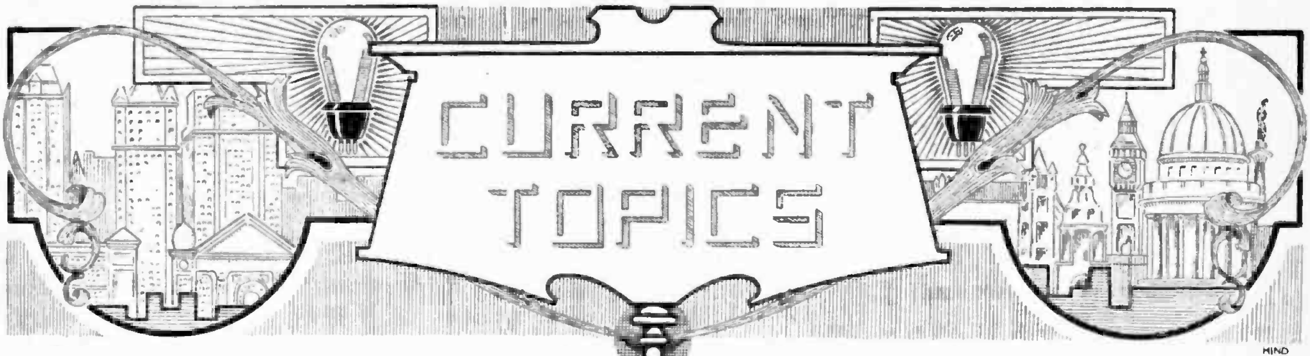


1 2 3

Continuity through the aerial coil is tested between *a* and *a*, with crystal contact broken and tuning condenser disconnected. The latter may then be tested for short-circuits by disconnecting the coil. The insulation of the by-pass condenser is shown between *b* and *b*, with transformer primary disconnected. The primary itself is tested between c and c (still with crystal contact broken).

The secondary winding is tested between *a* and *a*. Continuity of the filament circuit as a whole is shown between *b* and *b*. This test is only necessary when the valve is of a type which shows no visible glow. The insulation of the grid circuit is indicated between c and c, with grid bias battery disconnected. Also test insulation between transformer primary and secondary.

Continuity of the anode circuit is shown between *a* and *a*, with phones in position or their terminals short-circuited. The insulation of the by-pass condenser is tested across *b* and *b*. If these tests fail, each individual joint should be tested again; for instance, there may be an internal disconnection between the valve holder terminals and the sockets.



Events of the Week in Brief Review.

BEAM STATIONS TESTING.

We understand that the new beam stations at Grimsby and Skegness for communication with Australia have been handed over to the Post Office by the Marconi Company and are now undergoing a seven days' official test.

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BROADCAST RECEIVERS ON LIGHTSHIPS.

The fund, initiated by the *Daily News*, for equipping British lightships with broadcast receivers has been completed by a gift of £1,200 from Lord Inchcape, chairman of the P. and O. Line.

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ONE IN TEN.

About 4,000 persons are reported to have taken out wireless receiving licences in the Irish Free State, while, according to the *Irish Independent*, there are approximately 40,000 users of wireless sets. The Wireless Bill passed by the Free State Parliament during December provides for fines up to £10 for the illicit use of wireless apparatus.

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TELEVISION DEMONSTRATED IN NEW YORK.

By means of the new American television apparatus described in last week's *Wireless World*, Dr. E. F. W. Alexanderson gave a remarkable demonstration of his invention in New York on January 10th. A moving picture was projected on a screen by wireless and showed the inventor conversing with a friend. The reproduction is reported to have been crude, but the heads and arms of the two figures moved as they had done in the original.

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ALTERNATING CURRENTS AND ELECTRICAL OSCILLATIONS.

A course of ten evening lectures has been opened at the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3, dealing with Alternating Currents and Electrical Oscillations, the lecturer being Dr. D. Owen, B.A., F.Inst.P. Two lectures have already been delivered, and the remainder will be given on Tuesday evenings, from January 25th next. Full particulars are obtainable from the Principal of the Institute.

THE PIRATES OF PERU.

Unlicensed listeners in Peru run the risk of having their sets confiscated by the police and sold to defray costs, according to a Lima report. A half-yearly tax of one Peruvian pound is levied on all listeners.

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TELEPHONING TO NEW YORK.

The Post Office wireless telephony service between London and New York is giving remarkable satisfaction, except during occasional periods of fading. Experiments are being conducted to obtain greater secrecy in the transmissions. On Saturday last the service was extended to all parts in New York State, a development which has been hailed with satisfaction by business men on both sides of the Atlantic.

RADIO SOCIETY OF GREAT BRITAIN.

At the next ordinary meeting of the Radio Society of Great Britain, to be held at 6 p.m. on Wednesday, January 26th, at the Institution of Electrical Engineers, Savoy Place, W.C.2, Sir H. C. L. Holden, K.C.B., F.R.S., M.I.E.E., will deliver a presidential address. Light refreshments will be available at 5.30 p.m.

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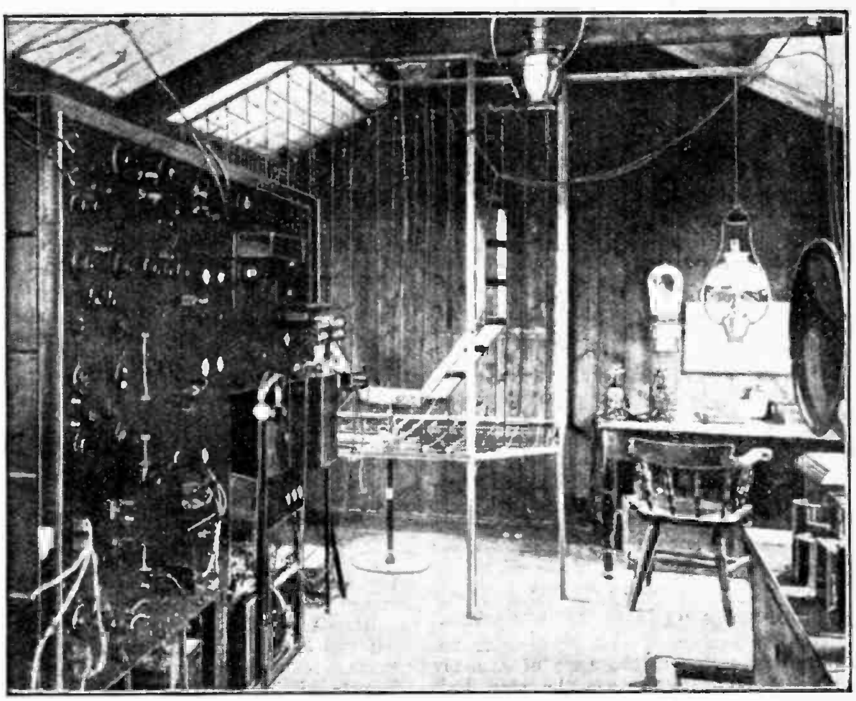
B.B.C. AND THE LISTENER.

A conference of representatives of wireless organisations was held at the B.B.C. headquarters, Savoy Hill, on Thursday last, when it was decided to form an advisory committee representing the Radio Society of Great Britain, The Wireless League, the Radio Association and the Wireless Association of Great Britain.



TRANSATLANTIC TELEPHONY RECEIVING STATION. A view in the instrument room at the Post Office receiving station at Wroughton, near Swindon. Here the Transatlantic telephony is picked up and relayed to the London exchange by means of underground cables.

The committee's main object will be to maintain *liaison* between these societies, comprising a large number of listeners and experimenters, and the Broadcasting Corporation. The chairman of the committee will be Captain Ian Fraser, M.P.

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SIGNALS FROM THE "RENOWN."

During the voyage of the Duke and Duchess of York to Australasia the "Renown" is endeavouring to keep in regular wireless touch with England. The "Renown" is fitted with a standard Admiralty short-wave set.

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CHANGE-OVER ON IMPERIAL AIRWAYS.

Flying mechanics of Imperial Airways, Ltd., are now being trained as wireless operators at the Marconi Company's college at Chelmsford. This innovation is due to the decision of the International Commission for Aerial Navigation that wireless telegraphy, not telephony, shall be used for normal communication between air liners and the aerodrome ground stations.

No change in the apparatus used on Imperial Airways machines will be involved, as the Marconi AD6 aircraft set, which is their standard equipment, is designed so that it may be used either as a telephone or telegraph transmitter by the simple movement of a switch.

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GECOPHONE "L AND D" RECEIVER.

In the review of this three-valve receiver appearing in the issue of January 12th, it was stated that the grid leak connection was returned to −L.T. Actually the filament connection of the grid leak is made to +L.T.

TELEPHONY WITH THE BEAM.

Early last week direct wireless telephonic communication was established between Ottawa and Bridgwater. Officials of the Marconi Company had previously spoken by the beam system from the Bodmin station to Montreal, and the Post Office engineers have also communicated by telephony over the same route.

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LECTURES ON "ACOUSTICS."

Since the advent of broadcasting the scientific study of sound has received greater public attention than formerly. The first of a series of public lectures on the subject, entitled "Acoustics of Buildings," was given yesterday (Tuesday) by Dr. E. G. Richardson, B.Sc., at the Physics Theatre, University College, Gower Street, London. The two remaining lectures of the series will be given at the same place on January 25th and February 1st, commencing at 5.30 p.m. The lectures are intended for students of the School of Architecture, but are open without fee or ticket to all others interested in the subject.

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WIRELESS IN THE BACKWOODS.

"Wireless Outback" is the title, the meaning of which is a little obscure at first glance, of a praiseworthy booklet issued by the New Settlers League of Australia to cultivate a popularity for wireless in the lonely Australian farmlands. The story is told of Farmer Brown, of the Boomerang district, whose ignorance of the benefits of wireless is only equalled by his determination to have nothing to do with "this new-fangled toy." But an enterprising dealer steps in with a broadcast receiver and Farmer Brown, listening out of mere curiosity, hears weather forecasts and market reports which change his plans to the great benefit of his pocket. The conversion is complete!

"Wireless Outback" contains an admirable description, in simple language, of the processes of broadcasting from the microphone to the receiver. It should do much to persuade settlers that a wireless set is indispensable.

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AMERICAN BROADCASTING CHAOS.

Wireless dealers in the U.S. are blaming the present chaos among the broadcasting wavelengths for the drop in Christmas sales. Unable to separate one transmission from another, set owners are asking: "What is the use of listening?" Complaints are being made over the Senate's delay in tackling the problem.

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NAVAL AIRCRAFT WIRELESS.

Ambitious naval wireless operators are taking advantage of the announcement that a limited number of volunteers from their ranks are required for duty as telegraphist air gunners with the Fleet Air Arm. Accepted candidates will undergo a course in aircraft wireless, and an additional inducement is extra pay.

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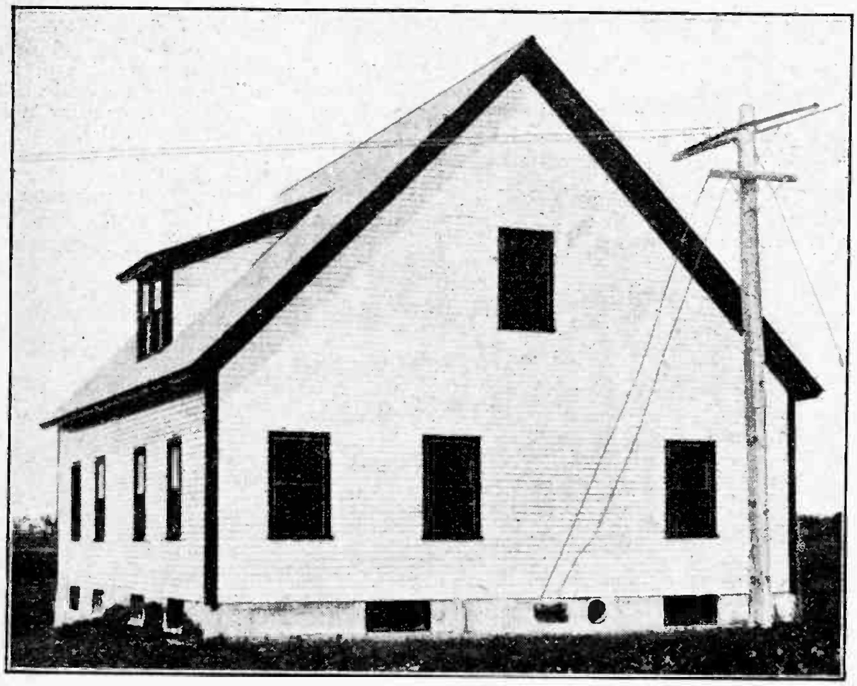
THE BETTER RAG.

A students' rag during which £1,200 was collected for the installation of a broadcast receiver and 600 pairs of phones in the Royal Victoria Infirmary, Newcastle, was referred to by the Bishop of Durham when he inaugurated the set, an eleven-valve instrument, on Saturday, January 8th. After such an effort, said the bishop, Murray's definition of "rag" an "an extensive display of unruly conduct in defiance of authority and discipline" must be amended to include "an organisation of energetic activity inspired by benevolence and comfort for the sick."

The fund was raised by the students of Armstrong College and the College of Medicine, Newcastle.



ON THE AMERICAN SIDE. This prosaic wooden building, situated at Houlton, Maine, houses the receiving instruments which pick up the Transatlantic telephony from Rugby. The station is connected to New York by land line.

BOOKS RECEIVED.

La Super-réaction à la Portée de Tous, by Dr. Titus Konteschweller.—A short description and explanation of the principles of super-regenerative receivers, with diagrams of typical circuits. Pp. 51, with 7 diagrams. Published by G. Budy et Fils, Paris. Price 5 francs.

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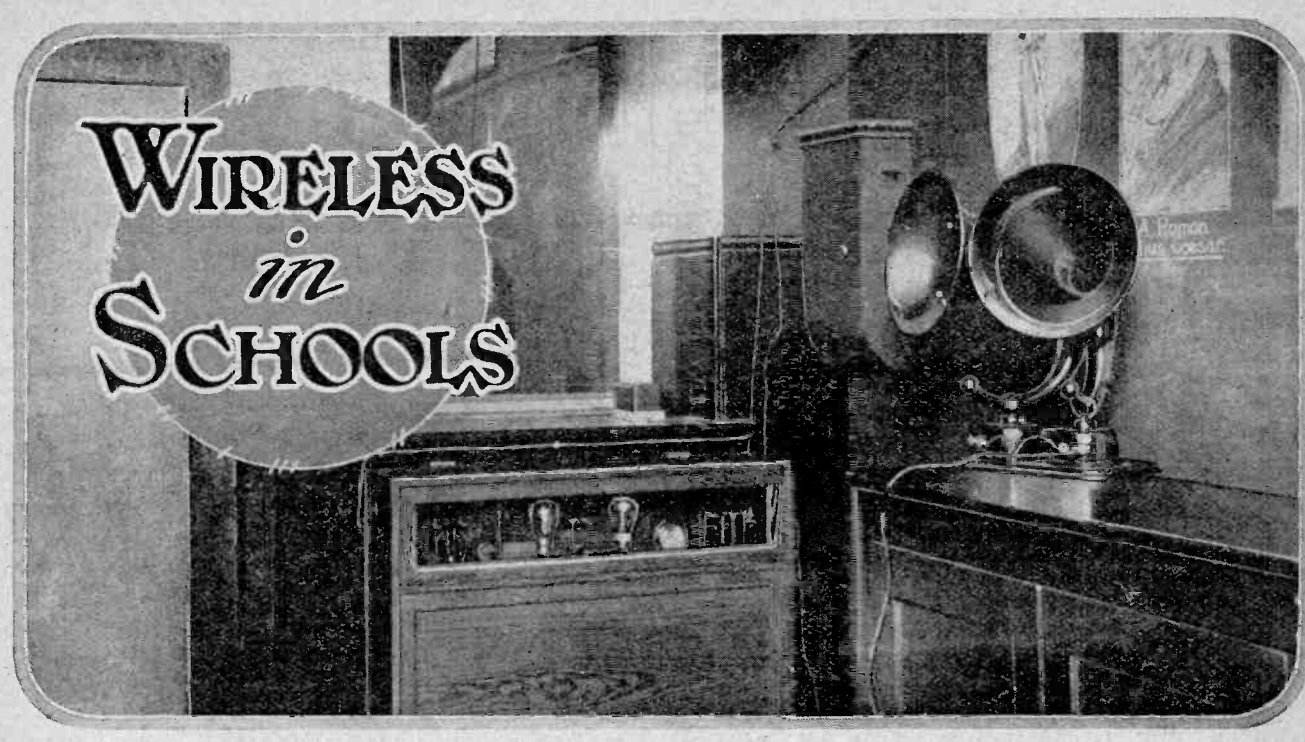
The Radio Amateurs' Handbook, by F. E. Hardy, Communications Manager, American Radio Relay League. First edition.—Contains much useful information for amateurs and experimental transmitters, including advice on "Getting Started," installing and operating a station, tables and useful data. Pp. 178, with numerous illustrations and diagrams. Published by the American Radio Relay League, Hartford, Connecticut. Price $1.



Wireless in Schools

An Account of the Group System as Applied in Sheffield.

By H. LLOYD, M.Eng.

THE possibilities attending the use of broadcasting as a supplementary educational medium in schools have roused the interest of educationists all over the country, and the interest in the matter is steadily growing. Appreciation is naturally highest in schools where successful practical results have been achieved, and from these places there emanates ample testimony to the real value of the broadcast lesson when it is properly presented to the scholars.

Leaving on one side the question of the "staging" of the transmission, which is a task for the education experts to tackle, there are a number of technical problems to be solved in order to obtain satisfactory reception in the classroom of the matter which the B.B.C. provide for inclusion in school curricula.

Classroom Acoustics.

To get good results in the schoolroom is much more difficult than reception at one's own fireside, or at the demonstration room of a wireless dealer's. Most classrooms show a particularly unpleasant type of echo effect which reacts on the loud-speaker so as to alter its performance considerably. If the words of the lecturer follow one another too rapidly they become quite lost amongst the echoes of the sounds immediately preceding them. Considerations of hygiene preclude the possibility of ordinary draping being used, but it is almost certain that before long there will be found in schools a classroom set apart for wireless reception, having its walls so treated as to minimise sound reflection.

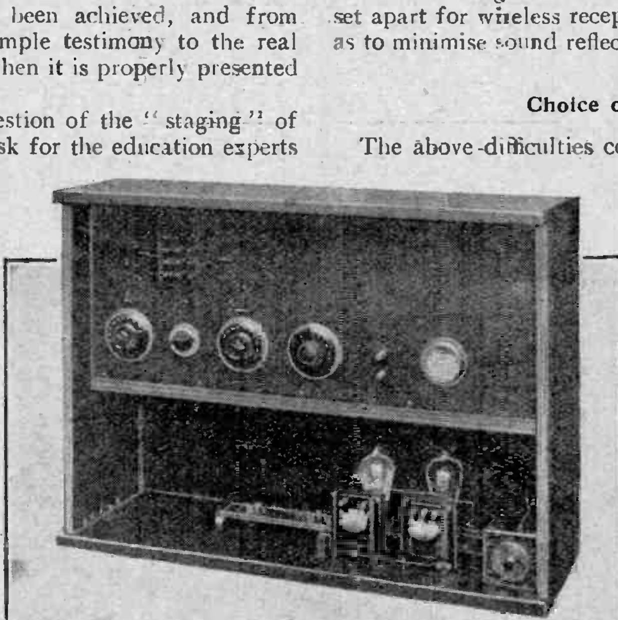


Fig. 1.—Central receiving set serving a group of schools through G.P.O. telephone lines. The line amplifier occupies the lower compartment of the cabinet.

Choice of a Receiver.

The above difficulties confront one even though the receiving apparatus be properly chosen, efficiently maintained, and carefully operated.

The choice of a suitable receiver therefore raises several problems, and it is these that the group system has set out to solve. Experiments made with this scheme during the past twelve months in Sheffield can now be said to have established the fact that it possesses many points of superiority, both technical and economic, over the ordinary system of independent receivers.

Schools in the main industrial centres generally require to receive alternatively

Wireless in Schools.—
from their local station or from Daventry. They must be able to use the transmissions from either station without interference from such sources as neighbouring power stations, tramways, or works employing electrical plant. The maintenance of the apparatus must be capable of being conveniently organised, and there should be no

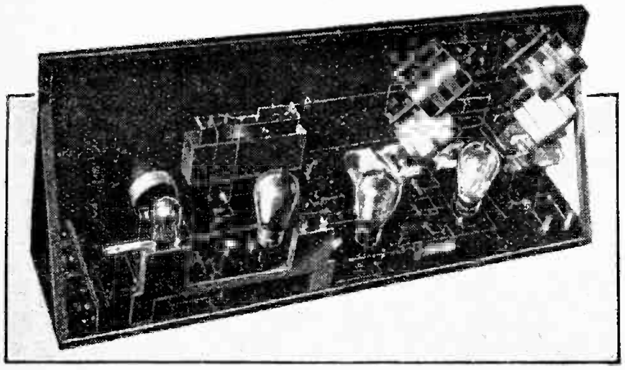


Fig. 2.—Interior of central receiver showing arrangement of long and short wave coils.

possibility of failure due to unskilful operation of a receiver.

The question of maintenance is of the utmost importance, and standardisation of apparatus throughout each educational area would be very desirable. Of course, one difficulty about standardisation lies in the fact that in many cases presentations of apparatus are made to schools; various types of installation are found, requiring different kinds of valves and batteries, often being unnecessarily elaborate for the purpose in hand, and therefore needlessly difficult to operate. Under the category of maintenance must not be forgotten the necessity—at the present state of wireless development—for periodic overhaul and modernising of receivers. With complete sets of apparatus in every school, whether of standard pattern or not, a continual and heavy expense would be involved It is, in fact, not possible to standardise with independent receivers at each school, if all-round efficiency is to be obtained, on account of the varying conditions in different localities; one school may be subject to severe interference from electric furnaces close by, demanding a screening system so intensive as to be ridiculous if applied to the receiver in a school half a mile away; another may be in a blind spot, and yet another may be so close to the local station as to require an efficient wave-trap for Daventry reception. Many other special cases might be mentioned.

In the Sheffield Group System, the area is divided up into a number of districts, each district enclosing about twelve schools. The schools in each group are linked together by ordinary telephone lines rented from the G.P.O., and the networks are fed from a receiving station situated in a position chosen for its general suitability. The equipment at each of the schools consists of a two-stage resistance-coupled amplifier, with volume regulator, and loud-speakers.

Receiver Circuit.

The receiver, which is illustrated in Figs. 1 and 2, consists at present of a conventional pattern of neutralised H.F. amplifier and anode-bend detector, followed by one stage of resistance-coupled amplification. The tuned circuits can be changed over by a single switch from the 1,600 metre wavelength to that of the local station, and sufficient condenser adjustment is provided to allow for slight wavelength changes. A shunted pair of headphones for monitoring and a valve voltmeter connected in the manner shown in Fig. 3 ensure uniform quality and volume of output from this set. The volume is adjusted by a separate filament rheostat on the H.F. valve, a method perhaps not entirely above criticism, but simple and satisfactory in practice. The receiver proper is followed by a bank of small power-valves, each of these valves feeding one of the groups of schools through transformers which have been specially designed for the lines by Messrs. Ferranti, Ltd. Provision has been made for easily adding to the number of valves in this bank as the number of groups of schools increases.

The school amplifiers are all identical, and require no skill to operate. Figs. 4 and 5 indicate respectively the circuit and layout details. When an amplifier is installed the resistances in the input circuit are adjusted so that with the standard strength of signal coming in from the master receiver, a suitable volume for normal purposes is obtained when the volume control is set at

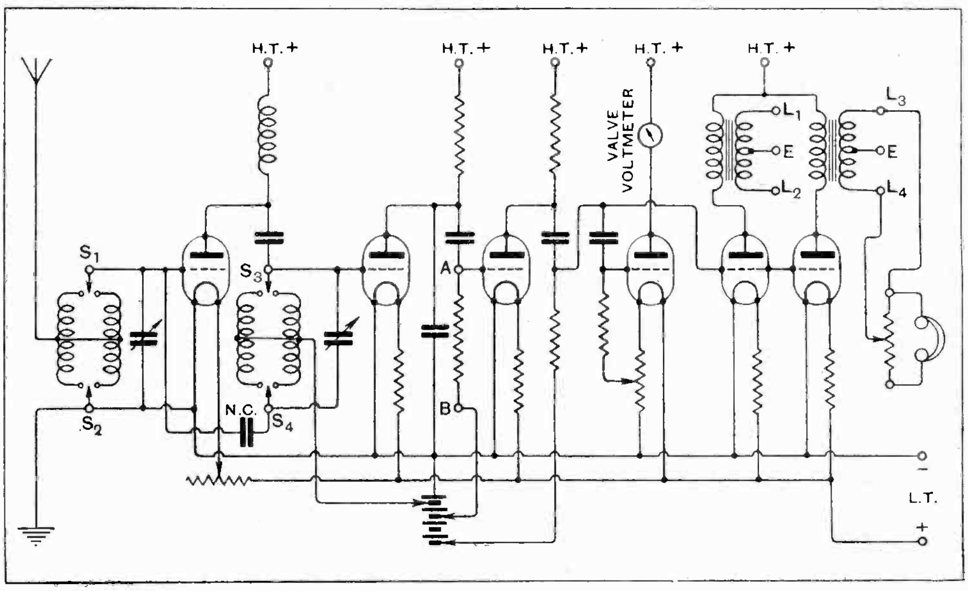


Fig. 3.—Circuit diagram of central receiver and line amplifier.

Wireless in Schools.—
about half-way. The amplifier is then locked up. Inserting the loud-speaker plug into the jack switches on the valves, and the volume control knob projecting through the cabinet enables the loudness to be adjusted if necessary. Any overloading is indicated by the milliammeter in the anode circuit of the second valve, and thus visual indication of blasting is given. Output transformers are fitted to isolate the loud-speakers, these being of the low-impedance type.

A considerable amount of time was spent in deciding upon the kind of loud-speaker to use, and it was finally decided to adopt the method shown, of using two medium-sized instruments of the horn type mounted on a common base-plate and pointing towards the two far corners of the class-room. Clear speech being the first consideration, this arrangement gave the most satisfactory results.

Maintenance of Amplifiers.

Maintenance of these amplifiers is simple and economical to organise, a small floating surplus stock of H.T. and L.T. accumulators of the standardised patterns enabling periodical renewals to be made without interrupting the service. The steady reading of the milliammeter gives timely warning of grid-battery deterioration.

The photograph in the title of this article shows a typical school installation. The lightning-arrester on the incoming land-line can be seen above the amplifier. The batteries are contained in the lower compartment of the cabinet.

Small class-rooms have been chosen in all cases for regular wireless reception, whilst for special occasions when it may be desired to use the school assembly halls, a portable equipment has been developed, consisting of a single stage amplifier using an anode voltage of 300 and a Brown P.Q. type loud-speaker. This additional apparatus is arranged to plug in to the output jack of the school's own amplifier.

On the days when wireless programmes are to be received the master set is tuned in at the appointed time to the required station, and the outgoing strength checked on the valve voltmeter by the operator in charge. At the schools the loud-speakers are plugged into the amplifiers, and the loudness adjusted by the volume controls so as to be well short of blasting. Thus it is reasonably certain that even in unskilled hands the system will not be overloaded at any point, and that all schools connected to the system receive signals of equally good quality and strength.

The scope and elasticity of the system just described are very great indeed. Equal results are obtained at all schools, irrespective of local electrical disturbance or geographical situation, with comparatively cheap standardised apparatus. Economising in the schools means that the master receiver can be a much higher grade instrument than would generally be found in a school, and improvements in design have only to be applied to the master set for all the schools immediately to benefit by them. Complete specifications of the standard apparatus are available in blue-print form, so that persons wishing to make presentations to schools can easily add to the group system if they desire. The amplifiers are built from standard components, and lend themselves very well to home construction.

The group system is, of course, not limited to wireless reception alone. It is well known, for instance, that gramophone reproduction can be appreciably improved by using in place of the ordinary sound box a magnetophone pick-up and special amplifier; gramophone records are widely used in schools, and with a gramophone at the central distributing station, a large number of schools might be supplied simultaneously with high quality gramophone reproduction, the process involving considerably less wear and tear of the records than if they were played in the ordinary way, with steel needles. It will be appreciated that the application of this principle opens up considerable possibilities. A land-line has recently been connected between the master receiver and the University, and by the use of this it is possible to transmit matter to the schools such as lectures and musical recitals at times when the broadcasting service is otherwise occupied. A Marconi-Sykes microphone and Marconi "A" amplifier is installed at the University, and the output from this is applied to the grid circuit of the first L.F. valve of the master receiver, terminals being provided on the receiving panel for the purpose.

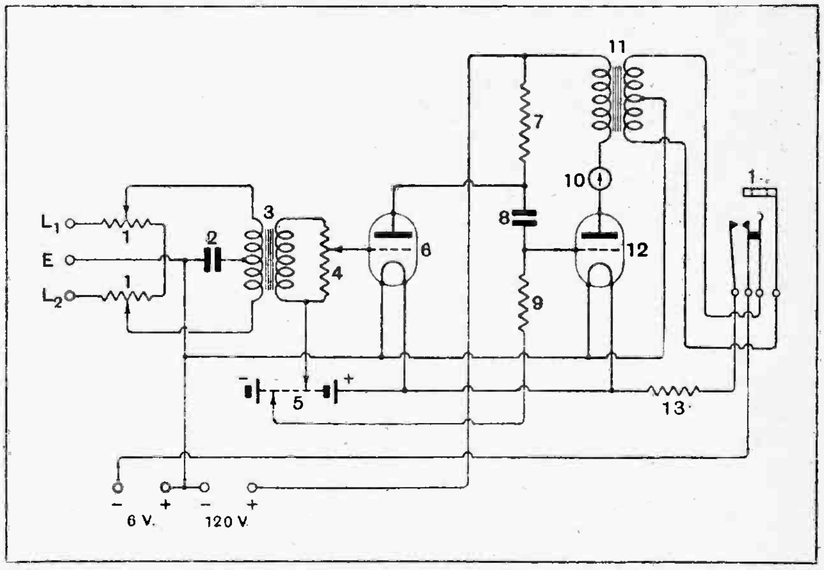


Fig. 4.—Circuit diagram of school amplifier Values of components are as follow: 1, 300 ohms; 2, 0·01 mfd.; 4, 100,000 ohms.; 7, 100,000 ohms; 8, 0·1 mfd.; 9, 0·5 megohm; 13, 1 ohm.

Automatic Control.

The further suggestion has been made that certain portions of the evening broadcast programmes would be very useful in connection with the "play-centres" that are opened at some of the schools during the winter months. For this purpose a Venner time-switch controls the master receiver, so that Daventry may be automatically switched on for the required period in the evenings.

Wireless in Schools.—

In conclusion, it may be said that the group system as it has been applied to the schools in Sheffield has successfully overcome many of the serious drawbacks that were at first encountered in an attempt to provide wireless reception in schools. There is still much to be done in connection with educational broadcasting, both on the "programmes" side and also on the technical side, but so far as the latter is concerned, the group system goes a long way towards solving the problems of providing easily operated standardised equipment, giving uniformly good quality even in localities where, owing to the proximity of electric furnaces and other industrial interference factors, ordinary reception would be quite out of the question. In the necessary experimental work much valuable data has been acquired, and educational authorities from other cities are visiting Sheffield for the purpose of studying the system.

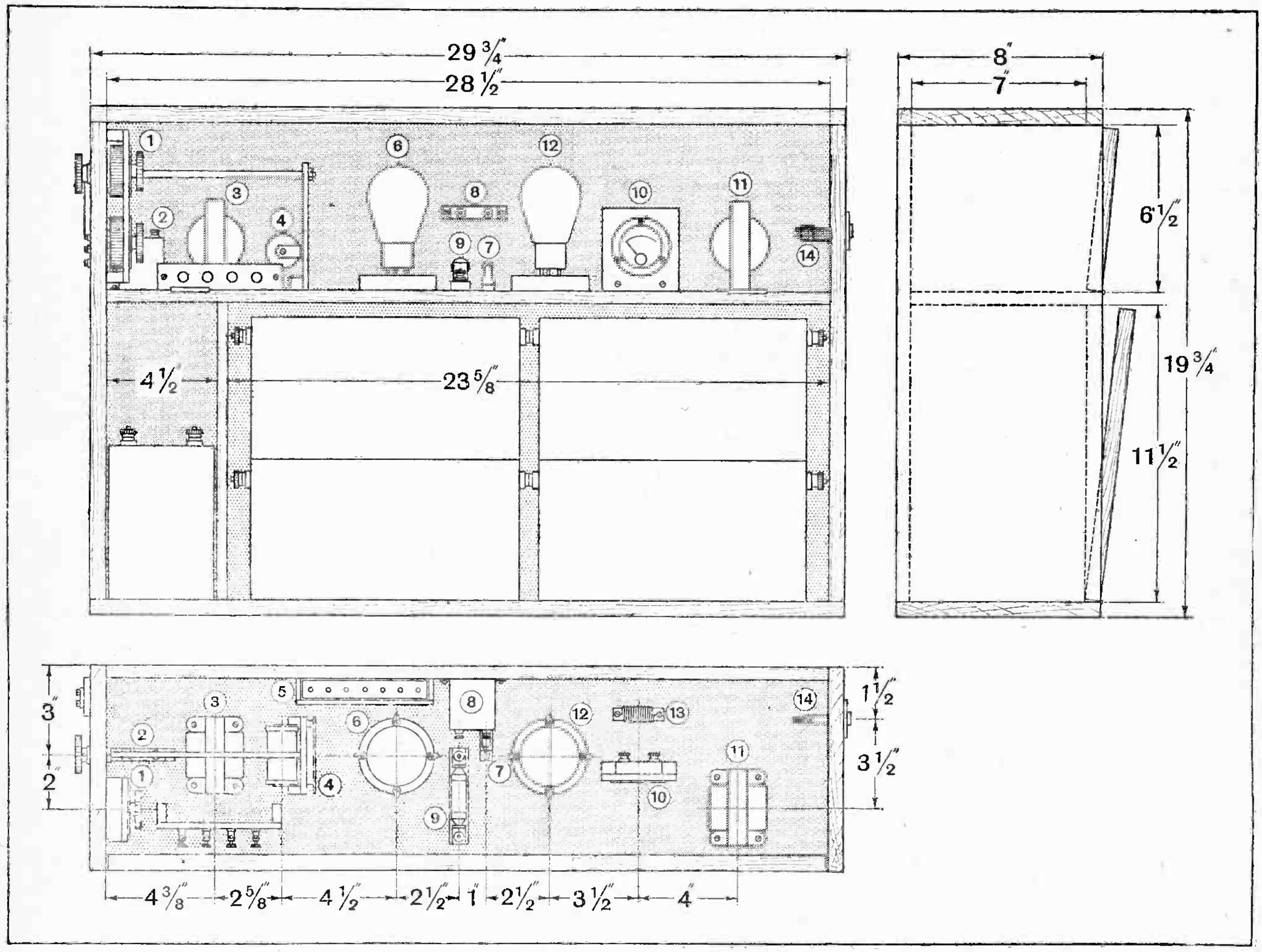


Fig. 5.—Layout of components in the school amplifier. Components are numbered to correspond with the circuit in Fig. 4.

The "Wireless Trader" Year Book and Diary, 1927.

The new edition of this invaluable Year Book fully maintains the high standard set by its two predecessors. Revised and thoroughly up to date it comprises nearly 400 pages of trade facts and information which will be found of the greatest use not only to traders but to amateurs and experimenters.

The first portion contains general information, including postage rates, and summaries of the Shop Acts and Factory and Workshop Acts, broadcasting information, notes on the principal patents covering wireless receivers, and a short article on Patents, Designs and Trade Marks, which indicates the procedure to be followed and the points to be avoided by inventors in applying for patents or in the registration of trade marks. Thirty pages are devoted to technical data and tables followed by a descriptive list of the principal wireless journals and text books. The Diary and Memoranda portion contains 100 pages interleaved with blotting paper, and the Directory section of 130 pages comprises the trade and professional addresses of wireless manufacturers, agents, associations, publishers and factors, a classified list of wireless goods and components with the names of their respective manufacturers, a territorial list of factors, and an alphabetical list of proprietary names.

The price of this useful book, which is published by the Trader Publishing Co., Ltd., 139-140, Fleet Street, E.C.4, is 5s. 6d. post free in Great Britain, or 7s. 6d. overseas.

CALIBRATING A WAVEMETER.

Use of Harmonics to Calibrate the Range 20 to 2,000 Metres from a Single Known Wavelength.

If you wish to calibrate a wavemeter, the easiest way is to borrow one which is already accurately calibrated and to transfer readings direct to your own. If this is not possible, it is not a good plan, except for the roughest of work, to attempt to draw curves from observations on a number of broadcasting stations the wavelengths of which are liable to sudden variations. It is not only more accurate, but also more expeditious, to use the phenomenon of harmonics. The scheme outlined below enables anyone to calibrate a wavemeter over a range of from 20 to 2,000 metres by means of one single observation of one station the wavelength of which is accurately known. As mentioned above, it is not satisfactory to work from a transmission within the broadcast band, and this scheme is therefore prepared on the basis of a short-wave fundamental. None the less, examination of the example given in the chart will show that it may be commenced anywhere within the range, as, for example, by using the wave of Radio Paris (said to be fairly constant) and starting at the point designated as B9. The numerical example given is based on the crystal-controlled transmission of 2XAF, which can be heard sufficiently for the purpose on any short-wave set on Tuesday and Saturday nights relaying the WGY programme. If another basis is used, start at a point on the plan approximating to the wavelength chosen, thenceforth neglect the numerical values given, but preserve the method shown by the key.

Apparatus Required.

Taking first the case of a buzzer wavemeter. In addition to a receiving set a source of oscillations will be needed. Both of these may consist of any single valve detector circuit and neither need any calibration, though if a rough one already exists it will be a help. They are preferably not coupled magnetically, but may have a common earth lead—of course, neither has an aerial. The basic transmission is tuned in on the receiver and the oscillator is brought into resonance. Then the tuning of the receiver is slowly altered, and, at the points where a harmonic of the oscillator and the fundamental of the receiver (or *vice versa*) cause a beat, a reading is taken on the buzzer wavemeter. In the case of a heterodyne wavemeter, this replaces the oscillator; but now the wave is held on the receiver and the tuning of the meter is varied, direct readings being taken as beats are passed.

It is well to sketch rough curves on squared paper as the calibration proceeds, in order to avoid such chance of error as may be caused by missing a harmonic or by reading in mistake the faint beats of a harmonic of the receiver with a harmonic of the oscillator. It will be noted, however, that the table provides numerous checks after the first series of points has been secured.

Procedure.

It is assumed that a heterodyne meter is being dealt with; if a buzzer wavemeter is being calibrated, substitute the word "oscillator" for "receiver," and the word "receiver" for "meter."

(1) Having got the basic wave on the receiver, jot down the approximate setting for future guidance. Find the corresponding loud heterodyne on the meter, read the setting at the dead centre of the beat, and then vary the tuning of the meter upwards, reading off successively the waves shown as A2, A3, etc., in the table. These are points where a harmonic of the meter beats with the fundamental of the wave held on the receiver.

	FUNDAMENTAL.	MULTIPLES.									HARMONICS.								
		2	3	4	5	6	7	8	9	10	ii	iii	iv	v	vi	vii	viii	ix	x
A	32.79	65.58	98.37	131 2	163 95	196.74	229.5	262.3	295.1	327.9	—	—	—	—	—	—	—	—	—
B	(A 6) 196.74...	393.5	590.2	787.0	983.7	1180	1377.18	1574	1770	1967	A 3 check	A 2 check	49.18	39.35	base check	28.11	24.59	22.09	—
C	(B 7) 1377.18...	—	—	—	—	—	—	—	—	—	688.6	459.06	344.3	275.4	A 7 check	A 6 check	172.1	153.0	137.7
D	(C iii) 459.06...	918.1	B 7 check	1836	—	—	—	—	—	—	A 7 check	C ix check	114.8	91.81	76.51	A 2 check	57.38	51.01	45.91
E	(D v) 91.81....	183.6	C v check	367.2	C iii check	550.9	642.7	734.5	826.3	D 2 check	D x check	30.60	22.95	—	—	—	—	—	—
F	(D vi) 76.51....	C ix check	A vii check	306.0	382.5	C iii check	535.6	612.1	C ii check	765.1	38.25	25.50	—	—	—	—	—	—	—
G	(A 5) 163.95...	A 10 check	491.85	655.8	819.5	B 5 check	1148	1312	1476	1640	81.98	54.65	40.99	base check	27.35	23.42	20.48	—	—
H	(G 3) 491.55...	B 5 check	G 9 check	B 10 check	—	—	—	—	—	—	245.9	A 5 check	123.0	A 3 check	G ii check	70.26	61.48	G iii check	B iv check
J	(H vii) 70.26...	140.5	210.9	281.0	351.3	421.6	G 3 check	562.1	632.3	702.6	35.13	G vii check	—	—	—	—	—	—	—
K	(J 6) 421.6....	843.1	1265	1686	—	—	—	—	—	—	J 3 check	J 2 check	105.4	84.31	H vii check	60.22	52.69	46.84	42.16

Calibrating a Wavemeter.—

(2) Leave the meter at A6 and bring the receiver into resonance. Then read off successively Bii, Biii, etc., where the harmonics of the receiver beat with the varying fundamental of the meter. Then go upwards on the meter and get B2, B3, etc., where the converse is happening, as in the case of the A series.

(3) Leave the meter at B7 and bring the receiver into resonance. Proceed as before and get the C series.

(4) Leave the meter at Ciii and bring the receiver into resonance. Read D2, D3, etc., first, then Dii, Diii, etc.

(5) Leave the meter at Dv and bring the receiver into resonance. Read the lower E series first, then the upper.

(6) Now, leaving the meter at E5 (which is also the base of the D series), reduce the wavelength of the receiver till the next lower harmonic of the meter is found, which is, of course, D6. This is the base of the F series, of which the lower range is read first.

(7) It is now necessary to get back to A5, as follows: Leave the meter at F3, which is also A7. Refer to the note made of the basic setting under (1) above and by this adjust the receiver approximately to the basic wave. Get this adjustment accurate by means of the harmonic from the meter, and then, leaving the receiver on this adjustment, move the meter setting downwards, past the harmonic at A6, till it beats at A5. As you already have a reading for this it will hardly be possible to arrive at the wrong harmonic. Bring the receiver to resonance, then vary the meter to read off the G series, lower section first.

(8) Leave the meter at G3, bring the receiver to resonance, and get series H.

(9) Leave the meter at Hvii, bring the receiver to resonance and get series J.

(10) Leave the meter at J6, bring the receiver to resonance, and get series K.

The operation (7) might, of course, have been simplified by merely resetting the meter to the known point A5, but this might involve a slight error (especially with a buzzer meter), which is an undesirable risk in an original calibration.

You will now have a series of over eighty points, more or less suitably spread over the scale. There are one or two places where more points might be helpful, and it is suggested that G10 and Kiv might be used as further fundamentals to fill in with. Only harmonics up to the 10th have been used, but no doubt further ones may actually be heard, and if these are recorded additional points may be usefully obtained with little extra work.

Experimental Precautions.

Needless to say, apparatus should not be moved during the proceedings, and at a break, where the receiver or oscillator is holding a setting, it should be turned off by an on-and-aff switch or by disconnecting a battery lead, lest error be introduced by a variation in the filament temperature, though such error would probably be very small in any case.

This scheme sounds a somewhat lengthy proceeding. It does, of course, call for some patience, but should prove not only a useful but also an interesting piece of wireless work, especially for those who desire a change from aerial reception. Where extreme accuracy is not demanded, the whole proceeding, apart from the subsequent drawing-up of curves and charts, might take a moderately skillful worker perhaps four hours. Finally, it is not suggested that one should wait till the late hours to find 2XAF and then straightway buckle to. Enough to get the wave accurately and then switch off, leaving the apparatus set till a more convenient hour the following day.

R. E. T.

CLUB REPORTS AND TOPICS

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

To Club Secretaries.

Strange though it may appear, a rumour is gaining ground that several clubs in a more or less flourishing condition are hiding their cheerful lights under bushels. By so doing they are not only depriving wireless amateurs at large of the benefit of their experiences, but are forgoing the advantages of increased membership and added local interest. Send in your report, Mr. Secretary, of that informal meeting which seemed to fall so flat; if the proceedings contained one ray of enthusiasm and originality a report will help to appease the mental hunger of thousands of fellow amateurs.

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Tricks with Echo.

The unexpected pleasure of a visit from the President, Capt. H. J. Round, M.C., A.M.I.E.E., gave a fillip to the proceedings of the Muswell Hill and District Radio Society's informal meeting on January 5th. Capt. Round gave a most interesting talk on the production of artificial echo in some of the B.B.C. transmissions. The echo is obtained by the use of an additional microphone in the studio connected through an amplifier to a Rice-Kellog type loud-speaker placed in an empty "echo room." A third microphone in the "echo room" is connected to the ordinary microphone in the studio and the resultant transmission contains just the requisite amount of echo, which can be controlled at will by means of rheostats in the amplifier leads. Capt. Round mentioned that he intended applying this principle to open-air bands and concerts, remarking that if necessary he could obtain the effect of playing in a cathedral!

A membership application form and copy of the new syllabus can be obtained from the Hon. Secretary to the Society, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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Healthy Competition.

The conclusion of the first half of the winter session of the Preston and District Radio Research Society was marked by a highly successful set competition for home constructors. In the efficiency section the first prize was taken by a *Wireless World* "Everyman's Four" receiver, second and third prizes being awarded in respect of amateur-designed 4-valve sets. A novelty in sets was a 3-valve receiver constructed for a doll's house.

An attractive syllabus has been prepared for the latter half of the winter session. Prospective members should apply to the Hon. Secretary, Mr. J. B. Cookson (2BDA), 14, Lune St., Preston.

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L.T. Economy.

A sound exposition of the methods adopted by the Edison Swan Electric Co., Ltd., in the production of valves was given by Mr. L. H, Soundy at the last meeting of the Bristol and District Radio Society. The lecturer explained that when the company first produced valves the main idea was to obtain a heavy emission of electrons, and this was accompanied by a large filament consumption. In the interests of economy of L.T. current, the coated filament was produced, and it was then realised that it was hopeless to attempt to control a large electron stream with a feeble grid fluctuation such as would be caused by a weak incoming signal. This was the primary fact which led to the introduction of the RC2 type valve, which, it was pointed out, should be used with an anode resistance of the order of three to five megohms, and was totally unsuited to any form of transformer or choke coupling.

The RC Threesome set was next described by the lecturer, and modifications suggested for use where the listener was situated too far from a broadcast station to obtain satisfactory loud-speaker reception.

At each meeting of the Society, a valve is balloted for amongst the members present, the winner on this occasion being Mr. C. F. Coleman, who received an Ediswan PV5DE valve which had been kindly presented by the lecturer.

Hon. Secretary: Mr. S. J. Hurley, 27, Cotswold Road, Bedminster, Bristol.

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FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 19th.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, Tottenham, N.17. Lecture by Mr. F. H. Haynes, Assistant Editor of "The Wireless World."

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Discussion on a Mains Receiver.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture: "Acoustics in a Room, and their Effect on a Loud Speaker," by Mr. J. F. Stanley, B.Sc.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Lecture: "H.T. from D.C. and A.C. Mains," by Mr. G. W. Wigglesworth.

THURSDAY, JANUARY 20th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Lecture: "The Design of Amplifiers for Broadcasting," by Mr. M. L. Kirke (of the B.B.C.).

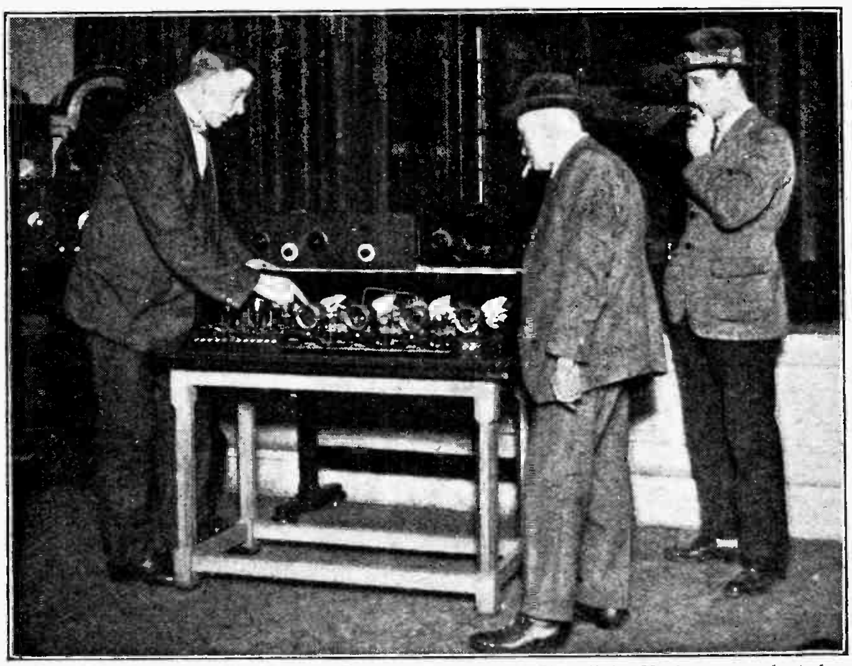
North London Experimental Radio Society.—Lecture-demonstration: "Quartz Theory and Low-power Transmitters," by Mr. A. Hinderlich, M.A. (Further particulars from Hon. Sec., 61, Carey Street, W.C.2.)

FRIDAY, JANUARY 21st.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Questions Night. Subject: "Transformers." Conducted by Mr. W. F. Cooper, B.Sc.

Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square. Lecture: "Circuits," by Mr. J. Hollingworth, M.A., M.Sc.

Bristol and District Radio Society.—At 7.30 p.m. In the Physics Lecture Theatre, Bristol University. Lecture by Messrs. The Marconiphone Co., Ltd.



HACKNEY RADIO WEEK. Last week was "Radio Week" in Hackney, conducted under the auspices of the Hackney and District Radio Society, who held an exhibition of amateur-built wireless apparatus in the Electricity Demonstration Hall, Lower Clapton. The photograph shows Mr. F. Donovan demonstrating a six-valve receiver.

Social Night.

An amusing skit on broadcasting was a feature in the programme of the "Diamond Concert Party," which entertained members of the Taunton and District Radio Society on their recent Social Night. Special amusement was caused by a number of clever allusions to prominent members of the Society. At the first meeting of the new year, held on January 3rd, Mr. E. Atkins (of Messrs. Siemens Bros.) gave a lucid talk on the use of dry batteries for wireless purposes

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Programmes and Auditions.

Great improvements in broadcasting during the present year were foreshadowed by Mr. J. A. Whitehouse, of the British Broadcasting Corporation, in his lecture before the Ipswich and District Radio Society on January 3rd. The difficulties arising during the transmission of the daily programmes were described with good-humoured pleasantry. As the lecturer remarked, with 10 or 15 entertainments running through the same switchboard, great care had to be taken to avoid a talk on vegetables being superimposed on a violin solo! To-day, he added, there was an absolute dearth of good comedians, and at audition times in London, when the officials tried out as many as 40 a day, they were lucky to be able to accept 3 or 4.

Hon. Secretary: Mr. H. E. Barbrook, 22, Vernon Street, Ipswich.

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What's in a Name?

"Some Absurdities of Wireless Nomenclature" will be the title of a talk to be given this evening (Wednesday) at the Engineers' Club, Coventry Street, W., at 7 p.m., by Dr. F. T. Fawcett, M.A., under the auspices of the Institute of Wireless Technology. Further information can be obtained from the Hon. Asst. Secretary, at 71, Kingsway, W.C.2.

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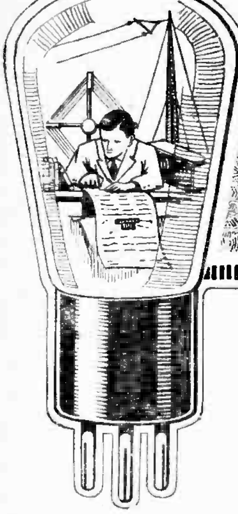
Experiments with Dielectrics.

Some fascinating experiments on the properties of dielectrics were carried out by Mr G. Gowlland at the Croydon Wireless and Physical Society's meeting on January 3rd. Various shapes of dielectric bodies were employed, some of them being composed of sealing wax, sulphur, metal balls coated with wax, and glass vessels lined with tin foil and containing salt solution. Mr. Gowlland illustrated the rotation of a dielectric when interposed between the knobs of a Wimshurst machine. The bodies can be made to rotate in either direction, but for bodies of certain shape there was a particular angle between the axis of the body and the discharge between the knobs below which rotation did not take place. The lecturer explained that the rotation was considered to be due to the action of the brush discharge on the dielectric body.

Visitors are welcome to any of the Society's meetings at 128, George Street, Croydon, and full particulars will be gladly furnished by the Hon. Secretary, Mr. H. T. P. Gee, of 51 and 52, Chancery Lane, W.C.2.



READERS' NOVELTIES

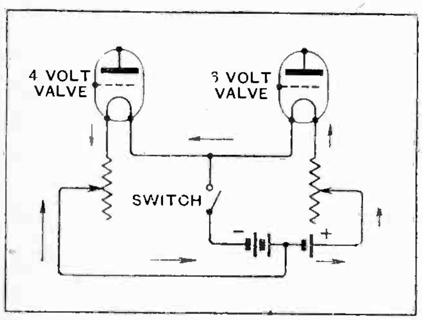
A Section Devoted to New Ideas and Practical Devices.

Valves for Readers.

For every practical idea submitted by a reader and accepted for publication in this section the Editor will forward by post a receiving valve of British make.

L.T. CONNECTIONS.

If 4-volt and 6-volt valves are used together in the same receiver there are two methods of reducing the voltage applied to the filaments of the 4-volt valves; either a separate tapping may be provided on the accumulator or fixed resistances may be included in the L.T. circuit. The former method is hardly to be recommended, as it throws an extra load on two cells of the accumulator, which run down more rapidly than the third and may give rise to complications



Circuit showing possible fault when using a tapped L.T. battery.

when recharging. However, in case some of our readers may have adopted this scheme, a word of warning about the method of switching may not be out of place.

In general, the filament switch is included in the common negative L.T. lead, as this is the only position which gives complete control with only one switch. The fallacy of this method is at once apparent from the circuit diagram, which shows that a closed circuit is formed by one of the accumulator cells and the two filaments in series. The obvious remedy, of course, is to dispense with the master switch and to interrupt the current to each valve independently by means of its filament resistance.—D. V. O.

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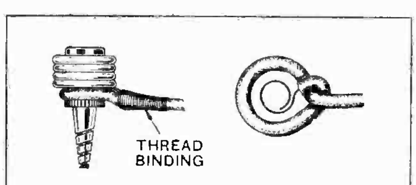
WANDER PLUG CONNECTIONS.

When connecting flex to an ordinary wander plug the use of a "strain loop," as shown in the sketch, is to be recommended. The end of the flex is bared and clamped under the locknut in the usual way, care being taken that the insulation continues right up to the point where the wire enters the hole in the wander plug. A single turn of the insulating wire is then passed round the outside of the plug, and the end of the lead is passed through the loop, as shown at the right-hand side of the sketch. The loop is then finished off with thread binding in the usual way. C. M. A.



Flexible connection to wander plug with strain loop."

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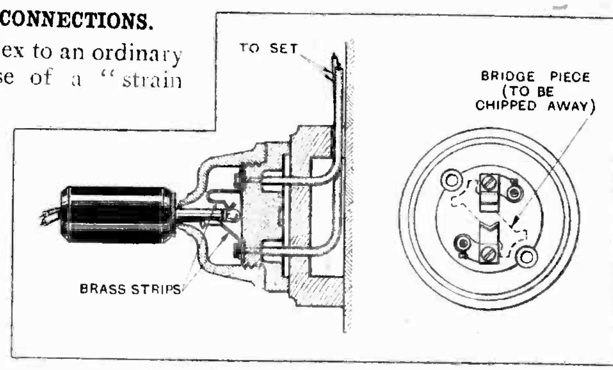
LOUD-SPEAKER JACK.

A porcelain ceiling rose can be easily converted for use as a jack in a loud-speaker distribution system.

The bridge piece between the terminals is chipped away, and spring contacts are fitted as shown.

If an ordinary telephone jack were employed a special mounting would have to be devised, and it is doubtful whether the appearance would equal that of the ceiling rose.—T. G.



Porcelain ceiling rose used as loud-speaker jack.

SOLDERING FLUXES.

The following fluxes each have a specific use in wireless work:—

Mixture of Tallow and Oil.—For soldering lead, as when making earth connections to water pipes or lining instrument boxes with sheet lead for screening purposes.

Pure Hydrochloric Acid.—For soldering zinc.

Wet Powdered Sal-Ammoniac Mixed with Resin.—For soldering copper.—J. B.

THE SET BUILDER

LAYOUT

Considerations when Arranging Components on Panel and Baseboard.

RECEIVING sets are not usually designed on the drawing board for the dimensions of the respective components, naturally, may not conform to particular requirements. The procedure invariably consists of deciding upon the circuit principle, bringing together the components most suited to that circuit, and then to actually lay the parts out and thus get some idea of the general overall dimensions.

In this preliminary stage the layout adopted will closely follow the arrangement of the components in the theoretical circuit diagram, the relative positions of parts with regard to electrical efficiency, the convenience of wiring together with good appearance and easy manipulation.

Controls on the Front Panel.

With all the parts to hand, one first decides as to which components are to be mounted on the front panel, and in this respect, should it be noted, the fewer the better. The aim is not to cover the panel with controls, and only those components which it is necessary to constantly adjust in the process of reception.

Very rarely are there more than three tuning dials, and to these may be added, perhaps, in the case of a receiving set, an inconspicuous "on and off switch" and a volume control. Terminals disfigure a front panel, and when the set is brought into use the straggling connecting wires are unsightly.

The aim should be to keep the panel as clear as possible, and the dials should be well spaced. It is as well to avoid the fixing of components to the back of the panel when this necessitates even a single screwhead showing on the front.

Symmetry.

The centres of two or more similar dials should fall in line, though the circuit arrangement does not always permit of symmetry. A symmetrical layout often implies that efficiency is being sacrificed, and it is the unbalanced arrangement of the controls, with some uniformity of distribution, that denotes a well-designed set.

Unless compactness is an essential, no endeavour should be made to cramp components into small space, for the wiring will become difficult and probably unsightly, whilst the layout as indicated by the theoretical circuit cannot be followed, owing to the need to cover all the available space. It invariably happens, moreover, that a few additional components are considered necessary after the general design has been decided upon.

Baseboard Assembly.

As to the components behind the panel, an arrangement of uniform distribution looks well in a simple set, though it is better in a large multi-valve receiver to group the components. Those parts which are related to one another in their operation can possibly be assembled into a small space.

It is as well to arrange components so that they definitely fall in line with each other, particularly if several identical parts are to be successively used in the several units or stages. The centres of the tuning dials establish axes running across the baseboard from front to back upon which other components may fall or about which they may be symmetrically arranged. Such parts as valve holders and their associated fixed or variable resistances may, though not necessarily, fall in line from end to end of the baseboard, and other components

Layout.—
may fall on this line or on, perhaps, one or two other lines determined by their relative size, purpose, and position in the circuit.

Direct and Short Leads.

The wiring layout is a governing factor in the disposition of the parts. The leads must be kept down near the baseboard, and the majority must run either parallel to the front panel or at right angles to it. If it is possible to skew a component so that one of its terminals is presented in a position that will save perhaps an inch of wire in the wiring, or even a single bend in the wire, it is worth while doing.

For the purpose of shortening the connecting wires, components may be assembled on both sides of the baseboard; bridging condensers and grid cells are always best hidden away beneath the baseboard, though in such apparatus as a short-wave receiver or the successive stages of a multi-valve amplifier transformers and valve holders may be secured to the top and undersides of a platform.

Many points in layout are too obvious to refer to here, particularly as to the avoidance of stray couplings. Needless to say, care must be taken to place screens or other large areas of metal out of the fields of coils. Coupling between coils used for tuning or as high-frequency chokes must be avoided, and the possibilities of stray electrostatic coupling must not be overlooked.

WHEN DESPERATE REMEDIES SUCCEED.

THE most original experiment carried out at Stag Lane Aerodrome on a dozen Cossor valves recently, when they were taken up in an aeroplane by Captain C. D. Barnard, and dropped from a height of 600ft., reminds me of the days when, seated on a ration box in a dugout, I manipulated a Mark III trench-set crystal receiver.

We were attached to batteries of artillery, and our job was to receive signals from aircraft and convey them to the battery commander.

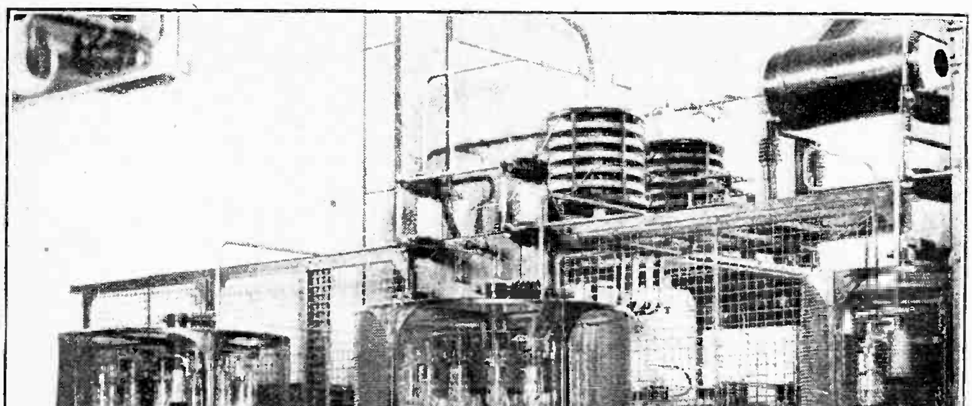
In the Stag Lane experiment the experience of one particular valve, which was said to have increased its emission by 25 per cent. as a result of its contact with terra firma, is reminiscent of the days when our sets, phones, and aerials, suffered to a great extent through being in close proximity to, perhaps, four 9.2 howitzers, in addition to being subject to violent shakings due to the explosion of enemy projectiles in the near neighbourhood.

Many times have I seen a Mark III trench crystal set—a wonderful little instrument—lifted from its ration box and dashed to the ground by the impact of shells. And much earth have I seen descend on the three-guinea pairs of phones with which we were issued! Often they would fall to the ground with a sickening thud on such occasions as night gas attacks, when we scuttled for our gas-masks, and the phones went flying into space.

It would be extravagant and absurd to say that nothing was ever the worse for these adventures, but it was a recognised fact that, in some instances, such treatment was a mysterious but effective remedy for an ailing component or pair of phones.

I once knew an operator who, trying to adjust a deficient diaphragm in a pair of "Brown's adjustable" whilst holding a lighted cigarette, burnt the ear-caps very severely. After that his signals came bouncing in! But it is risky to attempt such cures; they may prove rather expensive after all!

W. T. L.



TRANSATLANTIC TELEPHONY. Circular banks of high-power transmitting valves at the G.P.O. station at Rugby.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Problems of Higher Power—A Possible Solution—Criticising the Corporation—2LO's New Studio—A Co-Optimistic Broadcast—News Comments from the Spot.

A High Power Menace.

By a strange irony of fate it appears that at a moment when the last stragglers from the European wavelength scheme are coming into line (the Spanish stations are tardily complying with the Geneva provisions), a new trouble threatens the peace of the broadcast ether in the shape of *high power.* Stations of super-power are blossoming forth here and there with a bland assurance which would be amusing if it were not serious.

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New Stations.

The last few weeks have witnessed the opening of Langenburg on 468 metres with a *nominal* power of 20 kilowatts, and the installation of a 50-kilowatt transmitter at Warsaw working on 1,050 metres. Rumours are also current that a German station at Herzogstrand may employ 100 kilowatts; while among the "certainties" is a Rhineland station with a site at Ludwigshaven operating on a power of 20 kilowatts. Leningrad is to use 10 kilowatts, and Moscow, according to a Soviet news item, may use 50 kilowatts.

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A Battle of Power?

No matter how readily these stations comply with the requests of Geneva regarding wavelength, their power will undoubtedly cause interference with their humbler neighbours. This is a question which Geneva apparently forgot. The position was foreshadowed in November last by *The Wireless World.*

There is every indication that the next few months will see the gradual development of a battle royal which will show only too clearly that, under these conditions at least, "power is might."

FUTURE FEATURES.

Sunday, January 23rd.

LONDON.—Popular Chamber Music.
BIRMINGHAM.—Music by Irish composers.
CARDIFF.—Second Concert of Cardiff Musical Society's Season.

Monday, January 24th.

LONDON.—Shortened Version of "The Beggar's Opera."
NEWCASTLE.—"Fire," by A. J. Alan—London Radio Repertory Players.
BELFAST.—Familiar Tunes.

Tuesday, January 25th.

LONDON.—French Songs sung by Helen Henschel.
BIRMINGHAM.—Orchestral Concert.
CARDIFF.—Burns Night Celebrations.
GLASGOW.—Burns Programme.
ABERDEEN.—Burns Night.

Wednesday, January 26th.

LONDON.—"The Indefinites" Concert Party.
BIRMINGHAM.—City of Birmingham Police Band.

Thursday, January 27th.

LONDON.—Hampstead Programme.
BOURNEMOUTH. — Yeovil Town Silver Prize Band.
CARDIFF.—"In the Dark," a Play in one act.
MANCHESTER.—Short Violin Recital by Leonard Hirsch.

Friday, January 28th.

LONDON.—"Martha," an Opera by Flotow.
GLASGOW.—Orchestral Concert relayed from St. Andrew's Hall.

Saturday, January 29th.

LONDON.—Military Band Concert.
BELFAST.—American Indian Songs.

A Possible Solution.

How the authorities at Geneva are likely to solve this problem is a little difficult to foresee. Assuming that ultra-selectivity in the average broadcast receiver is still a long way off, the ordinary broadcast band from 250 to 500 metres will be inadequate for a host of stations all working on high power, even if the present scheme of wavelengths is rigidly adhered to.

Probably the ultimate solution of the problem will lie in the direction of a colossal regional system, in which the present wavelength scheme will be swept away, widely spaced wavelengths being allotted to a strictly limited number of stations operating on very high power. This arrangement, which, of course, could only be reached by international agreement, would involve the closing down of many of the smaller stations, though a number of the lower power transmitters would still operate as relays.

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The Next National Concert.

The seventh of the B.B.C. national concerts from the Albert Hall will take place on February 3rd, when Herman Scherchen will conduct and Iturbi will be the pianist. Beethoven's No. 3 Symphony in E flat will be among the items given, and Iturbi will play Liszt's concerto in E flat for piano and orchestra.

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Criticising the Corporation.

Despite assurances from Savoy Hill that the present programmes were arranged weeks ago under the *régime* of the old B.B.C., the Corporation is still being assailed by the critics on account of the supposed tendency towards higher education "Too many talks," is the slogan of the critic, but how many people are aware that, comparing present programmes with those of two years ago, the amount of time devoted to talks is practically the same?

The real reason for the present outcry is due, I think, to the ill-timed alterations to the programme schedule and to certain variations in the Children's Hour. If these changes had been deferred until, say, March, they would not have been associated with the accession of the Corporation and fears of "red tape" and bureaucratic interference would have been averted.

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2LO's New Studio.

The new studio now under construction at Savoy Hill will be the loftiest in this country if not in Europe, this effect being brought about by removing the floor of one of the present studios to provide a larger one double the usual height. How far we have progressed since the early theories of the "deadened" studio is shown by the fact that the draping will be of the flimsiest description, removable at will. The present artifice of employing a separate "echo room" will no longer be necessary, and there is every possibility that the acoustic effects obtained will resemble those in an outside concert hall.

The enlarged studio will probably be opened in the course of a few days.

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"Fire."

Mr. A. J. Alan, who has frequently thrilled listeners with his hair-raising stories told over the microphone, is breaking fresh ground on January 22nd when he will present a short play, of which he is the author, entitled "Fire."

Taking our Pleasures Seriously.

Under the heading "Entertainments" our esteemed contemporary *The Times* gaves details of a number of forthcoming broadcast talks with such titles as "The Growth of Industry," "The Sugar Beet," and "Scotland's Industrial Story."

Can Scotland forgive?

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National Dances.

A series of national dances will be broadcast by the Wireless Military Band from 2LO on February 5th.

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Co-Optimists in a Broadcasting Episode.

That the possession of a good home, complete with hard-working wife, a pair of flat irons and a distinctly "knobby" valve set, does not necessarily spell happiness is being demonstrated nightly by Mr. Gilbert Childs and Miss Doris Bentley in the Co-Optimists' 13th Programme at His Majesty's Theatre, London.

The scene is the family kitchen of the Harris home, where Jim Harris (Gilbert Childs), oppressed by the loquacity of his wife (Doris Bentley) and the rascality of an absent brother-in-law, is discovered seeking consolation in his humble broadcast receiver. But there is oscillation both indoors and out, and not being a "world-beater," the set refuses to soar above its environment. Matters are complicated by the appearance of the scurvy brother-in-law Albert (Stanley Holloway), whose inane hilarity after having smashed up Jim's bicycle banishes further consideration of the broadcast receiver. Treats, explanations, entreaties, tears, and a few odd kicks follow in breathless succession, but the episode closes (after Albert has removed his objectionable presence) in a touching scene which I refuse to describe.

Jim's tussles with the wireless set are really funny, as are his remarks on the various programme items which (we must take his word for it) come in on the 'phones. The loud-speaker is apparently only of use for demonstrating local oscillation.

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The Studio on the Stage.

A feature of the Co-Optimists' entertainment which would perhaps appeal more strongly to readers of *The Wireless World* is the ingenious "broadcasting" episode in which the actors are Mr. Melville Gideon and Miss Mary Leigh.

In the front part of the stage, which represents a broadcasting studio, we find Mr. Melville Gideon seated at the piano and breathing a song, full of sweet nothings, into a Marconi Reisz microphone. Far up stage is a balcony scene wherein a love-lorn maiden (Miss Mary Leigh) is discovered with her ear close to a Marconi Public Address loud-speaker operating at open-air strength. Mr. Melville Gideon's song is merely whispered, but, thanks to the amplifying equipment, it can be heard all over the theatre.

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A Talk on Flying.

Commercial flying will be the subject of a broadcast from 2LO by Captain Sinclair and Captain Barnard, under the auspices of the Air Ministry, on January 26th.

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England's Forgotten Corner.

Few parts of Britain are now out of range of at least one broadcasting station, but there is one little corner of England where the good folk listen regularly to Continental stations because these are received with greater volume and clarity than those in Britain. The district in question is the N.E. corner of Norfolk, where the towns of Sheringham and Cromer both suffer for the sin of being beyond the 100-mile radius from Daventry.

What is worse, it seems that the district will remain forsaken even when the regional scheme takes effect, for I hear that there is no truth in a recent rumour that East Anglia will have a special high-power station of its own.

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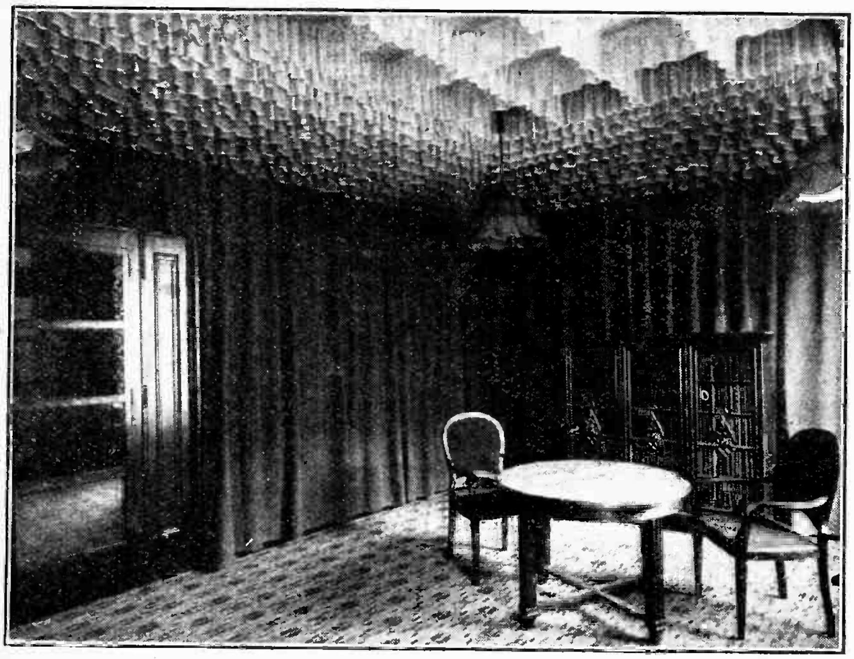
Broadcasting from the Spot.

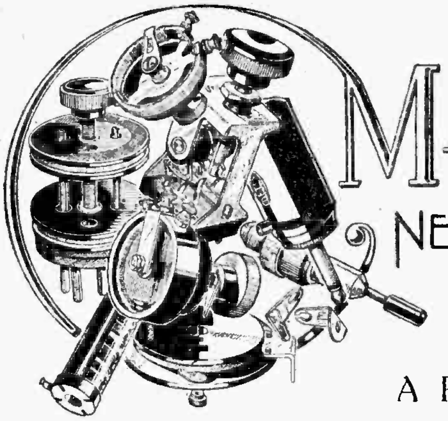
The first broadcast description of an event actually in progress was carried out at Twickenham on Saturday last on the occasion of the England *v.* Wales Rugby match.

The description was given from a new portable wooden hut which is lined with felt throughout and contains a single microphone. A hinged glass panel is fitted which can be raised to enable the announcer to see the whole of the field. The hut is by no means conspicuous, being only 5 ft. 6in. high and 4 ft. 6 in. wide.

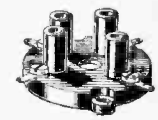
It is hoped to give a similar broadcast description of the Arsenal *v.* Sheffield match at Highbury on Saturday next.



STUDIO DESIGN IN GERMANY. An ingenious and peculiar arrangement of the ceiling draping is the prominent feature of a new studio at the Cologne Broadcasting station. The newest trend in studio design is towards the abandonment of elaborate draping, the new studio now under construction at 2LO being an example of this latest practice.



MANUFACTURERS' NEW APPARATUS



HIND

A Review of the Latest Products of the Manufacturers.

NIFE HIGH TENSION BATTERIES.

Batteries, Limited, Crabbs Cross, Redditch, have recently drawn attention to the need of floating a layer of paraffin on the electrolyte of their Nife cells.

A depth of paraffin of about $\frac{1}{8}$in. is recommended to protect the electrolyte from the atmosphere. The electrolyte is strongly alkaline, and prolonged exposure to the air changes the alkaline hydroxide solution to a carbonate. The addition of paraffin will increase the service obtainable from the cells.

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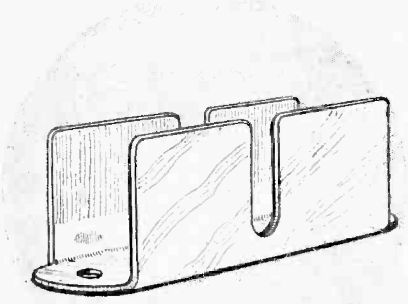
GRID CELL FIXING.

When building a receiving set the amateur is often required to make up the necessary metal strips for attaching the grid cells either to the inside wall of the cabinet or to the baseboard.



A useful clip for attaching grid batteries to the baseboard or cabinet.

A useful clip is now obtainable from A. F. Bulgin and Co., 9-11, Cursitor Street, London, E.C.4. It is an aluminium stamping, a single clip giving support to a small 9-volt battery, while two or more clips can be used with the larger type 15-volt battery.

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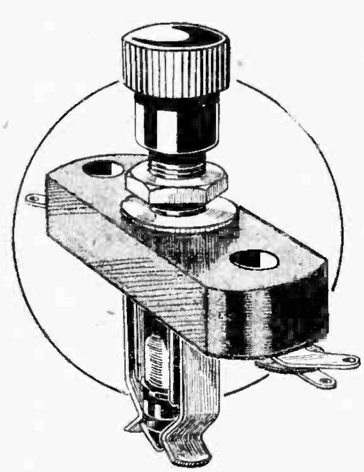
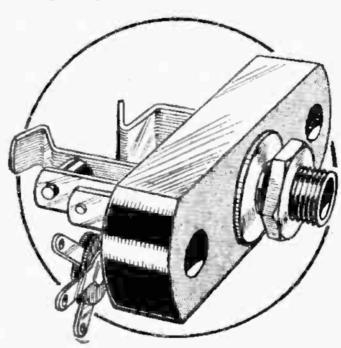
LOTUS SWITCHES AND JACKS.

A plunger action is frequently preferred to the more common type throw-over key for a switch movement which is to be operated from the front of an instrument panel. A key, as a rule, is not so easily fitted as a plunger, the former requiring a slot in the panel in addition to holes for the fixing screws, while the latter is accommodated in a single drilled hole and probably looks much neater.



Lotus two-pole switch. It is more easily fitted than the key type.

The "Lotus" plunger action switch, a product of Garnett, Whiteley and Co., Ltd., Lotus Works, Broadgreen Road, Liverpool, is built upon a substantial moulding into which is secured a plated brass bush to serve as a fixing and a bearing for the plunger. An ebonite endpiece on the plunger actuates the spring contacts, the stem of the plunger not forming part of the electrical circuit. To facilitate the making of soldered connections, the tags are spread apart.



One hole fixing Lotus break jack. The spreading out of the connecting tags is a good feature.

The specimen examined was fitted with a two-pole action suitable for the switching of batteries into circuit, or for throwing telephones or loud-speaker across output terminals.

"Lotus" break jacks are of very similar design to the plunger switches, the contacts being operated by the connecting plug. To ensure good connection with the stem of the plug, a spring contact is provided instead of relying upon the connection the plug makes with the one-hole fixing bush. Four contacts were available on the break jack examined, so that it could be arranged to close the filament circuit when the telephone plug is inserted.

In both switches and jacks all springs are of German silver and fitted with non-oxydising contacts.

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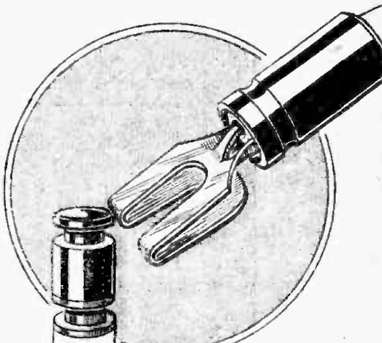
ANOTHER NEW CONNECTOR.

Although designed essentially for the motor industry, the new "B.E.S.T." terminal and connector should prove useful in a number of ways for connecting wireless apparatus.



An ebonite pillar with a brass ring replaces the battery terminal in the "B.E.S.T." Connector, so that the circuit can be broken and the connecting lead retained in position.

The connector comprises a small ebonite and brass stem and spring clip, the former being provided with a 2 B.A. thread, so that it can be substituted for an existing terminal on the battery. The clip makes contact when inserted under the brass ring, whilst the circuit is broken by transferring it to the groove in the ebonite extension piece. The clip is of liberal area, and falls into position with a positive snap action.

An ebonite sleeve is supplied for making connection with a rubber-covered cable. This connector is a product of the British Engineering Service and Transport, of Dyne Road, Kilburn High Road, N.W.6.

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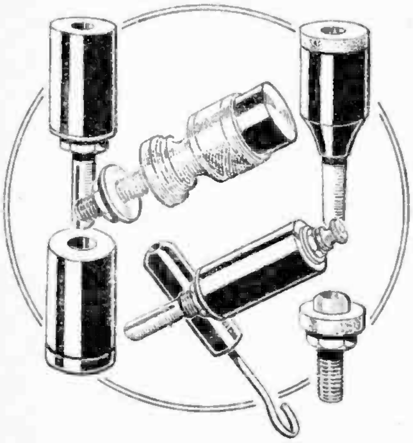
J.J.R. CONNECTORS AND TERMINALS.

A wide range of plug and socket connectors are obtainable from J.J.R., Ltd., 7A, Ross Parade, Wallington, Surrey. Two forms of plug are supplied—one taper-ended, and the other the usual split pin. The sockets, which are suitable for fitting to instrument panels or terminal strips, carry coloured rings for easy identification, while the tops of the taper plugs are similarly fitted with coloured screw-on caps.

The method of terminating the flexible leads is a good feature of these connectors. The taper plug has a detachable cap, and it is only necessary to pass the wire through a hole in the top and screw



J.J.R. connectors and terminals. The terminal ended plug is fitted with a light fuse.

down. Frayed ends are thus avoided. A hole in the side of the plug is available for side connection. In the case of the split plug the wire is passed down through a hole drilled obliquely in the insulating material and then clamped under a nut and washer.

A socket connector is also supplied, so that with a plug it can serve to break contact intermediate in a flexible lead.

The "J.J.R." terminal is fitted with a coloured non-rotating top. It is well finished and nickelled. The coloured top-piece about which the knurled holding-down screw revolves is very securely fixed, a point to look to in terminals of this design.

For making connection under a terminal, a useful loop with insulating sleeve is included among the "J.J.R." products. It is a very simple device, and a dozen of these to hand when connecting up an apparatus avoids all danger of short circuit by frayed ends of flexibles.

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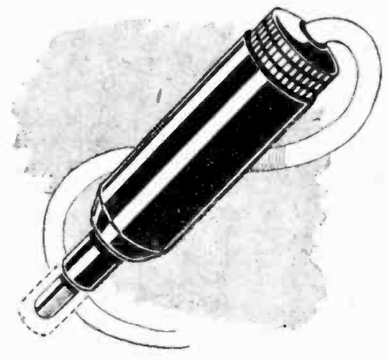
A PROTECTED PLUG.

The H.T.C. Electrical Co., of Boundaries Road, Balham, S.W., have recently introduced a new idea in the design of battery plugs. It is usual, when using plug and socket connectors, to fit the sockets to the terminal strip and the plugs to the flexible leads from the batteries. With this arrangement there is risk of short circuit between the unprotected



The H.T.C. Battery Plug is fitted with a protecting sleeve which covers the metal part when the plug is withdrawn from the set.

plugs, and to guard against it an ebonite sleeve has been fitted, which, by means of a spring action, slides forward and covers the metal end of the plug. Thus the plugs can be left to hang free when disconnected without risk of short circuiting the accumulators or high tension batteries.

The plug is constructed throughout from ebonite, turned and polished, the brass plug being slightly tapered and split. The flexible lead is secured under a knurled screw on top-piece.

TRADE NOTES.

The Carborundum Booklet.

The Carborundum Company, Ltd., of Trafford Park, Manchester, have issued a useful booklet dealing with the Carborundum Stabilising Detector Unit. Circuits are given with instructions for the insertion of these absolutely permanent detectors, and the reader is shown how to progress from a simple crystal set to a multi-valve receiver.

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A Filament Life Test.

How a number of valves embodying the Mullard P.M. filament emerged unscathed from a life test of 1,000 hours, conducted by the National Physical Laboratory, is told in an illustrated brochure issued by the Mullard Wireless Service Co., Mullard House, Denmark Street, W.C.2. A report of the test was contained in *The Wireless World* of December 22nd last.

Transmitter for New Zealand.

The Hon. J. C. Coates, M.C., Prime Minister of New Zealand, recently visited the Hendon Factory of Standard Telephones and Cables, Limited, and inspected the new 5KW broadcasting set recently manufactured there for installation at Wellington, N.Z.

The apparatus was actually demonstrated, and Mr. Coates expressed keen pleasure at the purity of speech and music obtained.

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Unipivot Galvanometers.

The Cambridge Unipivot instruments for D.C. measurements are dealt with in a well-produced brochure issued by the Cambridge Instrument Co., Ltd., 45, Grosvenor Place, London, S.W.1.

The introduction of the Unipivot principle over twenty years ago considerably extended the usefulness of moving coil galvanometers, as it made possible the production of robust portable instruments possessing the sensitivity of laboratory apparatus employing delicately suspended coils requiring accurate levelling. The catalogue covers a wide range of galvanometers and testing sets, and the manufacturers state that they can arrange for any of their instruments to be tested at the N.P.L. prior to delivery, subject to certain conditions.

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New "Gecophone" H.T. Batteries.

Two new types of "Gecophone" H.T. batteries with interchangeable units, specially designed for wireless work, have been placed on the market by the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2. These new batteries, both of 66 volts—one has standard units and the other has super-capacity units—are notable for their robust construction and compactness. The aim of the designer has been to secure uniformity of discharge and silence in operation. The batteries are equipped with an improved type of covered container.

oooo

Boosting Up the Dance Band.

The Olympia Dance Hall has recently been installed with the "Amplion" Band Repeater Equipment. The acoustics of the hall were found to be not altogether favourable for orchestral music when it was desired to cover the whole of the dancing space, but with the aid of the eight "Amplion" demonstration loud-speakers concealed above the orchestra music is now perfectly audible on all parts of the floor. Similar apparatus is in use at the Olympia Circus, in which the Ring-Master makes frequent announcements to the vast audience.

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The Brown Budget.

The current number of the house organ of Messrs. S. G. Brown, Ltd., of North Acton, contains readable articles dealing with wireless in schools and loud-speaker demonstrations and an interesting story of a 1,000-miles trip up the Amazon, steered by a "Brown" Gyro-Compass.

The Editor's Mail

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 HEAVISIDE LAYER.

Sir,—In Professor Appleton's article on this subject in your issue of January 5th reference is made to some investigations carried out by us. It is stated that the directional receiving methods which we employed have failed to provide any evidence of downcoming waves resulting from their deflection from the Heaviside layer. As we feel that this gives a false impression of the present position, we should be glad of an opportunity of making the following remarks.

In the Proceedings of the Royal Society for March, 1925,[1] we described some experiments made with tilting loops and aerials in an attempt to obtain direct evidence of the reception of waves from the Heaviside layer. As far as this object was concerned, the experiments failed, for reasons which were fully explained in our paper. As Professor Appleton is undoubtedly aware, however, we published a second paper in the Proceedings of the Royal Society for March, 1926,[2] containing the results of further experiments in which the investigation was carried to a successful issue. These experiments showed that *by directional methods alone* we were able to distinguish between waves travelling horizontally along the ground and waves arriving in a downward direction at the receiver. Further, by combining these directional measurements with signal intensity measurements we obtained four independent means of detecting downcoming waves, and also of measuring their intensity and angle of incidence at the earth's surface.

These experiments were made concurrently with, but quite independently of, those carried out by Professor Appleton and Mr. Barnett, and the two sets of results obtained are in complete agreement.

R. L. SMITH-ROSE.
R. H. BARFIELD.

Ditton Park, Langley.
January 6th, 1927.

Sir,—I regret that my article has called forth a letter of protest from Dr. Smith-Rose and Mr. Barfield. My aim in writing the article was to describe the early history of the problem of obtaining satisfactory proof of the existence of the Heaviside layer without going into too much detail. I had in mind the possibility of describing in a later article, thus completing the series, the more recently published confirmatory experiments of Dr. Smith-Rose and Mr. Barfield, and also those carried out by Dr. Breit in America.

E. V. APPLETON.

Potters Bar.
January 7th, 1927.

DISTORTION IN LAND LINES.

Sir,—The article by Mr. Tyers and the correspondence from him and from Mr. Gardner demonstrate quite clearly that the listening public is kept in most profound ignorance by the B.B.C. concerning the characteristics of their transmissions.

The only indications concerning transmission quality that the writer has seen were (1) a statement by Capt. Eckersley in a contemporary journal that the 2LO characteristic was substantially uniform between 30 and 10,000 cycles; (2) a statement in the *Manchester Guardian* that the curve for the Birmingham station was sensibly uniform from 50 to 10,000 cycles. These figures apply, of course, to direct transmissions and presumably with pure sinusoidal input. I suggest that any other public service which only gave such meagre information concerning the quality of their service, as distinct from quantity and variety, would be dealt with very summarily.

When S.B. transmissions are concerned there is no possible doubt that the standard does not reach the above uniformity. There is generally, apart from all the varieties of land line noises, a comparatively early cut-off of the higher frequencies resulting in very muffled tone. That the cut-off is considerable can be easily demonstrated by listening to a switch over from direct to S.B. transmission. The point is of very considerable importance to provincial listeners, for the amount of S.B. transmission is increasing, and, in my opinion, *the proper place for correction devices is at the transmitting end, not at the receiving end of the process.*

What is required is an independent investigation of the characteristics of *all* B.B.C. main stations, together with typical land lines, tested not only on sinusoidal inputs, but, much more convincing still, by oscillograph wave forms of more complicated wave shapes.

I agree with Mr. Tyers that there are a number of people who know the receiving end of the business quite as well as do the B.B.C. engineers, and such listeners who have done everything within the limits of present knowledge and their means to ensure a high standard of reproduction are getting a little wearied with the avowals of technical perfection of the B.B.C. without being given the necessary technical proofs. It would appear to be little use organising such fine fare as provided by the national series of concerts if all but those for whom 2LO is the local station have to put up with land line distortion which is sufficient to mar the best programmes obtainable.

W. SYMES.

Manchester.
January 12th, 1927.

Sir,—By great courtesy of B.B.C. engineers I spent a very fascinating afternoon at Savoy Hill a week or so ago and was shown some actual curves of frequencies passed by various land lines lent by the G.P.O. to B.B.C. Most of them were most irregular in the way the sonic frequencies were passed, generally looking more like malarial temperature charts than any instrument response. One comparatively short line had a complete cut-off above 3,000 cycles! As different lines are used at different times the practical difficulties in compensating can be imagined.

Incidentally, I had opportunity of hearing the Rice-Kellog cone loud-speaker working. A re-broadcast of Westminster Abbey organ was on at the time. Although quite ignorant of organs, not only did I recognise the presence of the pedal notes, but they forced themselves on my attention. On switching over to a very superior horn model speaker no pedal notes could possibly be made out and volume was less.

A. L. BARHAM.

London, S.E.1.
January 11th, 1927.

THE B.B.C. PROGRAMMES.

Sir,—As you invite your readers' views on the matter of the make-up of the B.B.C. programmes I am writing to endorse very heartily all you say in your leading article in to-day's issue. You have put the matter so well and so clearly express my own views that I have little to add. Personally, I prefer the so-called "highbrow" music, but I fully recognise that the jazz bands, banjo merchants, and "tea-shop" music must be adequately represented, if they are good of their kind, as I believe they are. What I do *not* want is all the kinds jumbled up in fifteen-minute snippets each evening, which is pretty much what we have now. I sigh for the good old days of a clear two hours of something definite from 8-10 p.m., and the weather and news *then* and not at 9.0 or 9.30, which breaks up the evening so badly.

ARTHUR J. WEBB.

Croydon.
January 12th, 1927.

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[1] "Proc. Roy. Soc." A, vol. 107, pp. 587-601.
[2] "Proc. Roy. Soc." A, vol. 110, pp. 580-614.

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.

An Efficient Two-valve Broadcast Receiver.

I wish to construct a 2-valve receiver with a crystal rectifier for the broadcast band of wavelengths and would like a circuit diagram with details of the parts to be used. Can I use the highly-efficient high-frequency transformers of the "Everyman's Four" type? D. S.

A receiver of the type suggested should prove entirely satisfactory for the loud-speaker reception of the local broadcast station and for the telephone reception of distant stations. The circuit diagram of the receiver is given below, and it will be seen to include one stage of balanced H.F. amplification, crystal rectification and one low-frequency amplifier.

Tuned transformers of the type suggested are used, these being marked T_1 and T_2. H.F. transformer T_1 can have a secondary winding of 68 turns of No. 27/42 silk-covered Litzendraht wire wound on a Paxolin tube 3in. in diameter and 3½in. long and a primary winding of 14 turns of No. 30 D.S.C. with a tap at the eighth turn from the end connected to earth.

Transformer T_2 should have a secondary winding of 68 turns of No. 27/42 Litzendraht wire on a Paxolin tube 3in. in diameter by 3½in. long and a primary and balancing winding of 14 turns each, if valve V_1 has an A.C. resistance of 20,000 to 30,000 ohms. If valve V_1 has a lower A.C. resistance, say, 15,000 to 20,000 ohms, the primary and balancing windings should each have 12 turns. No. 40 D.S.C. copper wire is used.

These two transformers should be constructed and mounted in exactly the same manner as the two transformers in "Everyman's Four" receiver, being fixed at right-angles, with transformer T_2 upright.

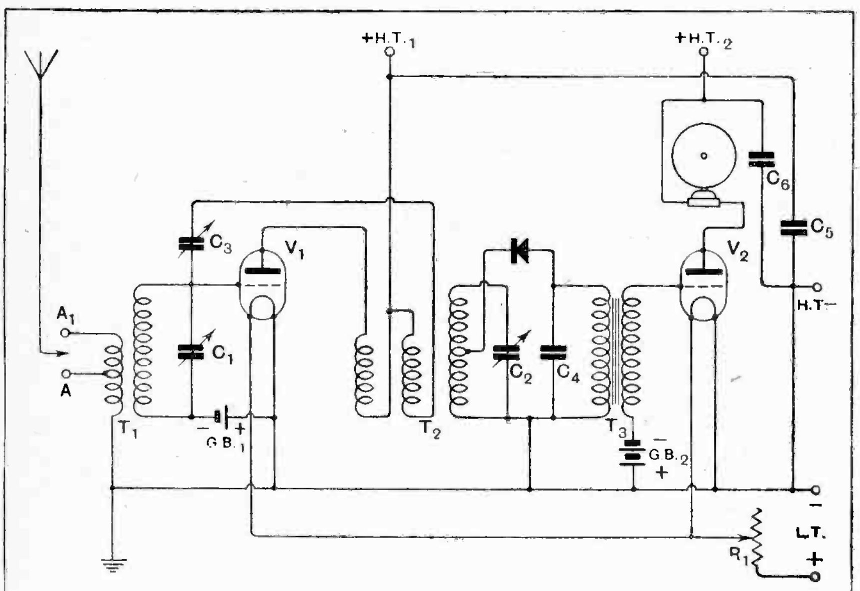
Tuning condensers C_1 and C_2 are of 0.0003 mfd. and C_3 is a balancing condenser. This condenser should be of a type which can be critically adjusted. The third transformer, T_3, is a low-frequency one and may have a ratio of between 3 : 1 and 8 : 1, depending entirely upon the characteristics of the crystal detector. With a low resistance detector the 8 : 1 transformer could be used; such a rectifier is of the wire-contact type. When a Carborundum type of detector is used the lower-ratio instrument should be employed. Transformer T_3 should be a high-class instrument.

A shunting condenser C_4 will have to be used and may have a capacity of 0.0005 to 0.001 mfd. Condensers C_5 and C_6 are of the Mansbridge type and may be of 2 mfds. each. Valve V_2 should be of the power type and its grid bias GB_2 adjusted according to the anode voltage applied at +H.T.₂. A filament rheostat R_1 of up to 5 ohms is used.

It will be noticed that the crystal detector is connected to a tap on the secondary coil of H.F. transformer T_2. The correct tapping place depends essentially on the type of crystal detector used. For an average detector of the wire-contact type this tap may be made at the 15th turn from the end connected to −L.T.

To balance the receiver tune in the local station at full strength, remove valve V_1, place a piece of paper over one of its filament legs and put it back in the holder, making sure that the remaining three legs make good contact with the sockets of the valve-holder. Now adjust the balancing condenser C_3 until no sound is heard. Turn the condenser very carefully and make sure that it is set at the silent point.

If, now, the valve is restored by removing the piece of paper from the filament leg, it will be found impossible to make the set oscillate by tuning, provided, of course, that the two coils are arranged as in "Everyman's Four-valve" receiver. There is no excuse for anyone who allows a set of this type to oscillate.



Two-valve broadcast receiver with a crystal detector.

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The Milliammeter as a Distortion Indicator.

I am told that a milliammeter can be connected to a receiver to indicate distortion. If this is true, will you tell me where to connect the meter, and how to tell when distortion is being produced? S. J.

A milliammeter connected in the anode circuit of the last valve is of great help when adjusting the grid bias and anode voltage. Tune the set to receive signals of normal strength, and notice whether the needle of the milliammeter moves. If it kicks upwards the grid of the valve has too large a negative bias, and the valve is rectifying because of the curvature of the lower part of the characteristic.

Reset the grid bias and again watch the needle of the milliammeter. If it kicks downwards there is insufficient grid bias; probably grid current is flowing.

When the needle appears to move above and below its normal reading the valve is being overloaded, and the input should be reduced. It will be noticed that the effect of low notes is to cause the needle of the milliammeter to move violently, whereas notes of higher frequency, and of apparently equal strength, do not affect the milliammeter. It is assumed, of course, that the earlier valves of the receiver are not distorting; this is almost invariably the case.

The Wireless World AND RADIO REVIEW (14th Year of Publication)

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THE BRUSSELS RADIO CONFERENCE.

A FURTHER important meeting of the Union Internationale de Radiophonie will take place in Brussels from January 26th to 29th, to continue the good work done some time back at the meeting held in Geneva. At the Conference held in Geneva it will be remembered that a great step forward was made in the direction of rearranging the wavelengths of the European broadcasting stations, but the efforts of the Conference then were confined to stations working under 600 metres.

The Conference at Brussels will deal with the question of wavelengths and the power of the long-wave stations, and will also consider problems, both technical and legal, arising out of interference produced by local causes, such as tramways, lifts, electric motors, etc. But perhaps from the point of view of many of our readers the most important item on the agenda is the question of allotting an international system of call-signs to be transmitted between programme items to enable stations to be easily identified. It will be remembered that this important question was raised in *The Wireless World* recently and has been the subject of considerable correspondence. One or two suggestions have been put forward which, no doubt, will be considered carefully at the Brussels Conference.

Readers will look forward with the keenest interest to any decision which may be arrived at which will overcome the present unsatisfactory position arising from the difficulty of identifying foreign transmissions.

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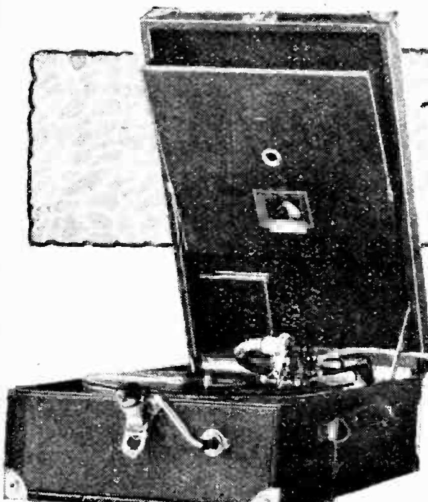
ARRANGEMENT OF PROGRAMMES.

The suggestion put forward in our issue of January 12th has been well received by a large number of our readers who have written to us expressing their appreciation. A further selection of letters is published in this issue under "Correspondence."

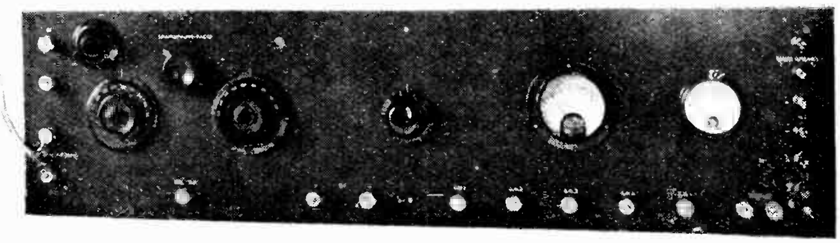
Briefly, the suggestion which we made was that the B.B.C. should so arrange the programmes that entertainment and broadcasts of the same character should all be included in one evening's programme instead of conducting a variety programme attempting to appeal to the whole community every night. We suggested that the B.B.C. should endeavour to classify the listening public into groups and so compose their programmes that every evening in the week the whole programme should, as far as possible, appeal to one group, thus enabling us to choose our evenings for listening-in and leaving us free for our other appointments on the evenings when tastes which are not ours were being catered for in their turn.

We hope that this suggestion will be considered carefully by the new Programme Committee, over which Captain Ian Fraser will preside. Each member should be representative of one of the groups into which we have suggested the B.B.C. should divide the public, so that he can watch over the interests of his group in the construction of the programmes.

CONTENTS.



HIGH QUALITY REPRODUCTION



A Combination Broadcast-Gramophone Equipment.

By R. P. G. DENMAN, M.A., A.M.I.E.E.

IN an article which appeared in *The Wireless World* for November 4th, 1925, attention was drawn to the extraordinary improvements which were then taking place in the technique of gramophone recording and reproduction, and some advantages of electrical reproducing methods were discussed. During the past twelve months some interesting papers and articles have been published,[1] in some of which details of the Western Electric Company's recording and reproducing system were given. Also a complete electrical reproducing instrument—the Panatrope—has been put on the English market.

Superiority of Electrical Reproduction.

To those who have had the opportunity of hearing an instrument of this kind it is evident that the quality obtainable is in many respects vastly superior to that given by an ordinary gramophone, and in fact approaches very closely that given by broadcast receivers working under the most favourable conditions. It seems, therefore, that the time has come when sets capable of giving the best possible quality from both sources should be making their appearance. It must be pointed out at once, however, that such a set is necessarily going to be very expensive.

This applies almost as much to the set for broadcast reproduction only as to a combination equipment, the cost of which need not be much greater. It is true that very satisfactory, if somewhat subdued, reception can be obtained with a set employing, say, 150 volts H.T. But far greater volume than this will yield must be provided before anyone can conscientiously sit back in his chair and declare that further improvement is impossible without fresh discoveries. One must be able to feel the floor gently vibrating under one's feet when a low organ note is played before any such statement becomes permissible, and even then there is always something to be done. Nothing shows the inadequacy of the conventional "power amplifier" more clearly than one's first attempts at the electrical reproduction of gramophone records. It is soon realised that to give, without overloading the valves, an acoustic output from present-day loud-speakers equal to that obtainable from a gramophone, calls for an *audio-frequency* supply of three or four watts, involving roughly two output valves of the L.S.5A class, working on an anode supply of some 300 volts. Anyone who possesses a gramophone and a wireless set can easily verify this point by connecting a milliammeter in the H.T. feed circuit, adjusting the set to give as much volume as the gramophone on a loud record, and then noting the agitation of the milliammeter.

A Costly Set.

It is a hard fact, then, that really high quality, which cannot be considered apart from adequate volume,[2] calls for an expensive set; and whatever may be thought of such sets for broadcast use, it is not worth while considering anything else for gramophone reproduction, because the ordinary mechanical instrument can nowadays hold its own with all but the best electrical outfits.

The future of the high-quality combination set would seem to lie chiefly in large installations for the use of

[1] Maxfield and Harrison; "Methods of High Quality Recording and Reproduction of Speech Based on Telephone Research." *Journal of the American Institute of Electrical Engineers*, March, 1926, p. 243.

A. Dinsdale; "Wireless and the Gramophone." *The Wireless World*, Sept. 15, 1926, p. 399.

S. T. Williams; "Recent Developments in the Recording and Reproduction of Sound." *Journal of the Franklin Institute*, October, 1926, p. 413.

E. J. Wyborn; "The Electrical Reproduction of Gramophone Records." *The Gramophone*, December, 1926, p. 288.

[2] "Receiving apparatus ought therefore to be adjusted to give about the same volume of sound as is being used in the broadcasting studio, and if it is incapable of giving the necessary output without introducing other kinds of distortion, ideal results cannot be obtained." L. C. Pocock; "Faithful Reproduction in Radio-Telephony." *Journal of the Institute of Electrical Engineers*, September, 1924, p. 793.

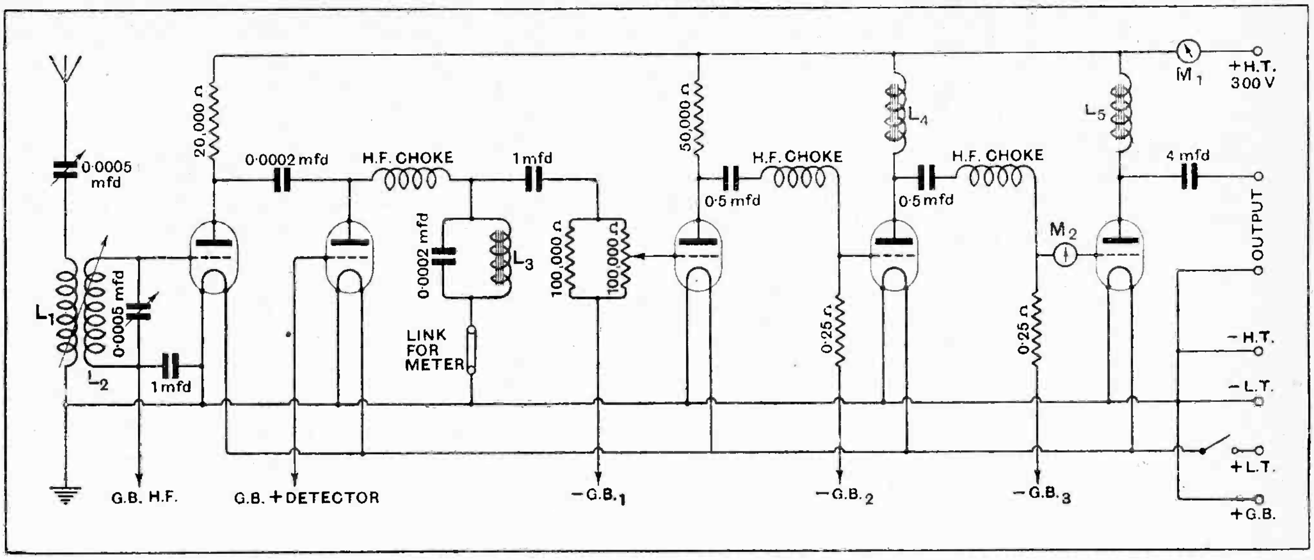


Fig. 1.—Circuit diagram of the demonstration receiver in the Science Museum, South Kensington. The H.F. chokes each consist of 600 turns. L_1 and L_2 are No. 50 coils; L_3=400 henries; L_4=150 to 200 henries; L_5=20 to 30 henries, designed to carry 100 mA. D.C.; M_1 is a milliammeter, range 0 to 100 mA.; M_2, Weston galvanometer. From left to right the first stage valve (H.F.) is of the D.E.5 or D.E.8 class; second stage (Det.) L.S.5B; third and fourth stages (1st and 2nd L.F.), D.E.5; fifth stage (Power), three L.S.5A valves in parallel.

public and semi-public institutions, such as clubs, restaurants, and so on.[3] In this article I propose to describe an assembly which is powerful enough for a large room or small hall. There is nothing unusual about it except perhaps in the nature and extent of the power supply. The aim has been to take the fullest advantage of the many improvements in transmission, reception, and gramophone recording; and, short of obvious absurdities, such as the use of enormous chokes and condensers in an attempt to obtain 99 per cent. amplification at 16 cycles, to spare no effort in the pursuit of this object. The result is naturally imperfect, but some idea of the performance to be expected may be gathered by visitors to the Science Museum, South Kensington, who have heard the B.B.C. demonstration equipment which is installed there.

The design of the receiver and amplifier does, in fact, closely conform to the B.B.C. design, as may be seen by comparing Fig. 1, which is the diagram of the Science Museum receiver, with Fig. 2, which shows the connections of the combination set. Fig. 3 and the photograph

[3] Development has already begun in this direction so far as gramophone reproduction is concerned. In the U.S.A. large auditorium talking-machines having horns up to forty feet in length are being constructed. See *Journal of the Franklin Institute, loc. cit.*

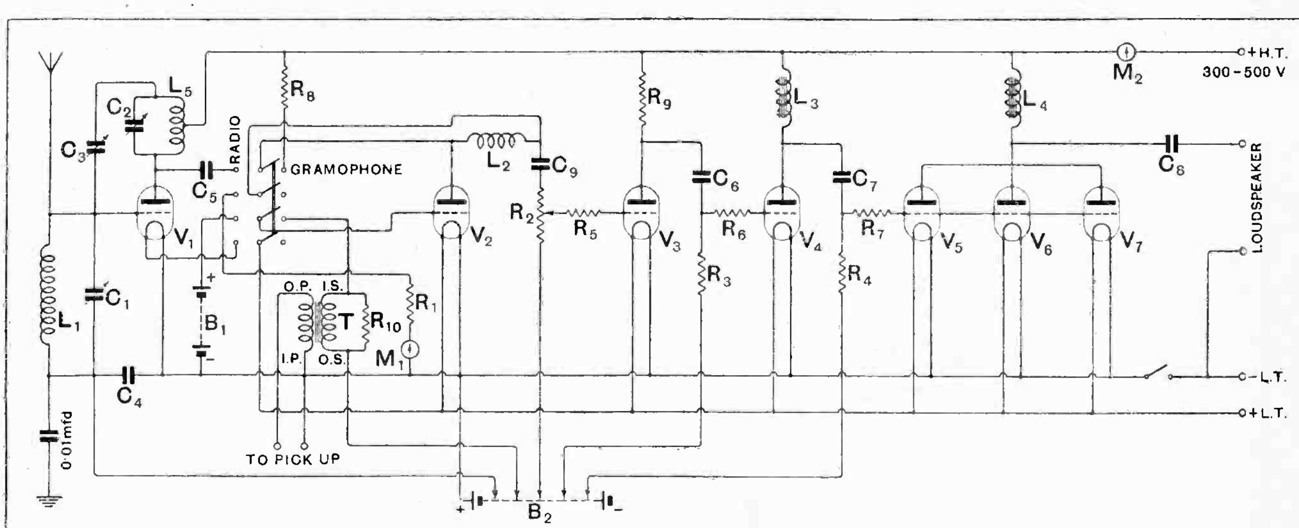


Fig. 2.—Circuit diagram of broadcast-gramophone equipment. L_1, No 50 coil; L_2, H.F. choke (Varley); L_3, L.F. choke, 400 henries (R.I.); L_4, L.F. choke, 32 henries to carry 100 mA.; L_5, centre tapped anode coil; C_1, 0.0005 mfd.; C_2, 0.0003 mfd.; C_3, neutralising condenser; C_4, 1 mfd.; C_5, 0.0002 mfd.; C_6, C_7, 0.1 mfd., working voltage 400 (Camden); C_8, 4 mfds.; C_9, 1 mfd.; R_1, 5,000 ohms, wire wound; R_2, 40,000 ohms, variable (Marconiphone); R_3, R_4, 0 5 megohm; R_5, R_6, R_7, 0.25 megohm; R_8, 150,000 ohms, wire wound; R_9, 40,000 ohms, wire wound; R_{10}, 250,000 ohms; T, Marconiphone "Ideal" transformer ratio 6 : 1 or 8 : 1; B_1, H.T. accumulator, 12 to 14 volts; B_2, dry cell battery, 200 volts; M_1, Weston galvo. (Model 425); M_2, Weston milliammeter, 0 to 200 mA. (Model 301); V_1, V_2, V_3, V_4, L.S.5B valves; V_5, V_6, V_7, L.S.5A valves.

High Quality Reproduction.—

in the title of this article show the general appearance of the set, which was intended to be as presentable as possible. The various grid batteries are carried on a shelf which projects from the back of the cabinet, but all connections to the set are made in front, so that the set itself can be quickly withdrawn.

Receiver Connections.

The components are all mounted on $\frac{1}{16}$in. copper sheet for partial screening. With the change-over switch in the "Radio" position, the connections are those of a conventional neutrodyne H.F. stage, followed by a rectifier of special design, as used in the B.B.C. receiver. The connections for the first three valves are re-drawn in Fig. 4. The rectifier, which was the subject of a patent taken out in 1920, is not as efficient as an ordinary bottom-bend detector, and it requires a preliminary H.F. stage at quite short ranges, but it is practically perfect. It consists of a triode, to the grid of which a positive potential, sufficient to neutralise the space-charge, is applied. In this way the lower portion of the valve characteristic is made approximately straight. It will be seen that this is really a special case of two-electrode rectification, the operation of which is practically linear. With such a rectifier, one hundred per cent. of linear modulation at the transmitter could cause no distortion. The low-frequency amplifier, which is used both for broadcasting and for gramophone reproduction, comprises two stages of resistance coupling, a choke-coupled stage, and three output valves arranged in parallel with choke feed to the loud-speaker. Examination of Fig. 2 will show how the detector valve is arranged to act as an additional low-frequency amplifier for gramophone reproduction. This extra amplification is not necessary with an efficient pick-up device, but it has been found useful when experimenting, as the amplifier will deal with very weak inputs.

Resistances of 0.25 megohm are inserted in series with each grid. The purpose of these resistances, the use of which is due to Capt. Round,[4] is to prevent the application of H.F. voltages across the grid filament capacities of the valves. These capacities are so small that no appreciable current flows through them at low frequencies, and no potential is, therefore, developed across the resistances. A variable resistance arranged as the first grid leak provides a convenient volume control. It must not be reduced in value below about 1,000 ohms, or there will be a 50 per cent. drop in amplification at 50 cycles.

The H.T. supply was originally derived from small 300-volt accumulators, but, as the current taken was about 100 mA., it was necessary to recharge them at frequent intervals. A firm was therefore asked to supply a double-current motor generator to work off 200-volt D.C. mains and to give the following outputs:—

H.T.—Up to 500 volts 250 milliamperes.

L.T.—Up to 10 volts 10 amperes.

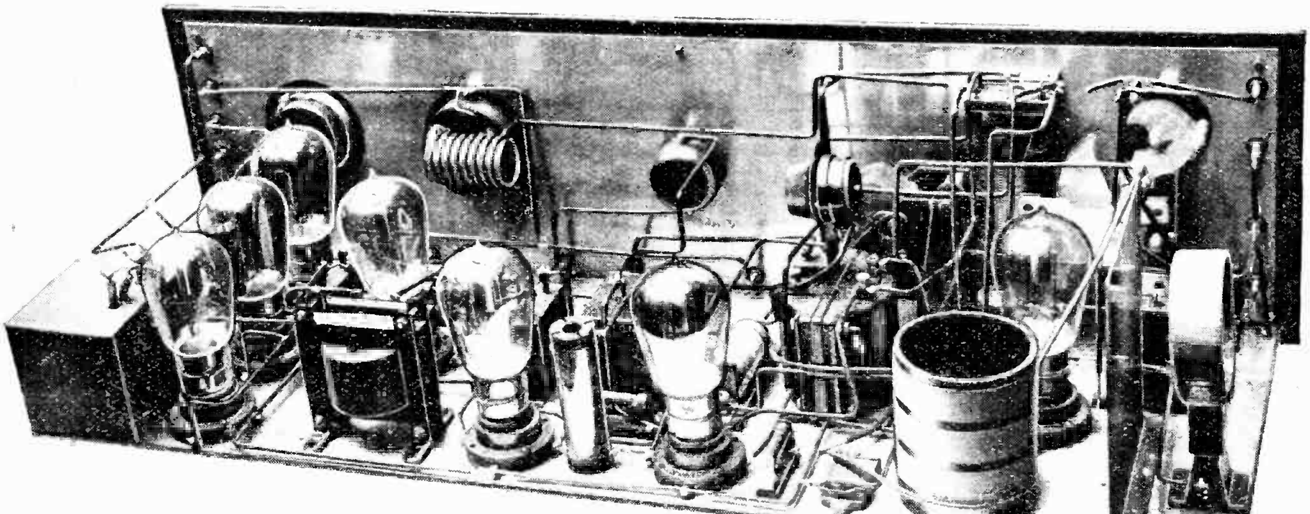


Fig. 3.—Interior of combination set showing layout of components. Note metal screen behind panel.

This was in excess of requirements at the time, but the ability to obtain these large outputs has proved extremely useful, for it is possible to work at greater efficiency with L.S.5A valves if the H.T. voltage is in the neighbourhood of 500.[5]

Choice of Valves.

The use of such a voltage throughout the set makes it desirable to use high-vacuum valves of the L.S.5 and L.S.5B types on a filament voltage of from 5 to 6, and this involves a total filament current of about 6 amperes. The high cost of the L.S.5 types is admittedly a grave disadvantage, but the use of D.E.5 and D.E.5B valves on a high anode voltage cannot be advised. Fig. 5 gives the generator connections. An old and decrepit 6-volt accumulator is floated across the L.T. side, with a Ford cut-out connected as shown to prevent it from motoring the generator when this is switched off.

[4] See *Experimental Wireless*, August, 1926, p. 502.

[5] E. Green; "Use of Plate Current—Plate Voltage Characteristics in Studying the Action of Valve Circuits." *Experimental Wireless*, August, 1926, p. 469.

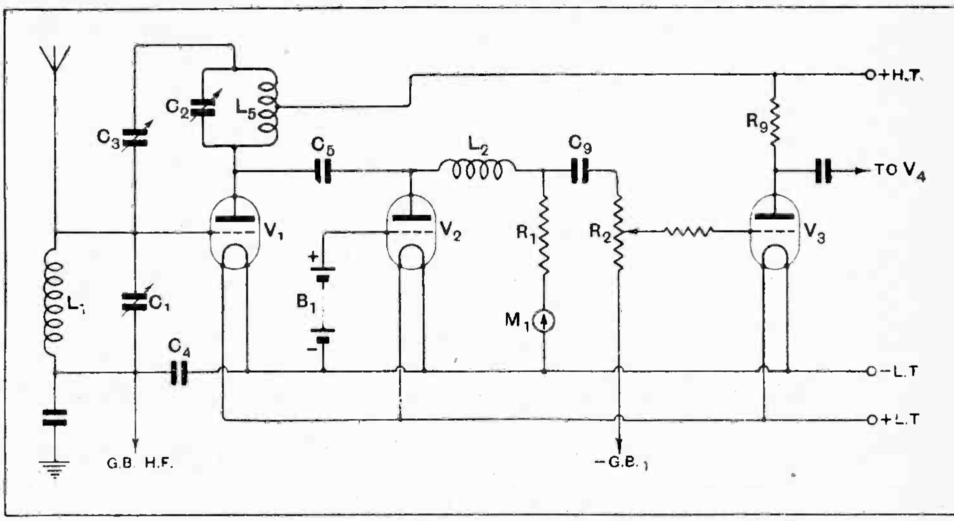


Fig. 4.—Schematic diagram of first three valves for broadcast reception.

High Quality Reproduction.—Almost any accumulator will do, and will save considerable expense in large smoothing chokes.

When the change-over switch is in the "gramophone" position, the leads from the pick-up (which if over a few feet in length should be run in earthed lead-covered cable) are taken through a 6 : 1 or 8 : 1 "Ideal" transformer to the detector valve, now arranged as an additional amplifier. Since this transformer is not preceded by a valve it has a rising characteristic unless it is damped by a resistance, which, placed across the secondary, should have a value of 100,000 ohms, unless it is preferred to fit a resistance variable up to about 250,000 ohms to give a measure of control over the high frequencies.

How far have we already departed from the ideal of distortionless working? We have first a pair of tuned H.F. circuits, involving a slight cut-off at the highest audio-frequencies. The rectifier is sensibly perfect. The coupling condensers and grid-leaks give us

$$\frac{R}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} \times 100 \text{ per cent. per stage}$$

of the total amplification available, or about 98 per cent. per stage at fifty cycles; say 96 per cent. overall. The 400-henry choke (L_3), used with a valve of 30,000 ohms anode resistance, involves a drop in amplification at fifty cycles down to

$$\frac{\omega L}{\sqrt{R^2 + (\omega L)^2}} \times 100 \text{ per cent.},$$

or about 98 per cent., thus reducing the total overall figure to 94 per cent.

Valve capacities and so forth will affect the high frequencies to some slight extent, but we may assume that all these effects will be negligible in comparison with the droop in the loud-speaker response curve at these extremes.

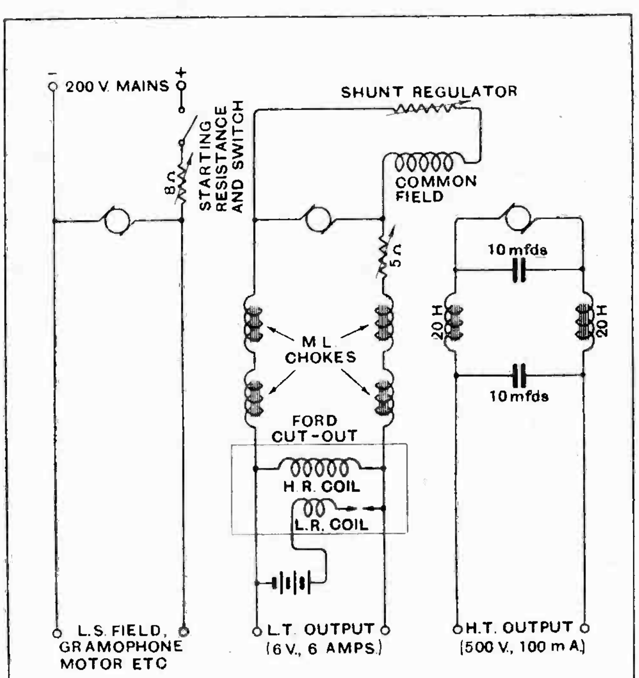


Fig. 5.—Connections of D.C. motor-generator.

Pick-up Devices.

The difficulties which confront the designer of a gramophone pick-up device are similar to those encountered in the early days of broadcasting microphones; but they are lessened because :—

(*a*) Energy is collected from what is virtually a point-source (*i.e.*, the record-groove), and large resonant diaphragms are therefore not required.

(*b*) The source acts as a positive drive; *i.e.*, the needle is constrained to follow the groove which has been prepared for it.

All sorts of pick-up devices have been used, from the carbon-button microphone to the piezo-electric effect; but apart from electrostatic pick-ups (which offer attractive possibilities in lightness of moving parts, but poor hopes of efficient working on account of the small changes of capacity obtainable) the moving-coil and moving-iron methods are probably the best to employ.

Since some sort of needle is at present indispensable, it is obvious that any design must take account of mechanical resonance effects associated with the needle and its attachments. There are two, and only two, ways of dealing with this. The more elegant and scientific way is to call to one's aid the valuable "matched impedance" or "mechanical transmission line" principle of the Western Electric Company. This method is employed in the design of the all-mechanical gramophones of

High Quality Reproduction.—

the Victor Talking Machine and "H.M.V." Companies, and has the effect of giving an even response, coupled with high mechanical efficiency, which in turn means less wear on the record. In electrical reproduction an efficient pick-up is very desirable, but it is not so important as high quality, since in any case with loud-speakers of 1 per cent. efficiency we cannot yet dispense with an amplifier. The design of a matched-impedance pick-up is fraught with great difficulty. The writer was fortunate enough to have a friend who, with infinite patience, worked out a design for one of these. It took weeks to calculate and over one hundred hours of highly skilled work to construct. In the end a cut-off in the higher frequencies was encountered, owing to an unforeseen circumstance connected with the magnetic circuit. A photograph of this pick-up is shown in Fig. 6. The steady field is supplied by an electro-magnet, and the audio-frequency coil, which measures only ⅛in. in diameter, contains 5,000 turns of No. 47 S.W.G. enamelled wire.

There is no doubt that for the amateur a damped resonant arrangement is preferable. Very good quality can be obtained, and the efficiency can be made surprisingly high, judging by the results given by the "Panatrope," which has only two stages of amplification. There is, moreover, one definite advantage which this type of pick-up has over the matched-impedance type. The latter, being undamped, transmits a considerable amount of vibration to the air direct, and is apt to set up a disagreeable noise which is audible even when the lid of the machine (if any) is closed. A damped resonant pick-up is much quieter. If a moving-iron instrument is to be used, the natural frequency of the reed should be high. It can be made to lie somewhere in the region of from 2,000 to 4,000. The overtones elicited when such a reed is in free vibration may be calculated on the assumption that the system approximates to that of a bar free at one end and supported at the other. This in turn may be regarded as one-half of a free-free bar—*i.e.*, a bar free at both ends—vibrating with a central node, and the first and second overtones will then have frequencies corresponding to 3.3 and 6.76 times the natural frequency. These are enharmonic intervals of about one octave and a fourth, and two octaves and rather more than a fourth respectively, and they are obviously most undesirable. By placing the fundamental resonance high in the scale and damping the reed properly the effect can be made negligible.

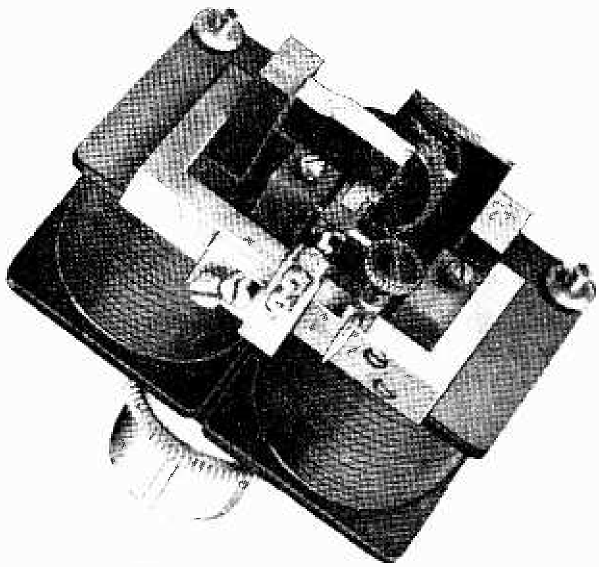


Fig. 6.—Pick-up device designed on the "mechanical transmission line" principle.

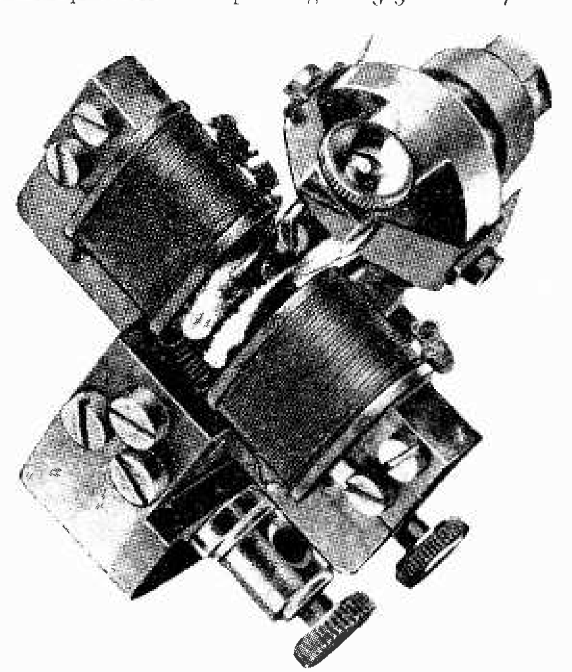


Fig. 7.—Experimental pick-up designed by the author.

Rubber appears to be the favourite damping material, and it certainly gives extremely good results, but probably no mechanical damping is perfect (*i.e.*, linear with frequency). The effect of grease damping definitely increases with frequency and there is thus a cut-off in the upper register, as those who may have experimented with the pick-up described in a former article will have noticed. It is known that a series of very thin sheets of paper gives a close approximation to linear damping, the air entrapped between the sheets being forced out as these are compressed. A simple and effective method is therefore to pack the space between the reed and the pole-pieces with layers of tissue-paper.

An experimental pick-up which has given very good results is illustrated in Figs. 7 and 8, and is shown in the playing position in the photograph in the title of this article. One pole of the permanent horse-shoe magnet carries a double pole-piece on which are mounted two 1,000-ohm telephone bobbins. The other pole terminates in the reed-mounting, an enlarged view of which appears in Fig. 8. The reed is pivoted and is fastened by a screw at the top to a strip of fibre which is kept in tension by means of screws on either side of the mounting.[6]

[6] This device is due to Mr. J. B. Woodroffe, of 93, Harwood Road, S.W.6, who is prepared to supply pick-ups of his own design to readers of this journal.

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The effect of this is to allow a fairly free movement of the reed for the few thousandths of an inch over which it is required to travel, but to exert sufficient restoring force to keep it in a mean central position when moved across the record. Any further damping is best introduced by strips of tissue paper inserted between the reed and the pole-pieces, as shown in Fig. 7.

From the point of view of quality, this pick-up is as good as any I have tried, but it is necessary to adjust the paper damping with some care.

Fig. 9 is a photograph of the pick-up used on the "Panatrope" by the British Brunswick Co., to whom I am indebted for permission to describe it.

The component parts are illustrated in Fig. 10. A strong permanent magnet A has two soft-iron pole-pieces B_1, B_2; B_1 forming an upper and a lower North pole and B_2 an upper and lower South pole respectively. The needle-adjusting screw C of the reed D is inserted in the end of the square shaft E ($\frac{3}{16}$in. long × $\frac{3}{32}$in. square), which is wrapped round with thin rubber and forms the axis about which the reed vibrates. It is carried in square bearings F formed in the two lower portions of the pole pieces. The audio-frequency coil G surrounds the reed, which plays between adjustable rubber stops. One of these is shown in Fig. 10. They are carried on brass washers, which fit loosely over the threaded posts I. Pressure on the reed is adjusted by turning the milled edges of the two eccentric face-cams J. A brass cover-plate K is fitted over the front of the pick-up. The action is easily followed. When the needle moves to the left the direction of the flux is from the lower (left-hand) North pole upwards through the reed to the top (right-hand) South pole. When the needle moves to the right the direction of the flux is downwards through the reed from the upper North pole to the lower South pole. An alternating E.M.F. is therefore generated in the audio-frequency coil.

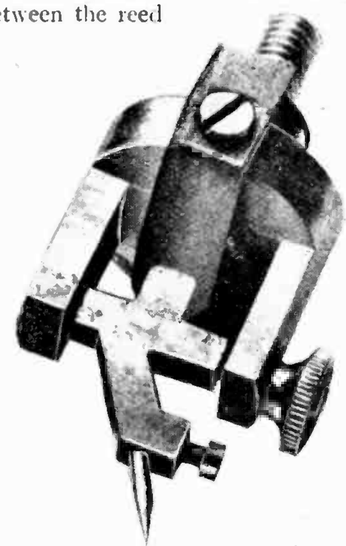

Fig. 8.—Reed movement of pick-up device illustrated in Fig. 7.

The reed is $\frac{5}{8}$in. in length. The portion within the coil is $\frac{1}{8}$in. square, while the top is $\frac{1}{4}$in. wide and only 21/1,000 in. thick.

The fact that the bearings and axis of vibration of the reed are square is curious, and is perhaps intended to ensure that the rubber is compressed at right angles to its surface. The arrangement of the needle-adjusting screw on this axis is an excellent feature of the design. A note concerning the first demonstration of this instrument appeared in *The Wireless World* for October 13th, 1926. Those who have heard the "Panatrope" will not need to be told that the quality is remarkable.

Scratch Filters.

The possibility of eliminating "surface-noise" or needle scratch in an electrical system is attractive, but it is generally held nowadays that perfect reproduction would call for the inclusion of all frequencies up to 10,000, and there is probably little scratch at higher frequencies than this. Now, difficulties involved in getting the wax clear of the cutting tool when the angles become very acute, set an upper limit (with present turntable speeds) of something like 6,000 to the frequencies actually recorded, and this must have the effect of reducing the scratch introduced at this stage. In the "Panatrope" an acceptor circuit tuned to 6,000 cycles is shunted across the pick-up, and it is obvious that a more elaborate low-pass filter circuit may be used to eliminate all frequencies above those actually recorded, with the object of cutting out any scratch originated in the reproducing system proper, due to the different combination of needle and wax employed there. For example, the network shown in Fig. 11 might be connected experimentally between V_3 and V_4. This is a two-section low-pass filter with mid-shunt termination, designed to work into the given resistance of 500,000 ohms. The nominal cut-off frequency is 7,000, but attenuation will begin somewhat below this frequency. With the same output resistance, the values of L_6, L_7, and C_{11} for any other cut-off frequency f_c will be given by:—

$$L_6 \text{ and } L_7 = \frac{150{,}000}{f_c} \text{ henries}$$

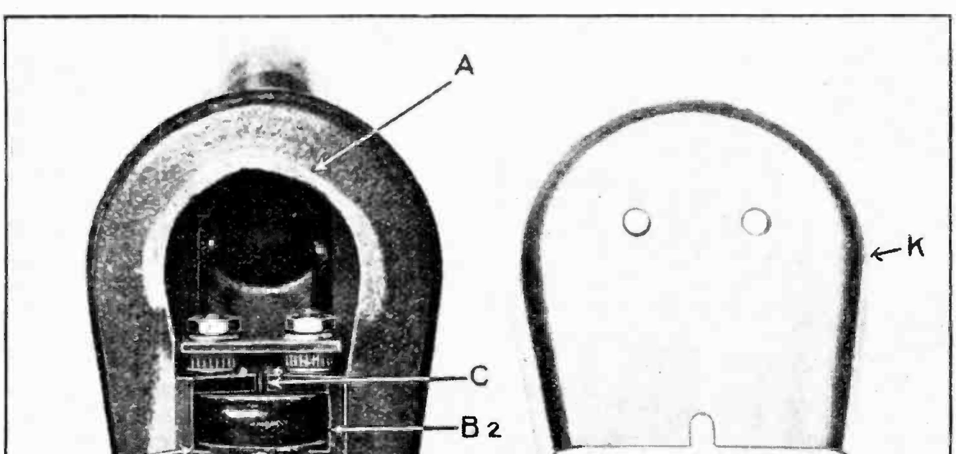

Fig. 9.—"Panatrope" pick-up device designed by the British Brunswick Company.

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and

$C_{11} = \frac{0.6}{f_c}$ mfd., respectively, while $C_{12} = \frac{1}{2}C_{11}$; and C_{10} is best made equal to 0.8 times C_{11}.

It should be borne in mind, however, that waning efficiency in the pick-up, amplifier, and loud-speaker conspire to reduce the response at high frequencies in any case, and even without a filter circuit there is much less scratch than one would expect.

With regard to fibre needles, these are wrong in theory unless a complete pick-up is designed for them on the mechanical transmission line principle, the masses and compliances being matched with those of a typical needle. This, of course, amounts almost to an absurdity, and in all other cases, scratch or no scratch, a stiff needle is required and will give the best results.

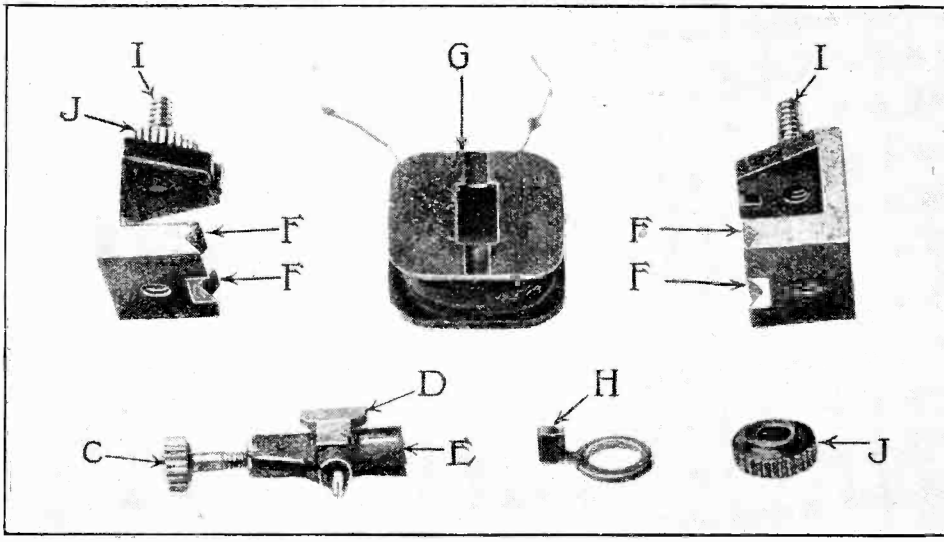

Fig. 10.—Dismantled portions of the "Panatrope" pick-up.

Loud-speakers.

The loud-speaker is of the free-edge, coil-driven cone type.[7] The particular instrument used was designed by Dr. N. W. McLachlan, to whom I am indebted for much friendly help. Fig. 12 shows the loud-speaker mounted behind a hole cut in the door of the author's workshop. Fig. 13 shows the movement.

Dr. McLachlan has already described his loud-speaker on one or two occasions,[8] and further valuable information will be found in a book by him which will shortly be published,[9] so that it is only necessary to say here that I have found it satisfactory to wind the moving coil to suit the impedance of the output stage, rather than to use a transformer, which presents a problem in design not likely to be soluble at the first attempt.

Assuming that three L.S.5A valves are used in parallel, their A.C. resistance is about 900 ohms. It was therefore decided to wind 1,000 turns of No. 47 S.W.G. enamelled wire on a two-inch moving coil former. The D.C. resistance of this came out at about 1,300 ohms. The impedance was measured at various frequencies with the following results :—

Frequency.	R (ohms).	C in parallel.	L in series.	1 ωC or ωL.
50	10,000	1 mfd.	—	3,180 ohms
100	2,500	0.6 mfd	—	2,660 ohms
200	1,500	0.15 mfd.	—	5,320 ohms
550	1,400	—	0.10 H.	345 ohms
1,000	1,580	—	0.112 H.	710 ohms
3,000	2,000	—	0.09 H.	1,130 ohms

The second column represents the sum of the D.C. resistance, and what may be termed the useful or (electrical) radiation resistance. In the first three measurements the impedance was treated as that of a condenser in parallel with this resistance, and in the last three as that of an inductance in series. The last column gives the calculated value of the out-of-phase component of the impedance at the frequency named.

The value of 10,000 ohms for R at 50 cycles suggests that resonance is present, but at this very low frequency it is probably far from harmful. Measurements made on the current in the moving coil show that this is not less than 40 per cent. or so of the maximum at all frequencies down to 40 and up to 6,000 or 7,000, and there is a definite acoustic output from 40 up to 9,000 and over.

It is not easy to overload a well-designed coil-driven loud-speaker, but the amplifier requires more attention in this respect. When this, too, has been properly designed, it is possible to deceive a musical person into thinking that the tiny seven-inch cone is a full orchestra playing only twenty or thirty yards away. I make this statement with a due sense of responsibility; the incident has actually occurred. It is not that the reproduction is

[7] This type of loud-speaker was first described by Messrs. Rice and Kellogg. See *Journal of the American Institute of Electrical Engineers*, September, 1925, p. 982.

[8] See *Experimental Wireless*, March, 1926, p. 152.

[9] Now in the Press and shortly to be announced by the publishers of *The Wireless World*, Iliffe & Sons Ltd., Dorset House, Tudor Street, E.C.4, under the title "Loud-Speakers."

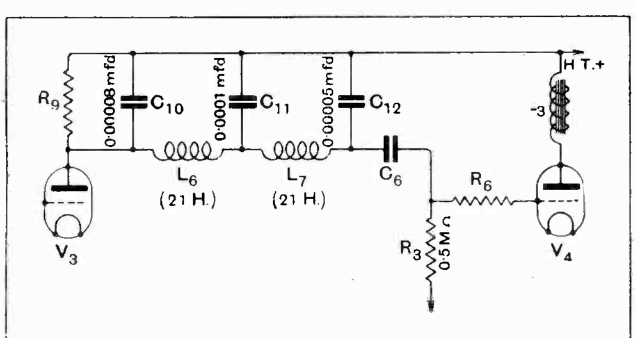

Fig. 11.—Filter circuit for eliminating "scratch" noises. The cut-off frequency is approximately 7,000 cycles.

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perfect—that is, of course, ridiculous. The point is that complete illusion is possible, given the right conditions. But let suspicion be aroused for an instant, and this illusion will vanish. Even if we could achieve the ideal of perfect, stereophonic reproduction, the knowledge that what we heard was only a reproduction would probably rob us of the fruits of victory.

Conclusion.

As was pointed out at the beginning of this article, good quality is expensive, chiefly because it involves an adequate power supply. Although the power used in the final stage of this set is about fifty times the amount consumed in an average "power valve," it must not be inferred that the *loudness* is fifty times as great (whatever that may mean), or still less that the loud-speaker will be audible at fifty times the distance. It is certainly possible to obtain an impressive volume, but when it is remembered that the peak values in recorded music are often six times the average value for the whole record, and that most broadcast sets are adjusted in such a way that the final stage is at least slightly overloaded at these peak values, it will be seen that the primary value of any additional power is not to increase the volume, but to take care of the peaks. What is left over is available for a general increase in volume, but even so there is a distinct temptation to overstep the limits of grid-current and bottom-bending. There is this consolation, however, that such distortion is less noticeable at large intensities and in complicated orchestral passages. Distorted dance music in particular will often be accepted without protest by that much-put-upon organ, the human ear, whereas the purer tones of Bach or Mozart must be accorded all the respect due to them, for any alien tones introduced by the valves will be unable to find cover under a cloud of modern harmonies.

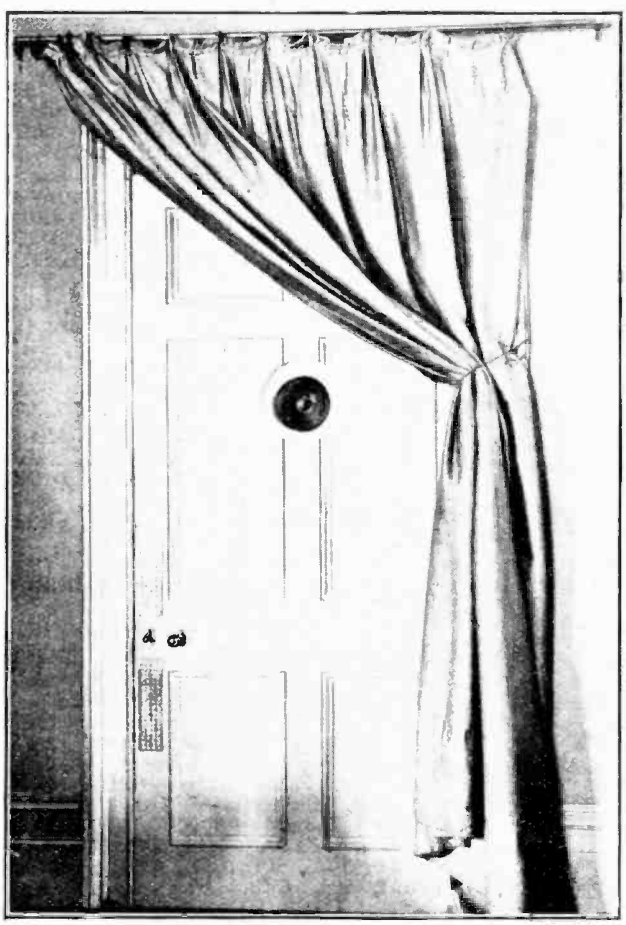

Fig. 12.—Coil-driven cone loud-speaker mounted in door which acts as baffle.

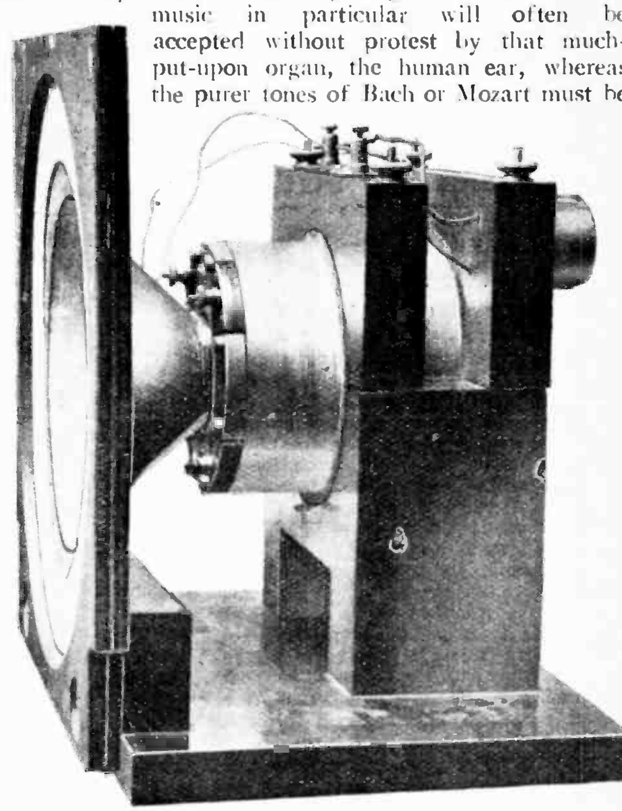

Fig. 13.—Movement of coil-driven loud-speaker.

In conclusion, as some may wish to know the general effect of various departures from the standards advocated in this article, I append a few notes:

1. The anode voltage may be reduced from 500 to 400 or to 300 with only a moderate loss of volume, since the input *power* can be kept up to 10 watts per valve and only the *efficiency* is slightly reduced. The 1,000-turn moving coil is suitable for an output stage consisting of two or three L.S.5A valves at this voltage. It is also possible to use D.E.5B's in the previous stages, but they will have rather a short life, as 300 volts is still well above their normal rating.

2. Instead of the special rectifier shown in Figs. 2 and 5, a bottom-bend rectifier may be used and will be much more efficient. In all probability it will be hard to detect any difference in quality.

3. A reed-driven cone, such as the large (36in.) or small Western Electric-Standard-B.S.A. instrument, may be used with excellent results in place of the coil-driven free-edge cone, but the coil drive and baffle have advantages which it would be idle to deny. If any type of horn loud-speaker is to be used, see first of all if it is

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capable of any useful radiation at, say, 100 cycles, by fitting a properly designed horn.[10]

4. If a variable resistance is shunted across the pick-up as a volume control, it will cut off the high frequencies. Use a variable grid leak as shown in Fig. 2, or, better still, a tapped anode resistance.

5. If the amplifier tends to oscillate (which may occur if it has not been screened), small condensers of about 0.0001 mfd. may be connected from one or more anodes to earth, and across the input transformer secondary, without much detriment to quality; but this should be done only as a last resort.

My best thanks are due to the General Electric Company for the loan of valves, and to the Development Section of the B.B.C. for many valuable suggestions.

[10] See "The Design of Loud-speaker Horns," by Capt. H. J. Round, *Modern Wireless*, October, 1926, p. 501.

TRANSMITTERS' NOTES AND QUERIES.

General Notes.

In view of the anticipated rapid growth of Transatlantic wireless telephony and the probability that public telephony will eventually be extended in other directions, it is, perhaps, necessary to warn correspondents not to send us any quotation or extract from messages overheard.

One of the conditions under which a receiving licence is granted is:—

"The Licensee shall not divulge or allow to be divulged to any person (other than a duly authorised officer of His Majesty's Government or a competent legal tribunal) or make any use whatsoever of any message received by the station other than time-signals, musical programmes, and messages sent for general reception and messages received from a licensed experimental station in connection with experiments carried out by the Licensee."

oooo

Mr. G. Gore (G 5DA) is no longer using his station at Berwick-on-Tweed, but is temporarily transmitting from 192, Heathfield Road, Handsworth, Birmingham. He expects soon to move to a permanent address in London.

oooo

Mr. J. Egremond (G 5MX), 40, Northlands Road, Southampton, wishes to get into touch with another transmitter who will co-operate with him in experiments on the 150-200 metre waveband.

oooo

Mr. C. L. Champion (G 6CP) has been given a special permit for high power tests on 10, 12, 15 and 18 metres, as well as his present wavelengths of 8 and 23 metres.

oooo

Mr. E. Megaw, whose station GI 6MU, at 3, Fortwilliam Drive, Belfast, is one of the best known and most active in Northern Ireland, informs us that since Christmas he has been working on a daily schedule with Y DCR, R. J. Drudge-Coates, at Rawalpindi, with very interesting results. Two-way communication has been established between these two stations on telephony and C.W. with powers as low as 2.5 watts.

Y DCR reported that 6 MU's telephony was also received clearly by Y 2BG at Assam.

Mr. Megaw, during the first week of the New Year, has also worked with stations in all five continents, including Z 4AA at Dunedin and FI 8FQK in Saigon.

oooo

We understand from Mr. A. J. Scott-Dack, who is at present on board R.M.S. *Oronsay*, that a special series of transmissions has been arranged by the Farmers' Broadcasting Service of Sydney, N.S.W., from their station 2FC on 442 metres at 7 a.m. Sydney time on January 24th to 27th (9 p.m. G.M.T. on January 23rd, 24th, 25th and 26th), the power used being about 10 kw. Mr. Scott-Dack, who is going to use an "Everyman Four" receiver in his own attempt to pick up this station, will be pleased to hear from any other readers who succeed in hearing these special transmissions. His permanent address is 17, Salisbury Road, Harrow.

oooo

Calls Heard.

We would ask those readers who so kindly send us extracts from their logs to type the call-signs in capital letters, as it is sometimes difficult to determine whether a small "l" represents the figure "1" or the letter "L," and, even with the best intentions in sub-editing, mistakes will occasionally occur.

oooo

Belgian Amateurs.

We understand from our Belgian correspondent that the Reseau Belge is still urging the Government to give their transmitting stations the call-signs 3AA to 3ZZ, so that there may be no chance of confusion with the new German call-signs 4AA to 4ZZ. The Belgian Ministry of Posts, Telegraphs, and Telephones is said to be favourably considering this matter.

oooo

New Call-signs Allotted and Stations Identified.

G 2DL R. H. Lauderdale, 3, High Street, Penge S.E.20; transmits on 45 and 170 metres and will welcome reports from all parts.

G 2FD (ex 2ABY), F. W. Davies, 57, Peter Road, Walton, Liverpool; transmits on 23, 45 and 90 metres.

G 5MX J. Egremond, 40, Northlands Road, Southampton.

G 6WI (ex 2BOR), T. S. Wilkin, 102, Lisle Road, Colchester.

G 2AHC F. C. Rand, 5, Melbourne Grove, East Dulwich, S.E.22.

D 7FJ A. J. Faurhöj, 5, Humlebackgade, Copenhagen, Denmark.

oooo

QRA's Wanted.

G 5OU, B NOTH, DNSC, SKRBP, F BERRI, F OMEGA, S IVR, K LLO, LW SIN1, FJHP, GFUP.

Calls Heard.

Extracts from Readers' Logs.

Rawalpindi, India.

(November-December.)

Great Britain:—G 2CC, 2BP, 2NH, 2IT, 2XY 2VQ, 2NM, 2BI, 5TZ, 5HS, 5KZ, 5MA, 5IS, 5FQ, 5VL, 5MQ, 5WQ, 5SZ, 5LB, 6RE, 6OG, 6MU, 6RG, 6BR, 6IA, 6YD, 6NF, 6AR, 6BD. Australia:—A 2RX, 2BB, 2YI, 2YX, 3DC, 3BQ, 3PX, 3MA, 3TM, 3KN, 3EN, 5GQ, 5HG, 5DA, 5WH, 5LF, 5RM, 5KX, 6MU, 6GB, 6BU, 6AG, 7AA, 7CW, 7DX, 7CS, 7BQ. Belgium:—B Y8, B7, O8, V33, OH, CH5, B82. Denmark:—D 7MT, 7XF. France:—F 8EN, 8EA, 8BU, 8JRT, 8MN, 8ZMM, 8BA, 8CP, 8YOR, 8DK, 8LGM, 8KG, 8IF, 8CA, 8VL. Italy:—I 1BW, 1CO, 1MC, 1PN. Japan:—J 3AZ, KZB, 1OZ, 1TS. Germany:—K 4UHU, 4MCA, 4ABG, 4ACA, 4YAE, 4ABR. Sweden:—SMTN, SMUK, SMUV, SMVL, SMSH, SMWR, SMXV, SMXP, S2ND, S2NL, SDK, SPM. Holland:—N OPM, OAZ, OQQ, OWR, OFP. Philippine Islands:—PI 3AA, 1HR, 1BD, 1DL, 8AA, 3AC, WUAJ. U.S.A.:—U 9MC, 2CRB, 6DAT, 6BUC, 6CUC, 6CVW. South Africa:—O A3E, A5Z, A5X, A3Z, A4L 1SR. Austria:—Ö HL, KE. Miscellaneous:—SS3SE, TPAV, KEL, BNSK1, BNSK2, PK1, TPAW, OXZ, DNSC, 1B, LIT1B, P9AB, LA1E, QST, CS2YDC, 1DH, GWLK, SPMA, SKTR, R1NN.

(0-v-1 Reinartz.)

R. J. Drudge-Coates (Y DCR).

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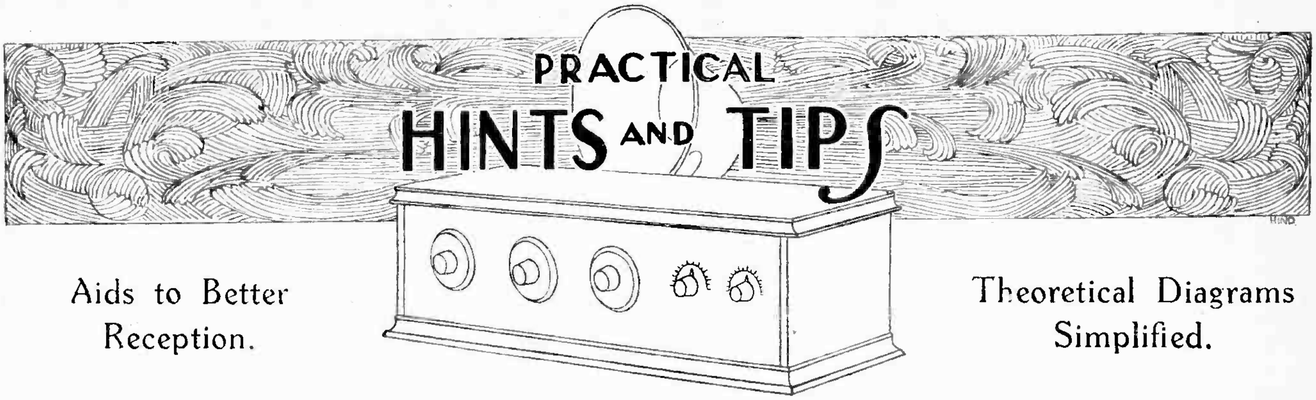
E. Dulwich, S.E.22.

Spain:—EAR6, EAR9, EAR18, EAR19. France:—F 8IL, 8CP, 8QRT, 8BP, 8OEO, 8DD, 8JD. Germany:—K 4XR, 4AP, 4YAE, 4XW. Belgium:—B K44, H5, O5, S5. America:—U IAAX, IEU, WIK, WIZ. Sweden:—SMUK, SMVG. South Africa:—O A5X, O AS, O A6N. Denmark:—D 7JO, 7BD, 7AW, 7ZG. Holland:—N OVV, 2PZ. Great Britain:—G 2AK, 5MS, 5KZ, 5US, 5XY, 5AD, 5HY, 6OO, 6XL, 6YQ, 6ZA, 6IO, 6AI, 6CL, 6VP. Northern Ireland:—2IT, 6MU. Miscellaneous:—SUC, OXUA, KTC, PCRR, PCMM, PCTT.

(0-v-1 Reinartz) On 20 to 200 metres.

E. P. T. Miles.



Aids to Better Reception.

Theoretical Diagrams Simplified.

HIGH-EFFICIENCY COILS.

It should be made clear that there is little advantage to be gained by connecting a coil of extremely high efficiency directly in series with the aerial and earth. The resistance which must inevitably exist in this circuit is likely to exceed very considerably that of even an indifferent inductance.

The good effects of low-resistance coils are only appreciable when they are used in a lightly damped circuit; for example, it is easy to see that the secondary winding of an H.F. transformer (comparatively loosely coupled to the primary) and connected between grid and filament of a negatively biased valve, will be almost undamped. This is one of the most obvious applications of the low-resistance coil.

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OVER-AMPLIFICATION.

The use of three stages of L.F. amplification may, for ordinary domestic purposes, be considered as dangerous, due to the risk of introducing distortion by overloading. In the days of comparatively inefficient valves and couplings there may have been some justification for such an arrangement, but it is now certain that any signal worth amplifying will give sufficient volume—as much as any ordinary "power" or "super-power" valve can handle—with only two stages, always providing that suitable components are used. These remarks apply equally to transformer and resistance amplifiers.

A really accurate estimation of the grid voltage swings likely to be dealt with is a matter of some difficulty, and, in any case, even assuming that we have the necessary apparatus for measuring the high-frequency voltage set up across the grid and filament of our detector valve, it will be necessary to ascertain the average percentage of modulation at the transmitting station before we can arrive at even an approximate idea of the voltages likely to be impressed on the grids of the successive valves in an amplifier. In spite of the difficulty of making accurate calculations it is, however, quite possible, without going deeply into the subject, to form a good idea of what is happening at each stage under certain stated conditions, and it is interesting to trace the progress of signal impulses through a chain of amplifying valves. Even a superficial consideration of this matter will show that the use of three L.F. stages is likely to give rise to serious overloading.

Referring to Fig. 1, which shows in the simplest "skeleton" form a conventional arrangement in which the first valve (V_1) operates as a "bottom bend" or anode rectifier and the remainder as resistance-coupled L.F. amplifiers, it is assumed that the modulated high-frequency input from the aerial (or H.F. amplifier) has a value of 0.5 volt. Now, this cannot be considered as a very robust signal; in fact, an examination of a typical valve curve will show that a very much weaker signal will not be rectified efficiently, and, moreover, for reasons which need not be entered into here, it is doubtful if rectification of such small voltages will be reasonably distortionless. It is, in any case, fairly safe to assume that a high-frequency voltage of half a volt represents the smallest input likely to be dealt with when the object is to obtain high-quality reproduction.

If the detector valve is of the modern "high-amplification" type, it is reasonable to assume that an amplification of 20 will be obtained from the first stage. Thus, allowing a modulation of only 10 per cent. at the transmitting station, an L.F. voltage of about 1 volt will be set up across the grid and filament of the first L.F. valve (V_2). This will probably be of the same pattern as the detector, so, again allowing a magnification of 20, we get a pulsating signal voltage of 20 on the grid

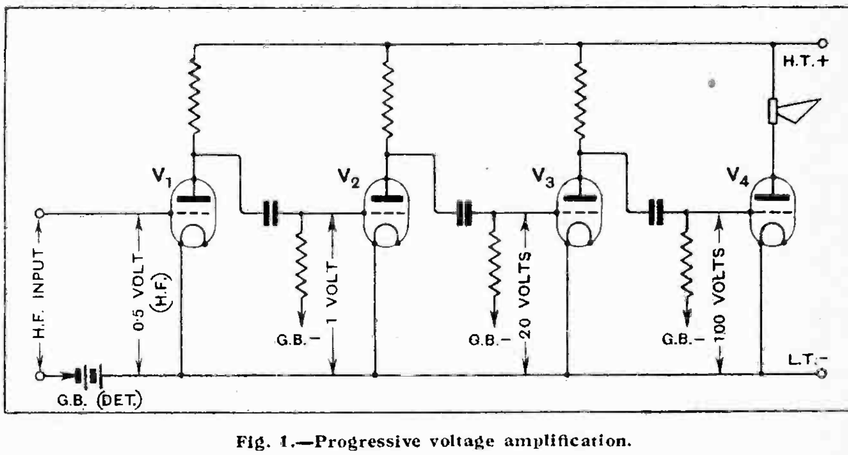


Fig. 1.—Progressive voltage amplification.

of the second amplifier (V_3). This is quite as much as can be handled by the ordinary power valve, which, it should be realised, will, when correctly biassed, deal with voltages twice that of the bias applied; this is certainly not likely to exceed 10½ volts, and will probably be less.

From the foregoing it will be clear that, unless we are willing to instal a "super-power" valve, further amplification is quite unnecessary, and a third L.F. valve is not required, even to deal with the comparatively weak input signal under consideration; V_3 may, therefore, be made the output valve, with the loud-speaker in its anode circuit. Should stronger signals be desired, it would seem preferable to increase the input voltage when necessary by making use of high-frequency amplification, rather than by adding a third L.F. valve. Moreover, it must be remembered that leaky grid rectification and transformer coupling will give greater amplification of weak signals.

Referring again to the diagram, we will imagine that the third L.F. amplifier (V_4) is connected up as shown. Allowing an amplification of 5 from the preceding stage, we get a voltage of 100 on the grid circuit; this can only be handled by a valve of the L.S.5*a* type with 50 volts bias and several hundred volts on the plate. Comparatively few amateurs are willing to make arrangements for the supply of current to such a valve.

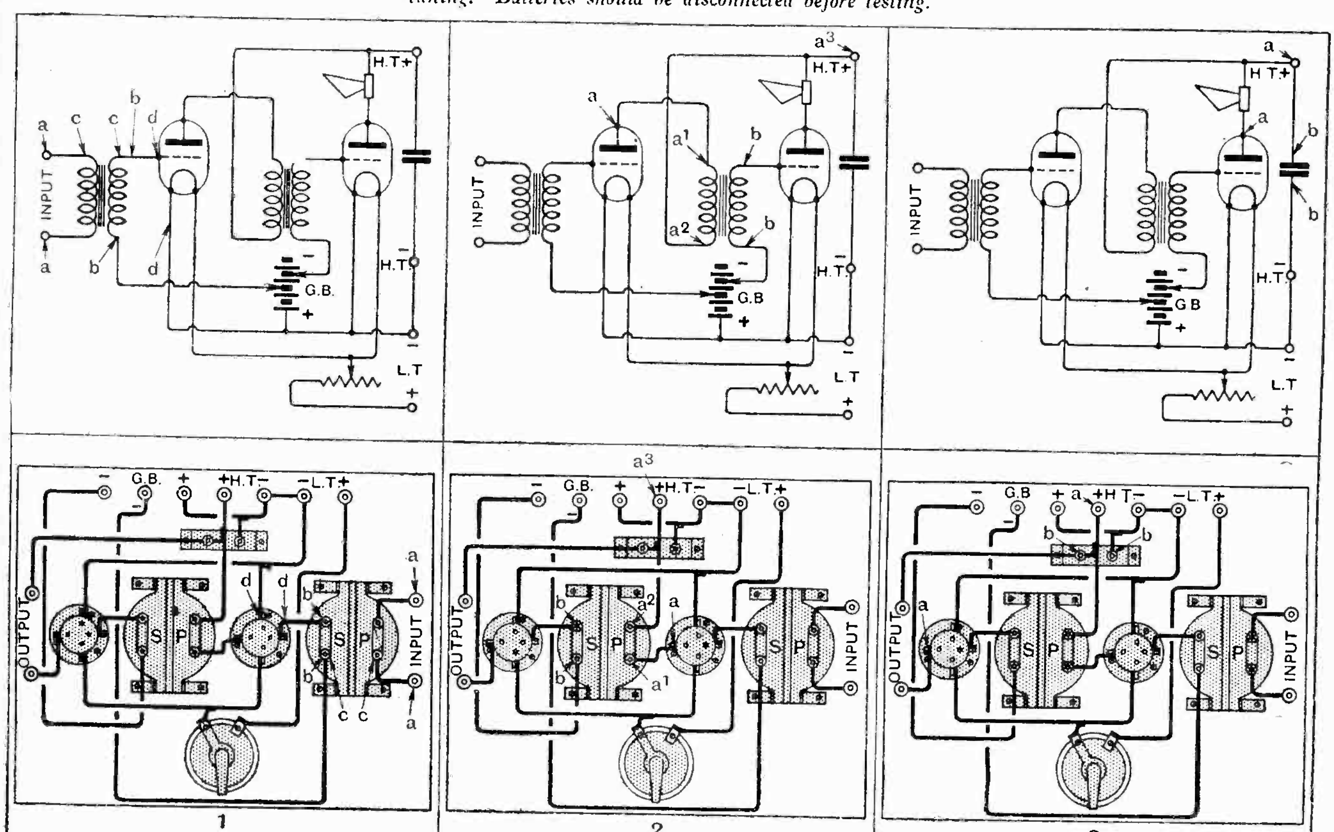
Finally, it should be pointed out that an addition to the number of low-frequency amplifying valves increases the risk of trouble from oscillation or howling. Even if this is not actually evident, a multi-valve amplifier may give rise to a particularly unpleasant form of distortion when it is on the verge of oscillation.

DISSECTED DIAGRAMS.

Point-to-point Tests in Theory and Practice.

No. 57.—A Two-stage L.F. Amplifier.

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.



The primary and secondary windings of the first L.F. transformer are tested, respectively, between *a* and *a*, and *b* and *b*; insulation between the winding at *c* and *c*. The insulation of the grid circuit as a whole is shown between *d* and *d* (with bias battery connection removed).

The complete anode circuit of the first valve is tested between *a* and a_3. Sections of the wiring, including the transformer primary, may be tested across the points marked *a* and a^1, a^1 and a^2, a^2 and a^3. Continuity of the secondary is indicated between *b* and *b*.

The anode circuit of the second valve is tested between *a* and *a* with output terminals short-circuited. The insulation of the large by-pass condenser should be high, or there will be a continuous wastage of H.T. battery current; this is tested between *b* and *b*.

Broadcast Receivers

An Inexpensive "Local and Daventry" Receiver of Unconventional Design.

THE unconventional appearance of the Cosmos 3-valve set is the first feature to excite comment during a preliminary examination. The designer has cut adrift from the prevailing fashion of the American cabinet with ebonite front panel, and produced a compact instrument in the form of a railway waiting-room sandwich container. A more detailed examination will reveal that there are many advantages to justify this form of construction. Considerable ingenuity in the arrangement of components has reduced the overall dimensions to a diameter, at the base, of 10in., and a height of 9in.—surely a record for a three-valve set. Further, the robust construction and clean exterior ensure that tuning controls will not be disturbed nor valves damaged during spring cleaning or other periods of domestic activity. Few modern receivers are so satisfactory in this respect.

Neither is the general effect spoilt by an untidy arrangement of batteries and leads. A neat multiple cable connects the receiver with the H.T., L.T., and grid bias batteries, which are assembled in a crate specially designed for the purpose.

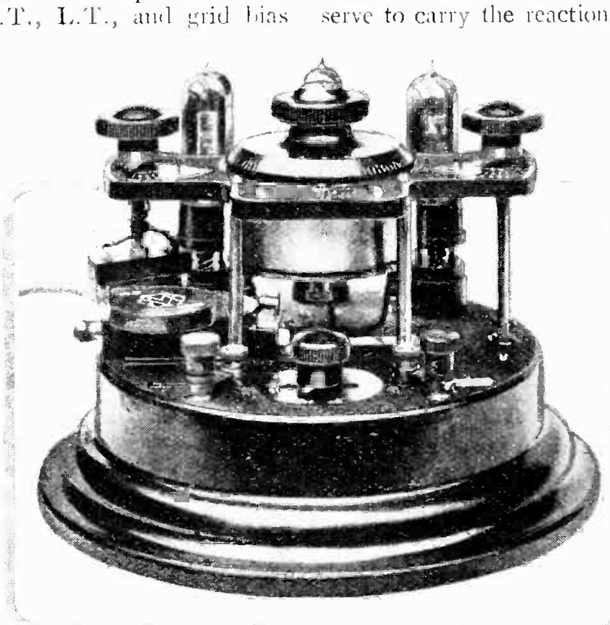
In construction the receiver is no mere assembly of components. It is obvious that every detail has been carefully thought out before the set was put into production, for extensive use has been made of special mouldings. That this method of construction is justified in practice is evident from the low price of the finished product. There is, however, one disadvantage, namely, that progressive detail improvements can only be carried out at prohibitive cost where they involve the alteration of moulds. Thus we find various rudimentary fixtures on the present model which suggest that, at some period during its evolution, a crystal detector was an important feature of the circuit. The circuit at present in use follows well-tried principles and comprises a reacting valve detector with leaky grid rectification, followed by two low-frequency amplifying stages. Resistance-capacity coupling is used throughout, S.P. 18/G valves being recommended for the first two stages, with an S.P.18/R as the output valve.

Details of Construction.

The circular moulded base contains the coupling resistances, condensers, and leaks, and the greater part of the wiring of the set. The top of the base plate carries the three valve holders, the tuning unit, filament rheostat, filament switch, aerial condenser switch and terminals for aerial, earth, and loud-speaker.

All tuning controls are mounted on a separate platform raised from the base on metal rods, some of which also serve to carry the reaction coil connections to the interior of the set. The large central dial operates the tuning condenser, which is of the oil-immersed solid dielectric type, and is consequently rather more stiff to turn than the usual air-dielectric condenser. The control at the right-hand side is a vernier condenser for fine tuning, and the corresponding knob on the left is for reaction control.

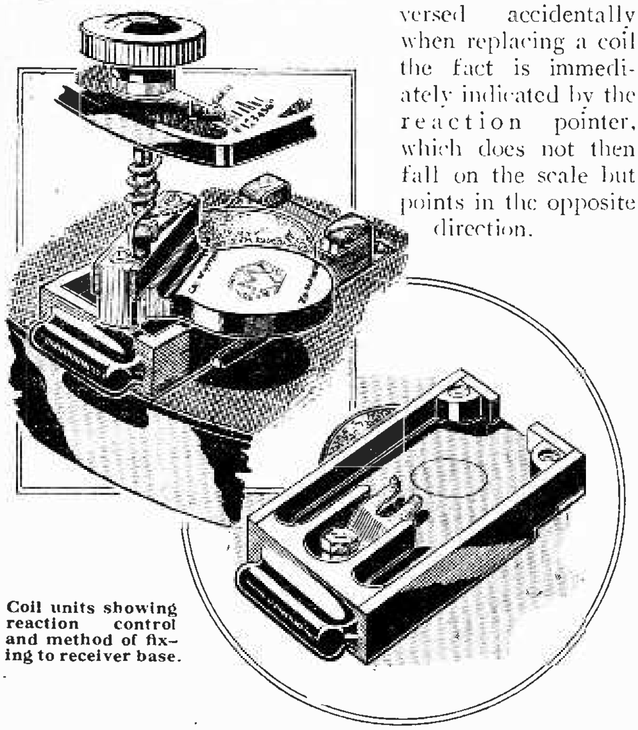
Separate tuning units are used for Daventry and for the 300-500 metre waveband. The design of these units is particularly neat, and the change-over from one wavelength range to the other is only a matter of seconds. The rectangular moulded base of the unit slides into position between guides in



Front view of receiver with cover removed.

Broadcast Receivers.—

the moulded base plate of the set and is held automatically by two contact springs at one end and by a slotted spring in the recessed base. Connection with the reaction coil is made through two spring clips at each end of an ebonite cross-piece mounted on the reaction control spindle. This spindle is capable of vertical as well as rotary movement, and is pulled up to release the reaction contacts before removing the tuning unit. In practice this device works very well indeed, and if the reaction connections are reversed accidentally when replacing a coil the fact is immediately indicated by the reaction pointer, which does not then fall on the scale but points in the opposite direction.



Coil units showing reaction control and method of fixing to receiver base.

A series condenser is included in the aerial circuit, and may be short-circuited by a screw-down type switch on the base. A similar switch is used to complete the filament circuit, and provides a firm contact of low electrical resistance—a most important point when using 2-volt valves.

Lucid Instructions.

The installation of the receiver can be carried out without any special wireless knowledge, for an informative instruction book, illustrated with line drawings, is sent out with each set. Adequate attention is given to the question of oscillation, and instructions for care and maintenance are also supplied on a separate card.

Before testing on broadcasting a series of routine tests were applied for current consumption, wavelength range, and overall amplification.

Wavelength ranges on a 100ft. aerial were as follow :—

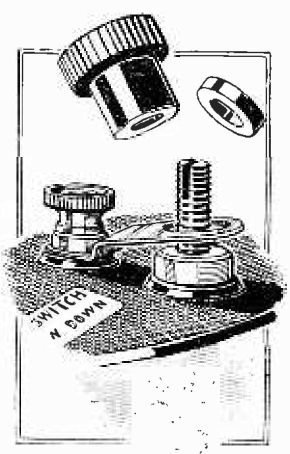
Aerial Switch.	Short Wave Unit. (No. 955703)	Long Wave Unit. (No. 955706)
Up	260-490 metres	1,400-2,550 metres
Down	360-540 metres	1,750-2,800 metres

These are in good agreement with the ranges specified by the makers, having regard to the allowance necessary for differences in aerial constants.

The current consumption of the set is high. The filaments take a total current of 0.9 amp. from a 2-volt accumulator cell, and a service of only 30 hours, or approximately one week, may be expected on a single charge of the 30 ampere-hour capacity cell recommended by the makers. Incidentally, the dimensions of the battery crate preclude the use of a larger cell.

Grid Bias Valves.

The total anode current is 15 milliamperes, which is too heavy a discharge for the small-type cells in the H.T. battery. It is not difficult to ascribe a cause for this abnormal anode current. A further test showed that the output valve (S.P.18/R type) accounted for 12 mA., leaving only 3 mA. for the detector and first L.F. amplifier. Now the H.T. voltage on the last valve is 132 volts, and the maker's own curves for the S.P.18/R valve show that a negative grid bias of at least 9 volts is required to correspond with this anode potential, even allowing for the fact that grid current does not start until the grid potential is raised to +2 volts. Yet a grid bias battery of only 4½ volts is supplied with the set—just half the required value—and this fact alone satisfactorily accounts for the anode current measured. With the correct grid bias of −9 volts, the anode current would be 6.5 mA., which is quite a reasonable figure for a valve of this type.



Screw-down switch used to break filament circuit. A similar switch short-circuits the series aerial condenser.

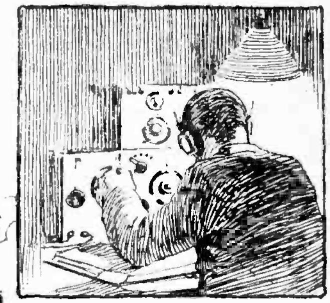
There is just one possible excuse for the choice of such a low value of grid bias, namely, that in course of time the voltage of the H.T. battery will fall and that −9 volts would then introduce distortion. Under present conditions the fall of H.T. voltage is likely to be extremely rapid, and there can be no doubt that a tapped 9-volt grid battery and an additional paragraph in the instruction book regarding progressive adjustment would better have met the case.

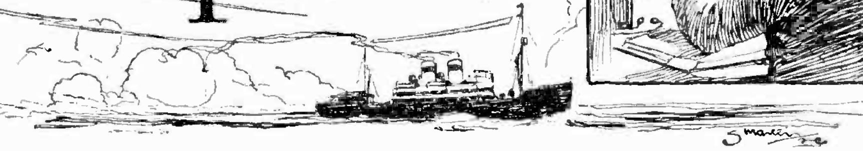
In our opinion the quality of reproduction is very pleasing and will more than satisfy average requirements. This fact will no doubt carry weight with musical people to whom faithful reproduction is more vital than excessive volume. Adequate loud-speaker volume can be relied upon within a radius of 15 miles of a main station and 50 miles of Daventry when making use of a standard outdoor aerial.

At £8 5s. 6d. (including royalty) the Cosmos 3-valve set represents good value and can be relied on to give satisfactory service if a tapped 9-volt grid battery is substituted for the standard grid battery.

Necessary accessories add another £6 10s. to the cost, while the moulded dustproof cover involves an additional expenditure of 10s. 6d. . The receiver is manufactured at the Trafford Park Works of the Metropolitan-Vickers Electrical Co., Ltd., and is distributed by Metro-Vick Supplies, Ltd., 145, Charing Cross Road, London, W.C.2.

CURRENT TOPICS





Events of the Week in Brief Review.

UP-TO-DATE MANCHURIA.

Manchuria is making a bid for a place in the world's ether by the erection of a high-power wireless station at Mukden, plans for which are being considered by the Mukden Government.

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BROADCAST LICENCES IN GERMANY.

Germany is still a long way behind Britain in the number of receiving licences issued. During December 39,442 new licences were issued to German listeners, bringing the total to 1,376,564. In this country there are more than two million.

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NO WIRELESS "ON APPRO."

When Rupert Garnham, of Willesden, pleaded that he omitted to take out a receiving licence because his wireless reception was "far from satisfactory," the Willesden magistrate stated that the Government made no provision for wireless on approval. The defendant was fined 20s.

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WIRELESS ABBREVIATIONS IN THE NAVY.

New abbreviations see the light of day in the latest edition of "The King's Regulations and Admiralty Instructions for the Government of H.M. Naval Service" now being issued to the Fleet. The last edition appeared about twenty years ago. New abbreviations include "D/F" for wireless telegraphy direction finding and "R/T" for wireless telephony. There seems to be a loophole for confusion between the latter and "R.T.," which denotes range-taker.

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NEW TRANSATLANTIC TELEPHONY STATION.

Work is proceeding slowly but surely on the erection of a new Post Office receiving station at Kemback, a small village in Fifeshire. This station will ultimately form the main receiver for transatlantic telephony. An official of the G.P.O. informs us that the present receiving station at Wroughton, near Swindon, will not be dispensed with, but will act as a stand-by for use during breakdowns or on occasions when atmospheric conditions prevent favourable reception at Kemback.

THE "PARTICULAR PERSON."

The Post Office allows a rebate when a caller on the Transatlantic telephony service cannot speak to a "particular person." If this privilege were extended to the line service the Post Office would lose heavily. "Particular" people gave up 'phoning years ago.

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EXTENDING THE TRANSATLANTIC TELEPHONY SERVICE.

The official transatlantic telephony service continues to gain in popularity. At 1.30 p.m. on Saturday last the service was extended in England to include the area within a radius of about 110 miles from London, including the towns of Bournemouth, Bristol, Gloucester, Worcester, Birmingham, Nottingham, Grantham and Boston (Lincs). Simultaneously the service was extended in America to include the States of Maine, New Hampshire, Massachusetts, Vermont, Rhode Island and Connecticut.

A "Report charge" of £2 has been instituted, and is payable instead of the ordinary charge when a "particular person" call cannot be effected.

BEAM TESTS WITH AUSTRALIA.

All last week the Post Office was engaged in conducting official tests with the new Marconi beam stations at Grimsby and Skegness for communication with Australia. Up to the moment of going to press we have been unable to elicit from the Post Office any information regarding the success of the tests, but messages from Sydney indicate that the stations are working satisfactorily duplex, the average speed being between 150 and 200 words per minute for seven hours. The official speed requirement was 100 words per minute each way over a period of seven hours, so it can be seen that the new stations are acquitting themselves well.

In Australia it is being found that the best period for reception from England is still in the morning, but it is hoped that experiments now being conducted will improve conditions at other times of the day.

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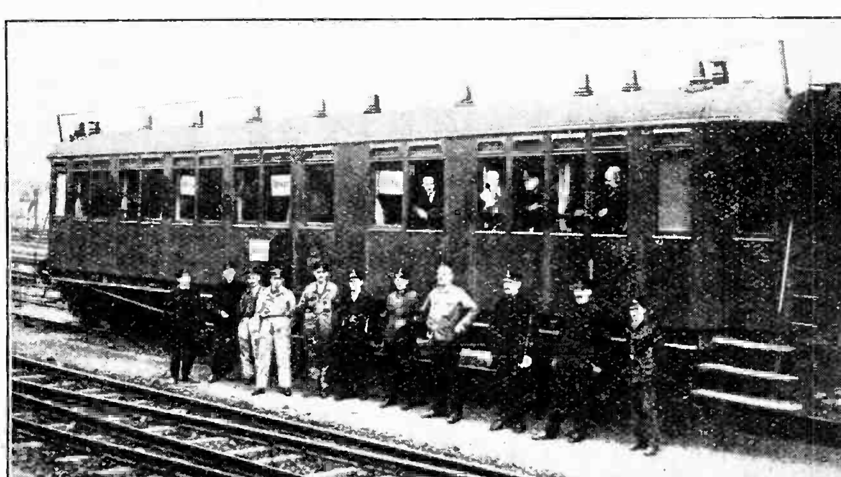
OSCILLATING LAMPS.

An unlooked-for form of wireless interference was mentioned by Mr. E. H. Robinson in his talk on "Short Wave



WIRELESS ON AUSTRIAN TRAINS. Passengers on the express trains of the Austrian Federal Railways can now enjoy broadcast concerts while travelling. A small fee is charged for admission to the "Radiowagen." The above photograph, showing members of the railway staff, was taken on the occasion of the inaugural run.

"Transmitter and Receiver Design" at the informal meeting of the Radio Society of Great Britain and the Transmitter and Relay Section on January 14th. The speaker observed that short wave interference was frequently caused by ordinary electric lamps. He pointed out that vacuum lamps are capable of setting up oscillations on wavelengths of the order of 4.5 to 5 metres and recommended the use of gas-filled lamps when experiments are being conducted on ultra-short wave lengths.

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COMMERCIALISING PICTURE TRANSMISSION.

An interesting company was registered on January 13th with the name "Wireless Pictures, Ltd." The objects of the company are to acquire any patents for inventions relating to television and what is known as "photo telegraphy," and the electrical transmission and reception by wire or wireless of signals, drawings, etc. The nominal capital is £100 in £1 shares, and the subscribers are J. M. Sharp and F. R. Sprinz, both of 75-77, Shaftesbury Avenue, W.

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WAVES OF ONE METRE.

A course of six lectures on "Short Electric Waves" will be given by Mr. J. H. Morell, M.A., on Mondays, at 6 p.m., commencing February 7th at the East London College, Mile End Road, E.1. The lectures will deal with the experimental treatment of short waves from 200 metres down to 1 metre, with demonstrations. At the first lecture the chair will be taken by Admiral of the Fleet Sir Henry Jackson, G.C.B., K.C.V.O., F.R.S.

The fee for the course is 10s. 6d., but students of the Engineering Faculties of the Colleges and Institutions of the University of London can obtain free admission tickets on application to the Registrar of the College, Mile End Road, E.1.

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AUSTRIAN PICTURE TRANSMISSION.

Tests which are to be undertaken by the Austrian Marconi Company (Radio Austria) jointly with the Telefunken Gesellschaft of Germany, and which it is hoped will lead to the establishment of a public service for the exchange of news and pictures by photographic wireless telegraphy will be in connection with the Karolus-Telefunken-Siemens system, says a Vienna correspondent of *The Times*. Tests made last year yielded good results, but these were only one-way tests, and were therefore inconclusive. The tests now contemplated will be made over the widest range of atmospheric conditions, taking in both the spring and the autumn equinoctial periods.

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THE EDITOR'S MAIL.

Mr. A. L. Basham asks us to draw attention to an error in the spelling of his name in the correspondence columns of the January 19th issue.

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OBSOLETE COMMUNICATION LAWS.

In view of the extraordinary developments in international communications during the past few years, particularly in regard to cable and wireless transmission, the London Chamber of Commerce has decided that the time has arrived when the constitution and rules of procedure of the International Telegraph Conference should be remodelled in accordance with modern practice. A strenuous campaign is to be opened to introduce reforms.

Complaint is made that Great Britain has only one vote in the Conference and is placed on an equality with Albania, Lebanon, Luxembourg, Morocco, Ecuador, and Senegal!

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THE WIRELESS WHALER.

A number of Antarctic whalers have been fitted this season with Marconi wireless telephone apparatus which has enabled them to adopt tactics in finding and killing whales which would be impossible without this means of intercommunication.

If one of the vessels so equipped sights a number of whales, perhaps after two or three weeks' searching, it can immediately inform the other ships in the same fleet by telephone and all can make for the best spot for hunting.

The Marconi ½-kw. telephone sets fitted to all the ships of the Southern Whaling and Sealing Company, Ltd., and to other whaling fleets, have been specially designed for this class of work. Their operation has been reduced to such a simple proposition that they may be worked by a harpoon-gunner in full kit. Reception is by loud-speaker, so that there is no need to remove head coverings in order to use the telephone.

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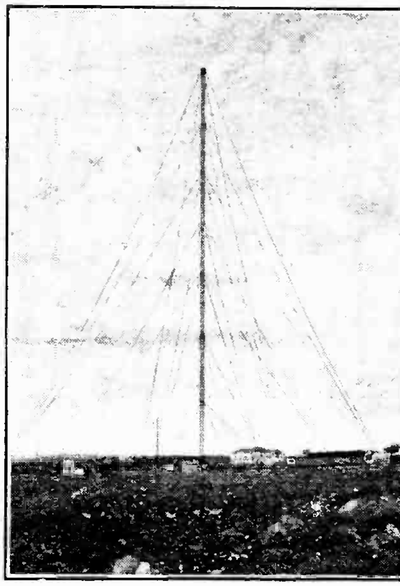
R.S.G.B. DIARY AND LOG BOOK.

With reference to the paragraph headed "International List of Call-signs" on page 70 of our issue of January 19th, we understand that the R.S.G.B. Diary and Log Book can be obtained from the Publishers, Messrs. Printing-Craft, Ltd., 34, Red Lion Square, Holborn, W.C.1, or through any newsagent. Members of the R.S.G.B. can obtain copies upon application to the Hon. Sec. at 53, Victoria Street, S.W.1, on forwarding 6d. to defray postage.



A WIRELESS OUTPOST IN SYRIA. The 600 ft. mast of FFD, the civil radio station a few miles south of Beyrouth. It is a spark station operating on 600 and 800 metres.

FORTHCOMING EVENTS.

WEDNESDAY, JANUARY 26th.

Radio Society of Great Britain.—Ordinary meeting. At 6 p.m. (Tea at 5.30.) At the Institution of Electrical Engineers, Savoy Place, W.C.2. Presidential address by Sir H. C. L. Holden, K.C.B., F.R.S., M.I.E.E.

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Lecture: "Transformers," by Mr. Garside, of Messrs. Ferranti, Ltd.

Muswell Hill and District Radio Society. At 8 p.m. At Tollington School, Tetherdown, N.10. Lantern Lecture: "The Manufacture and Maintenance of Dry Batteries," by Mr. E. Atkins, of Messrs. Siemens Bros., Ltd.

Barnsley and District Wireless Association. At 8 p.m. At 22, Market Street. Illustrated Lecture: "Astronomy," by Mr. J. Fletcher.

Tottenham Wireless Society. At 8 p.m. At 10, Bruce Grove, Tottenham, N.17. Lecture by Radio, by Mr. F. Dyer (G 6HY).

THURSDAY, JANUARY 27th.

Stretford and District Radio Society. At Stretford Town Hall. Lecture: "Efficient L.F. Transformer Amplification," by Messrs. Ferranti, Ltd.

North London Experimental Radio Society. Informal meeting at 1, Buckingham Avenue, Whetstone, N.20. Demonstration: "An Experimental Transmitter," by the Hon. Secretary.

FRIDAY, JANUARY 28th.

Leeds Radio Society. At 8 p.m. At Collinson's Café, Wellington Street. Lecture by Mr. A. J. M. Bever, British Radio Research Society.

Sheffield and District Wireless Society. At the Department of Applied Science, St. George's Square. Lecture: "The Tantalum Rectifier," by Mr. D. W. Skinner.

Bristol and District Radio Society. At 7.30 p.m. In the Physics Laboratory, Bristol University. Practical Demonstration of Constructional Work, by Mr. A. E. Pendock.

MONDAY, JANUARY 31st.

Croydon Wireless and Physical Society. At 8 p.m. At 128a, George Street. Lecture: "Recent Developments in American Radio Apparatus," by Mr. G. Warner Parr.

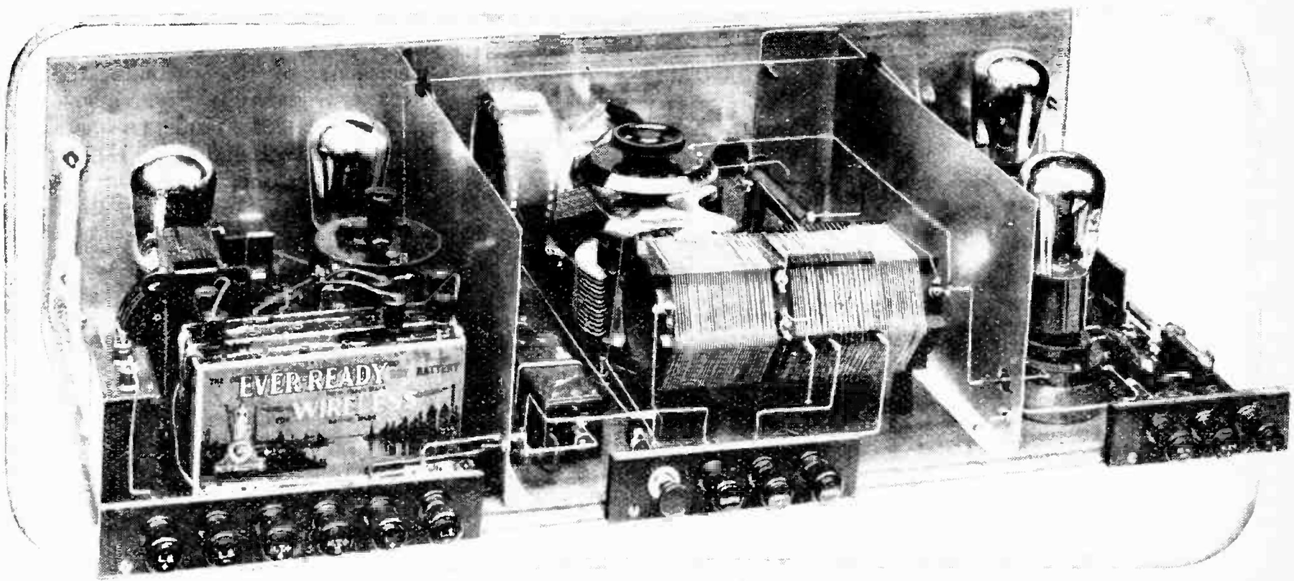
Hackney and District Radio Society.—Lecture: "Valve Curves," by Mr. Phillips.

BOOKS RECEIVED.

A Portable Radio Direction-finder for 90 to 7,700 kilocycles, by F. W. Dunmore.—Describing an instrument of the rotating-coil type with only two controls (balancing and tuning), designed for operating on wavelengths of 39 to 3.300 metres. No. 536 of the Scientific Papers of the Bureau of Standards. Pp. 22, with 13 illustrations and diagrams. Published by the Bureau of Standards, Washington, D.C., U.S.A., price 10 cents.

Aide-Mémoire du Radio-club de France, by A. Givelet.—Containing notes and memoranda on various components, diagrams of standard receiving and transmitting circuits, useful tables and data, the Morse code and international abbreviations, and a glossary of technical terms in French, German, English, Italian and Spanish. Pp. 190, with numerous illustrations and diagrams. Published by G. Budy et Fils, Paris.

WIDE RANGE BROADCAST SET.



Details of the Construction and Operation.

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

(*Continued from page 66 of previous issue.*)

THE panel is made from $\frac{1}{8}$in. aluminium sheet, and the reason that the writer uses this material in preference to ebonite may briefly be given as follows:—First, since the *main* duty of a panel is to *support* components, and not to insulate them, the material used should be strong and one which does not bend or warp as time goes on; secondly, in order to eliminate all hand effects, it is as well to have an earthed metal screen behind tuning condensers and reaction controls which is automatically given by the aluminium; and, thirdly, an aluminium panel $\frac{1}{8}$in. thick is stronger than a $\frac{1}{4}$in. ebonite panel and is very much cheaper.

Against these advantages must be set the one disadvantage that in certain cases the aluminium panel has to be bushed. In this case an alternative arrangement is to cut large clearance holes in the aluminium and to use a strip of ebonite fixed to the back of the panel on which to mount the components which require insulating, so that the ebonite deals with the insulating and the aluminium deals with the support of the components.

Finishing the Panel.

In the Wide Range set the panel has the additional advantage of forming the common L.T. negative "bus-bar," and thus considerably simplifies and shortens the wiring. The panel should be bought cut to the size shown in Fig. 5, and the various holes marked out and drilled. The finish given to the panel depends on the tastes of the constructor; the panel may be rubbed horizontally all over with very fine emery-paper, or it may

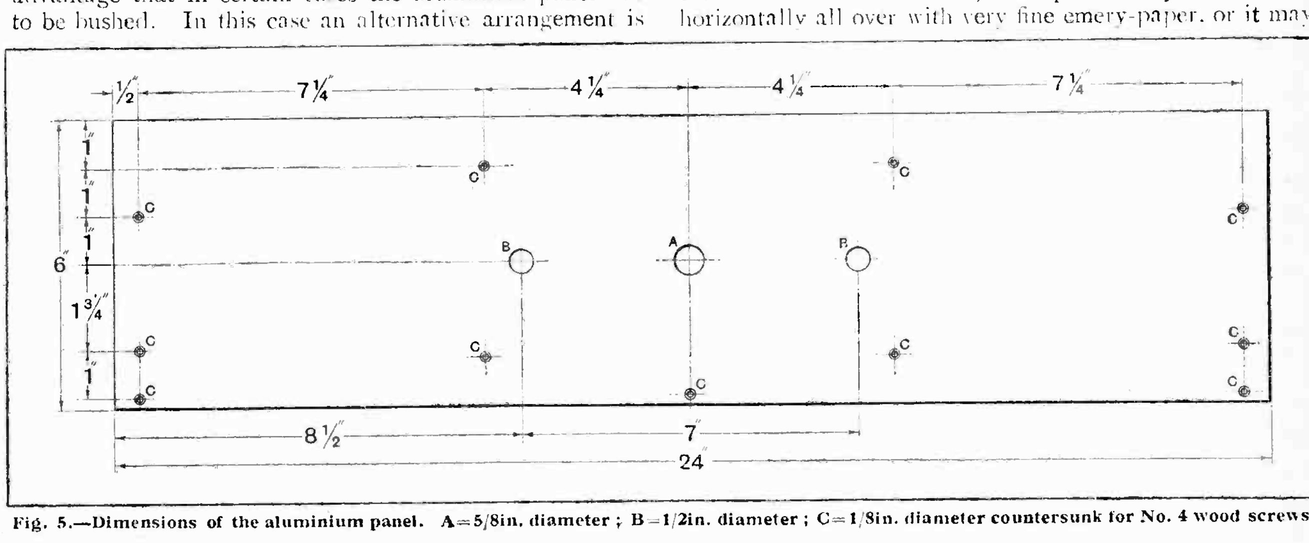


Fig. 5.—Dimensions of the aluminium panel. A=5/8in. diameter; B=1/2in. diameter; C=1/8in. diameter countersunk for No. 4 wood screws.

Wide Range Broadcast Set.—

be polished (which takes quite a long time), or it may be finished as shown in the photographs in last week's issue.

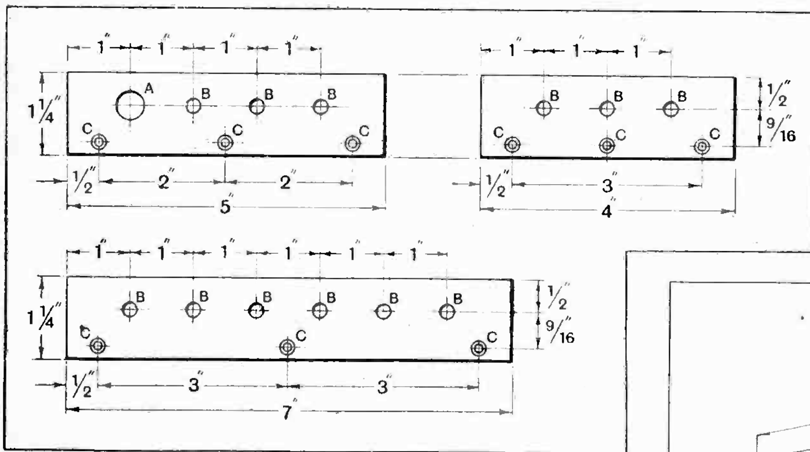


Fig. 6.—Details of the terminal strips. A=7/16 in. diameter; B=7/32 in. diameter; C=1/8 in. diameter countersunk for No. 4 wood screws.

This latter finish is very easy to do, and, in the writer's opinion, gives a very pleasing effect. It is done with the aid of a piece of very fine emery-paper placed over the ball of the thumb and given a half-turn twist on the panel. Very light pressure should be used, and it is advised that experiments first be tried on the back of the panel. The slightly irregular effect resulting from this hand finish gives a more pleasing result than the absolutely regular engine-turned finish, and, of course, is infinitely cheaper. When the whole panel has been satisfactorily decorated it should at once be lacquered with colourless lacquer, which will preserve the finish indefinitely.

The two screens which enclose the tuning compartment should be made of about 24 gauge aluminium sheet cut to the dimensions shown in Fig. 7. Do not forget that one screen has a right-hand and one a left-hand turnover, as shown in Fig. 8. The dimensions of the ebonite terminal strips are given in Fig. 6, and the arrangement of terminals and the switch may be found from Fig. 10.

The panel should be fixed to the baseboard by means of the aluminium brackets, the terminal strips screwed on, and the various components (except C_4 and L_1, L_2, L_3, which are not yet

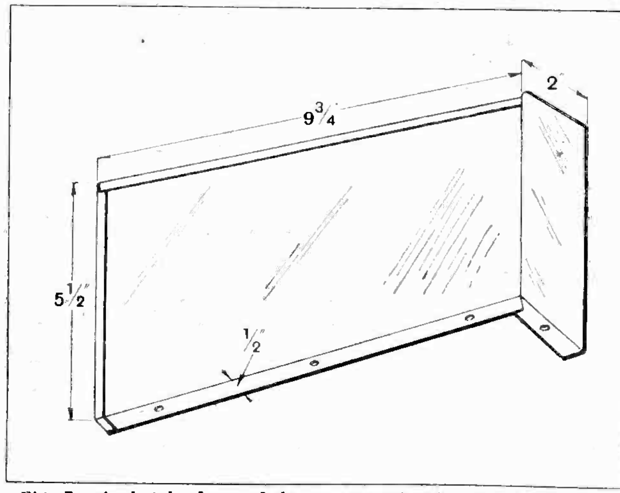


Fig. 7.—A sketch of one of the screens, showing the dimensions, and also the method of strengthening by folding over the edges.

ready) arranged as shown in Fig. 8, and screwed down. The valve holders V_1 and V_2 are mounted on ½in. blocks

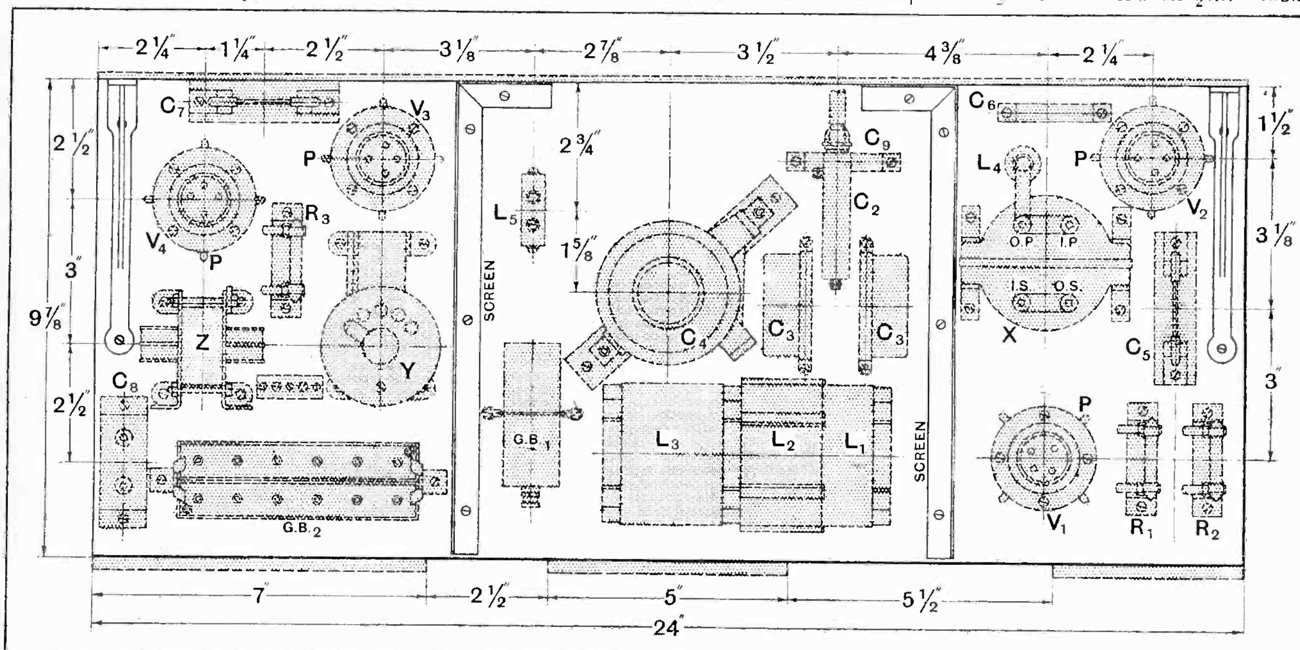
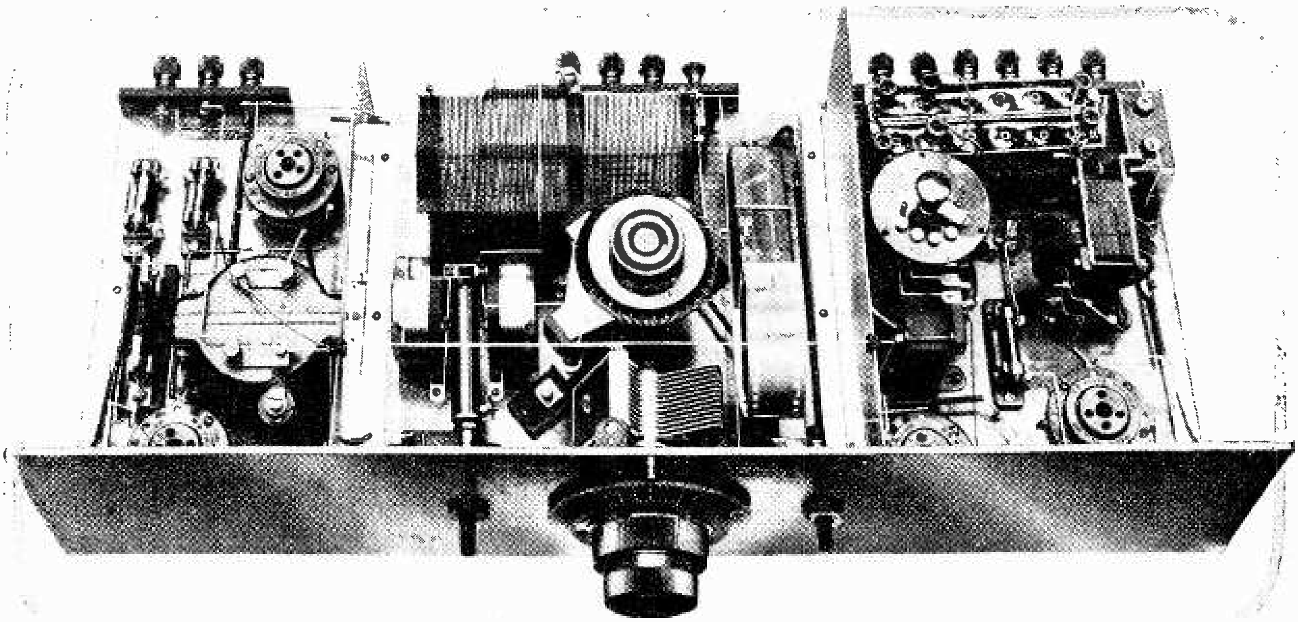


Fig. 8.—Showing dimensions of the baseboard and layout of the apparatus. The letters such as C_1, L_3, V_2 placed against the various components correspond to those on the circuit diagram Fig. 1 (in last week's issue) and to those on the wiring diagram Fig. 10. The letter P beside each valve holder indicates the plate terminal.

Wide Range Broadcast Set.—

of wood to keep the H.F. wiring clear of the baseboard, but the holders of V_3 and V_4 may be screwed down direct. In Figs. 8 and 10, between Z and Y will be seen a little strip of ebonite, carrying three pairs of soldering tags

The way in which the Becol former is mounted on the two ebonite legs may be gathered from the sectional sketch, Fig. 9, which also shows the mounting for the rejector condenser C_1. When all the components have been screwed down to the baseboard, the two screens



A view looking down on the set, with cabinet and valves removed. The rejector coil illustrated here and in the photograph at the head of this article is of suitable size for cutting out the longer wave stations such as Birmingham, while the photograph on the cover of last week's issue shows the size of rejector used for 2LO.

which are used to position the flexible ends of the grid bias leads from V_2, V_3, and V_1.

The Short-wave Coil.

As will be seen from Fig. 8 the three coils L_1, L_2, and L_3 are all wound on the same former, which is a 3in. diameter Becol former, 6in. long. The ribs on the former should preferably be grooved with 18 turns per inch on which to wind the wire. The grid coil L_1 consists of 56 to 60 turns of 24 S.W.G., single silk-covered: the aerial coil is wound over this on ebonite spacing strips in the manner often described in *The Wireless World*, and consists of 14 turns of 38 S.W.G. tapped at the fifth turn. The rejector coil is wound with 24 S.W.G. single silk wire, and consists of 23 turns for the lower (2LO) end of the broadcast band or 38 to 40 turns for the upper (5IT) end.

Litz wire is not necessary, but it might be of some advantage for positions *within* a mile from the local station.

may be fitted. The holes drilled in the panel for the screen-fixing screws are placed symmetrically, so that, since the two-valve compartments are not of the same size, the fixing holes will not come in the same position in the turnover part of the two screens. For this reason the fitting of the screens should be delayed until all the components are in position on the baseboard.

As may be seen from the wiring diagram, Fig. 10, the

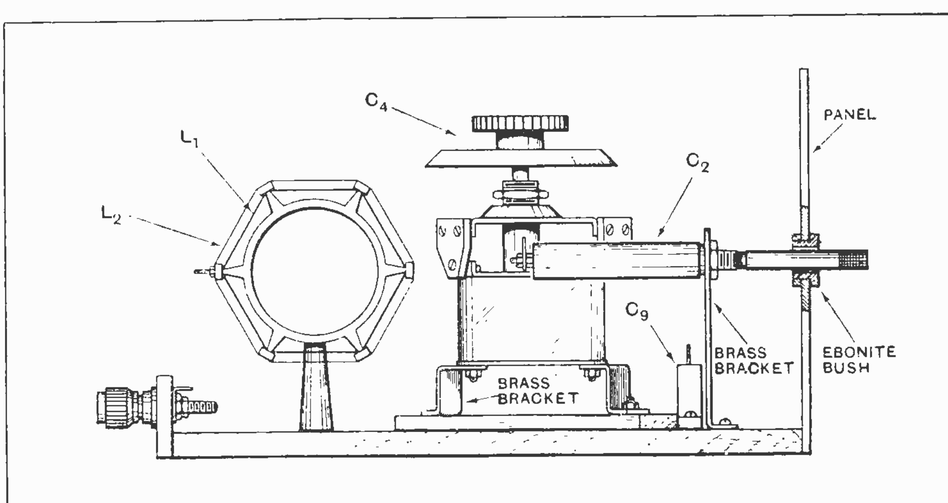


Fig. 9.—A sketch showing the mounting of the short-wave coils and the rejector condenser. Although there is no need to bush the panel for the ebonite handle of the reaction condenser C_2, it should be done to balance the bush required for the long-short-wave switch.

Wide Range Broadcast Set.—

panel requires bushing for the condenser C_1 in order not to short-circuit the single-grid bias cell $G.B_1$; but, since the bushing has only to stand $1\frac{1}{2}$ volts D.C., it may be made from $\frac{1}{32}$in. fibre sheet cut to form two washers, and a strip $\frac{3}{16}$in. wide used to line the fixing hole in the panel. The other two bushes in the panel may be turned from 1in. ebonite rod, or the alternative arrangement of sheet ebonite and clearance holes used.

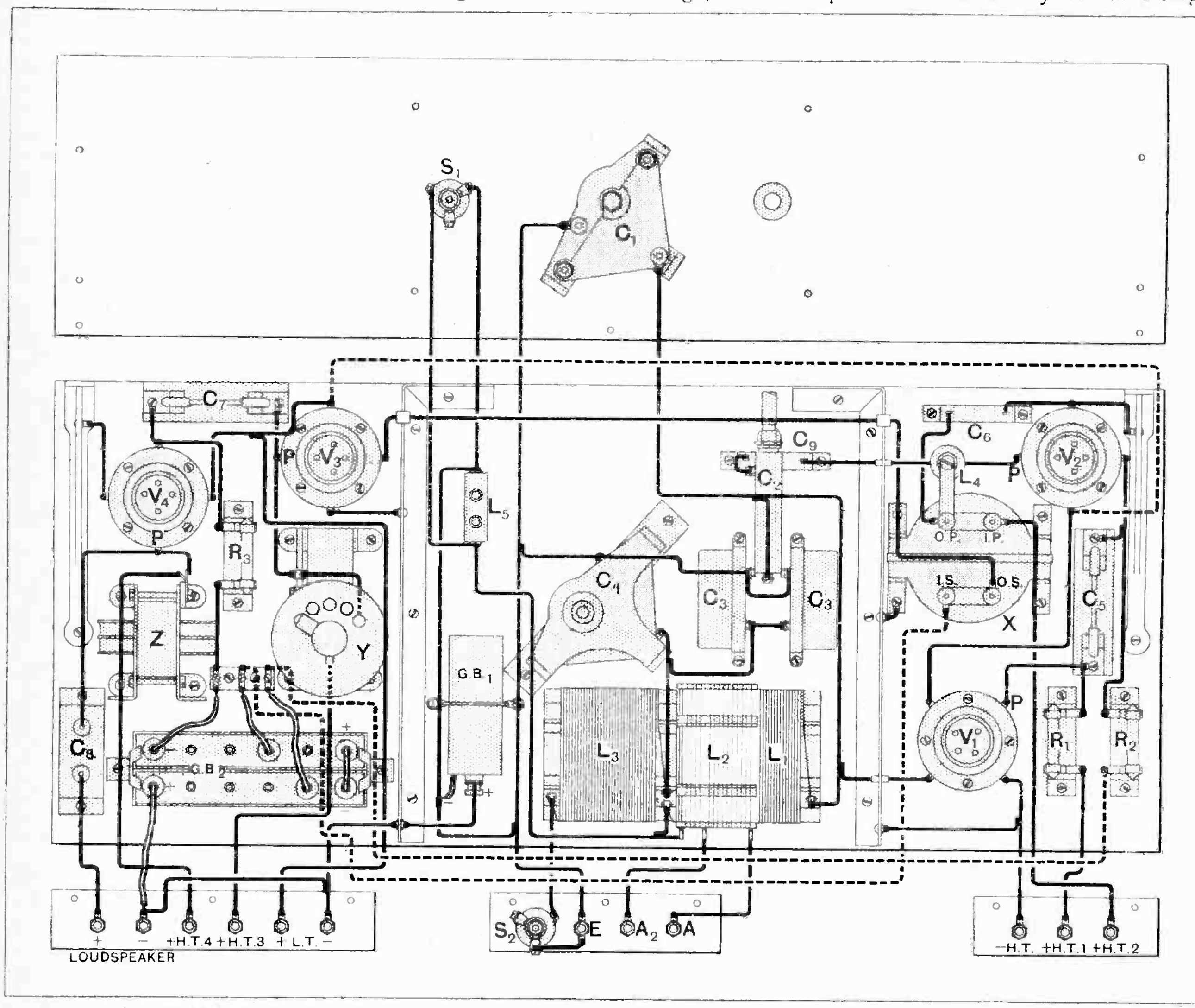


Fig. 10.—The wiring diagram of the set. The connections shown by dotted lines pass under the baseboard and are run in grooves cut in the latter. The lettering corresponds to Fig. 8 and to the circuit diagram Fig. 1.

Before finally fixing the screens, the various soldering tags should be attached, and the two half-inch clearance holes cut out. The positions of tags and holes may be determined from the wiring diagram, Fig. 10, and a good view of one of the holes is shown in the photograph at the head of this section of the article.

The wiring should present no difficulty at all with the aid of Figs. 1 and 10.

The Valves.

As each valve has its own + H.T. terminal, various types may be used of the two-volt, four-volt, or six-volt class, though all the valves used should be of the same filament voltage, since there are no filament resistances incorporated in the set. Four-volt valves are to be preferred to two-volt, and six-volt to four-, since the A.C. resistance of a valve decreases with increase of filament voltage, or the amplification factor may be made larger for the same A.C. resistance for valves with larger filaments.

The valves recommended by the writer by actual test in the set are given in the following table :—

Position.	2-Volt.		4-Volt.		6-Volt.	
V_1	P.M.1H.F.	S.T.21	P.M.3	S.T.41	P.M.5 or 5a	S.T.61
V_2	P.M.1L.F.	S.T.22	P.M.4	S.T.42	P.M.6	S.T.62
V_3	P.M.2	S.T.22	P.M.3 or 4	S.T.42	P.M.6	S.T.62
V_4	P.M.2	S.T.23	D.P.254	S.T.43	D.P.256	S.T.63

It will be seen that V_1 is a high-amplification valve; V_2, since it is an L.F. amplifier, followed by a transformer, should be a low-resistance and low-amplification

Wide Range Broadcast Set.—
valve for quality purposes. V_3, although followed by a choke, should preferably be of low resistance for good quality, and the output valve V_4 should, of course, be of the very low resistance type.

When the wiring has been completed and tested for accuracy, the set is ready to try. Using one of the above sets of valves, appropriate H.T. values are 80-120 for V_1; 120 for V_2, V_3, and V_4, or, if more H.T. is available, up to 160 for V_3 and V_4. Grid bias for V_2 should be 6 to 7½ volts, and about 10½ and 18 for V_3 and V_4, the actual values, of course, depending on the valves used.

Operation of the Set.

The reaction condenser knob should be turned anti-clockwise (decrease reaction) as far as will go, and the aerial and earth connected. To set the rejector, pull out the switch S_2 on the terminal block, thereby cutting out the rejector, and tune in the local station on the main tuning condenser; it is extremely probable that the signals from this station will be too much for the set *when tuned*, and will be badly distorted; but never mind this for the moment. When the station is correctly tuned, as judged by the noise from the speaker, switch in the rejector by means of S_2, and turn the rejector condenser (C_4) slowly until the noise from the loud-speaker diminishes and finally ceases. The rejector tuning should be quite sharp, and when nearly correctly set may be finally adjusted by exchanging the speaker for a pair of phones and tuning for minimum sound in the latter. NOTE.—It is advisable to be very careful about these final adjustments when wearing telephones, or temporary deafness may result if the rejector is not properly tuned!

When the rejector has been correctly adjusted, the condenser C_4 should be left alone, and the rejector put in and out of circuit by means of the switch S_2.

The procedure for finding other stations is to rotate the knob of the main tuning condenser (with the rejector in circuit, of course) and to turn the reaction condenser in a clockwise direction *very slowly* until the set is heard to be near the oscillation point.

About half-an-hour's experimenting with the set in various condenser dial positions will enable the constructor to know exactly how far he may go with the reaction so as to just not oscillate, and he may be quite confident that he *cannot* cause interference by accidental oscillation on the wavelength of the local station when he is searching for other stations.

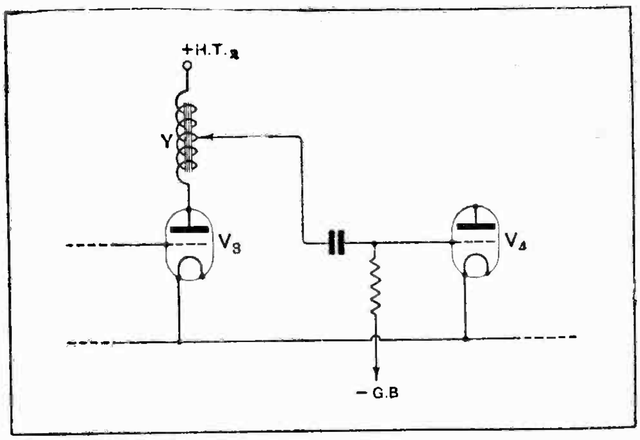


Fig. 11.—Showing an alternative method of connecting the tapped choke Y in the plate circuit of V_3. This method is rather better than that shown in Fig. 1.

For the long waves it will be found that a little less reaction is required than for the short waves, especially when a good plug-in coil is used, so that even a hank-wound, long-wave coil will work with the form of reaction control used, although it is not advised. The coil used for the average aerial should be No. 150, to cover from Hilversum to Daventry and Radio Paris.

To alter the tone of the set to suit any particular loud-speaker or individual taste, various values for the condenser C_5 (Fig. 1) may be tried. This condenser is of the clip-in type for this purpose. To raise the tone use a smaller value, and to lower the tone use a larger value for this condenser.

This set enables practically full use to be made of an outside aerial near the local station in order to receive other stations, and on test on aerials at distances from 2LO varying from under two to just over sixty miles has fully justified that the design has fulfilled the conditions required at the commencement of this article.

The set was *not* designed for indoor aerial work, although in London three or four stations have been well received on the speaker with a 10ft. aerial, but on an outdoor aerial it will give many stations at really good strength—especially after dark.

TRADE NOTES.

Indestructible Valves.

Testimony as to the mechanical strength of Osram valves has been received by Messrs. The General Electric Co., Ltd., in a letter from Mr. T. J. Box, of Slough. He says: "Recently my wireless set was pulled off the shelf on which it normally stands and fell 4 ft. to the floor. The four battery connections were dragged from their terminals, which are on a strip at the back of the set; another strip taking the aerial and earth wires—which was fastened by two screws at the end of the set—was torn from its place, a low-loss aerial coil former was broken; two soldered connections in the set became severed; but two Osram valves, a D.E.3 and a D.E.3b, remained intact and are still functioning as effectively as ever."

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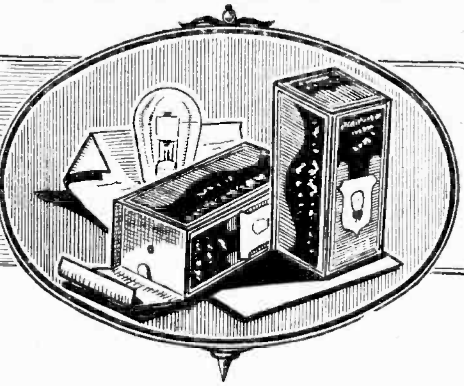
Set Construction for the Novice.

"Radio for the Million" is the title of an interesting quarterly publication, the first number of which has just been issued by The Mullard Wireless Service Co., Ltd., Mullard House, Denmark St. London, W.C.2. The aim of the new periodical is to provide those who have no technical knowledge of wireless with simple details for building broadcast receivers. The first number deals with the choice of a receiver and gives constructional details, with blue prints, of the "Franklin P.M.," "Rodney P.M.," "Nelson P.M." and the "Grenville P.M." Radio terms are simply explained and advice is given on the choice of suitable valves. Copies can be obtained through any radio dealer or direct from the Mullard Wireless Service Co., Ltd., free on application.



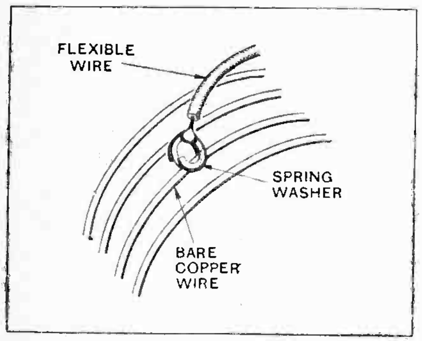
NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

COIL TAPPING.

Air-spaced coils wound with copper wire of heavy gauge are frequently used in receivers designed for the reception of short-wave stations.

A simple and effective method of picking up contact with the turns of



Contact clip for short-wave coils.

these coils is shown in the diagram. A No. 2BA phosphor-bronze spring washer is soldered to the end of a flexible lead, thus forming a clip which can be forced on to the winding at the required point.—W.C.B.

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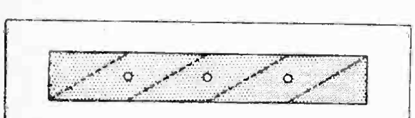
SOLDERING TAGS.

Double-ended soldering tags are frequently made use of in constructing modern receivers, a typical example being the H.F. transformers used in the "Everyman's Four" receiver.



Method of cutting double-ended soldering tags.

These tags can be easily made from strip metal by drilling a series of equally spaced holes and then cutting the metal obliquely, as shown by the dotted lines in the diagram. Contact strips from discharged flash-lamp cells may be used for this purpose, or, if preferred, strips may be cut from ordinary tinned iron.—H. A. 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 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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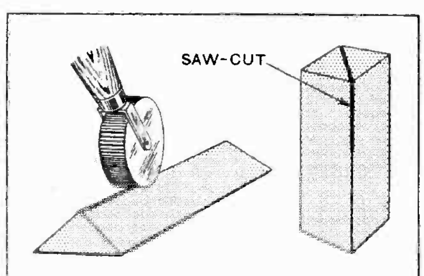
"EVERYMAN" SPACING STRIPS.

If a knurling tool of suitable type is available the ebonite spacing strips required in the construction of

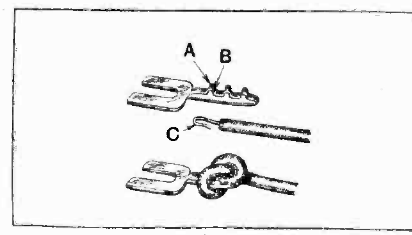


Making ebonite spacing strips for "Everyman" transformers.

"Everyman" transformers can be quite conveniently made by the method indicated in the diagram. Strips of square section and of suitable length are first cut from ebonite sheet. These are then held vertically in the vice and cut diagonally with a back saw. Finally the 90° edge is serrated by means of the knurling tool as shown. It is possible that less pressure will be required if the tool is warmed before use.—J. B. T.

SPADE TERMINAL CONNECTIONS.

The annoyance caused by breakage of flex wire connected to spade terminals of the kind shown in the sketch may be overcome by baring the wire, twisting and cleaning the strands, bending back as at C



Strengthening spade terminal connections.

and gripping the bare wire by the lugs A and B only. The remaining lugs are used to grip the end of the insulation covering, and a knot is tied and adjusted to lie over the shank of the terminal. By this means the electrical joint will be relieved of any mechanical strains.—H. E. C.

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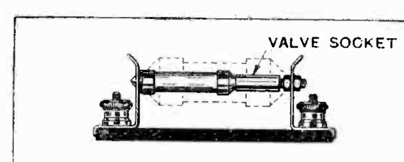
INTERCHANGEABLE ANODE RESISTANCES.

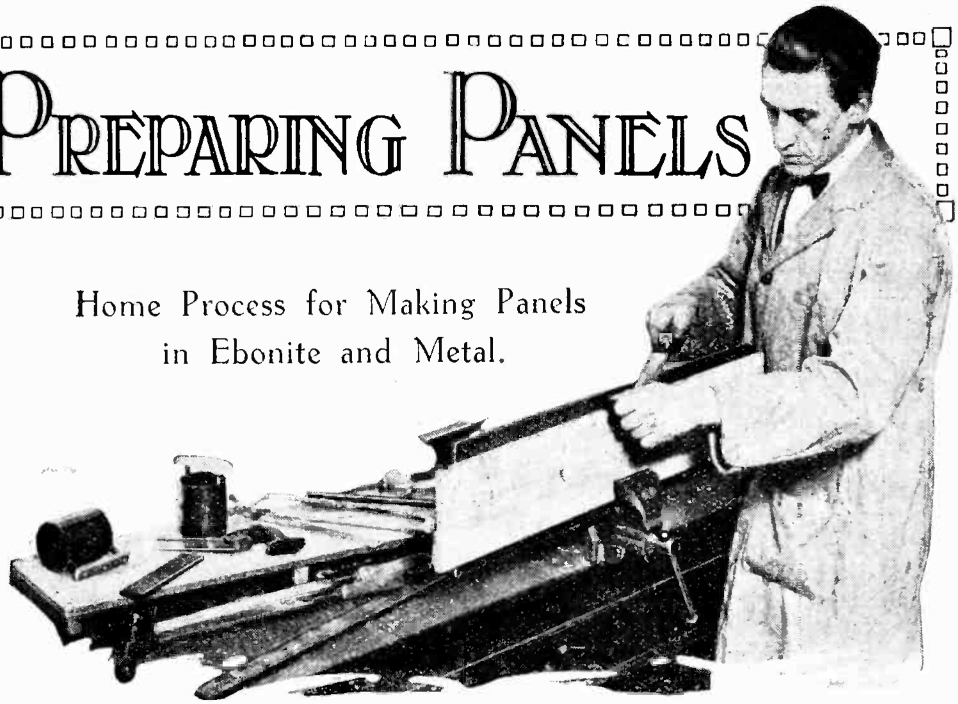
Users of anode resistances of the large cartridge type who wish to try higher values, from 0.25 megohm upwards, which are usually of the grid-leak pattern, will find that the assistance of a single valve socket will render the two sizes interchangeable if the holder for the larger type is retained.—J. M. T.



Adaptor for small type anode resistances.

THE SET BUILDER

PREPARING PANELS



Home Process for Making Panels in Ebonite and Metal.

THE standardisation of panel sizes would save amateurs a great deal of trouble by obviating the need for sawing and filing long edges straight and square, an operation for which many have neither the facilities nor the skill. However good the design, a set presents a very poor appearance if the edges of the panel are not perfectly true. Every endeavour has been made on the part of the ebonite manufacturers to set up a series of useful sizes, and in co-operation with the British Engineering Standards Association have drafted a schedule of standard panel sizes.

Standard Panels.

Criticism cannot be made as to the suitability for general set construction of the range selected, which includes panels for all the more popular sets and many intermediate sizes, yet until the manufacturers of cabinets decide to make cabinets only to the specified dimensions, the amateur must invariably undertake the task of squaring up the panel. Another difficulty is that many ready-made cabinets are not exactly correct to dimensions to within the necessary limits of 1-64in., while others are not perfectly square, necessitating careful adjustment of the panel to fit.

There is little chance of the adoption of standard panels for some time to come, and the need for standardisation would cease to exist if every retailer would provide himself with a small power-driven circular saw. With the teeth carefully set panels can be cut exactly square and to size, the edges being true and sharp and almost free from saw marks.

The equipment needed to square up a panel includes a workshop bench preferably fitted with a large vice, a tenon saw, a large medium-cut flat file, a straight edge, and some medium grade carborundum cloth. Assuming that the piece of ebonite is only slightly oversize, it should be clamped with its longest edge just above the jaws of a large parallel-jawed vice. The edge must not project high above the jaws or the panel will vibrate, though this difficulty is perhaps overcome by working only from end to end of the panel and at no time across the edge.

An Improvised Vice.

If a vice is not available, the panel may be clamped to the edge of a bench by means of two hard wood strips screwed in position with the edge of the panel about ½in. above the top of the bench. If these battens do not grip sufficiently to prevent the panel from slipping down under the pressure of the file, two nails should be driven in under the bottom edge. To clamp a panel for sawing a similar form of battening may be employed, secured to the top instead of the side of the bench and with the part to be removed just projecting.

With the source of light behind the panel, the straight-edge, or steel rule providing it is as long as the panel, should be placed along the panel edge and slightly tilted so as to reveal the hollows.

Filing Long Edges.

Large irregularities are removed by cross-filing and working down to a line. Final trueing up is effected by standing at the right-hand end of the panel, holding the file at an angle of about 45° to the panel face and surfacing the edge with a slow, firm cutting stroke, keeping the file perfectly level. For this purpose the panel may be raised to a convenient height as the filing will not cause it to vibrate. The novice may find that a pencil line near to the edge will serve as a guide and will indicate if too much is being cut away

Attention is next turned to one of the ends. A scratch line is set out across the end as near to the edge as possible, using the steel square and a sharp-pointed scriber. If the first edge is not true, then this line will be out of position, while if working to the cabinet, the square should be applied to ascertain whether or not a true right angle is required. As all dimensions are set out across the panel from the true edge, it is advisable to mark this edge with a small centre-punch dot near its centre but on the back face of the panel. The end is trued up by working down just to the line, and the square should be used to ensure the correctness of the right angle at the corner as well as to check that the edge is square to the faces.

Preparing Panels.—

It is the opposite end of the panel that is next finished to the exact length, the width being adjusted last. Assuming that the ends are each perfectly square to the first long edge, then the width line as measured across the panel from the two ends should be found to be exactly square.

To clean up the edges a piece of carborundum cloth should be secured flat on the bench and the panel drawn backwards and forwards along it with an even pressure on both ends and standing perfectly vertical. A slight extra pressure at either end will result in more ebonite being cut away, sufficient to correct for any small discrepancies in the size or squareness of the cabinet. Care should be taken to keep the edges and corners perfectly sharp, for herein is the difference between the work of the beginner and skilled instrument maker, a distinction which is readily observed.

Setting Out on the Front of the Panel.

As to locating the holes for the components, it has often been said that one should work on the back of the panel, making long intersecting scratch lines; some amateurs even go to the trouble of gumming a sheet of paper to the back of the panel and using pencil and compasses. If this were the correct method, then the drawings given in the pages of this journal are not shown in their most helpful form, for they will require reversing in applying the dimensions to the panel. There is no need for long scratch lines. Intersecting cross lines should be less than $\frac{1}{8}$in. in length and drilled away, removed by countersunking, or covered by dials, clamping rings, etc.

Setting out on the front of the panel is preferable, as the relative positions of the components and the appearance of the layout can be better considered; fractures around holes, should they occur in drilling, will be at the back, while slight errors in location and which the eye would readily detect cannot arise as a result of not drilling through at exact right angles to the face.

Applying a Matt Finish.

As to finishing the faces of a panel, the erroneous idea that the best method is to use emery paper and oil is at last losing favour. Such a process is good enough for small jobs, such as ebonite brackets and fittings cut from the solid with limited surface areas, but for the entire face of the panel it must be admitted that the effect is not very pleasing, particularly as the poor finish is contrasted with the polished or sand blast knobs and dials carried by the panel. An oiled finish is not durable and smears to the touch even if rubbed dry. If oil must be used, then all traces should be washed away with turpentine, which will dry off and leave the ebonite clean. Fine emery and other powders can be used to produce a matt surface, and carefully worked with a circular motion will give a satisfactory result.

The best surface finish which the amateur can apply is probably a scratch line effect by rubbing with a medium grade carborundum cloth with a movement parallel to the longer sides. A little thin oil may be used for the purpose of holding the carborundum powder, but this again necessitates washing off with turpentine. The carborundum cloth should be wrapped round the face of a block of wood.

The best practice is to purchase the sheet ebonite with a finished surface, such as a good uniform matt free from scratches or with a high polish resembling a buffed finish. Care is needed when clamping in the vice to avoid marking the surface, particularly if there is a chance of the panel slipping in the jaws. A sheet of strong paper wrapped round the panel will usually prevent accidental scratching. Sheet ebonite and other insulating materials are available with one face bearing a figured or "engine-turned" design. These surfaces not only have a good appearance appealing to certain tastes, but are more durable and do not readily show discoloration or dust.

Metal Panels.

Ebonite was undoubtedly primarily adopted for panels owing to its insulating properties. Good insulation between the few components carried by the panel is now rarely required, yet the continued use of ebonite is accounted for by the ease with which it is cut and drilled and its absence of grain, such as would give rise to a tendency to split in one particular direction.

Metal panels have long been in use for general instrument construction, and amateurs are taking an interest in the possibilities of using aluminium. Hard-rolled aluminium sheet, $\frac{1}{8}$in. in thickness, is comparatively easy to work, though finishing is a little difficult. Small circles on an aluminium surface look well when reflecting light, and are produced by giving one complete rotation to a piece of fine emery paper under the thumb. The positions for the circles should be carefully set out by ruling the panel with pencil line into $\frac{5}{8}$in. squares. Two coats of transparent hot lacquer should be applied to protect the surface from corrosion. Panels can similarly be prepared from 5-32in. hard brass sheet and finished in a like manner to aluminium, buffed, and lacquered, or even nickel or antique silver plated.

TABLE OF RECOMMENDED PANEL SIZES*.

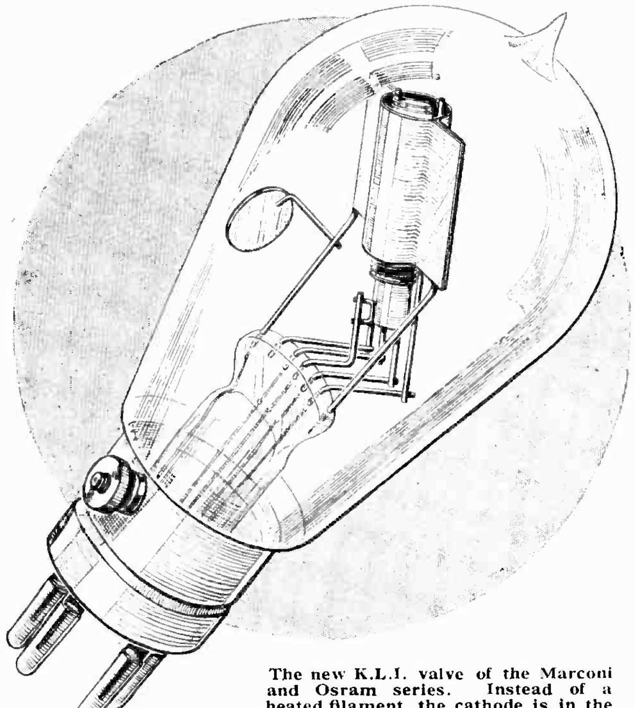
Size	Thickness	Size	Thickness	Size	Thickness
6″×6″	Thickness $\frac{3}{16}$″	8″×10″	Thickness $\frac{1}{4}$″	10″×12″	Thickness $\frac{1}{4}$″
6″×8″		8″×12″		12″×12″	
6″×9″		8″×16″		$1\frac{1}{4}$″×36″	Thickness $\frac{1}{4}$″ (for terminal strips)
7″×10″	Thickness $\frac{1}{4}$″	9″×12″	Thickness $\frac{1}{4}$″	$2\frac{1}{2}$″×36″	
7″×12″		9″×15″			
7″×14″		9″×18″			
7″×18″		9″×24″			
7″×21″		9″×30″			
7″×24″		9″×36″			

* British Engineering Standards Association. Specification No. 234.

FILAMENTLESS VALVES FOR A.C. SUPPLY.

The Introduction of an Indirectly Heated Cathode to Eliminate the Filament Battery.

THERE are several forms of battery eliminator which can be considered satisfactory for supplying anode current directly from alternating current mains. Of the batteries required for operating a receiving set, it is the H.T. battery which is in general the least satisfactory. It must be capable of giving a liberal current output at a high voltage, requires constant attention if of the secondary battery type, and is easily damaged by accidental short circuit. Although giving less trouble, the filament heating battery is costly to run, is messy, and a spare charged battery must always be in readiness.

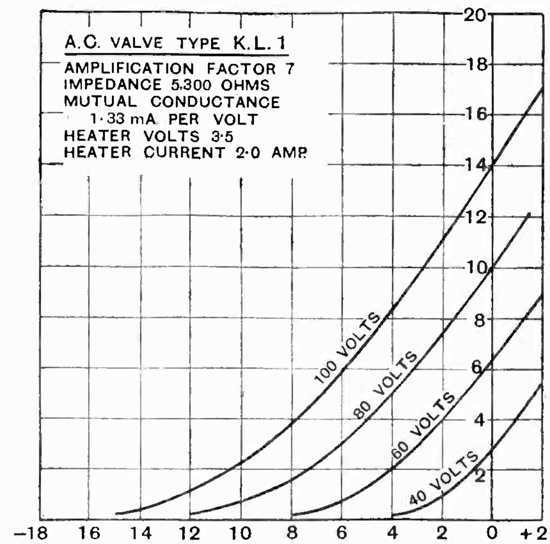


The new K.L.I. valve of the Marconi and Osram series. Instead of a heated filament, the cathode is in the form of a coated cylinder, which is heated from the interior.

Many endeavours have been made to devise methods for filament heating directly from the public supply, and in the case of direct current mains, the valve filaments can be heated through a current-limiting resistance. Where several valves are used the filaments are series connected and precautions taken with regard to the correct adjustment of grid potential.

A.C. Heated Filaments.

With alternating current a satisfactory solution is more difficult. Many amateurs provide for filament heating with alternating current stepped down through a transformer, but although this arrangement can perhaps be tolerated in the case of a single L.F. stage, it is undoubtedly quite unsuited to the heating of the filaments of high frequency and detecting valves. A better method is perhaps to make use of a thermionic rectifier and use valves in the receiving set requiring a filament current of less than 100 mA. Another arrangement, and one in which A.C. hum is absent, consists of an "arc" rectifier with an accumulator floating across its output to keep the voltage constant.



The grid volts anode current characteristic show the K.L.I. to be a good general purpose valve or with 100 volts on the plate it is suitable as a moderate power amplifier.

With the object of running the valves directly from an A.C. supply, a valve was devised some time ago in the United States in which a heater operated from the mains raised the temperature of a cathode which emitted electrons in the same way as a heated filament. This valve has not attained a wide popularity.

The Indirectly Heated Cathode.

Similar in general principle, yet of very different construction, is the new K.L.1 valve, which has just been added to both the Osram and Marconi series. It is provided with an indirectly heated cathode, the heater unit being enclosed in a nickel cylinder some 1$\frac{1}{8}$in. in length by $\frac{1}{8}$in. in diameter. This cylinder is sealed at the top and extends over the heater, covering the supporting wires, apparently for the purpose of avoiding any emission taking place directly from the red-hot interior of the unit.

Two narrow metal strips appear to lie along the cylinder on opposite sides, and the surface is covered with a thin white deposit. A spiral grid surrounds the cathode at a distance of about $\frac{1}{16}$in., and with a spacing of just under $\frac{1}{16}$in. is the usual cylindrical anode. The general method of supporting the electrodes is unusual, being inclined at about 45° from the perpendicular, so as to

Filamentless Valves for A.C. Supply.—

avoid heat being directed towards the "pinch." Two fins project from the anode, probably for the purpose of facilitating cooling by radiation. A small disc attached to one of the plate supports is used to carry the "getter," which is ignited in the process of exhaustion and throws a mirror only over a small part of the globe.

The electrodes take their support entirely from the foot tube, so that passing out at the base are the grid and anode leads, which connect to the usual pins, the heater leads, which are joined to the pins customarily used for filament heating, whilst the cathode is connected to the metal cap which carries a screw terminal. The cathode is, of course, not in electrical connection with the heater. Attention might be drawn to the need for spreading out the wiring of the receiver to avoid induction from the A.C. carrying leads owing to the fact that the valve is fitted with the standard type of socket. In fact, one of the heater leads carrying a comparatively heavy alternating current is brought through the glass pinch of the valve alongside the grid lead, and the introduction of a slight A.C. hum may probably arise owing to the closeness of these leads.

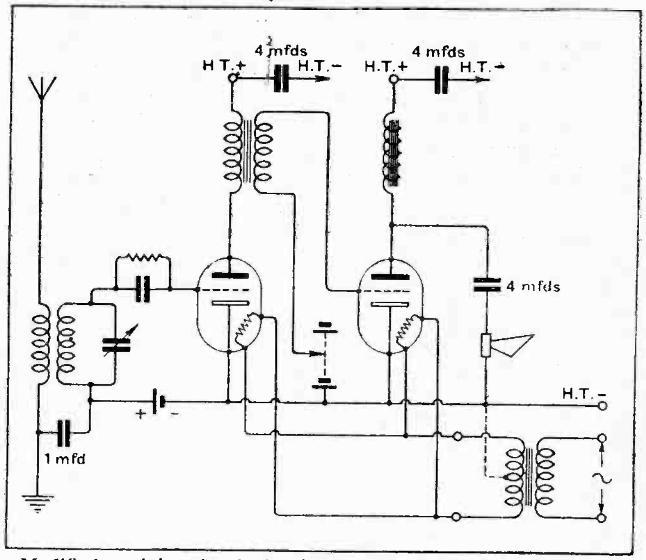
Good General Purpose Valve.

The valve possesses the characteristics of a moderate power amplifier, although it is suited also for use in a high-frequency amplifier or as a detector using grid rectification. The amplification factor in relation to the A.C. resistance is unusually high, due to the exceptional "filament" properties of the glowing heater. The average impedance is 5,300 ohms, with an amplification factor of 7, giving a mutual conductance of 1.33 mA. per volt. It is interesting to observe that the emission slowly builds up after applying the heater current, which is 2.0 amperes at 3.5 volts, derived from a small step-down transformer. At full heater current, five seconds elapse before any emission is obtained, it slowly creeping up to a maximum after about 15 seconds. After switching off, moreover, the emission continues for a few seconds. Some difficulty arose during the process of testing the valve, as it was found that for a constant heater current the anode current for given settings of grid and anode potentials very slightly increased over a period of half an hour.

Heater Efficiency.

It will be noted that the heater wattage is 7, as compared with, in the case of an average 6-volt dull-emitter valve, 1 to 1.5. Assuming an overall efficiency of 30 per cent. for a small battery charging rectifier and an accumulator watt hour efficiency of possibly 60 per cent., it will be seen that nearly 8 watts are consumed from the supply mains for operating a dull emitter valve. As compared with the heater-fitted valve, the power taken from the main is also probably of the order of 8 watts.

No information can as yet be given as to the life of the valve, though there is little doubt that it is at least as durable as any other type.



Modified receiving circuit showing heater and cathode connections. A positive bias is applied by means of a cell when using leaky grid condenser rectification.

Tested in a receiver as a low-frequency amplifier in the output stage operating a loud-speaker, no A.C. hum could be discerned during the transmission, though a very feeble mains noise could be heard in periods of silence. Such a hum is permissible, being less than that normally experienced when applying direct current to a set from mains. An important feature is that it can be used as a detector with inappreciable ripple, and that in bringing the receiver adjustments to the threshold condition of oscillation the mains noise is not accentuated and is practically undiscernible. In a stabilised transformer-coupled high-frequency stage, weak signals can be tuned in without the slightest masking by background noise, though listening with telephones, following a single L.F. stage, one was aware that the mains were connected to the receiver. In the hands of the amateur the utility of this valve will probably develop, and it is a great advance towards the production of receiving sets working entirely from alternating current supply mains.

Catalogues Received.

Athol Engineering Co., Seymour Road, Crumpsall, Manchester. Leaflet descriptive of the *Athol* Reversible Valve Holder. Leaflet dealing with the *Athol* Earthing Plug, Baseboard Coil Holder, Loud Speaker Extension, etc.

British General Manufacturing Co., Ltd., "Radio Works," Brockley, London, S.E.4. Catalogue of *Britimax* Wireless Components.

H.S. Electric, Ltd., Birmingham. Leaflet describing the valves of the *Octron* range.

S. G. Brown, Ltd., Western Avenue, North Acton, W.3. Complete catalogue (20 pp.) of *Brown* Wireless Instruments, season 1926-27.

Radiall Company, 50-52, Franklin Street, New York (London office: 24-26, Maddox Street, Regent Street, W.1.). "The Radiall Book," dealing with the "Amperite" filament resistance, and giving details of most popular circuits now used in America.

E. K. Cole, Ltd., 513, London Road, Westcliff-on-Sea. Pamphlet regarding the *Ekco* High Tension Units for obtaining H.T. from mains.

Rothermel Radio Corporation of Great Britain, Ltd., 24-26, Maddox Street, Regent Street, London, W.1. Leaflet on "How to Use Royal-Frost Pan-tab and Gem Radio Jacks."

STEREOPHONIC RECEPTION.

Combined Use of Loud-speaker and Phones to Improve Quality of Reproduction.

By MANFRED VON ARDENNE.

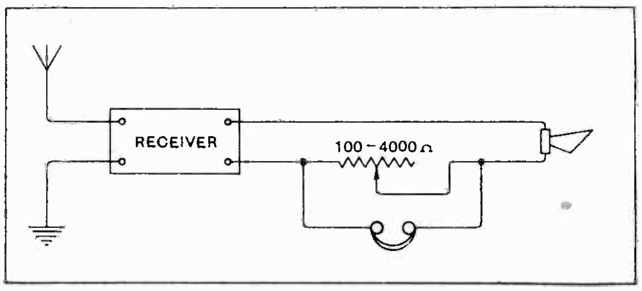
THE reproduction in a loud-speaker of sound transmitted by wireless is very often compared with that of a gramophone. This is rather surprising, since the characteristics of the different musical instruments are, in fact, quite differently reproduced by gramophone and loud-speaker. In one respect, however, both gramophone and loud-speaker differ from the original direct reception of sound, and it is this common feature of the two that leads to such comparison.

In the concert hall, sound reaches our ears from practically every angle, and the impressions reach our brain with a certain difference in phase, due to the time sound takes to travel the distance from ear to ear. These two influences combine to give us the effect of hearing from several points around us at once. Both gramophone and loud-speaker, however, lack this all-important phase-difference, because there is only a single microphone and a single diaphragm to receive and reproduce the sound-waves impressed on the apparatus. The absence of phase-difference induces us to complain of the "gramophone-like" reproduction of the loud-speaker, because the music of a full orchestra reaches our ear with the unnatural impression of being produced at one single point in space only. For really natural reproduction, not only the phase-difference itself is essential, but it must also constantly vary so as to give the impression of hearing from several points at once, the different points where the instruments are placed. The echo effects present in a large hall must also be taken into consideration, as has lately been successfully done at 2LO, where the writer had occasion to see the apparatus employed for the "artificial echo."

Introducing a Phase-difference.

At first it would seem that there are insurmountable difficulties preventing a solution of this problem. Two distinct transmitters and receivers would have to be employed, and that alone, of course, renders it impossible. It is, however, quite practicable, as the writer has shown as early as 1924, to produce artificially a constantly varying phase-difference at the receiving end without any elaborate apparatus. Thus perfectly natural stereophonic reproduction of the original sound-waves is obtained and the effect is most striking.

The circuit shows the simple arrangement by which this effect can be produced. The requisites are a receiver capable of giving good loud-speaker reception, an ordinary loud-speaker, a pair of headphones (these should not fit too closely), and a resistance variable between about 100 and 4,000 ohms. The station should be tuned to maximum strength on the phones, the loud-speaker should then be moved away from the listener till a slight echo effect becomes apparent (about 10 to 15 feet ought to suffice), and the variable resistance should then be used to regulate the signal strength on the phones till their effect on the ear is approximately equal to that of the loud-speaker. If these conditions have been fulfilled, a marked improvement in quality of reproduction will be noticed, due to the phase-difference introduced by the distance between loud-speaker and phones. This phase-difference also varies with the frequency of the sounds reproduced, and thus a constantly varying difference in phase produces the stereophonic effect so superior to ordinary reproduction. The sound-waves seem to reach our ears from all directions at once. It is of interest to note, especially for transmitting purposes, that the stereophonic effect is not lost if the phase-difference is produced at an earlier stage in the microphone-loud-speaker chain and only one reproducing apparatus is used to impress the "specially prepared" music on our ears.



Loud-speaker and shunted telephone connections for producing the stereophonic effect at the receiver.

The writer also succeeded in obtaining the same stereophonic effect on a gramophone[1]. Two distinct reproducing systems are used of similar characteristics complete with sound boxes and horns. The two needles are placed into the same groove, about 2½ inches apart. Thus the music produced in the one horn is always slightly behind the other and a stereophonic effect is obtained. The effect may be varied by changing the distance between the two needles. Smaller distances weaken the effect considerably, while distances above 3 inches produce an echo and 4 inches produces an unpleasant effect. For music played with a quick rhythm, such as dance music, the distance ought to be somewhat smaller than with slow music, as, for instance, an organ recital. Although it is not essential for the stereophonic effect, it is advisable to use two separate horns, some distance apart in a horizontal line. The difference in principle between these two methods of obtaining a stereophonic effect is that for wireless reception the phase-difference is produced by a difference in the distance the sound has to travel in order to reach the ear, while on the gramophone it is obtained by actually producing the same sound at different times. In both cases it is essential that the strength of sound measured at the ear is equal from both sources. In the

[1] The method was also discovered, independently of the author, by H. Kuchenmeister.

Stereophonic Reception.—

case of the gramophone that means that the same needles, diaphragms and horns have to be used.

With most gramophones it is not very practicable to add another horn. In order to overcome this difficulty an electromagnetic pick-up device may be employed giving fluctuating currents corresponding to the undulations in the record groove. These currents are then amplified by an ordinary low-frequency amplifier and reproduced in a loud-speaker. The phase-difference mentioned above can then be introduced by placing both needles on the record and the signal strength from the loud-speaker regulated till it is equal to that from the gramophone horn. The true stereophonic effect will then appear. It is interesting to note that the reproduction of the record by the electric sound-box, followed by a suitable amplifier and loud-speaker, is markedly superior in quality to that of the ordinary gramophone, because the scratching of the needle on the record is reduced. Of course, both diaphragm systems can be changed in this way, and thus a most striking effect can be obtained by the use of two amplifiers and loud-speakers. The resulting quality of reproduction combined with the stereophonic effect gives the impression of being present at the concert itself. Additional echo effects can then also be produced by varying the distance of the two loud-speakers. Since the requisites are within the scope of every amateur constructor, and because this field is comparatively new, wide opportunities for interesting and novel experiments are revealed. Wireless acoustics have been somewhat neglected and valuable information might be gained by experiments with stereophonic arrangements of this kind.

CLUB REPORTS AND TOPICS

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

Too Much "S.B."?

That the B.B.C. has been indulging in far too much "S.B." during the last few weeks was one of the points raised during an interesting debate on broadcast programmes at the last meeting of the Bristol and District Radio Society. It was contended that too much simultaneous broadcasting prevented listeners from obtaining variety of programme matter by changing over to another station. Discussion also centred on the subject of talks, and it was considered that the majority of speakers at the microphone read too fast; moreover, it was felt that general educational talks should not be given after 8.30 p.m. The meeting was unanimous in the opinion that the second news bulletin should always be broadcast at the same time, viz., 10 p.m.

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

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Southend Radio Exhibition.

The third annual exhibition held under the auspices of the Southend and District Radio Society was held at the Southend High School on Saturday, January 8th, and proved a very successful demonstration of the advances made in amateur and professional wireless during the past year. The proceedings were opened by the Mayor, Councillor W. J. Hockley, who expressed the town's gratitude to the Society for reorganising the wireless installation at the Victoria Hospital. The hospital's six-valve set has been entirely rebuilt by members of the Society.

A feature of the exhibition was the demonstration conducted by Mr. F. H. Haynes, Assistant Editor of *The Wireless World*, who experimented with a long-range receiver with a special L.F. amplifying stage, which successfully operated a large loud-speaker. The set proved its capabilities by tuning, step by step, to a large number of stations without heterodyning, transmissions being brought in with ample volume and good quality.

The championship prize of the exhibition was a silver challenge cup presented by Mr. H. S. Pocock, Editor of *The Wireless World*, for the best amateur workmanship. This trophy was secured by Mr. A. Webb, whose ten-valve supersonic heterodyne set aroused the admiration of all visitors.

The prize-winners were as follow :—

High School boys.—1, Mr. Britton; 2, Mr. Renall.

Exhibitor under 16.—1, Miss Mayer; consolation prize, Mr. Denham.

One-valve Set.—Mr. Thorp.

Two-valve Set.—Mr. Horsnell.

Three-valve Set.—1, Mr. Darvell; 2, Mr. Ball; 3, Mr. Seymour; consolation, Mr. Ambler.

Four-valve Set.—1, Mr. Greenbury; 2, Mr. Nicholls.

Five or more Valve Set.—1, Mr. A. Webb; 2, Mr. Hallahan; consolation, Mr. Savage.

Coils.—Mr. Hitchcock.

H.T. Accumulator.—Mr. Knife.

H.T. Smoother.—1, Mr. Lockhart; 2, Mr. Ward.

Loud-speaker.—Mr. Jagged.

Cabinet.—Mr. Greenbury.

Transformer.—Mr. Matthews.

Championship Cup for best workmanship by a member of the Society (given by Mr. Hugh Pocock, Editor of *The Wireless World*).—Mr. A. Webb.

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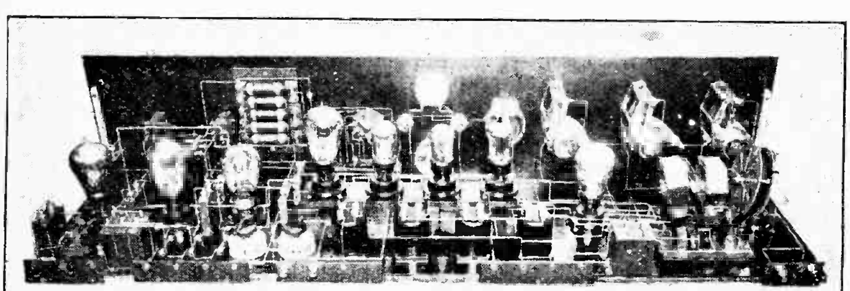
Dissecting a "Straight Eight."

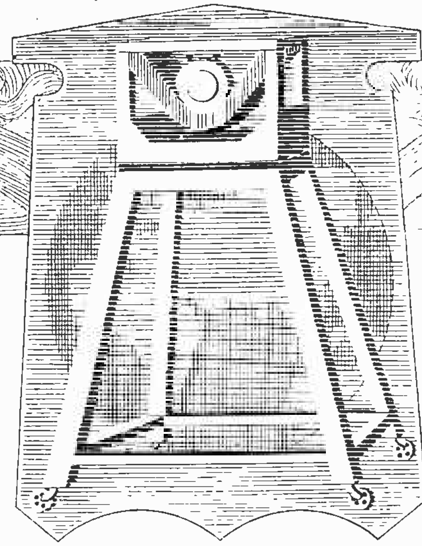
Wednesday, January 12th, was a memorable date in the annals of the Muswell Hill and District Radio Society, it being the occasion of a demonstration by the President, Capt. H. J. Round, M.C., A.M.I.E.E., of the Marconiphone "Straight Eight" receiver, of which he is the designer. After Capt. Round had explained the circuit used and the method of neutralising the five H.F. circuits, the receiver was tuned in to various stations, while a duplicate instrument, which had been dissected, was handed round for close inspection by the audience.

Residents in the Muswell Hill district who wish to join the Society are asked to communicate with the Hon. Secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, N.10.



A MULTI-VALVE PRIZE-WINNER. The 10-valve superheterodyne set constructed by Mr. A. Webb, which secured the silver challenge cup presented by the Editor of "The Wireless World" for the best amateur-built receiver at the Southend Radio Exhibition.

BROADCAST BREVITIES



NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

"Daventry Junior" — B.B.C. and the Critics—Tackling the Long Waves — Identifying Transmissions—Developments in America.

Two Stations at Daventry.

Apropos the announcement published first in these columns a fortnight ago, that Daventry will shortly conduct tests on the ordinary broadcast waveband, I now learn that for the purpose of these experiments the little Northamptonshire town will shortly have greatness thrust upon it in the shape of a new and powerful experimental transmitter distinct from the present high power station.

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The Last Word in Transmitters.

"Daventry Junior" will be ready for testing in three or four weeks' time, and will have a power approaching that of 5XX. The tests will be conducted outside the regular broadcasting hours, and will probably be on a wavelength between 300 and 400 metres. It will be the last word in broadcast transmitters, and will incorporate new apparatus of special construction which has been undergoing assembly for several months past.

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Portable Masts.

The masts are comparatively short, i.e., about 100 feet, are being put up in sections so that they will be easily portable with a view to transferring the station to another site if desired.

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What the Engineers Say.

On the success of these tests will largely depend the future of the regional scheme.

Although it is contrary to engineering practice to prophesy perfection, the B.B.C. engineers on this occasion go so far as to predict that if the regional stations are built on the same model as "Daventry Junior," they will remain up to date for at least ten years.

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Experienta Docet.

If these predictions are correct their importance can hardly be over-emphasised. A regional scheme of a sort was contemplated eighteen months ago, and listeners were hoping that by now the millennium of alternative programmes would already have begun. Perhaps it is as well that hope has been deferred. Since those sanguine days when we rushed at every new scheme like bulls at a gate, we have learned several valuable lessons. We have seen the foundation of a European wavelength scheme. We have secured a good deal of useful data on shielded areas and other causes of fading. Daventry's high power aerial has pointed the way towards improvement in design. We have learned lessons from the dual transmissions from Marconi House and Oxford Street.

All this experience has been taken into account in designing the new station.

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Throwing Out Ballast.

I think the B.B.C. are awakening to a realisation of certain of those weaknesses in the arrangement of programmes to which our daily Press has so tactfully alluded.

At the present moment the evening is divided into practically two programmes, the first, of a lighter nature, from 7.45 to 8.45 p.m., and the second from 9.30 until closing down. The second is intended to provide items of a more serious character. As a step towards lightening the load, the B.B.C. will, I understand, drop the 8.45 p.m. classical recital within the next few days.

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Union Internationale Tackles the Long Waves.

Having broken the back of the European wavelength problem as it affected the 200-600 metre waveband, the Union Internationale de Radiophonie is now out to tackle the problem of the longer waves. A conference of the Union opens in Brussels to-day (Wednesday), and deliberations will be continued until Saturday. Representatives are attending from all the principal European countries.

I understand that suggestions are to be put forward regarding certain experimental transmissions on long waves which it is hoped will lead to a solution of a problem which has been growing apace. There are now nearly thirty broadcasting stations working above 600 metres in Europe alone, and it is hardly surprising that, with the broader tuning which the longer waves involve, interference is becoming more marked.

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Identifying Stations.

The conference will also consider the question of interference by local tramways, electric motors, etc., both from its technical and legal aspects. Steps will be taken towards establishing an international system of call signs by which stations may be easily identified in the intervals between programme items.

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America's Broadcasting Network.

The National Broadcasting Company of America has christened the two divisions of its chain system of broadcasting by the names of the "Blue" and "Red" networks. The "Blue Network," which has WJZ at Boundbrook as its key station, includes station WBZ, KDKA, and KYW, while the "Red Network," with WEAF as its centre, includes stations WEEI, WRC, WCAE, WTAM, WWJ, WSAI, WGN, and KSD. The

HUB OF AMERICAN RADIO. A drawing showing the immense building, now under construction, which will be the headquarters of the American National Broadcasting Company in Fifth Avenue, New York. It will contain an auditorium studio with a capacity for 150 performers, together with numerous other studios, control rooms and offices.

famous WGY, Schenectady, is the latest recruit to the National Broadcasting Company's system. It joined their ranks on January 1st, and many of its programmes will be provided by that company. WGY will be included in the "Red Network," and for the present there will be no change in its broadcasting hours.

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"Disgusted" Takes a Hand.

There may be strange happenings in Glasgow on February 4th, for on that night 5SC will broadcast "My Programme" arranged by "Disgusted," "Fed Up," "Bored to Tears," and "Give us London." If this charming quartette fails to hold the attention of listeners I can imagine the Station Director rubbing his hands with well-merited glee. From all I hear, Glasgow has "asked for it."

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Answers to Correspondents.

"Bored," Bolton.—I fear you are wrong. The B.B.C. still broadcasts a "turn" which never receives criticism; it is known as the Announcer's Good-night.

"Constructive Critic," Pudsey.—Your suggestion that the B.B.C. should cut out anything which involves speech or music is not a sound one.

"Uncle," London, W.C.2.—Try a Labour Exchange.

Mr. Angus McHaggis, Aberdeen.—Licence fees are not returnable.

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A Hampstead Night.

The Hampstead district has other interests besides those in which Bank Holiday crowds are concerned, and those

[*Reproduced by courtesy of "The Star."*

GETTING OUT A SNAPPY PROGRAMME. This cartoon, published by our esteemed contemporary, "The Star," gives amusing expression to the general outcry against the "uplift" element in recent broadcast programmes.

interests should provide good material for the broadcast on January 27th, when descriptive matter and light music will be heard by listeners.

FUTURE FEATURES.

Sunday, January 30th.

London.—Popular Classics—Edward Isaacs, pianoforte.

Cardiff.—"The Waterlily," by Sir Frederick Cowen.

Monday, January 31st.

Birmingham.—The Olof Sextet.

Bournemouth.—Fantasies.

Newcastle. — Stanley Beckett's Quartet (vocal music).

Glasgow.—"Martha," an opera.

Tuesday, February 1st.

London. — B.B.C. International Concert, relayed from the Grotrian Hall, London. (Czecho-Slovakia.)

Cardiff.—"Elias and the Mushrooms" (play in one act).

Belfast.—Popular Grand Opera.

Wednesday, February 2nd.

Glasgow.—"Young Heaven" (a play in one act).

Aberdeen.—Scottish Programme.

Thursday, February 3rd.

London.—B.B.C. National Concert, relayed from Albert Hall.

Bournemouth. — Service for the Sick.

Manchester.—A Chamber Concert of Mendelssohn's Music.

Friday, February 4th.

London.—"The Chinese Puzzle."

Birmingham.—Russian Composers.

Cardiff.—"The Merrymakers."

Saturday, February 5th.

London.—Wireless Military Band, playing National Dances.

Newcastle. — Fragments from "Franz Lehar."

Belfast.—Concert relayed from the Wellington Hall.

The B.B.C. in 1926.

Figures for the year 1926, just compiled, show that the total programme hours were 65,870, giving the average hours per week per station as 59. The average percentage breakdown was .07. Assuming an average year's transmission of 3,000 hours per station, .01 per cent. breakdown represents actually only 18 minutes' break in broadcasting during the whole year.

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The Psychic "Mike."

Readers who remember the dismal failure of the last experiment in massed telepathy, when a group of celebrities in a London hotel were asked to divine the thoughts of the listening public who had been directed to think about certain objects specified by the 2LO announcer, will hardly be thrilled by another experiment to take place on February 16th.

On this occasion the rôles will be reversed, the broadcast public being asked to fathom the sapient cerebrations of a number of distinguished scientists locked in a room near Savoy Hill. Sir Oliver Lodge will be master of the ceremonies, and the experiment will be conducted under the auspices of the Psychic Research Society.

More Wavelength Changes.

Further changes in the wavelengths of B.B.C. stations took place on Sunday last. The stations affected and their new wavelengths are as follow, the original wavelengths being shown in brackets:—

	Metres.	
Birmingham	326.1	(491.8)
Bournemouth	491.8	(326.1)
Edinburgh	288.5	(294.1)
Bradford	252.1	(254.2)
Hull	294	(288.5)
Dundee	294	(288.5)
Stoke	294	(288.5)
Swansea	294	(288.5)

It is still too early to decide whether Birmingham listeners will accustom themselves to such a sweeping drop, but there can be little doubt that Bournemouth will relish the freedom from spark jamming which has troubled south coast listeners for many months past.

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Golf by Wireless.

Charles Heslop and Company, whose golfing sketch has been performed in almost every part of the world, will give a broadcast performance of the sketch on February 7th. Other artists to be heard on the same date are Elsie Carlisle, with Bobby Alderson at the piano, and Edna Thomas in negro spirituals.

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More About Hamlet.

"Hamlet's New Job" is the intriguing title of a broadcast by Canon Wilkinson from the Aberdeen station on February 8th. Hamlet is generally considered not only as the hero of what many regard as Shakespeare's greatest play, but as a character who would be out of place in any but his own time. Canon Wilkinson is to let in a fresh flood of light on the famous Prince of Denmark.

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A Jewish Concert.

A Jewish concert is to be broadcast from 2LO on February 2nd. On the same evening Mr. P. G. Wodehouse, the well-known author, will present one of the "My Programme" series.

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A War Talk.

"War Experiences Afloat" is a subject on which Captain Gregory will speak from Dundee through all the Scottish stations on January 27. He will deal with the exciting and amusing side of his adventures and will tell how the weather was as great an enemy as Germany, so far as he personally was concerned. As harbour master, Captain Gregory is now enjoying a little leisure from the buffeting of the waves.

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A Duplicate Cast.

When WGY, Schenectady, recently produced the Gilbert and Sullivan opera "H.M.S. Pinafore" a duplicate cast was employed, the speaking parts being taken by one group of artists and the singing parts by another group.

It is a little difficult to understand why this was so, though the idea might be adopted over here in order to find jobs for the artists who are supposed to have lost their occupations through the malign influence of broadcasting.

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.

ARRANGEMENT OF PROGRAMMES.

Sir,—It is a pleasure to respond to your appeal for views upon the allocation of matter in the B.B.C. programmes, as I concur in your view that the programmes at present are too scrappy.

I think the present outburst of criticism is mainly due to this cause, and that last year's arrangements were decidedly preferable, as one could select evenings when the programmes appealed to one's taste.

My own feelings are that the old B.B.C. were approaching the ideal except for the quality of the artists, who, we are assured, were often of poor standing as financial considerations precluded the best being invariably presented.

I am by no means convinced that it would not be better to concentrate on this weakness rather than provide alternative programmes, as I feel that too much listening is not good for "high-" or "low-brow," and the alternative programme may lead to loss of licences through satiety. Moreover, I am rather appalled at the possibility and result of the wireless service providing a continuous stream of inanity for those who fill the correspondence columns of the newspapers with violent complaints.

It is to be hoped that this great service will never be reduced to the intellectual level of the cinema, as so many desire. I am glad that you have not opened your columns to such criticism, and in your Editorials have awarded praise and blame in just measure. W. J. SKINNER.

Cheam.

January 12th, 1927.

Sir,—May I express the hope that you will continue your brighter programme campaign? One hour of amusement, half an hour of news, and three hours of education are not likely to do the trade, the wireless Press, or the listener much good. At the end of the present type of programme I feel like a child who has been let loose in a confectioner's shop and given repeated doses of castor oil between helpings; a sort of mental indigestion. Also, I object strongly to the idea of a sort of board of very superior individuals who say to me "for being a good boy you shall have a little amusement this evening, but only on condition that you allow us to educate you for the rest of the time." Listening used to be one of my favourite pastimes. It is now becoming an absolute bore.

January 14th, 1927. C. H. G.

Sir,—Your Editorial to-day on B.B.C. programmes hits me right where I live.

It happens that I have had the opportunity of listening to the Berlin programmes—in Berlin—for months on end, having at that time no alternative, and on comparing the two arrangements feel bound to say that our programmes seem to me speckled and unnecessarily difficult to memorise.

I suppose the majority of listeners listen between 4.30 p.m. and 10 p.m., or some portion of this period.

The Berlin programme was as follows:—

(1) 4.30 to 6 p.m.—Concert.

(2) 6 to 8.30 p.m. (7.30 p.m. on opera nights).—Talk.

(3) 8.30 to 10 p.m. (or 7.30 to 10).—An entertainment, of which one could say at once I listen or I do not.

Although I have now been listening uninterruptedly to the B.B.C. for fifteen months, I have never been able to feel so comfortable as to whether I shall listen or not. There is nearly always one item I should be sorry to miss, and I find it rather unsettling. Try to tabulate our programmes and there are too many numbers.

After all, from entertainments once a month to once a day is quite a jump, and we need not be so greedy.

There is one other point you do not mention.

How often one goes round the dial—London, Birmingham, Cardiff, and Bournemouth (my no-trouble stations)—only to find they are all doing the same sort of thing at the same time. I do not, of course, mean the S.B., which I recognise as a necessity; what a chance for an alternative—for the valve user—is missed here. W. E. CASTENS, Lt.-Col.

Wallingford.

January 12th, 1927.

Sir,—My opinion about the programmes is, that they have been cut up into such small pieces, nothing but scraps. It was delightful to have the news at 6.30 p.m., but the extra time seems to have disorganised the programme. No longer can one say: "There is to be a good concert or play to-night, come and listen." If there is one it takes place when one wants either to go to bed or dance. The second news at nine o'clock, I think, cuts into the evening, although I suppose it may suit country districts.

In criticising the construction and material of the programmes I always feel that what I should like personally would perhaps appeal to only a small minority, and I think our own choice would soon pall. I always feel indebted to the B.B.C. for giving us a fine selection of all kinds of music, and if they had had the funds we should have had better artists. Now that the corporation has a bigger revenue I trust that we shall have the best in every branch. Of course I realise a lot will have to be spent on the "regional" scheme, and even with two programmes to choose from I am afraid not everyone will be satisfied.

As for the talks they have increased and become stodgy, and I am sure the tired worker with a crystal set must be bored, and I am really sorry for the children. Why should they have school again? From the child's point of view half the joy was to hear your own pet "Uncle's" voice and have surprises, not everything cut and dried, and mapped out weeks beforehand.

I must apologise for this long letter, but I have the welfare of broadcasting very much at heart; having been a constant listener for three years I feel I can and am entitled to criticise.

London, W.8. A. M. J. SHORTER.

January 16th, 1927.

Sir,—I quite agree with your programme suggestion in this week's *Wireless World*. I enjoy the B.B.C. programmes very much, though, of course, not all equally; there would be something wrong either with me or the programmes if I did; but at the same time I think the B.B.C. are making a mistake in trying to please all the people all the time; a feel sure they would give even more pleasure than they do to the vast majority of their listeners of they followed your suggestion and gave each section of their listeners a real treat on one or two nights each week. I cannot listen every evening, but could easily arrange my time so as not to miss the programmes which are most attractive to me personally. I buy the *Radio Times* each week and have always tried to do this; but it would be much easier and I should not miss so many items I should like to hear if there were less chopping and changing with half-an-hour of this and half-an-hour of that, with no attempt at continuity.

I am a member of the Wireless League and a regular reader of *The Wireless World* and *The Listener*. I am writing to the Wireless League to call their attention to your article, as I feel sure it expresses the opinion of very many listeners.

Stockport. H. ANDREW JOHNSON.
January 13th, 1927.

AMATEUR INTERNATIONAL PREFIXES.

Sir,—I think it a great pity that this list was presented "to come into force" in about three weeks without proper time for criticism and amendment.

Those Governments, like our own, who have given recognition to the amateur are fully entitled to object to their existing arrangements being upset at the behest of a foreign body. It is not likely that countries with strong nationalistic ideas will agree to being lumped together, as is blandly proposed for ET (Poland, Esthonia, Latvia, Courland, and Lithuania).

The amazing part of the proposed scheme is the way in which the countries are named, without apparent rhyme or reason. Why mention all the French and Italian colonies separately, yet dismiss all the native States as "India"? Why allot a separate group to places like Greenland, Afghanistan, Eritrea, while grouping together Zanzibar and the Soudan, a thousand miles apart? Where is EZ, the zone of the Straits? Consultation of any stamp catalogue would have shown several omissions in Europe, yet, though Monaco and Andorra are mentioned, why ignore San Marino, Liechtenstein, and Danzig, to say nothing of Moresnet?

Seeing that the Europe group is fully allotted, I have said enough to dispose of the optimistic claim that "the present plan provides for every country in existence."

It is to be hoped that no attempt will be made to adopt the present incomplete plan, and that no similar plan will be presented without more careful consideration.

A. HINDERLICH (G 2QY).
London, N.W.2.
January 15th, 1927.

Sir,—You publish on January 12th a list of Amateur International Prefixes, suggested by the I.A.R.U.

I do not know the general opinion of British "hams," but those in this area regard the plan very unfavourably. Granted that from an *American* point of view EG may be all right for Britain, over here, G, GI, GW, and GC are of the greatest use and importance.

ET here would be most confusing to any G station.

It is typically American to give Austria EA, when everyone knows that Ö (— — — -) is the Austrian's own way of spelling Austria, which, to my mind, is much more suitable.

I wonder if such bodies as the T. & R., J. des E., R.B., etc., have been consulted, and what their opinions are on the subject?

While on the subject, why is it that the British Post Office alone will not sanction the use of giving the prefix of the "called station" followed by that of the "calling station" without the "de" intervening?

Every other country does this, and as the prefix is always given in any case, what is to be gained by bringing in what often leads to confusion?

For example, 2AB GI-G 6AB means that Northern Ireland is being called by Britain.

The inclusion of the "de" very often means that the G is taken as part of the call, and it takes time to explain that the station is G2AB and not 2ABG. As Britain is so far ahead in many ways, why this black spot in the amateur world?

Another little question—Why is every country in the world using "CQ," when here we in Britain are not allowed to send a general call?

I have no axe to grind against the "powers that be," as I have received nothing but courtesy from them, but I do think, if they were approached in the right way and spirit, they would see that we British "hams" would play the game, and could be brought into line with the rest of the amateur transmitting world.

I mention these two points in the hope that some move may be made in the matter by the R.S.G.B. and other such bodies in a combined effort, as if the matter were put to the "powers that be" by a representative body I am sure a sympathetic understanding would ensue. A. M. HOUSTON FERGUS
Jersey. (G2ZC).
January 16th, 1927.

MODERN AMPLIFIER PERFORMANCE.

Sir,—The letter of Mr. Symes in your issue of January 12th raises an interesting point concerning the cone loud-speakers now being manufactured by several firms, Messrs. Burndept being among the number. These speakers, as you are doubtless aware, are wound to a D.C. resistance of 750 ohms; in the original model made by the former Western Electric Co. the loud-speaker and output transformer of the special amplifier were made to suit each other. Now the firms making this type of speaker still keep to the 750-ohm resistance, and suggest it is more suitable to modern power valves.

Now I do not know the A.C. figures of the "Kone" loud-speaker, but I have some figures for two other makes of loud-speaker given by the makers, the Sterling "Primax," 21,000 to 23,000 ohms at 800 cycles, and 30,000 ohms at 1,000 cycles for the large model "Amplion."

Now the impedance at 100 cycles is obviously going to be somewhere about 2,500 to 3,000 ohms, so that the 2,000-ohm D.C. resistance is certainly none too high for even a 3,000-ohm valve. In consideration of the above it seems extraordinary that lowering this already low impedance is put forward as a step in the right direction; it would seem that it should be considerably raised to do full justice to the low notes.

In practice I find a 3,000-ohm valve gives a decidedly better tone on a 2,000-ohm loud-speaker than does the usual 6,000 to 8,000-ohm valve. C. M. KEILLER.
Cookham Dean,
January 13th, 1927.

Sir,—Mr. W. Symes, in a letter in the January 12th issue of *The Wireless World* under the above heading, touches upon the subject of loud-speaker and amplifier output impedances, and states that the general tendency is to use an output valve of too high an impedance. Now, while this may be true with certain loud-speakers, I venture to suggest that it is not by any means the case with the modern coil-driven free-edged cone type of loud-speaker, and that for the operation of such instruments the output impedance of the amplifier should be deliberately kept up.

The reasoning on which this opinion is based is as follows: The apparent impedance of the speech coil is lowest at some intermediate frequency, say 200 cycles, rising sharply with a reduction in frequency due to motional impedance and rising gradually with increasing frequency since the impedance of the coil is largely reactive.

But one of the requirements of this type of loud-speaker, in order that it may produce constant sound output at varying frequencies, is constant driving force, i.e., current.

Since the impedance of the coil varies considerably, the obvious way to ensure constant current, irrespective of the coil impedance, is to include a considerable "swamp" resistance in the coil circuit.

The most economical manner in which this may be done would appear to be by using an L525 in preference to a LL525 type of valve.

Output in excess of that obtainable economically from one L525 valve might be obtained by connecting up a second valve of this type to work push-pull with the first.

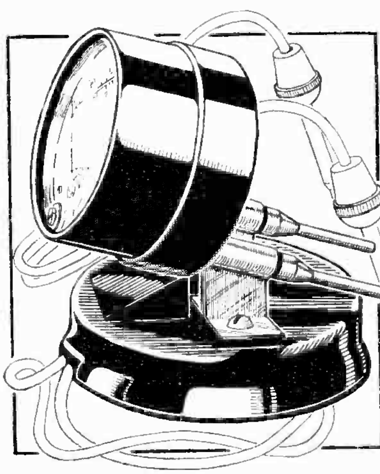
The inclusion of a transformer between the output stage and the speech coil provides us with an opportunity to adjust the effective resistance of the one to the other, and, in general, the step-down ratio should err on the small side to obtain the swamping effect of the valve resistance in the coil circuit.

The above point of view is, I believe, novel but apparently logical, and I would be glad if any of your readers competent to express an opinion on the subject would be good enough to do so. D. KINGSBURY.
London, S.W.20.
January 16th, 1027.

A Review of the Latest Products of the Manufacturers.

THE NEW WESTON VOLTMETER.

A testing voltmeter is essential in the maintenance of a receiving set. It is most necessary to be able to determine the potentials of the H.T. and grid bias batteries, whilst many dull emitter valves giving no visible glow are best tested as to correct working voltage by applying a voltmeter across the filament sockets. A voltmeter used for this purpose should preferably be dead beat and its reading should be correct within very narrow limits of accuracy.



Two-range Weston testing voltmeter.

The new Weston two-range voltmeter is specially designed for this purpose. The standard model has a two-range scale reading to 6 and 200 volts. The moving coil movement gives a full scale reading with a current of 7 milliamperes, so that an exceedingly small load is placed on the battery under test, which is essential if an accurate voltage reading is to be obtained. The series resistance for the high voltage scale is carried in a detachable base which is fitted with flexible leads and wander plugs.

The meter when withdrawn from the base can be connected directly across the battery on test, and for this purpose the connecting pins at the back are pivoted. A good arrangement is to provide pairs of sockets on the front of the instrument panel so that the voltmeter can be connected across the filament sockets of any of the valves in a receiver.

Although intended for use as a voltmeter, this instrument has another application. It can be connected in series with the plate leads to the various valves in turn, adjustments of grid bias and H.T. battery potential being made until the needle remains stationary with the strongest signals. This is a good indication that the L.F. valves are working on the straight part of their characteristic curves and that at no time is the grid becoming positive.

For this purpose, however, another meter is available. It is 2in. in diameter, arranged for recessed mounting through a hole in the panel, has a narrow black flange and a particularly open scale. It is secured to the set by a clamping pin, thus obviating the need for fixing screws.

A two-range voltmeter is also available of similar design for panel mounting in which a small plunger switch applies the meter either with its 6-volt range across the filament circuit or its high voltage range across the plate potentials.

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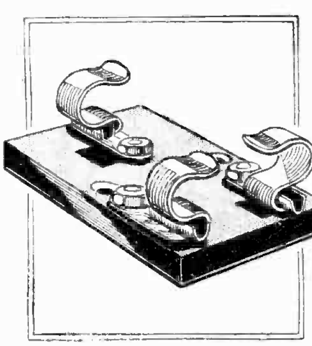
GRID LEAK CLIP.

When the grid leak circuit is returned directly between the grid and filament instead of shunting the grid condenser, it becomes necessary to make use of a small ebonite base with clips to support the leak resistance. A useful modification to the simple grid leak mount is to be found



A useful grid leak mount which readily permits connecting the leak either across the grid condenser or between grid and filament. Alternatively the grid leak can be moved from one clip to the other to change the grid basis.

in the J.J.R. holder, of J.J.R., Ltd., 7a, Ross Parade, Wallington, Surrey, which is provided with an additional clip, so that the resistance can be readily transferred from shunting the condenser to connect to the filament or biasing battery.

The clips are mounted on an ebonite basepiece. The screw heads are recessed on the underside, and countersunk securing holes are provided.

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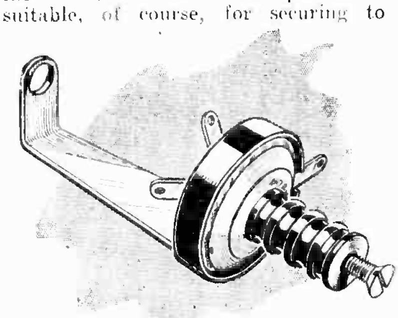
NOVEL GRID CONDENSER AND LEAK.

The need for carefully insulating a grid condenser from earth must not be overlooked for it is apparent that either poor insulation or an appreciable stray capacity to earth is actually in parallel with the tuned circuit.

Bearing in mind these requirements, Herbert Bowyer and Co., 1, Railway Mews, Tiverton Street, London, N.W.5, have introduced a combined grid condenser and leak which is carried on an elevated post so as to maintain good insulation and a low capacity to earth.

A single plated 4BA screw secures the unit to a baseboard or panel. It is suitable, of course, for securing to a

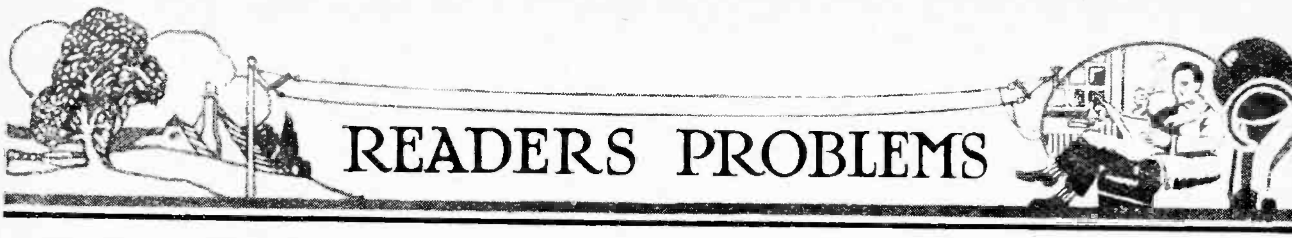


The Dorwood grid condenser and leak is fitted with an insulating pillar which elevates the condenser from the baseboard.

metal panel, whilst even in the case of an ebonite panel the spacing piece places the condenser sufficiently far from the front panel to eliminate hand capacity effects.

The grid condenser is circular and is clamped into a small Bakelite moulding under a thick brass disc so that air is practically excluded from between the plates, and the value can be relied upon to remain constant. A spring clip secures the grid leak. Three tags are provided so that the leak can either bridge the condenser or connect to the valve filament, though in the particular form of construction adopted it would be better perhaps to connect the leak directly across the condenser.

By the use of the insulating pillar the connecting tags become elevated from the baseboard at a sufficient height to facilitate wiring.



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 Resistance Problem.

I have a 3-valve broadcast receiver of quite normal design except for a special arrangement of valves. In the first two positions I use 3-volt 60 milliampere valves, while the output valve is of the 6-volt super power class. The two 60-milliampere valves are connected in parallel through a fixed resistor to the 6-volt filament battery. Without thinking I once removed one of the 60-milliampere valves, with the result that the one left in the set immediately lit up. Why should it? L. S. T.

The two 60-milliampere valves are connected as in Fig. 1. These valves require a filament heating current of 60 milliamperes at 2.8 volts, and the voltage of the accumulator is 6. Resistor

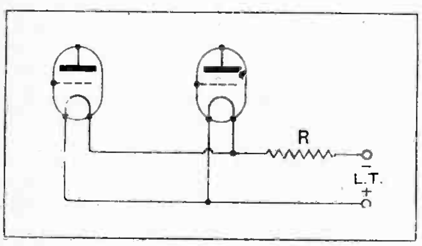


Fig. 1.—A resistance problem.

R is therefore called upon to absorb 3.2 volts at 120 milliamperes, the current taken by the two valves. From Ohms law, $R = \frac{E}{I}$ (or resistance equals the voltage divided by the current) we find that the resistor should have a value of $\frac{3.2}{0.12}$ or 26.6, say 27, ohms.

If, now, one of the valves is removed from the set the current which passes through the remaining valve must increase. Let us suppose that the resistance of the filament of the valve remains constant at 47 ohms, that is $\frac{2.8}{0.06}$ ohms. Then the total resistance in the circuit is 47 + 27, or 74 ohms, and as this is connected to a 6-volt battery the current flowing will be $\frac{6}{74}$, or 0.08 ampere. The filament of the 60-milliampere valve will, therefore, be over-run.

As a matter of fact, it is not quite fair to assume that the resistance of the filament remains constant; nevertheless, the above example gives one a good idea of the effect of removing one of the 60-milliampere valves from the set. Probably the valve will not be damaged if the extra current is allowed to flow for only a moment; if it is repeatedly overrun, however, its emission will diminish.

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Anode Current from A.C. Mains.

I wish to experiment with an A.C. anode battery eliminator as I understand that a device of this description can be made entirely satisfactory. T. K.

A properly constructed A.C. anode battery eliminator is a satisfactory substitute for the more usual form of anode battery; one can easily be made at small cost, and the only item which requires replacement at intervals is the rectifying valve.

The connections of such an instrument are given in Fig 2. A transformer having a primary winding P to suit the periodicity and voltage of the supply mains, has two secondaries; one of these, S_1, should be designed to give about 180 volts across each half of the winding, i.e., the voltage across the outer ends is about 360. The second winding, S_2, is for filament heating, and has a centre tap.

A rectifying valve V_1, having two anodes and a single filament, is used. Such a valve is the Marconi or Osram U5, and it will be seen that the two anodes are connected to the outer ends of the secondary winding S_1. The centre tap of this winding forms the negative H.T. terminal, while the centre tap of the filament winding S_2 is joined through a choke L to the positive terminal + H.T.$_2$.

A smoothing system, comprising choke L and condensers C, is necessary to level out the supply to the anode circuits of the receiver, and L must be liberally designed in order that it will carry the total anode current without overheating or without saturating the iron core. It may have an inductance of 20 or 30 henries. Condensers C, of 10 mfds. each, should preferably be of the 600-volt type.

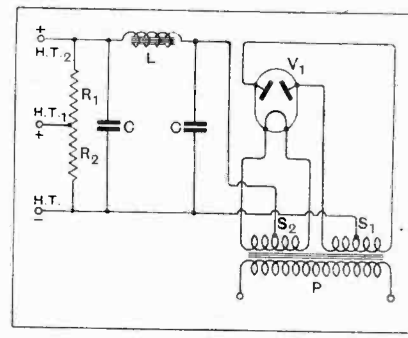

Fig. 2.—Connections of an A.C. anode battery eliminator.

It will be seen that the full voltage obtained from the rectifier is available between terminals marked − H.T. and + H.T.$_2$. This voltage will normally be connected to all the valves in the receiver excepting the detector. For the detector a separate anode voltage at + H.T.$_1$ is provided, and the voltage available can be adjusted by varying the point at which this terminal is connected to the high resistance R_1, R_2. Resistance R_1, R_2 can have a value of 10,000 or 20,000 ohms, the latter value being preferable. With + H.T.$_1$ connected to the centre of the resistance, as shown in Fig. 2, the voltage available for the detector is approximately half the voltage of + H.T.$_2$.

If preferred, two electric lamps of very low candle power can be used at R_1, R_2. No condensers are shown between + H.T.$_1$ and negative H.T.; a 2 mfd. condenser will usually be provided in the receiver itself.