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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 Neglected Selling Point.

SALESMEN in every industry attach great importance to what are termed "selling points" for the wares in which it is their business to interest the buying public, and at Olympia during the Exhibition we have had an excellent opportunity of acquainting ourselves with what are regarded by the salesmen as the selling points of every wireless set shown.

It has been impressed upon the public persistently that if it is only desired that the alternative programmes of the British stations should be receivable, then comparatively simple and rather inexpensive receivers will suffice; yet it would probably be no exaggeration to say that by far the greatest number of the wireless receivers exhibited at the Show were designed to be capable of reception of a big choice of stations abroad.

Experience has shown that the public prefer selective receivers capable of reasonably long-distance reception, and are quite prepared to pay a higher price for a set of this sort rather than content themselves with one which will give them adequate reception of the local stations only. This being so, how is it that more attention is not given by the radio salesmen to foreign stations and the interest to be derived by the public from their reception?

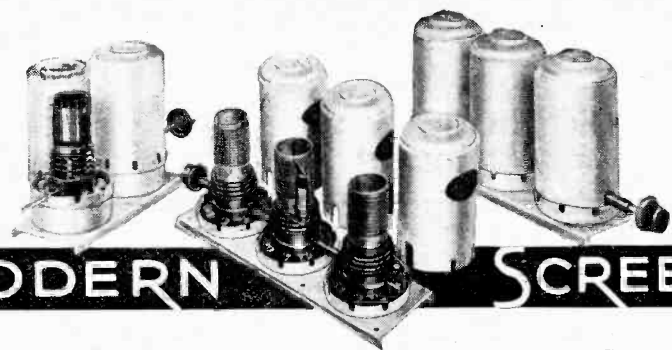
From end to end of Olympia there was scarcely a mention of foreign-station reception, or even, for that matter, any emphasis on the variety of programmes which receivers were capable of providing, with the exception of the few instances where names of stations were included on the dial settings. But even in these cases, where obviously the sets had been designed with the idea of drawing the attention of the user to the possibility of foreign reception, insufficient use was being made in sales literature of this ability of the set to receive the varied programmes.

Surely in putting forward the claims for a new receiver one of the first things with which the public should be acquainted is the capabilities of the set, and, apart from the primary consideration of quality of reproduction as a musical instrument, the next most important attribute of the set is surely its performance in the way of the choice of programmes which it can give the listener. Far too little attention, in our opinion, is paid to stressing to the public the variety of entertainment interest which the receiver of to-day is capable of giving.

We can, perhaps, provide a comparison by considering the way in which the attractions of owning a camera are conveyed to the public. The salesman stresses the attractive pictures which the camera is capable of taking, and, with a camera capable of high-speed work, prints of photographs taken with it to demonstrate its possibilities are almost invariably included with sales literature; in fact, the camera is sold largely on the interest aroused in its *performance* and the pleasure which can be derived from its *use*.

Why are the equivalent capabilities of wireless receivers not stressed on similar lines?

In This Issue



THE MODERN SCREENED COIL

Part III.—Designing the Coil to Suit the Screen.

By A. L. M. SOWERBY, M.Sc.

WHEN enclosing a tuning coil in a metal screen many changes in its properties takes place. In earlier articles of this series it has been shown that a considerable decrease in inductance can occur and that the self-capacity of the coil is increased. Perhaps the most important investigation concerns the alteration of high-frequency resistance—the constant which very largely determines the H.F. stage amplification which will be obtained in a receiver. In this article practical measurements are made which provide the constructor with the necessary data to choose the best size of coil for a given size of screen.

IN discussing the change of inductance brought about by the addition of a screening box surrounding a coil, emphasis was laid on the fact that the change in question is due to the formation of a new magnetic field, originating in the eddy currents set up in the screen by its proximity to the coil. Since there is no conductor so perfect that it has no resistance, it is quite clear that a supply of energy, even though it only be small, must be drawn from the coil to maintain these currents. In plainer language, the losses in the coil must be increased when a screening box is placed round it. We may therefore expect to find an increase in the equivalent series resistance of a tuned circuit as a result of screening the coil; that is, the losses due to the passage of current through the metallic conductors present will be augmented.

Besides this, there will inevitably be a small increase in those sources of loss which arise from voltages developed across imperfect dielectric material. For one thing, the distributed capacity of the coil is raised through the nearness of the earthed screen to the high-potential end of the coil; and then, in addition, the connection to this high-potential point has to be brought out of the screen through a wire protected by systoflex or other insulating covering.

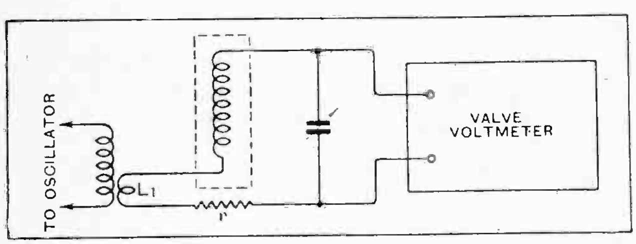


Fig. 1.—The circuit used for measuring the resistances of screened coils. A voltage is induced into the coupling coil L_1 by the oscillator, and the valve-voltmeter readings corresponding to various known values of *r* are observed.

When we add to these points the fact that the inductance of the coil suffers a variation through the addition of the screen, it becomes clear that the total effect of screening is going to be decidedly complicated. To measure the new constants of the coil in any given case is not so very difficult; to make out the numerical laws controlling the effect of screening with sufficient certainty to be able to predict the result of screening in any given case is a very different proposition.

From the purely practical point of view, it is fortunately not necessary to succeed in so ambitious an undertaking; the writer has therefore directed his measurements primarily towards obtaining a general idea of the effects of screening, and to finding the dimensions of the best possible coil to use in combination with screens of convenient and useful size.

Change of Inductance and Resistance.

In approaching the necessary measurements from this angle, the results already given for changes in inductance were taken as a guide. That this is reasonable will be realised if it is remembered that the change in resistance is largely due to the eddy currents set up in the metal of the screening box, and that the change in inductance is a measure of the magnitude of these currents. The greater, therefore, the reduction in inductance in any case chosen, the greater is the increase in resistance likely to be.

TABLE I.

Coil Number.	Diameter. (Inches).	Length (Inches).	Turns.	Wire.
1	1¼	0.92	90	34 enam.
2	1½	1.10	80	30 enam.
3	1½	1.50	88	30 d.s.c.
4	1½	2.0	98	28 s.c.c.
5	1¾	1.12	72	30 d.s.c.
6	2	1.0	62	28 enam.
7	2	2.05	80	26 d.c.c.

The screening box for all coils was cylindrical in shape; 2⅝in. diameter, 4in. in length.

The Modern Screened Coil.—

As a beginning to the measurements, the high-frequency resistance of a range of seven coils of different dimensions was determined, the coils first being in the open, and then centrally disposed in a screening box of comparatively small size. Details of the coils are given in Table I, below which is a description of the screening box used.

Measuring High-frequency Resistance.

In Fig. 1 is shown a diagram of the circuit used for measurement; it will be seen that a small (two-turn) coupling coil L_1 was connected in series with the coil under measurement in order to make it possible to induce a voltage into it, even when the coil proper was completely screened. Keeping the coupling between L_1 and the oscillator constant, several different resistances were inserted in turn at *r*, the voltage developed across the tuning condenser with each in place being observed by reading the valve voltmeter. From the voltmeter readings and the known values of resistance inserted, several independent values for the high-frequency resistance of the tuned circuit were computed, and the mean of these results, which were normally very close to one another, was taken.

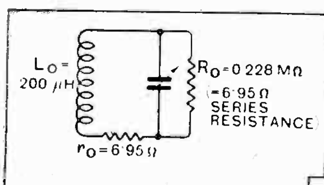


Fig. 2.—The true representation of the unscreened tuned circuit, on the assumption that conductor and dielectric losses are equal.

It will be observed that in all cases the result must include the high-frequency resistance of the coupling coil L_1, and of the various connecting leads, together with the series resistance equivalent to the dielectric losses in the tuning condenser, the valve voltmeter, and the former on which the coil is wound, in addition to conductor resistance in the coil itself.

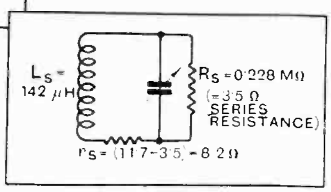


Fig. 3.—The true representation of the circuit containing the screened coil, on the assumption that dielectric losses are unchanged by screening. Note that *r* is *greater* than in Fig. 2.

The results obtained from these measurements are given in Table 2. Column 1 identifies the coil by reference to Table 1, while Columns 2 and 3 give the equivalent series and equivalent parallel resistance respectively of the tuned circuit at 300 metres with the coil unscreened. In Column 4 is shown the inductance assumed by the coil when screened; unscreened, every coil had been adjusted to exactly 200 microhenrys. Columns 5 and 6 repeat, for the tuned circuit containing the screened coil, the information given in Columns 2 and 3 for the unscreened coil.

One might expect that the rise in series resistance arising through the loss of energy occasioned by the eddy currents in the screening box would be easy to determine by observing the increase in resistance occurring when the screen was put into position. Comparison of Columns 2 and 5 in Table 2 shows quite clearly that there is something very fishy indeed about this simple mode of comparison, for the series resistance is in each case *lower* when the screen is in position than when it is omitted. Are we, then, to conclude that a coil has lower losses when screened than when unscreened? The figures of Columns 3 and 6 forbid so foolish a conclusion, for the dynamic resistance R of the circuit is in every case less (indicating higher losses) when the screening box is used.

TABLE 2.

Coil No.	r_0 ohms.	R_0 megohms.	L_s micro-henrys.	r_s ohms.	R_s megohms.
1	15.5	0.101	181	14.3	0.090
2	15.3	0.103	159	13.2	0.076
3	13.3	0.119	157	10.9	0.090
4	12.7	0.125	150	10.5	0.084
5	13.9	0.114	142	11.7	0.068
6	15.1	0.104	114	12.3	0.043
7	11.7	0.135	100	9.05	0.043

The actual position is that the true series resistance of the circuit is greater when the screening box is in position, but that the true parallel (dielectric) losses have remained approximately unchanged. In measuring the resistance of the circuit in terms of series resistance, the absorption of power by the dielectric losses is, of course, included, but a fixed dielectric loss will contribute less to the measured resistance when the inductance of the coil is lowered by screening.

Dielectric Losses.

This can best be made clear by an example; we will take the case of Coil 5 of Table 2. Let us assume that of the measured total resistance before screening one-half was due to conductor losses in the coil and one-half to dielectric losses in the condenser and elsewhere. That is to say, the true representation of the tuned circuit is that given in Fig. 2. The value of parallel resistance corresponding to 6.95 ohms, or one-half the total measured resistance, is calculated from the formula $R=\frac{3{\cdot}55L^2}{\lambda^2 r}$, which in this case becomes $R=\frac{3{\cdot}55\times 200^2}{300^2\times 6.95}$ $=0.228$ megohm. This value is accordingly inserted in Fig. 2.

Fig. 3 shows the conditions after screening the coil. Its inductance has dropped from 200 to 142 microhenrys, the true series resistance has risen to an unknown extent, and the true parallel resistance remains at its original value of 0.228 megohm. Now, if we reverse the calcula-

TABLE 3.

Coil.	Diameter. (Inches).	Length. (Inches).	MAGNIFICATION: Screened.	MAGNIFICATION: Unscreened.
1	1¼	0.92	79	81
2	1½	1.10	76	82
3	1½	1.50	91	95
4	1½	2.0	91	99
5	1¾	1.12	77	91
6	2	1.0	59	84
7	2	2.05	69	107

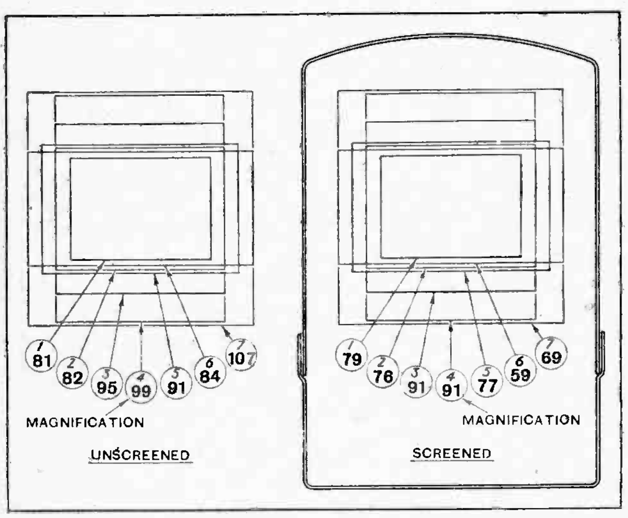
The Modern Screened Coil.—
tion just made, so as to find the contribution to the measured series resistance that will be made by the unchanged parallel resistance, we get: $r=\frac{3.55L^2}{\lambda^2 R}=\frac{3.55\times 142^2}{300^2\times 0.228}=3.50$ ohms.

TABLE 4.

Coil No.	Diameter. (Inches).	Length. (Inches).	Turns.	Wire.
8	1½	1.35	98	30 enam.
9	1½	1.9	115	28 enam.
10	1½	2.15	120	28 d.s.c.
11	1½	1.6	106	30 d.s.c.
12	1½	2.75	128	26 d.s.c.
13	1¾	1.95	109	28 d.s.c.
14	1¾	1.5	98	30 d.s.c.
15	1¾	1.7	102	28 enam.

Thus, the dielectric losses, which provided a contribution of 6.95 ohms to the measured resistance of the unscreened coil, contribute barely more than half this value to the measured resistance of the coil when screened, *although these losses themselves are unchanged.*

In the example taken we can find the change in the true series resistance of the coil by subtracting the dielectric-loss contribution of 3.5 ohms from the measured total of 11.7 ohms—we are left with 8.2 ohms. Since, according to our original assumption, the true series resistance was 6.95 ohms before screening, the addition of the screen has *raised* the true series resistance by



Schematic diagram showing relative sizes of coils to scale given in Table 3. The magnification of each of the seven coils screened and unscreened can easily be compared.

1.25 ohms. This rise is not enough to counterbalance the decrease in measured resistance brought about by the altered effect of the dielectric losses, so that the measured resistance is lower after screening than before, even though the losses in the circuit have been increased. The figures of Table 2, which at first sight appear to be absurd, thus have a very satisfactory (if rather involved) explanation.

It would perhaps appear that, by working on the lines just given, it would be possible to compute dependable values for the increase in true resistance of the coil in each case, and so arrive at a definite measure of the effect of the screening. The difficulty that stands in the way of so doing is that we can only guess the precise contribution made in each case by the dielectric losses, and, to make matters worse, we can certainly not assume that the value of parallel resistance expressing their amount will not change, to some small extent at least, when the screen is added.

The value of the numerical results of Table 2 is sadly reduced by these complexities and limitations, but enough information remains to enable us to extract considerable guidance in our efforts to find the best design of coil to use in the particular screening box to which the figures relate.

Dynamic Resistance Before and After Screening.

If we compare the columns giving the dynamic resistance of the circuit before and after screening the coils, we notice that the original dynamic resistance of the smaller coils is, as might be expected, rather low. Decidedly higher values are obtained by using a coil of larger dimensions; large coils can always be made more efficient than small ones. To set against this, there is the fact that when the coil is small, so that the screening box, which is of the same size in all cases, is more distant from it, the reduction in dynamic resistance brought about by screening is not very large, whereas the drop becomes very considerable indeed with the larger coils which fit the screen more closely. It is fairly clear, therefore, that there is going to be some best diameter and best length of coil, which will give a moderate dynamic resistance when unscreened, suffering only a moderate reduction when the screen is added. The final result will be better than that obtainable from a tiny, inefficient coil, even though this is almost unaffected by the screen, and will also be better than that from a really good large coil, which will be utterly spoilt by the screen.

Owing to the different values assumed by the inductances of the various coils when screened, comparison of dynamic resistances does not make very clear the diameter of coil which, on the data available, looks most promising. For this comparison another property of the tuned circuit, the "magnification," is more suitable, for its dependence on the inductance is but small.[1] Table 3 repeats the leading dimensions of the coils from Table 1, and gives their magnifications, screened and unscreened, as calculated from the data of Table 2.

Looking down the final columns of this Table, it is very evident that the region of greatest efficiency is to be found when the diameter of the coil is about 1½in.,

[1] The magnification of a coil is given by $\frac{2\pi f h}{r}$; for coils closely alike in type it is approximately constant over quite large changes in inductance. Use has been made of this fact in the measurements quoted in this article; in many cases the inductances of the coils were slightly off the intended value of 200 microhenrys, but the values for resistance have been corrected to 200 μH on the basis of constant magnification over the very small range involved.

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and its winding length $1\frac{1}{2}$in. to 2in.; for smaller coils it is evident that the inherent resistance is unnecessarily high, while with larger coils the losses due to the screen become overwhelmingly great. Nevertheless, the small

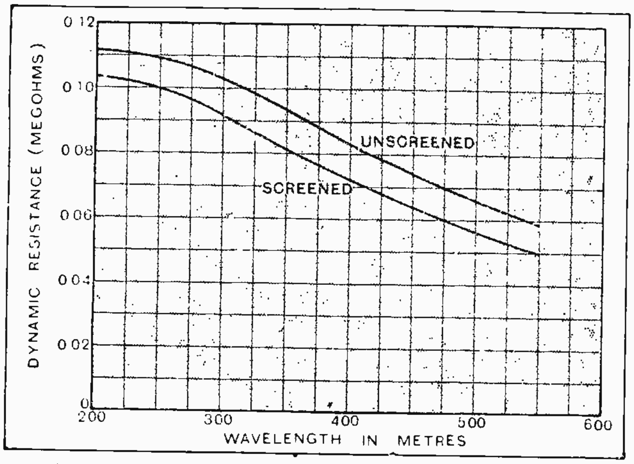

Fig. 4.—Dynamic resistance of tuned circuit including $1\frac{1}{4}$in. coil screened and unscreened. (Coil No. 1.)

coils, and especially the smallest coil of all, show higher efficiency than one might have expected; as a matter of interest, the dynamic resistance of the circuit, including the $1\frac{1}{4}$in. coil, screened, is shown for the broadcast range of wavelengths in Fig. 4.

In designing a coil for use in a screening box of fixed size, it is necessary to decide upon some value of inductance that the coil shall assume *when in its box.* 200 microhenrys may be taken as an inductance convenient for the broadcast band, and with this in mind the figures given in Table 2 for the inductance of screened coils were taken as a guide in estimating the number of turns required to reach this inductance for coils of different shape and diameter. Several coils were made up on these lines, the inductance of each being adjusted by removing or adding turns until, when screened, the desired figure was reached. These coils were then put into the same tuned circuit that was used in measuring the resistance values already quoted, and the new values of resistance were measured. Details of the coils are given in Table 4, and of their resistance in Table 5.

A glance down any of the last three columns of Table 5 shows that the best coil is that numbered "10," which is made by winding 120 turns of 28 double silk-covered wire on a former one and a half inches in diameter. The only objection to this coil is that its length—the actual winding is over two inches long—leaves little space in the screening box for the long-wave coil that usually has also to be accommodated. The next three coils, numbered 11, 12, and 13, all have about the same resistance, and fall very little short of coil 10. Of these, 11 is not at all a long coil, and will leave plenty of room for compact, long-wave coils. The writer, therefore, fixed upon it as being, from the practical point of view, the most desirable coil for a screening box of the size taken, and extended the measurements of resistance to cover the whole broadcast band. The results of these further measurements will be given in the next article of this series.

TABLE 5.

Properties of the Coils of Table 4 in Screening Box $2\frac{5}{8}$in. in diameter, 4in. long.

Coil No.	L_s micro-henrys.	r_s ohms.	R megohms.	m_s
8	200	15.95	0.099	79
9	200	15.2	0.102	83
10	200	13.9	0.114	$90\frac{1}{2}$
11	200	14.45	0.109	87
12	200	14.6	0.108	86
13	200	14.6	0.108	86
14	200	15.9	0.099	79
15	200	16.3	0.097	77

All resistances measured at 300 metres.

NEWS FROM THE CLUBS.

Opening of the Club Season.

The exhibition period invariably sees a quickening of interest in the radio clubs, many of which are already busily preparing their programmes for the winter session. In most cases the lectures and demonstrations are designed to appeal to all types of radio enthusiast, from the raw beginner to the more advanced student, and it is becoming a truism that to get the best out of wireless reception one should "join the local club."

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The Most Active Club?

Among the Societies which remain active throughout the summer is Slade Radio (Birmingham), probably the most energetic society in the Midlands, with a vigorous programme which has been adhered to from week to week since last May, when the majority of clubs had closed down for the "off season." Besides maintaining interest in lectures and demonstrations the Society has organised field days which have attracted the interest, not only of club members but the general public, to an extraordinary degree. The Society is now preparing its winter syllabus and all enquiries will be answered by the hon. secretary, at 110, Hillaries Road, Gravelly Hill, Birmingham.

Preparations in Grimsby.

The Grimsby and District Radio Society is preparing its winter syllabus and it is hoped that lecturers will be available by many of the leading manufacturers.

Hon. secretary: Mr. W. Markham, 104, Torrington Street, Grimsby.

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G.E.C. Lecture at Exeter.

Mr. F. E. Henderson of the General Electric Co., Ltd., will lecture to the members of the Exeter and District Wireless Society on Monday, October 19th, on the subject of "H.F. Amplification and Osram Valves."

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Appeal to Sunbury Enthusiasts.

New headquarters at the Parish Room, Green Street, Sunbury, have provided the Sunbury and District Radio Society with a good send-off for the winter session. Monthly meetings began on Friday, September 18th, with a talk on "Amateur Radio" by Mr. Denny (G6NK). It is hoped that the membership will be increased by the addition of all local radio enthusiasts and the hope is expressed that all "BRS" stations in the district will give the Society their support. Intending members are invited to write to the hon. secretary, Mr. Richard K. Sheargold (2AKN), Glenmore, Manygate Lane, Shepperton, Mddx.

For North London Set Constructors.

Constructional work is to be a leading feature of the Muswell Hill and District Radio Society's programme during the coming months.

Prospective members should apply for full information to one of the hon. secs., Mr. F. A. Tunstill, 15, Queen's Avenue, Muswell Hill, N.10, or Mr. R. G. Knight, 21, Beresford Road, East Finchley, N.2.

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An Anglo-American Radio Society.

From Mr. G. E. Gaunt, of 172 St. Leonard's Road, Girlington, Bradford, we learn that a Bradford branch is to be formed of the Anglo-American Radio Society. The objects of the Society, which already possesses a branch at Uxbridge, are to promote goodwill and fellowship between nations and to aid radio enthusiasts in their hobbies.

Full particulars can be obtained on application to Mr. Gaunt.

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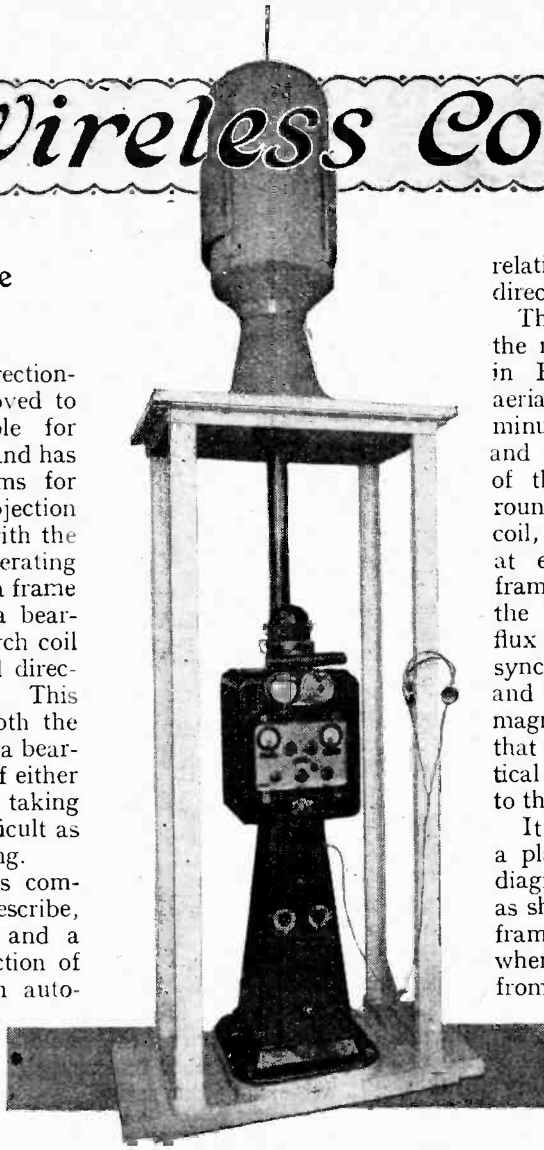
Send in Your Reports.

Club secretaries are invited to send in reports of the winter activities.

Many a visitor to a club meeting has first been attracted by reading the "Forthcoming Events" column in *The Wireless World. Verb sap!*

New Wireless Compass



Direct reading direction-finder mounted on demonstration stand to show instrument on bridge and revolving frame system on deck above.

The Rotating Frame System.

THE usual type of wireless direction-finder or compass has proved to be extraordinarily valuable for navigational and other purposes, and has been developed in various forms for different applications. But an objection which has always been present with the usual type is that the observer operating the apparatus has either to rotate a frame aerial when listening-in to take a bearing, or else has to rotate the search coil of a radiogoniometer where fixed direction-finding aerials are employed. This objection is not serious where both the observer and the station on which a bearing is being taken are fixed, but if either of the stations is moving, then the taking of observations becomes more difficult as the position is constantly changing.

With the new type of wireless compass which we are about to describe, these operations are eliminated and a continuous indication of the direction of the transmitting station is given automatically for as long a period as may be required, or so long as the station is transmitting signals on which a bearing can be taken.

In addition to operating automatically, this equipment can be worked by hand as an ordinary radiogoniometer. A special advantage of the automatic method is that even if a station is transmitting for only a few seconds an accurate bearing can be obtained of it, whereas it might quite well be missed with the more usual methods because of the unavoidable delay resulting from hand manipulation of the directional apparatus. This leads to an important application of the direction-finder, namely, to fleet manœuvres at night or in fog, as a predetermined fleet formation can be accurately preserved if the leading vessel is equipped with a transmitter and the accompanying vessels are each allotted their individual angles of position relative to the leading vessel. Ships in distress can be located without having to signal their position, and, further, the preparation of charts of electric field deviations due to the presence of coast-line or islands in the vicinity of a radio beacon which, with ordinary D.F. apparatus is a most laborious process, becomes relatively simple and rapid with the direct-reading compass.

The fundamental principle on which the new apparatus operates is shown in Fig. 1. The receiving frame aerial is rotated at 600 revolutions per minute by means of an electric motor, and on the same shaft are the poles of the electromagnet which rotates round a galvanometer-type moving coil, so that the electromagnet rotates at exactly the same speed as the frame aerial, both being driven by the same motor. In this way the flux from the electromagnet rotates in synchronism with the receiving frame, and the receiving frame and electromagnet are so related to one another that at any instant they have an identical angular displacement with respect to the centre line of the ship.

It is well known that reception with a plain frame produces a reception diagram corresponding to two circles, as shown at (a) Fig. 2, so that as the frame is rotated there are two points where maximum signals are receivable from the station under observation, and two points where signals are at a minimum. Also, where a vertical plain aerial wire is used, reception from all directions is of equal strength, so that you get a reception diagram corresponding to a circle, as shown at (b) in Fig. 2. By a combination of frame reception and a vertical aerial, the reception diagram is modified to a heart shape, as shown at (c), and here, it will be seen, the signals have only one maximum and one minimum, so that there is no longer ambiguity in the readings. In this apparatus, therefore, the combined signals from a vertical aerial and from the rotating frame are carried to a receiver where they are amplified and detected, and, after low-frequency amplification, are rectified in a final valve.

The resulting continuous current from the output terminals of the amplifier is taken to the galvanometer moving coil already mentioned, which is pivoted so that it is entirely free to revolve.

Once in every revolution the received energy in the frame rises to a maximum when it is in the direction of the station being received, and, consequently, once in every revolution the rectified energy providing the con-

New Wireless Compass.—
tinuous current in the galvanometer coil also rises to a maximum at the same moment, so that the field of the electromagnet surrounding the moving coil has the same angular displacement every time that the galvanometer coil receives the maximum current. As a result, the galvanometer coil tends to move to a definite position relative to the direction of the transmitting station. As this tendency is repeated

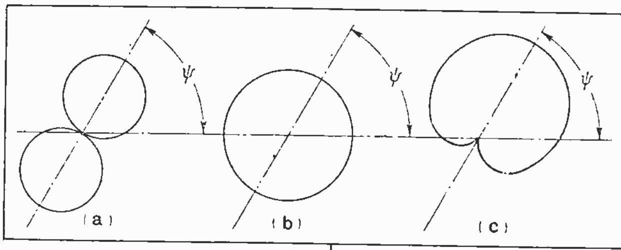


Fig. 2.—Reception diagrams corresponding to (a) plain frame reception; (b) vertical aerial reception; (c) a combination of both forming a heart-shaped figure.

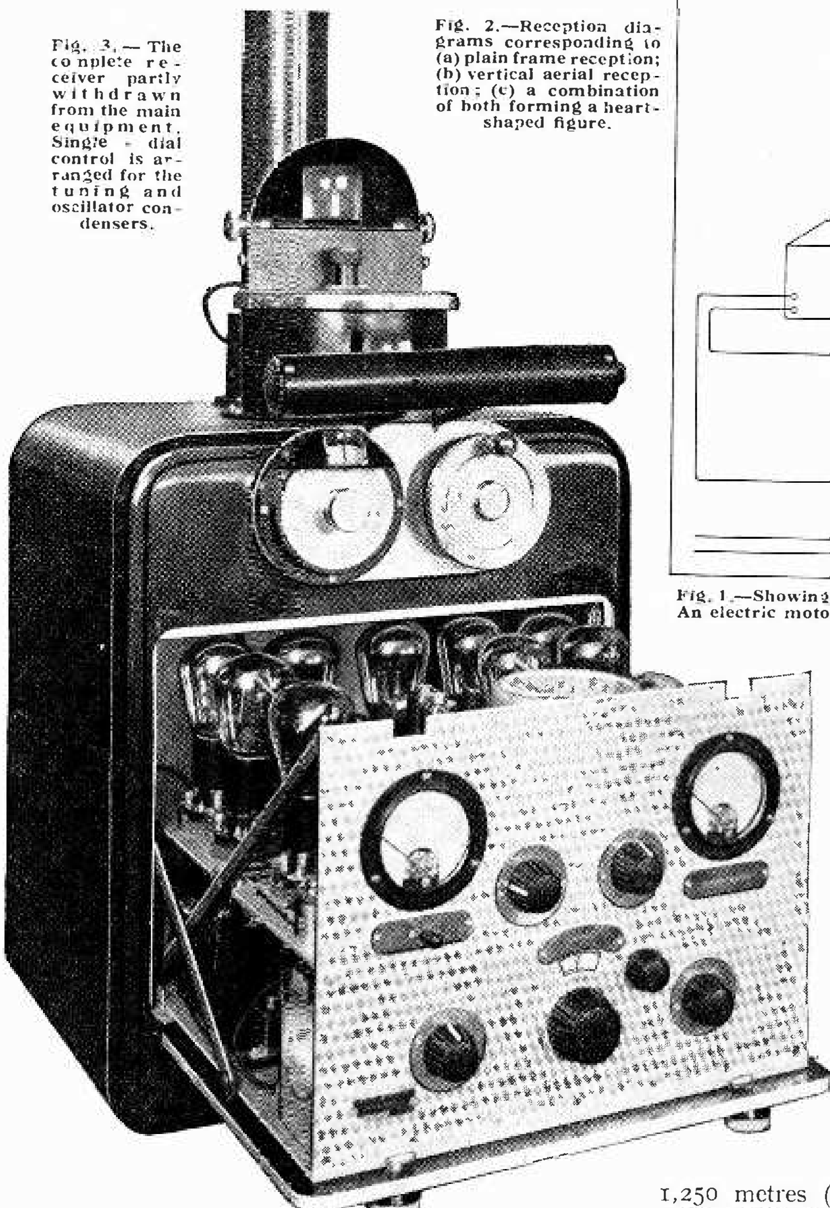


Fig. 3.—The complete receiver partly withdrawn from the main equipment. Single-dial control is arranged for the tuning and oscillator condensers.

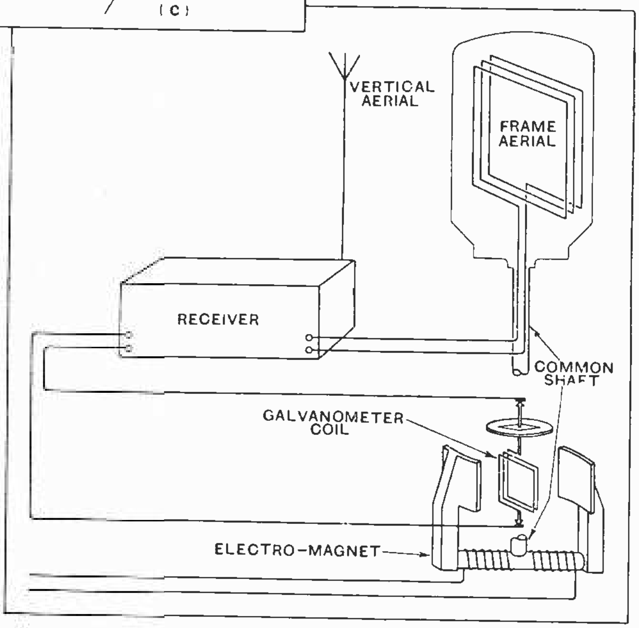


Fig. 1.—Showing the principles on which the new apparatus works. An electric motor rotates the frame aerial and the moving coil at 600 revolutions per minute.

every revolution (i.e., about ten times a second), the inertia of the coil and its associated dial prevents the rotation of these components by the varying torque developed by the rotating magnetic field surrounding it. Consequently, the coil comes to rest in the position corresponding to the direction of the transmitting station from which the signal to the receiver emanates.

Attached to the galvanometer moving coil is an indicating dial on which the bearing can now be read with reference to a fixed pointer. The steady position where the moving coil comes to rest is determined by the resultant effect of the torque couples acting upon the coil during the complete period of rotation, and the stability is such that, if the automatic indicating dial is slightly moved by hand, the coil promptly returns to its former position with quite an appreciable force.

Although the best results would naturally be obtained when the reception diagram corresponds in form to that of a perfect cardioid, as shown at (c) in Fig. 2, such an ideal reception diagram is not essential to satisfactory working, and it is sufficient if the intensities of reception at 0° and 180° to the direction line of the transmitting station are different. The equipment illustrated here is designed to receive on wavelengths extending from 450 to 1,250 metres (i.e., frequencies from 667 to 240 kc.).

The following conditions are necessary in order that readings may be entirely free from error:—

1. The moving coil must receive a continuous current of a constant value.

New Wireless Compass.—

2. The amplification and detection characteristic must not be rectilinear.

3. The maximum e.m.f. in the rotating frame aerial must not completely neutralise the e.m.f. received on a vertical aerial, and, conversely, the aerial effect in the frame must not be wholly compensated.

The illustrations give a general idea of the equipment as it appears when installed on board. The drawing, Fig. 4, shows the case containing the rotating frame aerial above, and below, the receiver and other apparatus associated with it. The two cases are joined by the driving shaft which rotates the frame aerial through the medium of two universal joints.

Automatic or Hand Control.

The vertical aerial is carried from the top of the apparatus at the point (1) and contact between this and the connecting cable inside the frame shaft (3) is maintained by a brass rod in an ebonite cup of mercury. In proximity with the frame aerial, sliding metal plates (2) are provided to correct for any disturbing field arising from the presence of metal bodies in proximity to the apparatus, as would be likely to exist on board ship. The plates are located on the case of the frame aerial and can be secured in any determined position by means of bolts. (4) shows a lens through which bearings are read while the equipment is working automatically, the scale inside being illuminated.

In addition to automatic reception, the apparatus can be operated by hand when it acts as an ordinary radiogoniometer, and a hand wheel is provided for such operation with the equipment, when required. This control is shown at (8) and the scale is then viewed through a lens at (5).

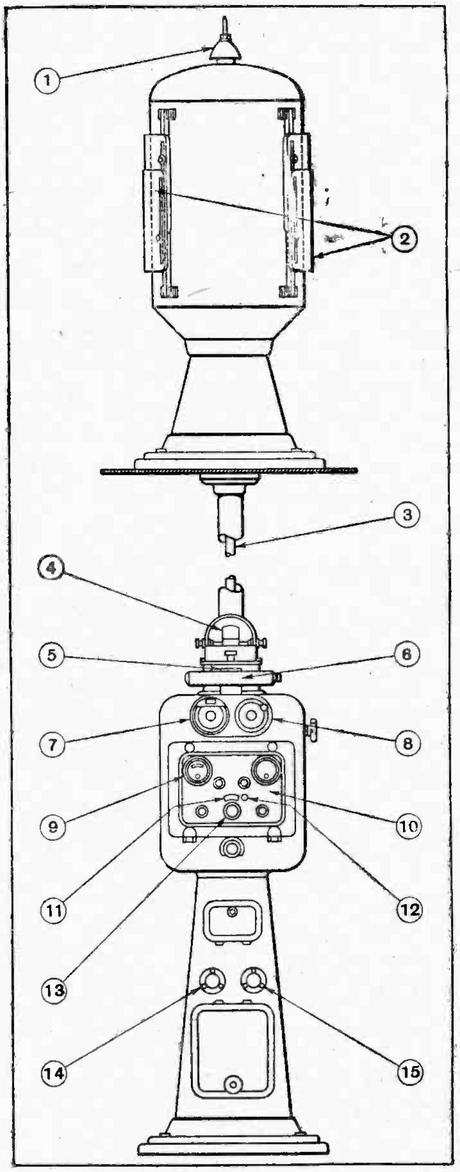


Fig. 4.—Diagrammatic illustration of the whole equipment. The case containing the rotating frame aerial is shown above and the receiver and associated equipment below.

The entire front panel is illuminated by a lamp, shown at (6). At (7) is located apparatus to take the bearing of the transmitting station to be added to the angle made by the centre line of the shift with North, the purpose being to read the direction of the transmitting station in relation to North without the necessity for making a separate calculation.

As has been pointed out above, it is important that the intensity of reception should remain constant in order to obtain accurate readings, and, accordingly, to assist in obtaining this result a voltmeter (9) is included on the main panel, indicated at (10). Wavelengths to which the receiver is tuned are shown on a calibrated dial at (11), and alongside the main tuning control knob (13) is a vernier control (12) for close adustment. At (14) and (15) are accommodated green and red lamps respectively, the green lamp indicating when the 4-volt battery is being charged and the red lamp showing when the ship's aerial is in use, since bearings can then only be carried out accurately of wavelengths remote from the wavelength to which the ship's aerial is tuned.

The Amplifier.

The amplifier is in itself interesting, as it consists of a superheterodyne comprising 10 valves. The successive stages are (1) aperiodic high-frequency amplification stage; (2) first detector; (3) oscillator; (4) (5) (6) intermediate frequency amplification stages; and (10) the final detector from which the continuous current energy is passed to the galvanometer moving coil. The complete receiver is shown in Fig. 3 partly withdrawn from the general equipment. In this way the circuits are readily accessible. The tuning condenser and oscillator condenser are mechanically coupled and controlled by a single knob. The same knob also varies the coupling of the frame aerial and the vertical antenna.

In operating the apparatus the listener first tunes in to the transmitting station under observation. This is done on the single tuning control (13), (Fig. 4), and tuning can be sharpened by means of the vernier control (12). The intensity of reception is then adjusted to a convenient level. In order to obtain a heart-shaped diagram and avoid the possibility of ambiguity in readings between two possible minima, the coupling of the vertical antenna to the receiver frame has to be adjusted, as has already been indicated. The amplifier is very selective, and only in the presence of very serious interference is it necessary to resort to the manual method of taking a bearing. In the presence of mechanical noise in the neighbourhood of the operator, however, the automatic indicator has the very great advantage, as it is immune from these effects, being independent of the ears of the operator. The apparatus has been recently developed at the laboratories of the Matériel Téléphonique in Paris, and is now a standard line of equipment.

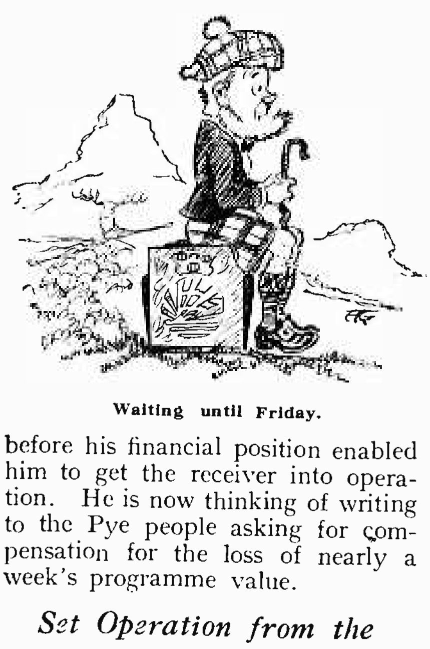
Unbiased

By FREE GRID.

When the Pye was Opened.

I NOTICE that an increasing number of set manufacturers are employing coin screws in their receivers, so that when a new instrument is unpacked, one is compelled to find a coin of the realm with which to undo the back of the set to put the valves in. An Aberdonian friend has written to me stating that a fellow citizen recently invested his last bawbee in a Pye Twintriple receiver because he was told that the price included absolutely everything and that there were no extras to buy.

Upon unpacking the receiver, he found that coin screws were employed and, as he had spent his all in paying for the receiver, he had to wait until the following Friday



Waiting until Friday.

before his financial position enabled him to get the receiver into operation. He is now thinking of writing to the Pye people asking for compensation for the loss of nearly a week's programme value.

Set Operation from the Power Plug.

A great friend of mine who claims to have a truly all-electric house—that is to say, one in which lighting, cooking, heating, and every other domestic service are carried out by electrical appliances—has forwarded to me a very peremptory letter which he has just received from his local electricity supply people, in which they state that it has been brought to their notice that he has been operating a wireless receiver from a socket connected to a heater circuit instead of to a lighting circuit. They demand, in brief, that he give them a written undertaking that he will in future operate his receiver from a lighting socket, failing which they will instruct their solicitors to take proceedings.

My friend is rather alarmed, and is seeking my advice on the matter, since he points out that it was I who some months ago advised him to save money by running his receiver from the heating circuit instead of from the lighting circuit, as in his locality the electricity charges are rather heavy. Now, it so happens that many years ago, before an H.T. battery eliminator became an article of everyday use, I received a similar demand, and straightway obtained legal advice on the matter, and as a consequence of this I have been able to advise my friend to ignore their insolent demand. They have, of course, no right whatever to prevent any consumer running his all-mains set, or even his H.T. eliminator, from a heating socket.

A very interesting case of this type has recently been fought out in Court. In this case a small retailer was summoned because he had been charging some accumulators from D.C. mains, using lamps as resistances. He had, of course, plugged in to the heating circuit, and the solicitor who appeared for the prosecuting company made a point of the fact that the defendant was committing an offence, insomuch that he was actually obtaining light from the heating circuit instead of from the proper lighting circuit. The supply company did not get away with it, however, as the opposing solicitor successfully pleaded that, although the defendant *was*, in fact, receiving light from the heater circuit, it was merely a noisome by-product for which the defendant had no use, and which he was, in fact, not utilising.

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P.M.G. and Electrical Silencers.

At last it appears that all our interference troubles, ranging from the truly dreadful noise produced by a trolley bus to the irritating clicks produced by electric light switches, are likely to disappear, for a well-known British firm have just marketed a complete range of interference-suppressing gear, suitable for attaching to any kind of electrical apparatus. These units—which, of course, consist of various combinations of H.F. and L.F. chokes, condensers and resistances, etc.,—are to be produced in great variety. Practically every type of interference is covered, including not only that emanating from rotating electrical machinery such as motors, generators and converters, but also that caused by instruments having non-rotating contacts, such as relays, mechanical rectifiers, and even the complicated automatic switches used in electric signs. Special forms of interference will call for special methods of suppression, and special units are to be made up to meet any particular need.

This is all very well in its way, of course, and the firm concerned are to be highly commended for their enterprise in this matter, but the point is—who is going to compel the owners of trams, fans, and other offensive electrical appliances to buy one of these gadgets, as apparently the P.M.G. is powerless in this matter? To my mind it appears to be utterly illogical to compel people to fit efficient silencers to their cars and motor bikes in order to prevent annoyance to the community at large, and yet to have no means of compelling other sections of the community to fit efficient electrical

Special methods of suppression.

silencers. I cannot see that there is any greater offence in making a hideous noise in the air than there is in making what is a far more hideous noise in the ether. What do you think about it?

MANCHESTER RADIO SHOW

AGAIN this year Manchester is holding its own special radio show, which opens on the date on which this issue appears. Manchester has, since the earliest days, been the centre of interest in broadcasting, and that interest has grown substantially since Moorside Edge transmissions commenced. This year the Manchester Show will be more than ever, as far as the exhibitors are concerned, a second edition of the London Show at Olympia, for it is being conducted under the auspices of the Radio Manufacturers' Association, and only those exhibitors who were eligible to take stands at Olympia will be showing at Manchester. This means that the Show will be all-British.

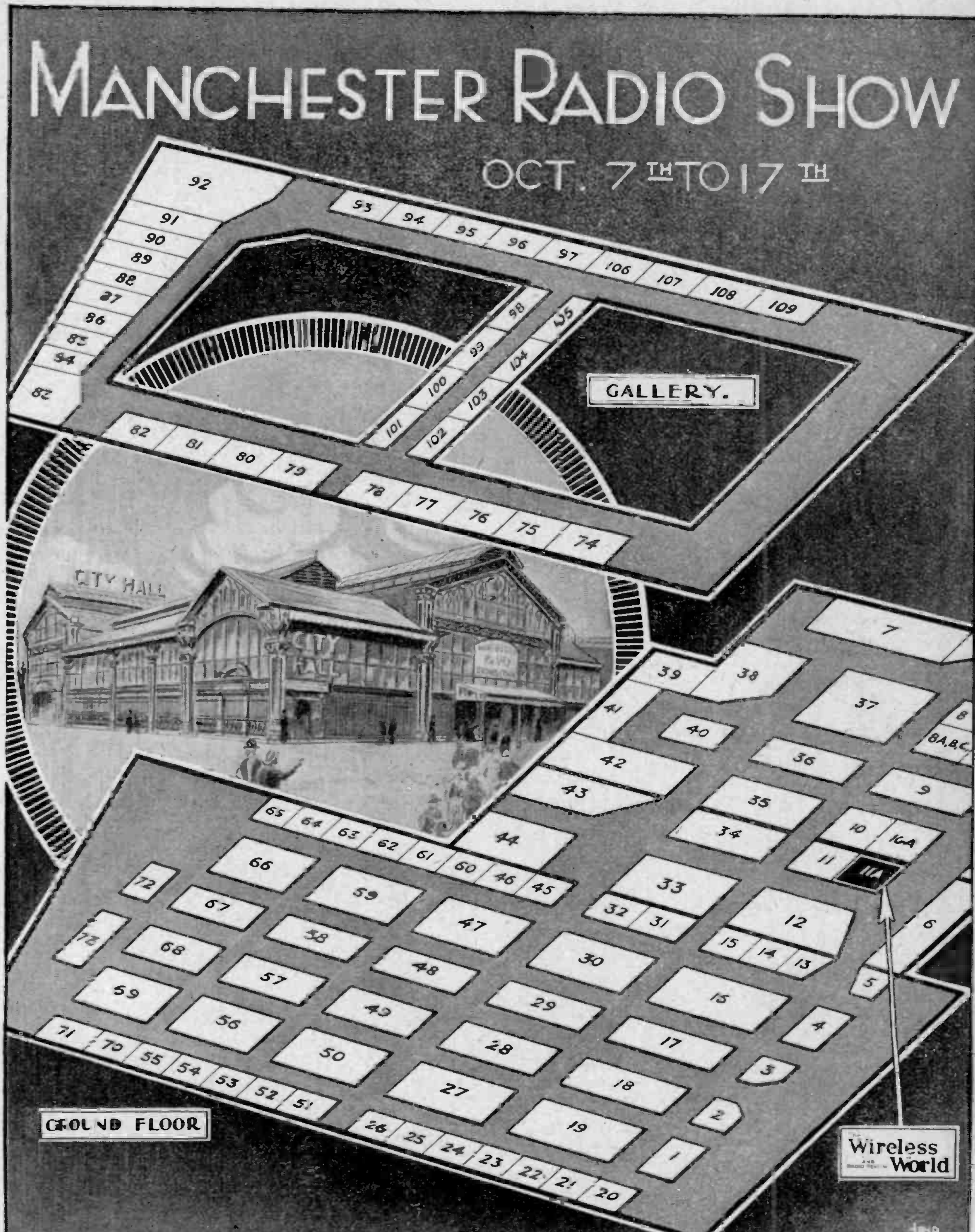
There are more licences per head of population in Lancashire than in any other part of the country, and more interest attaches to the home construction of receivers in the Manchester area than elsewhere in the country. The *Manchester Evening Chronicle* is again running a competition in connection with the Show for amateur-built sets, and although the judging will have been completed prior to the opening of the Show it may be anticipated with confidence that great interest will be taken by visitors in the exhibits of the winning apparatus.

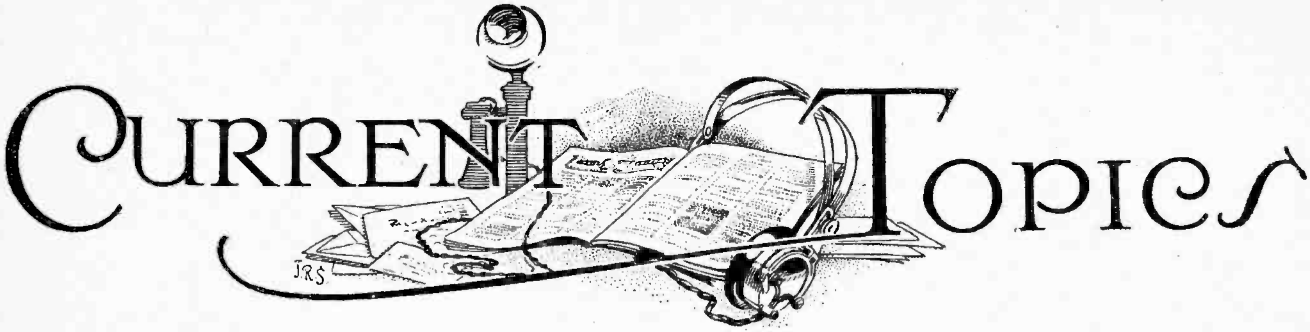
CITY HALL
DEANSGATE
OCTOBER 7th to 17th.

Since the Show is to be so largely a repetition of Olympia, *The Wireless World* will not this year undertake anything in the nature of a stand-to-stand report, as it is considered that the Olympia Show Numbers of *The Wireless World* constitute, in fact, an equally complete guide to the Manchester Show, when taken in conjunction with the list of exhibitors and the plan of the Show included in this issue.

LIST OF EXHIBITORS—SEE PLAN OPPOSITE.

	Stand No.
Belling & Lee, Ltd., Queensway Works, Ponders End, Middlesex.	(51)
Brown Bros., Ltd., 265-273, Deansgate, Manchester.	(38)
Brownie Wireless Co. of Great Britain, Ltd., Nelson St. Works, Mornington Crescent, London, N.W.1.	(31)
Celestion, Ltd., London Rd., Kingston-on-Thames.	(67)
Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester.	(69)
Clarke, H., & Co. (Manchester), Ltd., Atlas Works, Old Trafford, Manchester.	(37)
Cole, E. K., Ltd., "Ekco" Works, Southend-on-Sea.	(56)
Collie, J. H., & Co., 10, Canning Place, Liverpool.	(87)
Colvern, Ltd., Mawneys Rd., Romford, Essex.	(43)
Cossor, A. C., Ltd., Cossor Works, Highbury Grove, London, N.5.	(17)
Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Rd., North Acton, London, W.3.	(46 & 60)
Edison Swan Electric Co., Ltd., 155, Charing Cross Rd., London, W.C.2.	(30)
Epoch Radio Manufacturing Co., Ltd., 3, Farringdon Ave., London, E.C.4.	(76)
Ever Ready Co. (Gt. Britain), Ltd., Hercules Place, Holloway, London, N.7.	(57)
Ferranti, Ltd., Hollinwood, Lancs.	(47, 84, 85 & 86)
Formo Co., Crown Works, Regent Park, Southampton.	(73)
Fuller Accumulator Co. (1926), Ltd., Woodland Works, Grove Rd., Chadwell Heath, Essex.	(2)
Fullotone Gramophones (1929), Ltd., 73, Camden Rd., Camden Town, London, N.W.1.	(8)
Garnetts, Gresley Radio Works, Ordsall Lane, Salford.	(4)
General Electric Co., Ltd., Magnet House, Victoria Bridge, Manchester.	(61, 62 & 63)
Hardman & Co., Ltd., The Baum, Yorkshire St., Rochdale, Lancs.	(8A)
Harlie Bros. (Edmonton), Ltd., Balham Rd., Lower Edmonton, London, N.9.	(106)
Heayberd, F. C., & Co., 10, Finsbury St., London, E.C.2.	(35)
Bobday Bros., Ltd., 21-27, Great Eastern St., London, E.C.2.	(10A)
Hollingdrake, H., & Son, Ltd., Princes St., Stockport.	(8B)
Igranic Electric Co., Ltd., 147, Queen Victoria St., London, E.C.4.	(49)
Junit Manufacturing Co., Ltd., 2, Ravenscourt Sq., Hammersmith, London, W.6.	(14)
Kolster-Brandes, Ltd., Cray Works, Sidcup, Kent.	(19)
Lever, Honeyman & Co., 9, Basinghall St., London, E.C.2.	(34)
Lissen, Ltd., Lissenium Works, Worple Rd., Isleworth, Middlesex.	(59)
Lotus Radio, Ltd., Lotus Works, Mill Lane, Liverpool.	(28)
McMichael, L., Ltd., Wrexham Rd., Slough, Bucks.	(66)
Marconiphone Co., Ltd., 210, Tottenham Court Rd., London, W.1.	(68)
Moores, J., & Co., Ravald St., Salford, Manchester.	(40)
Mullard Wireless Service Co., Ltd., Mullard House, Charing Cross Rd., London, W.C.2.	(16)
Murphy Radio, Ltd., Broadwater Rd., Welwyn Garden City, Herts.	(15)
National Accumulator Co., Ltd., 50, Grosvenor Gardens, London, S.W.1.	(50)
Northern Steel & Hardware Co., Ltd., 1, Southgate, Manchester.	(74)
Oldham & Sons, Ltd., Denton, Manchester.	(29)
Olympia Radio, Ltd., 199, Shudehill, Manchester.	(11)
Ormond Engineering Co., Ltd., Ormond House, Rosebery Av., London, E.C.1.	(43)
Osborn, Chas. A., Regent Works, Arlington St., New North Rd., London, N.1.	(36)
Partridge & Mee, Ltd., 74, New Oxford St., London, W.C.1.	(55)
Partridge, Wilson & Co., Davenset Works, Evington Valley Rd., Leicester.	(32)
Pertrix, Ltd., Britannia House, 233, Shaftesbury Av., London, W.C.2.	(1)
Pye Radio, Ltd., Radio Works, Cambridge.	(18)
Radio Instruments, Ltd., Purley Way, Croydon, Surrey.	(48)
Rawson, H. C. (Sheffield & London), Ltd., 100, London Rd., Sheffield.	(9)
Redfern's Rubber Works, Ltd., Hyde, Cheshire.	(24)
Regentone, Ltd., 21, Bartlett's Buildings, Holborn Circus, London, E.C.4.	(70 & 71)
Richardsons, 24, St. John St., Deansgate, Manchester.	
Siemens Bros. & Co., Ltd., Caxton House, Westminster, London, S.W.1.	(52, 53 & 54)
Sovereign Products, Ltd., 52, Rosebery Av., London, E.C.1.	(5)
Standard Battery Co., 184, Shaftesbury Av., London, W.C.2.	(45)
Telsen Electric Co., Ltd., Aston, Birmingham.	(27)
Ultra Electric, Ltd., Erskine Rd., London, N.W.3.	(22, 23 & 25)
Varley (Oliver Pell Control, Ltd.), 103, Kingsway, London, W.C.2.	(64 & 65)
Ward & Goldstone, Ltd., Frederick Rd., Pendleton, Manchester.	(33)
Westinghouse Brake & Saxby Signal Co., Ltd., 82, York Rd., King's Cross, London, N.1.	(58)
Whiteley Electrical Radio Co., Ltd., Nottingham Rd., Mansfield, Notts.	(26)
Wingrove & Rogers, Ltd., Polar Works, Mill Lane, Old Swan, Liverpool.	(3)
"Wireless World," Dorset House, Tudor St., London, E.C.4.	(11A)
Wright & Weaire, Ltd., 740, High Rd., Tottenham, London, N.17.	(72)


MANCHESTER RADIO SHOW
OCT. 7TH TO 17TH
GALLERY.
CITY HALL
GROUND FLOOR
Wireless World



Events of the Week in Brief Review.

THE P.O. "MYSTERY" VANS.

The Post Office anti-pirate vans have been providing the national Press with some good "copy" during the past week. To the technically minded reader these stories make sad reading, but if they serve to reduce the number of pirates, much can be forgiven. More sympathy with these investigations by the Post Office would be aroused if the vans were employed for tracking down various forms of interference, but this would probably strike too near home, because one of the worst possible forms of interference is one which has been referred to frequently in the daily Press recently as a "mystery." Certain military gentlemen writing to the Press have likened it to machine-gun fire. The "mystery" which the Post Office has not come forward to solve is, in fact, directly attributable to the dialling system of the automatic telephone, which, in our own experience, can be heard all round the neighbourhood on a reasonably sensitive set; when it comes to dialling in the same house as a receiver, listeners with War-time experience feel impelled to spread themselves on the carpet!

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LICENCE FEES BY INSTALMENTS.

At a time when the question of paying wireless licence fees by instalments is being raised in the House of Commons, it is interesting to learn that German listeners are feeling the strain of having to pay their licence fees quarterly, instead of once a month, as formerly. We learn that over three hundred Germans have recently gone to prison through inability to meet the demands of the Reichpost.

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WHAT IS A REGIONAL STATION?

The high-power cult has seized France as well as Germany. On a recent visit to Lyons the French Postmaster-General M. Guernier, delighted the local amateurs by announcing plans for endowing Radio-Lyons with a power of from 60 to 80 kW. The station thus comes under the ambitious scheme fostered by General Ferrié to provide France with a regional scheme on the British model.

It is an amusing fact that directly a station becomes "regional" its power is raised and its range becomes international.

NO MORE ATMOSPHERICS?

And now, from Vimmerby, in Sweden, comes the news that Mr. G. Eriksson has constructed an apparatus "for the elimination of noises and atmospheric disturbances in wireless." The story goes that the apparatus is simple and cheap.

We wouldn't care much if it were complex and expensive so long as it did the trick. Unfortunately, the story has a postscript to the effect that Mr. E. has not yet concluded his experiments.

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WHY COPENHAGEN SOUNDS GOOD.

The musical programmes from Copenhagen have noticeably improved of late. We now learn the reason. The orchestra has been more than doubled in size and now consists of fifty-eight players, as compared with twenty-eight. There were no fewer than four hundred applicants for the thirty vacancies.

HIDE AND SEEK. A photograph of one of the Post Office "pirate"-hunting vans, reputed to be capable of locating wireless receivers. A search for man-made static, including the Post Office variety, would be more applauded by law-abiding wireless users.

WATCHING A "W.W." SET GROW.

The Muswell Hill and District Radio Society has chosen the *Wireless World* D.C. Super-Selective Five as the Society's receiver during the coming winter.

To-night (Wednesday) members will co-operate in its construction. Finishing touches will be given to the receiver on October 21st, while on November 4th it will be demonstrated by Mr. Leonard Hartley, B.Sc., A.I.C. The set will then be available to members wishing to test and compare components.

North London readers who would like to see a modern receiver in course of construction should note that the Society meets at Tollington School, Tetherdown, N.10, on Wednesdays at 8 p.m. Communications can be addressed to the joint hon. secretary, Mr. F. A. Tunstill, 15, Queen's Avenue, Muswell Hill, N.10.

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IMPORTANT MOVES IN ITALY.

In an important agreement arrived at between the Italian Government and the official broadcasting company—the E.I.A.R.—the concession granted to the company has been extended to the year 1948, when the Government will have the right to buy up the existing transmitters.

The agreement authorises the company to operate the new transmitters at Florence and Bolzano during the present month and those at Milan and Bari in April, 1932.

Trieste, which is already working, and Bolzano will be officially opened on October 28th.

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PEACE DOVE ON SHORT WAVES.

We hear that the League of Nations is going full speed ahead with the construction of its own short-wave station at Prangins, near Nyon, Switzerland. "Radio-Nations," as the station is to be called, will have six 130-ft. pylons arranged for beam transmission.

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IDEA FOR FIELD DAYS.

Bourricots jumelés, which might be rendered in English as "twinned Neddies," took a leading part in the recent radio procession at Mazagan, where the second Moroccan radio rally was attended by visitors in cars, on motor cycles and on camels. At the head of the procession came a pair of mechanically coupled donkeys which shared between them all the apparatus necessary for efficient reception.

SHORT WAVES FROM WARSAW?

Warsaw, which already possesses Europe's most powerful broadcasting station, may soon be heard on the short waves, using a power of 10 kW. The wavelength is not yet stated.

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A STOP-GAP STATION.

On October 15th a temporary broadcasting station will be opened at Marseilles to replace the P.T.T. station which was recently destroyed by fire. The wavelength is 315 metres.

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R.A.F. WIRELESS REUNION DINNER.

The annual reunion and dinner for past and present officers of the Wireless School, R.A.F., will be held this year at the Criterion Restaurant, Piccadilly Circus, on Saturday, October 24th, at 7 p.m.

Tickets and all information can be obtained from the hon. secretary, Mr. J. F. Herd, Ditton Corner, Datchet, Windsor.

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A SEA-SICK ANNOUNCER.

Two hundred and forty sea-sick passengers helped to enliven a running commentary recently broadcast through Lille-Radio from a boat in the English Channel.

According to a correspondent, listeners heard a graphic account given by the announcer, M. Dehorter, who was himself partly overcome by *mal de mer*. But he continued courageously to describe the immense waves, the smashing of glass in the captain's cabin, and the attitudes of his unhappy fellow-voyagers until he was mercifully faded out.

An enjoyable programme!

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A WIRELESS HANDBOOK.

The new Wireless League Handbook for 1931-2 contains, in addition to a history of the League and a list of facilities offered to members, a number of pages of general radio interest. A handy "faults-at-a-glance" chart is included, together with useful legal data, a guide to European broadcasting stations, and a list of approved traders and repairers in Great Britain. Copies are obtainable on application to the head office of the League, 12, Grosvenor Crescent, Hyde Park Corner, London, S.W.1.

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YOUNGEST ROYAL SET OWNER.

Princess Elizabeth is to have her own two-valve broadcast receiver in the course of the next few weeks. It will be installed in her nursery at 145, Piccadilly, and will be entirely under her own control for the reception of the Brookmans Park transmissions.

For some time the nursery has been equipped with a loud speaker connected to the Duke of York's set.

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NO MUNICIPAL RELAY FOR HULL.

Efforts at Hull to obtain a broadcast relay service operated by the municipal authorities have been defeated. The city council have deemed it better to accept an agreement with a local company.

The opposition, which won its case by only three votes, emphasised the uncertainty of the position of the wireless relay services and the probability that the Government will eventually acquire them.

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"MY PRISON RADIO."

A German ex-convict has been entertaining readers of a popular magazine with an account of how gaol-birds enjoy broadcast programmes without the knowledge of the authorities.

Miniature sets, he declares, are obtainable in most prisons, the hiring fees ranging from quarter of a packet of tobacco for a valve set to half that amount for a crystal. There is no demand for double earphones, as these would be easily detected and the wearer would get a week or a fortnight on "bread and water." A single earpiece suffices, as it can easily be held in the palm of the hand. The bars of the cell usually provide a good enough "aerial," while nearly every cell contains a water-pipe which serves as an earth.

All of which goes to explain why the German convict "gains his freedom with a sigh."

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HOW CANADA LISTENS.

An advance of 43 per cent. in the number of receiving licences issued in Canada during 1930, as compared with 1929, is reported by the Canadian Bureau of Statistics. The 1930 total amounted to 559,116.

Of the total sales during 1930, numbering 223,228 sets, Ontario took almost one-half, or 46.7 per cent.; Quebec, 27.5 per cent.; British Columbia, 7.9 per cent.; Manitoba, 5.2 per cent.; Nova Scotia, 3.9 per cent.; Alberta, 3.8 per cent.; Saskatchewan, 2.7 per cent.; New Brunswick, 2 per cent.; and Prince Edward Island, 0.3 per cent.

BROADCASTING FROM "MESPOT"?

Bagdad may soon have a broadcasting station. We hear that provisional accommodation for the studios and control room has already been found in the new rooms of the Central Telegraph Office in the heart of the city.

It is believed that the programmes would be announced in Arabic and English. There are many English people in Iraq who would welcome local transmissions.

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"THE SET."

The above is the title of the new journal issued by the Radio Association. Contributors to the first number, which is dated September, 1931, include the Duke of Sutherland, K.T., Lt.-Col. J. T. C. Moore-Brabazon, M.C., Sir Beachcroft Towse, V.C., and the Rt. Hon. George Lansbury, P.C., M.P.

Among the leading features are a directory of receivers (giving brief specifications, prices, etc.), tests of commercial sets, and simple hints on receiver operation. We understand that copies of *The Set* can be obtained by non-members at one shilling each on application to the Radio Association, 22-23, Laurence Pountney Lane, London, E.C.4.

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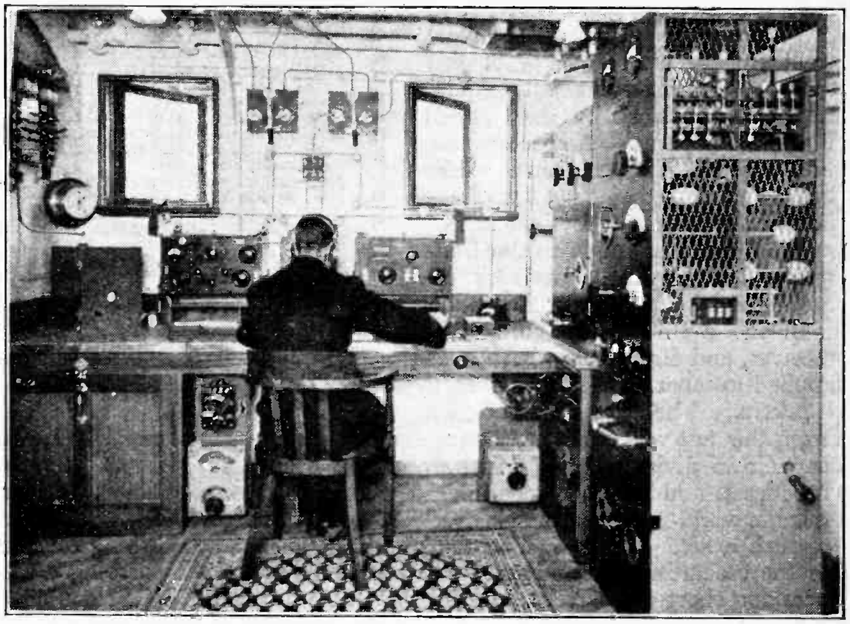
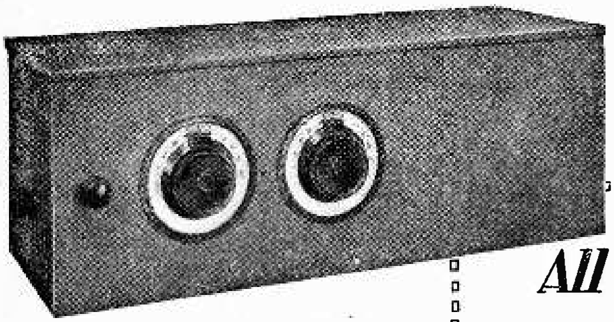
A LOUD SPEAKER PHENOMENON.

"In the Milan University a (loud speaker) installation has now been fitted up . . . rendering it unnecessary for the professor to take any special trouble to make himself intelligible."—*Indian Radio Times*.

We have heard loud speakers of this sort. Whatever is said sounds like "woof, woof."



THE WORLD AT HIS FINGER TIPS. A view in the wireless cabin of the new P. and O. liner "Strathnaver," showing the latest in Marconi marine radio equipment. On the right is the 2-kW. transmitter for long, medium and short wavelengths. An emergency transmitter is on the left of the operator. The direction finder is fitted in the chart room.



Type B.C. 3160 G.E.C. GECOPHONE

All Wave Superheterodyne

THERE is to be a vogue of short-wave superheterodynes, and probably the first complete commercially built receiver of this type is the six-valve set, model B.C. 3160, produced by the General Electric Company. A specimen set was acquired for test some weeks back, and in the course of the reception of American transmissions was applied to the tuning-in to the Kentucky Derby, which was also rebroadcast by the B.B.C. Reception from the B.B.C. with a broadcast receiver, and direct from 2XAF, was applied to separate moving-coil loud speakers. The conclusion drawn from this test was that a short-wave superheterodyne is capable of giving all that can be obtained from a rebroadcast, and the enormous interest which attaches to reliable world-wide reception is available to the possessor of such a set. In contrast to the uncertain behaviour of the oscillating detector and its low-frequency amplifiers for short-wave reception, the superheterodyne is much easier to handle. To the listener in remote parts the short-wave superheterodyne will, in many cases, give a programme comparable, on favourable occasions, with that which the local listener gets from his Regional.

The Gecophone Superheterodyne is battery operated, using two-volt valves and an H.T. battery of 120 to 140 volts. An anode current of 20 mA. is taken from the H.T. battery, and the L.T. current is well under 1 ampere. Brass barriers divide the containing cabinet into six compartments, and, starting from the aerial input, the first section contains the tuned grid circuit and aerial coupling passing the signal to the grid of an S.G. valve. In this compartment, also, is the volume control arranged to regulate the filament current of the H.F. valve. A trimmer across the aerial tuning condenser provides for getting the last ounce out of the set while permitting of ganged control for aerial and H.F. stage tuning. Immediately behind the aerial stage is the H.F. intervalve coupling, so that the second compartment contains essentially the H.F. transformer, ganged tuning condenser, and the decoupling components of the anode and grid circuits. In the next compartment is the oscillator, with its tuned plate circuit, to which the grid is coupled, and which links with the anode circuit of the H.F. valve by a lead passing through the compartment on the way to the first detector.

SPECIFICATION.

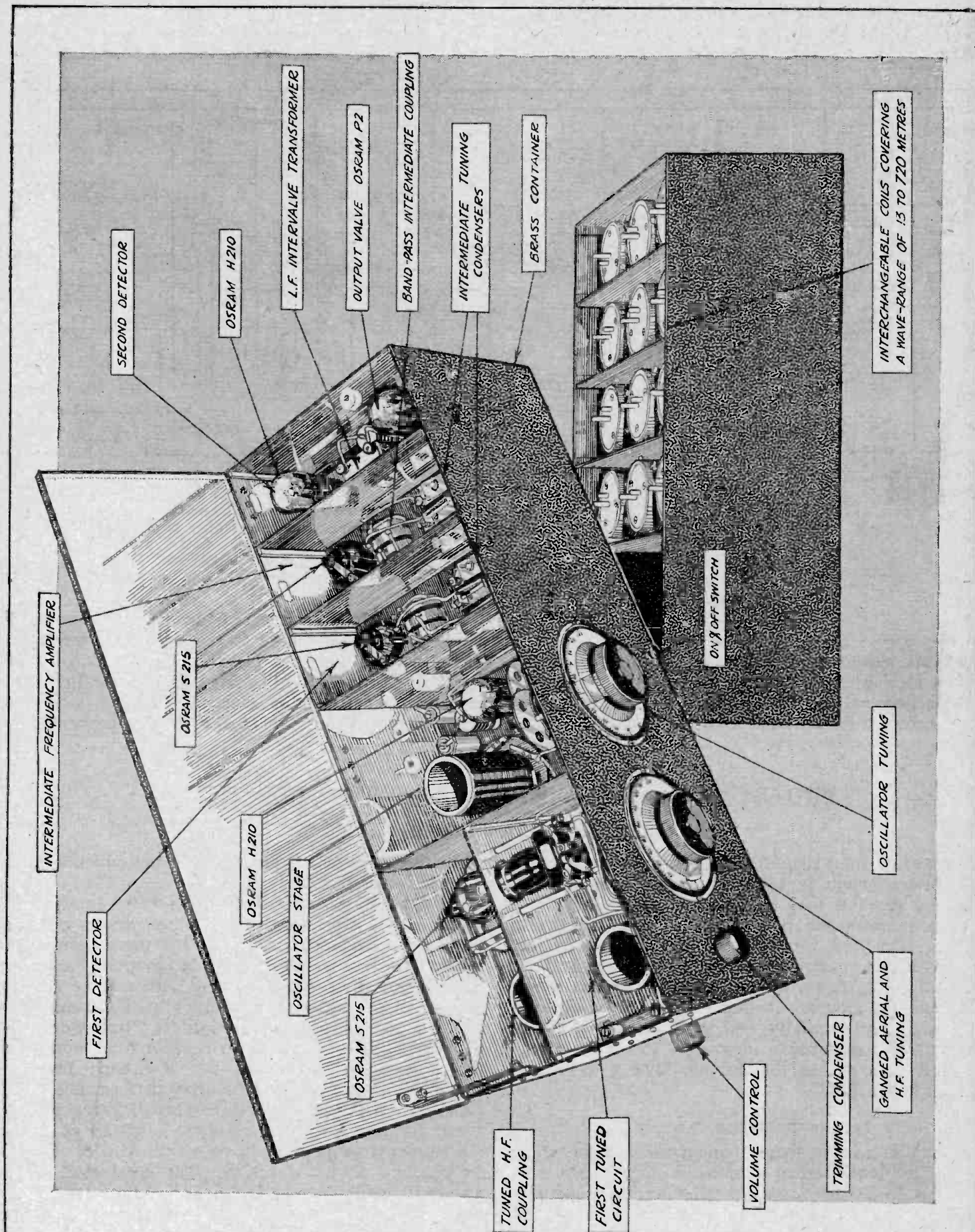
All wave superheterodyne 6-valve receiver, type B.C. 3160.
Single S.G. H.F. stage with S.215 valve preceding first detector.
Tuned transformer H.F. coupling.
Tuning controls of aerial and H.F. stage gang operated.
Seven sets of interchangeable coils covering wavelength range of 13/720 metres.
S.215 screen grid first detector using leaky grid. H.210 oscillator valve. S.215 in intermediate amplifier.
Band-pass intermediate couplings operating on 100 k.c.
Anode bend second detector with H.210 valve, transformer coupled to P.2 output valve.
Filter-fed output. H.T. consumption 20 mA. at 120 volts. Filament current consumption 0.85 amp. at 2 volts. Power output 300 milliwatts.
Price £27 10s., with coils for wave range 13/100 and 200/720 metres. Coils for 100/200 metres 15s. extra.

The resultant frequency produced by the combined oscillation of aerial and oscillator is applied to the grid of the first detector, a screen-grid valve, through a grid condenser and leak, with which is embodied a filter. The long-wave intervalve coupling in the anode circuit of the first detector is a transformer, tuned to a frequency of 100 k.c. Tuning condensers bridge both primary and secondary windings, which, combined with a shunt resistance and the adoption of suitable inductance to capacity ratios, produce a band-pass filter limiting the range of frequencies which the amplifier will accept. This feature represents up-to-date practice, and is the controlling factor in superheterodyne selectivity. Following the first detector stage is the fifth compartment, carrying a screen-grid valve and the second band-pass H.F. coupling, representing a single-stage intermediate amplifier. In the last compartment is the second detector and output power valve. A small negative bias applied to the second detector shows that it functions as an anode bend rectifier. It is followed by a transformer coupling, while in the anode circuit of the output valve is a choke filter feed.

13 to 720 Metres by Plug-in Coil.

Like all Gecophone receivers, the constructional merits of the set are outstanding. We find no haphazard assembly of components hidden away with the assumption that interior construction counts for little. The layout is such that the wiring consists of short and inconspicuous leads, tending towards easy maintenance. The extensive tuning range of 13-720 metres is covered by seven sets, each of three coils, which drop into position on bases, the contacts binding down strong spring blades. A desirable detail in the construction of short-wave receivers is the use of specially designed tuning condensers of the double-spaced type, having a generous air gap between fixed and moving plates. These condensers are particularly attractive, having clearly marked white scales, readings being taken from a black scratch line on a travelling transparent celluloid arm. Smooth operation results from the fitting of 30 to 1

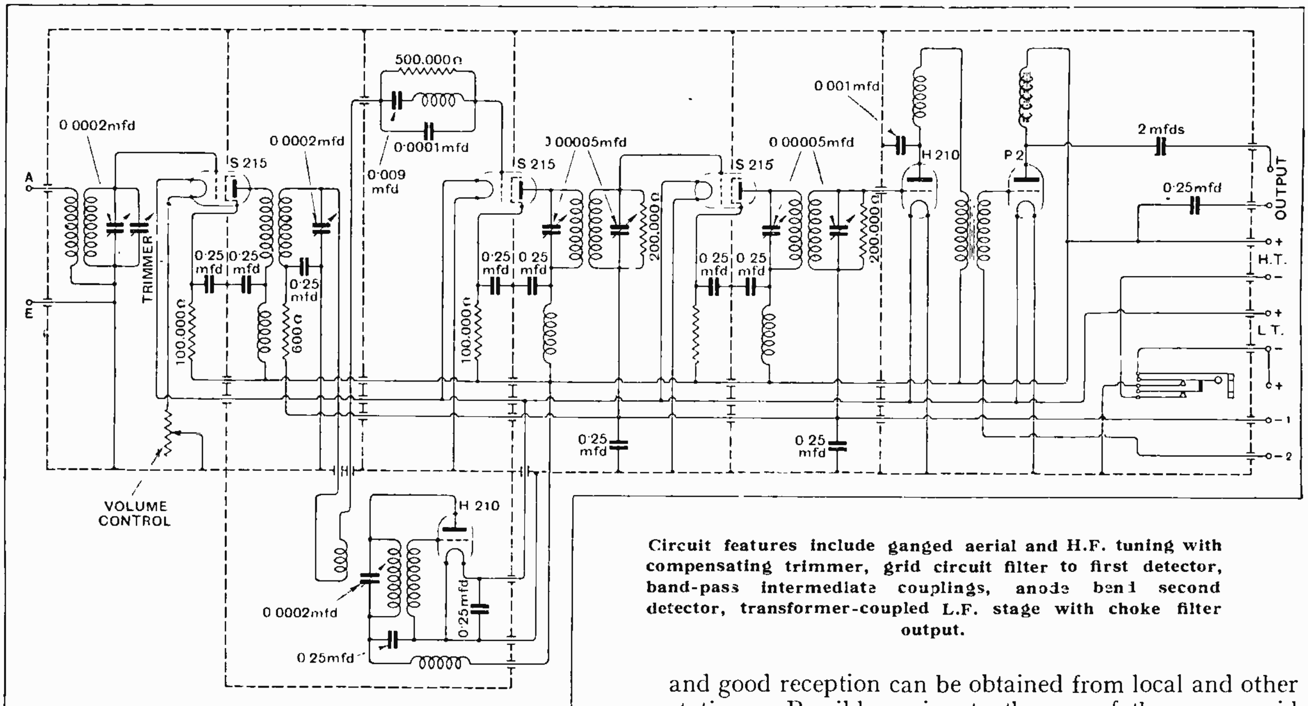
Gecophone All Wave Superheterodyne.—



Constructional details of the G.E.C. six-valve short-wave superheterodyne.

Gecophone All Wave Superheterodyne.—
friction-driven dials. No attempt has been made to produce a decorative set, it being far more attractive by virtue of the clean finish of its brass container and the matching of the mottled bakelite control knobs with a coppered colouring of the entire surface. Supplied with the receiver is a well-prepared sixteen-page booklet of instructions, giving tuning charts for the six ranges, which include a list of the short-wave stations.

A wise provision is the supply of coils to permit of reception on broadcast wavelengths, although it must be remembered that the design of the set has been developed around the requirements of short-wave reception. Two sets of coils are needed in the medium broadcast band,



Circuit features include ganged aerial and H.F. tuning with compensating trimmer, grid circuit filter to first detector, band-pass intermediate couplings, anode bend second detector, transformer-coupled L.F. stage with choke filter output.

and good reception can be obtained from local and other stations. Possibly owing to the use of the screen-grid H.F. stage, however, a powerful local station may be heard at many different settings, a condition that is not met with on the ultra short wavelengths where the addition of the H.F. valve is a definite advantage.

BROADCAST TRANSMISSIONS AND THE CONDUCTOR.

Giving the Musician Ultimate Control.

IT has often been suggested that the conductor of an orchestra which is being broadcast is in the unhappy position that he does not really know just how the performance is getting out to the listener. Between him and the listener, in addition to any uneven frequency response of the microphone and the transmitting apparatus, there is the control room, where it is possible to alter the rendering intended by the conductor quite substantially and with disastrous effects if the engineer responsible for control of the broadcasting as it goes out to the listener is not very well qualified in his job.

Let the Conductor Control.

It would seem that there is room for experiment on the part of broadcasting stations in this direction to endeavour to devise a system whereby the conductor should have a better control over what is being put out. This effect could be attained if arrangements were made so that the conductor was unable to hear his orchestra direct and heard only the reproduction as the listener would receive it.

An interesting experiment along these lines which, as far as we are aware, has not been tried, would be for the conductor to stand in his usual position in relation to his orchestra, but in a soundproof glass chamber, so that whilst he could see and be seen by his orchestra and conduct normally, he would hear nothing of the performance direct, but would be supplied with headphones giving him the rendering as the listener would receive it. By such means it might be found possible for the performance to be considerably improved from the broadcasting point of view, for any instruments which failed to go out as the conductor wished could be emphasised or modified in intensity at his direction. The conductor, as the musical genius, would, when once he had become accustomed to the new conditions, be able to correct shortcomings of the electrical side of the broadcasting system.

ENCYCLOPEDIA of WIRELESS TERMS

No. 1

Brief Definitions with Expanded Explanations.

ALTERNATING CURRENT (A.C.). An electric current which reverses its direction of flow at regular intervals. It passes through a sequence of values which is repeated during each complete interval of double reversal.

SINCE an alternating current flows alternately in opposite directions round a circuit, it is usual to consider one direction as positive and the other as negative. The choice of positive direction may be quite arbitrary in the case of a circuit carrying A.C. only, but if a direct current flows in the same circuit, a case in point being the anode circuit of a valve, the positive direction of the alternating current is taken as that in which the direct current flows.

Cycles and Frequency.

The time intervals for the two directions of flow are usually equal, and the variation of the current from the instant it starts from zero and passes through one complete sequence of positive and negative values back again to zero, is called one *cycle*. The time of one cycle in seconds is a *period*, and the *frequency* is the number of periods or cycles which occur in one second. The frequency is expressed in cycles per second, or periods per second, but for radio frequencies it is more conveniently expressed in *kilocycles* per second—that is, in thousands of cycles per second.

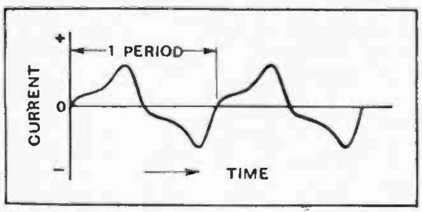


Fig. 1.—Showing how an alternating current is represented by a graph.

An alternating current may vary from instant to instant in any complex manner, but it is usual for the time of one sequence of positive values to be equal to the time of one sequence of negative values. The variations of the current with time can be shown as a graph (Fig. 1), where the horizontal axis represents the time in seconds and the vertical heights represent the values of the current to some scale. The resulting wave may have any shape, providing it repeats itself exactly during each successive period. By means of an instrument called an *oscillograph* it is possible to photograph the wave-shape of an alternating current—a tiny light-spot thrown on to a moving photographic film is caused to move backwards and forwards at right angles to the motion of the film.

THERE are many terms used glibly in radio with which the reader may not be fully conversant and to whom an explanatory reference list would prove valuable. This, the first of a series giving a clear and concise interpretation of radio terms, is arranged in a form for easy reference and will assist the beginner in gaining full benefit from the more advanced technical articles while providing a complete summary of the properties of apparatus and circuits met with in modern radio practice.

The ideal alternating current is one which obeys a sine law, giving a simple sine wave when plotted as a graph (Fig. 2).

As in the case of direct current, the strength of an alternating current is expressed in amperes, but since the A.C. is varying at all times a little care is necessary in defining what is meant by one ampere of alternating current. It is clear from the curves that the negative half waves exactly balance the positive half waves, and therefore the *average* current, taken over any whole number of cycles, is zero. (For this reason a moving coil ammeter will not indicate an alternating current.) But when an alternating current is passed through a resistance, heat is generated, whichever way the current is flowing, since the power developed is proportional to the square of the current at any instant. Thus heat is generated by each half wave of the current, and the average rate of generation of heat can be measured, or, in the case of a simple sine wave, it can be calculated. This generation of heat is taken as a basis for comparing the effects of the alternating current with those of a direct current. *The effective value of an alternating current in amperes is equal to the value of the direct current which has the same average heating effect in a given fixed resistance.* Thus, one ampere of A.C. will liberate heat at the same average rate as one ampere of D.C. in an equal resistance.

Interpreting the Graphical Curve.

Once the wave-shape of an alternating current is known, it is possible to determine the effective or virtual value from the graphical curve. For let I denote the effective value of an alternating current, and let i be the value at any instant. If this current flows in a resistance R ohms we have, by the above definition, that I^2R is the average power. Therefore

$$I^2R = \text{mean value of } i^2R$$
$$I^2 = \text{mean value of } i^2$$
$$I = \sqrt{\text{mean value of } i^2}$$

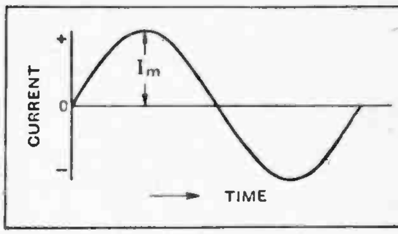
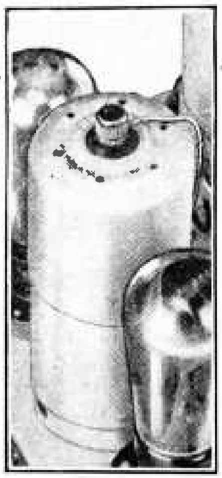


Fig. 2.—Simple sine wave of current.

Thus the effective value is equal to the *root* of the *mean* value of the *squares* of all the instantaneous values, being called, for brevity, the *root mean square* or R.M.S. value.

For a simple sine wave of current the R.M.S. value is 0.707 of the maximum or peak value; or the peak value is 1.414 times the effective value.



For the Battery Set

TWO NEW S.G. VALVES

The Marconi and Osram S21 and S22 Screen-grid Valves Reviewed.

FOR some time now it has been evident that the trend of receiver design is giving rise to the production of two distinctive types. In one class we have what may be termed the popular set embodying one S.G. H.F. stage followed by a detector with either a triode or pentode output valve, while in the other category can be included the more ambitious style of receiver in which two, or more, H.F. stages may figure. Where the H.F. amplification is handled by a single stage it is desirable to extract the maximum gain from the valve in the easiest possible manner, whereas with two or more H.F. stages available the amplification from each stage can, with advantage, be kept much lower.

Hitherto, valve manufacturers have not catered for each class separately as the same type of valve had to be employed irrespective of the number of H.F. stages fitted. This naturally introduced a certain complication in the design of multi-stage H.F. amplifiers, as in the interests of stability a portion only of the available H.F. amplification of each stage could be utilised. By the introduction of the S22 and the S21 screen-grid valves the Marconi and Osram valve organisations have simplified the work of set designers, as it is now possible to incorporate a valve having the most suitable characteristics for the particular function it is required to perform. The S22 is intended for use where a single H.F. stage only is employed, while its companion, the S21, has been developed for use in sets embodying multi-H.F. stages. Both valves are fitted with 2-volt filaments. The characteristics quoted by the makers for the S22 are:—

A.C. resistance, 200,000 ohms;
Amplification factor, 350;
Mutual conductance, 1.75 mA/volt.;
Max. anode volts, 150;
Max. screen volts, 75.

The above values are obtained with 120 volts on the anode, 75 volts on the screen-grid, and zero grid bias. The attainment of a mutual conductance of 1.75 mA. per volt with a 2-volt type screen-grid valve is a notable achievement.

The characteristics of two sample S22 valves, when measured under the same conditions as cited above, agreed with the makers' figures. However, these values are not the true working values, since valves of this type change their characteristics widely with any alteration in the operating conditions. Consequently, some measurements were then made with 150 volts on the anode, 75 volts on the screen, and with grid potentials of −1 and −1.5 volts respectively. The following values were obtained:—

MARCONI AND OSRAM S22 VALVE.

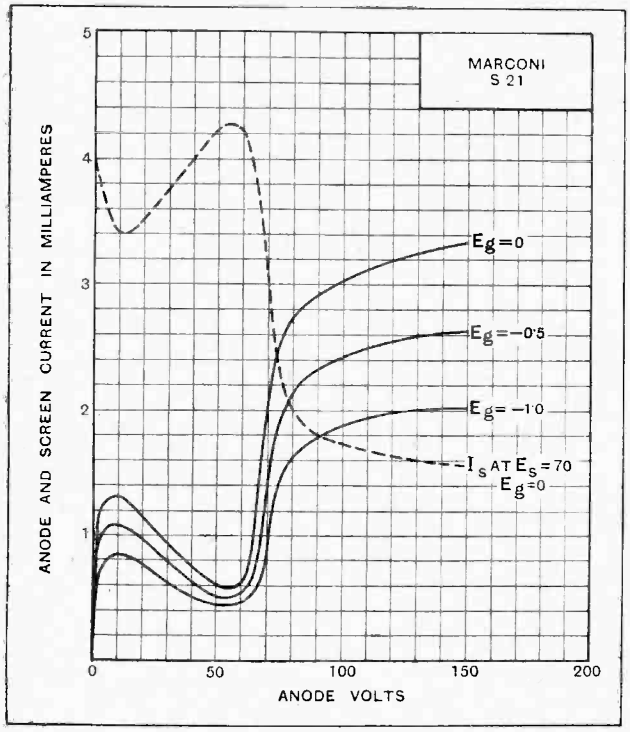
Grid Bias.	A.C. Resistance. (Ohms).	Amplification Factor.	Mutual Conductance.
—1 volt	470,000	800	1.7 mA/volt.
—1.5 volts..	720,000	980	1.36 mA/volt

Thus it will be seen that the best operating condition is with about −1 volt grid bias, and it would seem advisable to employ one of the special 0.9-volt grid cells for this purpose. As an alternative, the bias

Curves for the S22 which clearly show an extremely high efficiency for this type of 2-volt battery valve.

For the Battery Set—Two New S.G. Valves.—
can be taken from a small resistance in the negative lead from the H.T. battery.

The low anode-grid capacity in the valve—0.005 mmfd.—assures perfect stability when the tuned-anode or tuned-grid coupling is adopted with the popular type of screened coil. If the dynamic resistance of the tuned circuit at 200 metres is of the order of



Anode volts-anode current curves of the S21 valve for various values of grid potential.

75,000 ohms, the amplification for the stage should be about 110 times. This assumes the valve is given an anode voltage of 150, with 75 volts on the screen-grid and −1 volt grid bias.

In the two samples tested the average screen current was found to be about 1 mA., while the anode current was of the order of 2.5 mA.s under the most favourable operating conditions. As a volume control is an essential adjunct to every receiver, this may be achieved by dimming the H.F. filament, or one of the many input arrangements discussed from time to time in these pages could be embodied.

When an H.T. Eliminator is Used.

If the H.T. is derived from a mains unit the screen voltage must be regulated by a potential divider, and a convenient method of volume control would then be to fit a variable potentiometer as one element of the potential divider. Needless to say, both screen and anode circuits should be adequately decoupled, a 1,000-ohm resistance being employed for the former, while the voltage-dropping resistance could be made to serve the dual function for the anode circuit.

The better characteristics of the S22 as compared with those of the S21 are obtained largely at the expense of filament current, although neither valve can be regarded as exacting in this respect. The S22 consumes 0.2 amp. at 2 volts, while its companion is content with 0.1 amp. at the same voltage. The makers' characteristics of the S21 are:—

[1]A.C. resistance, 200,000 ohms;
[1]Amplification factor, 220;
[1]Mutual conductance, 1.1 mA/volt;
Max. anode volts, 150;
Max. screen volts, 70.

Two specimen S21 valves were tested, and in both cases the mutual conductance agreed with the makers' figures, but the other characteristics were not in such close agreement as in the case of the S22 specimens.

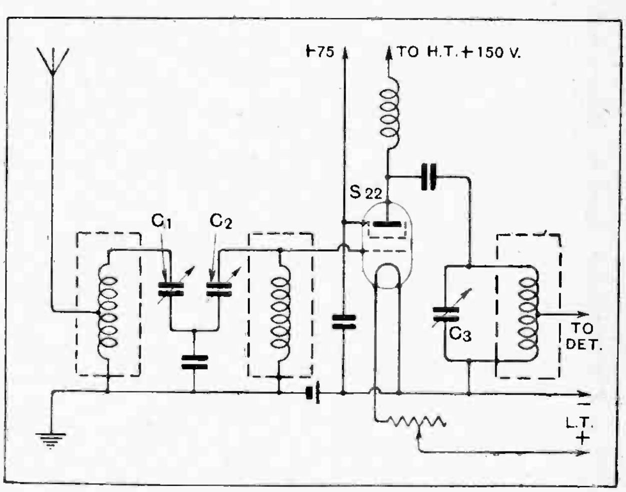
The following values were obtained from the better specimen under operating conditions:—

MARCONI AND OSRAM S21 VALVE.

Grid Bias.	A.C. Resistance. Ohms.	Amplification Factor.	Mutual Conductance.
—1 volt....	327,000	360	1.1
—1.5 volts..	490,000	490	1.0

The anode-grid capacity of this valve is the same as that of the S22, viz., 0.005 microfarads. Since this valve will be employed in sets fitted with two or more H.F. stages, quite a modest gain from the individual stages will suffice in the majority of cases, and rock stability can be assured, provided reasonable care is taken in the general design of the H.F. portion of the set. A gain of about 65 times per stage will be possible by using screened coils whose average dynamic resistance is of the order of 75,000 ohms, and, as the maximum amplification the valve will handle in the normal manner of operation before instability sets in is some 160 times at 200 metres with a tuned circuit of the above dynamic resistance, there is no likelihood of the borderline being attained.

[1] At $E_a = 120$, $E_{sg.} = 70$, $E_g = 0$.

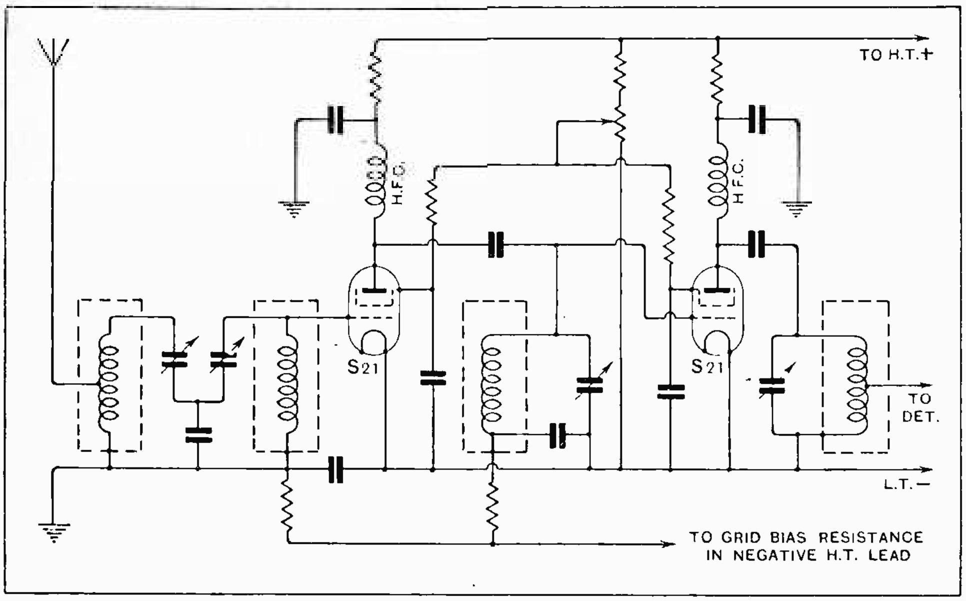


Single high-gain stage using an S22 valve preceded by a capacity-coupled band-pass filter.

For the Battery Set—Two New S.G. Valves.—

The most favourable grid bias with 150 volts on the anode and 70 volts screen potential is about –1 volt, and the 0.9-volt grid cell mentioned as suitable for the S22 will serve in this case also. When the various H.T. voltages are derived from a battery eliminator a useful circuit arrangement to employ is that shown in the diagram. Here separate decoupling resistances are employed, and these might quite serve as voltage-dropping resistances.

With the operating voltages suggested here, the average screen current is about 1.2 mA. and the anode current 2 mA. The mere fact that this particular valve has been designed to meet the requirements of multi-H.F.-stage sets does not preclude its use in sets embodying but one high-frequency amplifier; indeed, it would seem desirable to give serious consideration to its qualifications in sets designed for medium-distance reception where an H.F. stage affording a high gain might introduce serious difficulties in adequately controlling the volume. The more modest H.F. amplification obtained with the S21 in conjunction with a tuned circuit of comparatively low dynamic resistance, and further by tapping down the anode connection, would remove most of these difficulties; at the same time, good-quality reproduction would be more readily obtained.



Suitable circuit for an H.F. amplifier embodying two stages with S21 valves.

NEW BOOKS.

Foundations of Radio, by R. L. Duncan. Pp. 246+ix, with 145 figs. Chapman and Hall, 1931, 12/6 net.

It is possible to entertain quite a different conception of the Foundations of Radio than that held by this author. It is generally maintained that a sound knowledge of mathematics is essential to an adequate study of electricity, but the author has evidently tried, as far as possible, to avoid mathematics in this book, for his appendix deals only with elementary arithmetic as far as square root. But much more than this is required of the serious student, and without it there is little point in a cursory and necessarily very general discussion of such matters as the hysteresis of iron and Lenz's Law. One is puzzled to imagine the type of student to whom it is necessary to explain both the principle of the Wheatstone bridge and the manipulation of the symbols involved in the relative equation. Alternating currents are not discussed.

For those, however, who wish to understand the elementary principles of electricity, magnetism and sound, as far as they are applicable to radio and without going very deeply into the subject, this book is undoubtedly of service. The opening chapters explain the ordinary electrical units, the electron theory, magnetism and electro-magnetic induction, and these are followed by brief explanations of resistances and conduction, Ohm's Law, the construction and use of Primary Cells, a chapter on Sound, the elementary mathematics referred to above and several useful tables. W. A. B.

Cross-country Flying, by Major Oliver Stewart, M.C., A.F.C. Practical instructions in Aerial Navigation, including Meteorology and Wireless. Pp. 116, with 10 diagrams and 12 whole-page plates. Published by Constable and Co., Ltd., London, price 5s. net

A Course Indicator of Pointer Type for the Visual Radio Range-Beacon System, by F. W. Dunmore (Research Paper No. 336). A description of a tuned-reed course indicator in which the indications are given by means of a zero-centre pointer type instrument. Reprinted from the Bureau of Standards Journal of Research, Vol. 7, July, 1931. Pp. 24, with 22 diagrams and illustrations. Published by the Bureau of Standards, Washington, D.C., U.S.A., price 15 cents.

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The Gramophone Handbook. A practical guide for gramophone owners on all matters connected with their instruments, including electric and radio-gramophones, by W. S. Rogers, with a foreword by Compton Mackenzie. Pp. 116+xiv, with 46 illustrations and diagrams. Published by Sir Isaac Pitman and Sons, Ltd., London, price 2s. 6d. net.

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From Telegraphy to Television. The story of Electrical Communications, by Lt.-Col. Chetwode Crawley, M.I.E.E. A summary, in simple style, of the development of electrical communication. Pp. 212+xii, with 44 illustrations, including 24 whole-page plates. Published by Frederick Warne and Co., Ltd., London and New York, price 6s. net.

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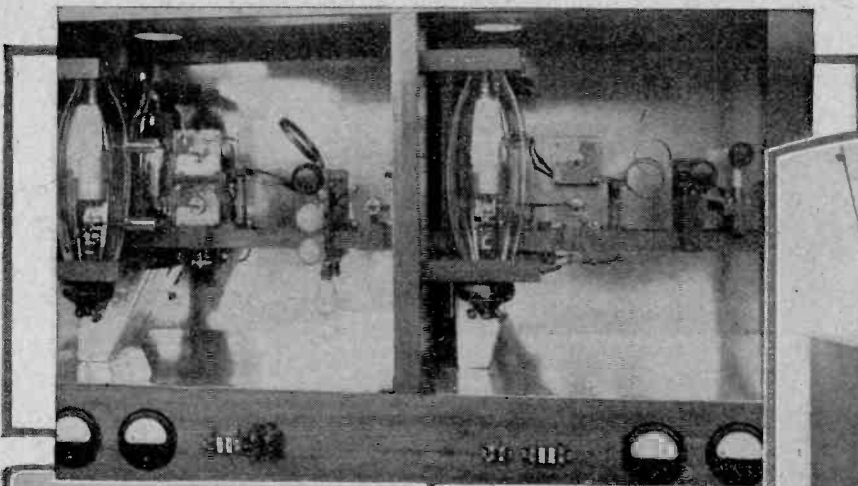
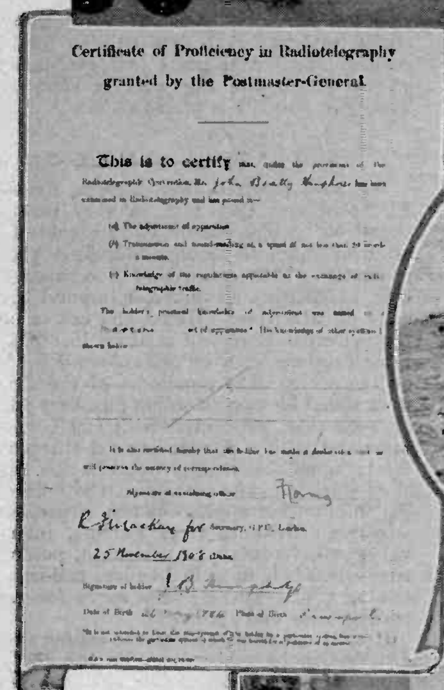
Störschutz am Rundfunk-Empfänger in der Praxis, by Henrich Ike. A short description of various methods of avoiding interference from statics. Pp. 32, with 30 diagrams. Published by Rothgiesser und Diesing A.G., Berlin. Price RM1.

Next Week's Set Review:—
COLUMBIA RADIO-GRAMOPHONE MODEL 602.



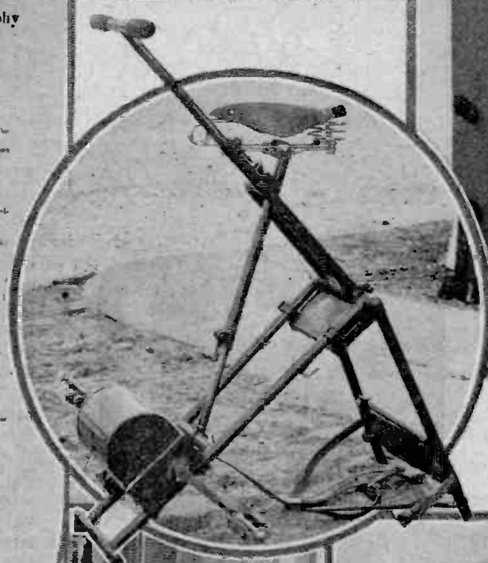
MIDGET - WAVE TRANSMISSION. The latest evidence of the new trend—a commercial ultra-short-wave transmitter by the German firm of Lorenz.

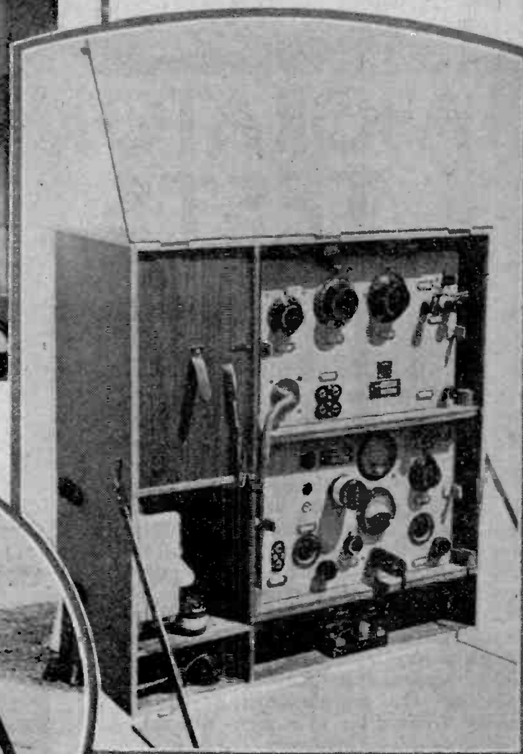


Certificate of Proficiency in Radiotelegraphy granted by the Postmaster-General

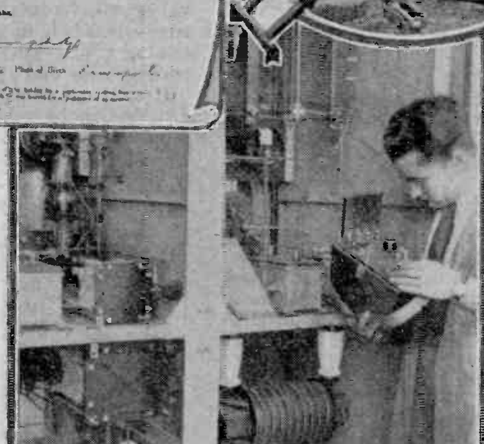
This is to certify

HISTORIC LICENCE. This interesting piece of paper is the property of a reader, Mr. J. B. Humphreys — the first man to be officially licensed to operate a commercial wireless installation.



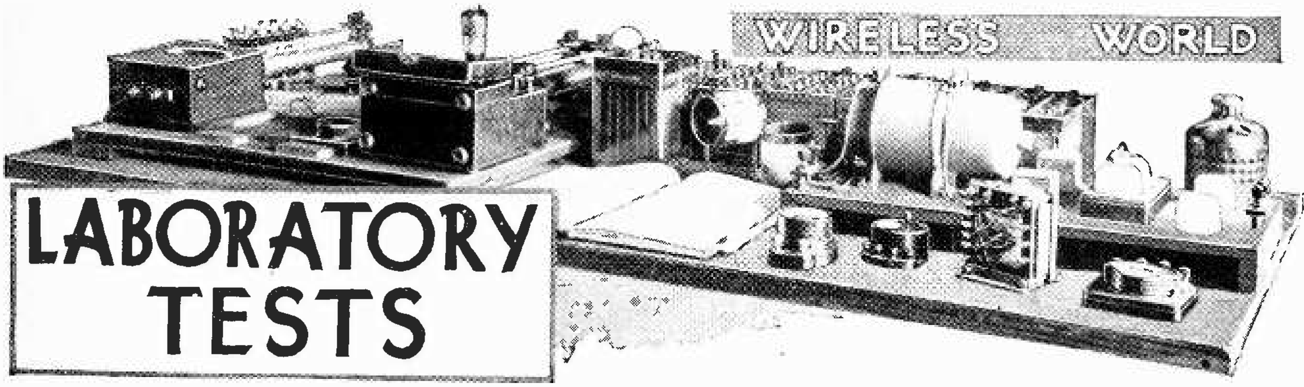


AERIAL EMERGENCIES are provided for on the Graf Zeppelin with this self-contained transportable set which can operate at a moment's notice with the power supplied by the pedal-driven dynamo on the left.



WHY VELTHEM DOES NOT JAM. A "snap" showing an engineer at the Brussels (Velthem) broadcasting station measuring the wavelength behind the modulator stage.

BRITAIN'S LONELIEST LIFEBOAT CREW enjoy the compensations of wireless at the new lifeboat station in the Southern Hebrides. The photograph shows the receiver being installed on the boat prior to its voyage from London.



LABORATORY TESTS

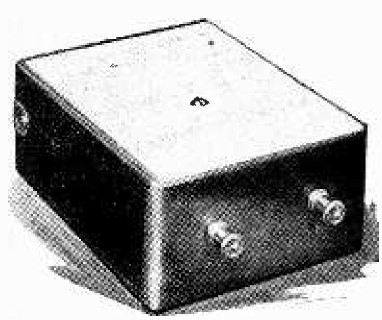
A Review of Manufacturers' Recent Products.

REGIONAL UNIT.

The Northampton Plating Co., St. Giles' Street, Northampton, have introduced recently a small unit, the purpose of which is to enhance the selectivity of a receiver when difficulty is experienced in separating the two programmes sent out from a Regional station. This device is appropriately styled a Regional Unit, and the price is 7s. 9d. No alterations are required to the receiver since the unit is interposed between the aerial terminal and the aerial lead. It functions as an absorption-type rejector, and, on test, was found particularly effective in reducing the signals from a powerful nearby transmitter to a mere whisper.

The rejected frequency band is not unduly extensive, but when connected to a set it has the effect of modifying the tuning slightly. This is a common feature of all rejectors and wavetraps.

The effective range of the unit is from about 200 metres to 550 metres, and tuning is arranged by means of a concealed pre-set-type condenser. This is adjusted by inserting a screwdriver into a hole in the case and engaging the blade in a saw-cut in the control knob of the condenser.



Northampton Plating Co.'s Regional Unit which functions as an absorption rejector.

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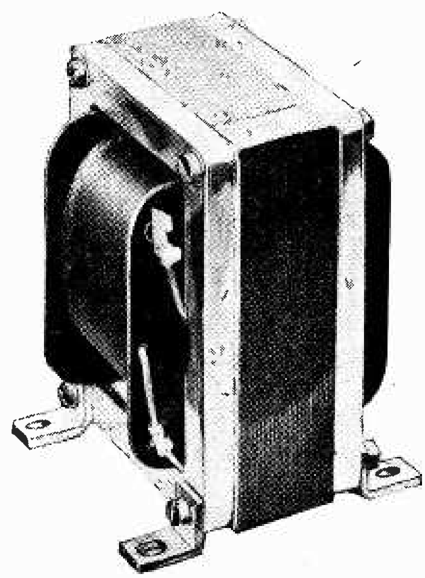
BAYLISS L.F. CHOKE.

William Bayliss, Ltd., Sheepcote Street, Birmingham, have introduced two standard model L.F. chokes described as type No. 3,442 and type No. 304. The former is rated to carry 50 mA. of D.C. and has an inductance of 30 henrys, while the No. 304 model has a rated value of 20 henrys and will handle up to 100 mA. of D.C.



Bayliss type No. 3442 L.F. choke rated to carry 50 mA. of D.C.

The specimen 3,442 sent in for test would appear to be a little below standard, as the inductance was somewhat lower than the rated value, even when no D.C. was following. The measured values are given below :—

D.C. in mA.	Inductance in Henrys.	D.C. in mA.	Inductance in Henrys.
0	25.6	30	24.0
5	25.6	35	23.6
10	25.4	40	23.1
15	25.1	45	22.6
20	24.8	50	22.0
25	24.4		

The A.C. flowing through the winding was maintained at 1 mA. throughout. The above values are sufficiently high for practically all normal requirements, and, as either an output choke or a smoothing choke, satisfactory results will be forthcoming. The choke has a D.C. resistance of 400 ohms, and the price is 17s. 6d. The type No. 304 is priced at 21s.

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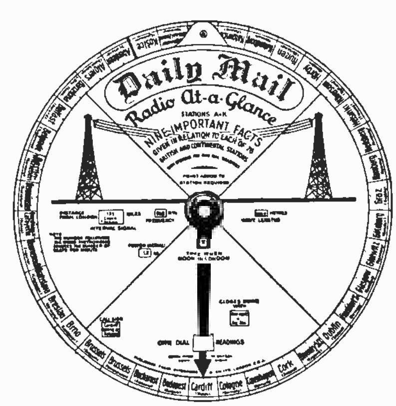
RADIO AT A GLANCE.

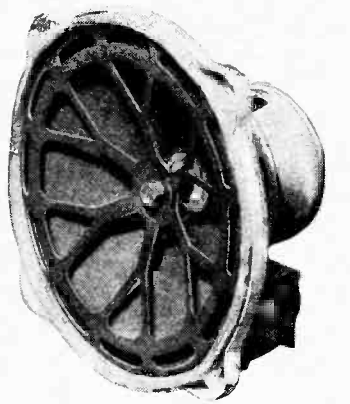
We have received from Messrs. Frank Pitchford and Co., Ltd., a very useful "gadget" which should be invaluable to all who listen to foreign broadcast programmes. This consists of a cardboard disc, about 9½in. in diameter, around the edge of which are printed the names of the principal European stations in alphabetical order, A—K on one side and L—Z on the other. The remainder of the disc is screened by two rotatable members one on each side, perforated with small windows and with a pointer printed thereon. By bringing this pointer opposite the desired station on the outer disc, the following information appears at the respective windows: Distance from London, interval signal, frequency, wavelength, power, time when it is noon in London, call-sign, closing signal, and a blank space for recording own dial readings.

It has been arranged that the selling and distribution be undertaken by the *Daily Mail* and that the price is 1s. It should not be a difficult matter to alter a few of the particulars should any wavelength be changed, as the spaces reserved for "own dial readings" are comparatively large and easily alterable.



MAGNAVOX TYPE D.C.140 MOVING-COIL LOUD SPEAKER.

The field winding of this loud speaker can be energised either directly from D.C. mains or by means of the H.T. current of the receiver as described in the July 15 issue of this journal. It is supplied either with a 2,500 ohm. (110-190-volt) or 7,500 ohm. (190-250-volt) field coil, and the minimum power required by the field is of the order of 5 watts.



Magnavox type D.C. 140 moving-coil loud speaker chassis and output transformer.

A shallow-angle $6\frac{1}{2}$in. cone is employed and is protected on the front by a rigid metal grille. The moving coil is of small diameter and is of the low-impedance type. An output transformer is incorporated in the chassis. The primary will carry up to 25 mA. of D.C., and is centre-tapped for push-pull output valves. In the case of single output valves the full winding is used with valves of over 2,000 ohms. A.C. resistance and either half of the winding may be used with valves below 2,000 ohms.

The sensitivity and power-handling capacity are alike excellent, and are very little less than those of full-sized moving-coil loud speakers. The response from 150 to 5,000 cycles is uniformly good, the output from 1,500 to 5,000 being slightly higher than that between 150 and 1,500. Below 150 cycles the output falls off, but there is still an appreciable response at 50 cycles. The cut-off below 150 cycles is, however, an advantage in any loud speaker intended for operation in conjunction with the H.T. supply of an A.C. mains receiver.

Supplies are obtainable from Magnavox (Great Britain), Ltd., 89, Kingsway, London, W.C.2, and the prices, including output transformer, are as follows: 2,500 ohm. field, £2 10s.; 7,500 ohm. field, £2 12s. 5d.

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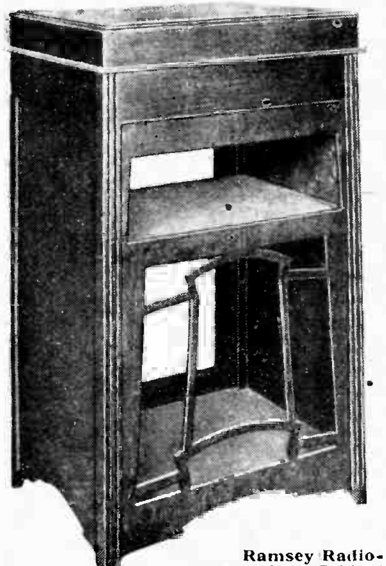
RAMSEY RADIO-GRAMOPHONE CABINET.

Made by F. W. Ramsey, 63, Shaftesbury Street, New North Road, London, N.1, this radio-gramophone cabinet is available finished in oak or mahogany, the prices being £3 5s. and £4 respectively, a superior type oak cabinet costing £3 15s. The cabinet is made of $\frac{3}{8}$in. plywood throughout, with the exception of the top, which is $\frac{3}{16}$in. thick.

It is divided into three compartments, the upper, which is disclosed when the lid is raised, measuring $20\frac{1}{4}$in. × 18in., and including the recess in the lid allows $4\frac{1}{2}$in. head-room for the pick-up arm. Immediately below the motor board is the compartment reserved for the receiver and amplifying equipment, measuring 25in. × $17\frac{3}{4}$in. × 12in. high, and an opening in the front will accommodate a panel 21in. × 7in. The size of the panel opening can be varied to suit individual requirements.

The bottom compartment will normally house the loud speaker and mains equipment or batteries, as the case may be. This measures 21in. × $17\frac{3}{4}$in., and is 20in. high. The front of this compartment is taken up by a large loud speaker grille, while the back is fitted with a removable frame, which can be covered by the constructor to suit his own particular taste.



Ramsey Radio-gramophone Cabinet finished in polished oak.

A loud speaker baffle board can be supplied at an extra charge of 1s. 6d., and silk for covering the loud speaker grille, and the back costs 5s.

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NEW RANGE OF GANGED CONDENSERS.

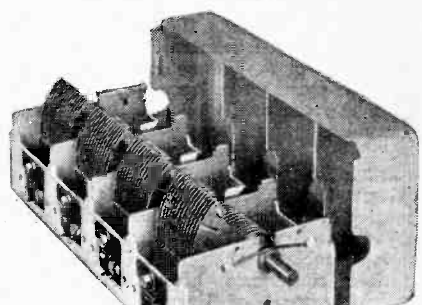
The British Radiophone, Ltd., Aldwych House, Aldwych, London, W.C.2, have just introduced a new range of ganged condensers; these are available in 2-, 3- and 4-gang models, the prices being 18s., 28s. and 38s. respectively. The outstanding feature of these condensers is the method of assembling the vanes. Spacing washers are not used, the vanes being locked in position by threading them on to specially shaped brass rods, which are then turned through an angle of 50 degrees. The brass bites into the aluminium vanes, locking each one firmly on the spindle and supporting rods. Special jigs are employed to assure perfect spacing of the vanes.

Although metals with dissimilar coefficients of expansion are used, it is impossible to loosen the vanes by heating the spindle and cooling the vanes, or vice versa, so that this method of construction would appear to be perfectly satisfactory in every respect.

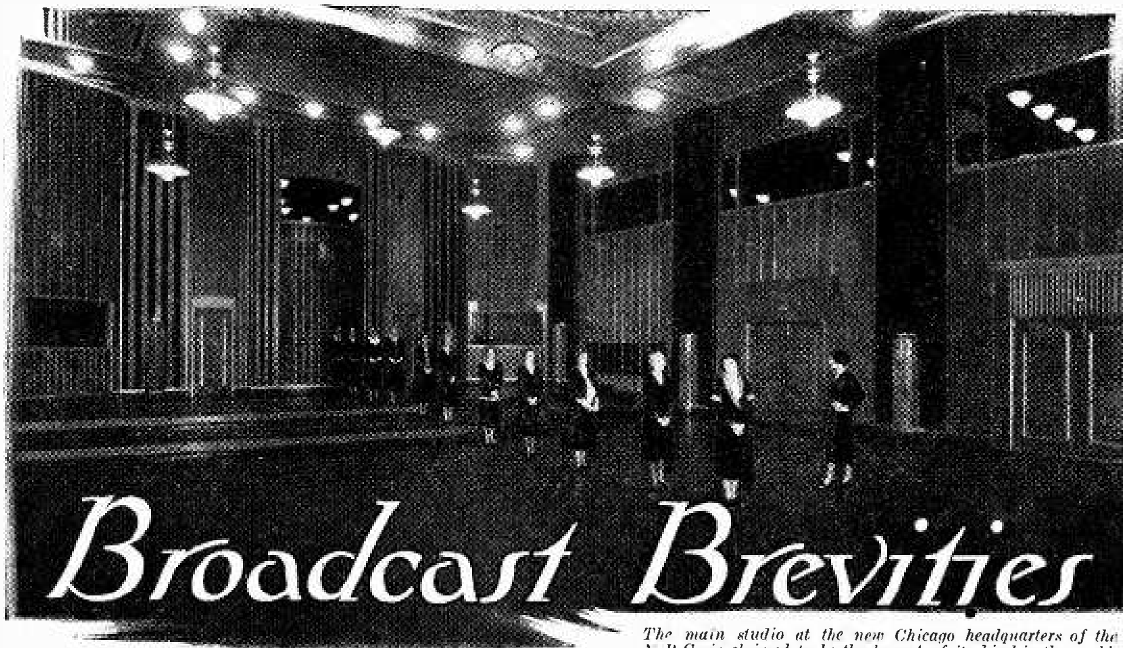
The outside vane of each set of rotors differs from the remainder in that it is provided with five saw-cuts extending to within $\frac{3}{8}$in. of the spindle hole. This divides the outer vanes into six parts, and each portion can be bent away from or nearer to its companion vane; the purpose of this is to enable accurate matching of each condenser over the whole capacity range. A small trimmer is fitted to each condenser in the unit, and these have a capacity of approximately 70 micro-mfds. All condensers in every unit are accurately matched before despatch.

Measurements made with a sample four-gang unit showed that extraordinarily close matching can be achieved by this method of construction. The only initial adjustment made before measuring the capacities was to set each trimmer to give the same minimum capacity in each case, and then measurements were made at various selected parts of the range. Over three-quarters of the scale the difference in capacity between each of the four condensers was of the order of 0.5 micro-mfds. only, but over the remaining quarter the differences were somewhat greater. By suitably adjusting the segments on the end vanes where necessary, the discrepancies over the last quarter of the scale were easily brought to within the same limits present over the first three-quarters of the scale.

The model tested was a very early sample, having been well handled before reaching us, and, furthermore, did not possess a protecting cover; this came to hand later. We understand that all production models will be accurately matched before despatch, the latitude not exceeding about 0.5 micro-mfds. over the whole scale. We feel confident that this condition can be attained quite easily, as we have had an opportunity of viewing, by the courtesy of the manufacturers, the assembling and testing of these condensers.



British Radiophone four-gang condenser unit. The case is cadmium plated, and finished with a colourless lacquer.



Broadcast Brevities

The main studio at the new Chicago headquarters of the N.B.C. is claimed to be the largest of its kind in the world. It measures approximately 100 × 45 × 30 ft.

By Our Special Correspondent.

B.B.C. and the U.I.R.—Welsh Programmes from 5XX.—New Arrivals at Broadcasting House.—Poet Laureate to Broadcast.—" Roxy and His Gang."—The Mid-week " Epilogue."

B.B.C. Rupture with International Broadcasting Union?

So disgusted has the B.B.C. become at the selfish attitude adopted in regard to wavelengths by certain of the European broadcasting organisations that the Corporation is seriously considering the severance of its connection with the International Broadcasting Union. To some people such a step might appear hasty and capricious, but I gather that the B.B.C. would act more in sorrow than in anger.

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Confusion Worse Confounded.

I can understand the sorrow, for if Savoy Hill breaks with the " Union Internationale de Radiodiffusion," the existing wavelength plan, bad as it undoubtedly is, would probably collapse like a pack of cards, and the confusion would be worse than ever.

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Fruitless Conferences.

What the B.B.C. feels is that the energies of its staff could be better employed in dealing with British broadcasting problems than in attending one fruitless conference after another in different corners of Europe. No threat to the other countries of the International Union is intended, but the B.B.C. is unable to ignore the fact that certain countries are not inclined to make any concessions towards conquering the interference difficulty; and this being the case the B.B.C. says, in effect: " Membership of the Union doesn't get us any forrader."

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The B.B.C. Would Save Money!

It is common knowledge, of course, that the B.B.C. was responsible for the formation of the Union. But it is also true that the Corporation still supplies a considerable portion of the funds necessary for its maintenance. Thus, with the departure of the B.B.C., the Union would suffer a financial as well as a moral blow, and I doubt whether its constitution is strong enough to withstand such punishment.

There are about thirty European member-countries, but they are sadly lacking in unanimity.

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A Queer Prospect.

The next meeting of the Union is to be held on October 19th in Rome, and thither Mr. Noel Ashbridge, Admiral Carpendale, Major Atkinson and others will trek, hoping against hope that their fellow members will prove a little more tractable. Let us pray that they do: I see dirty weather ahead if they don't.

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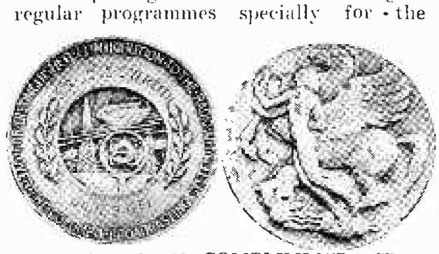
Welsh Programmes from Daventry.

For the first time in its history the Daventry long-wave station is to give regular programmes specially for the benefit of Wales. The innovation will begin on Friday evening, October 30th, when the 6.30 to 6.50 p.m. period will be set apart for the benefit of listeners in North Wales who have difficulty in picking up the Cardiff transmissions.

It is hoped that Mr. Lloyd George will be well enough to open the series with an address



AN AMERICAN COMPLIMENT. The first photograph to reach this country of the medal presented to Sir John Reith by the Columbia broadcasting system on the occasion of his broadcast over their network in June last.

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Choice of Three Programmes.

I understand that these Welsh periods will be continued at fortnightly intervals until the completion of the new West Regional station at Washford Cross. The programmes will be supplied by Welsh artistes, and Mr. E. R. Appleton, the West Regional Director, will have the co-operation of leaders in all branches of Welsh thought.

So for a short period on alternate Friday evenings we shall have three high-power transmissions to choose from. Sometimes the Welsh one may provide a happy relief.

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Dusty Days at Portland Place.

Quite a small colony of B.B.C. folk are already assembled at " Broadcasting House." One of the first of the engineers to migrate tells me that although he likes his new quarters well enough, he is unable to see much owing to the dust. Some of the dust is created by the workmen and some by people who are finding the offices too small.

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The Following Have Arrived . . .

Those already at work in the new building include the Chief Engineer, Mr. Noel Ashbridge, and engineers who are engaged in school broadcasting. Mr.

Tudsbery, the Civil Engineer, is also there. On the musical side the first arrival has been Mr. Walton O'Donnell, "O.C." of the Military Band music.

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Do You Want Savoy Hill?

The Savoy Hill building will remain as B.B.C. headquarters until the end of the year. Already the B.B.C. is faced with the task of finding a new tenant to which the old building will have to be sub-let until the B.B.C.'s own lease expires.

I wonder what sort of people rent old broadcasting palaces?

oooo

Munching in Silence.

Comes the first definite disappointment as a result of the economy measures at Savoy Hill. The stage was all set for an extension of the lunch-time broadcasts on Saturdays.

Many months ago I had advocated a musical period from 2 to 3 p.m. to enable "'orny 'anded sons of toil" like myself to pick up a tune during our normal lunch hour on Saturdays. But the axe has fallen, and it is not to be.

oooo

Voice-hunting Across Europe.

Philip Ridgeway's new series of "Parades" begins this evening (Wednesday), and listeners will hear one of these popular shows every fortnight until the end of the year.

In his search for fresh talent, and particularly for the "personality plus" voice, Mr. Ridgeway leaves no stone unturned. Quite recently he tuned in to a German station and heard a relay from a Berlin theatre. The voice of one of the artists struck him as being exactly the type he wanted.

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The "Personality Plus."

He immediately wrote to the station for information about the lady. He had absolutely nothing to guide him in describing her; nor even did he know her name, but from his idea of what she looked like the German station officials were able to identify her, but it is unlikely that she will be able to come to London. Mr. Ridgeway hopes to find her "double" over here, as he always prefers to employ British artistes for his shows whenever possible.

oooo

Water Polo and a Swimming Race.

A running commentary by W. J. Howcroft on the water-polo international, in which England and France are competing, will be relayed to National programme listeners on October 17th. The relay will include the English 220 yards swimming championship.

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A Celebrated Bassoonist.

Archie Camden, of the B.B.C. Symphony Orchestra, is recognised as the greatest artiste on the bassoon in this country. This instrument is often treated as a joke, but in Mr. Camden's hands it takes its place beside any other instrument in an orchestra. In America, bassoon players use Mr. Camden's gramophone records as a guide to show them how to play. He will give a recital for the Northern Region on October 12th.

Poet Laureate to Broadcast.

Few poets laureate have been regarded as specialists in any one subject—unless it be love-making—but Mr. John Masefield is an exception, for, although his range is wide, he has always shown a

[Photo by Howard Coster, reproduced by courtesy of the B.B.C.]

THE FINISHING TOUCH. The long-awaited statuary by Mr. Eric Gill which will occupy the large niche just over the entrance to Broadcasting House. The figures represent Prospero and Ariel, and it is claimed that they will effectually symbolise the spirit of broadcasting.

fondness for sea subjects. This fact should earn him an attentive hearing on Thursday, October 22nd, when he speaks on "Ships and Their Builders" at the Livery Banquet of the Shipwrights' Company at Salter's Hall. The speech will be broadcast from all the regional transmitters.

"Roxy" at Savoy Hill.

Mr. S. L. Rothafel, better known in America as "Roxy," is coming to Savoy Hill on October 14th. Now "Roxy" is a very interesting person. He is one of the big fun-magnates of the United States; in fact, I have heard him referred to as the "Cochran of America," and what he and his "gang" don't know about broadcasting could be sandwiched between the pips of the Greenwich time signal.

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Getting Ideas for America.

Whether "Roxy" and his gang will broadcast under the ægis of the B.B.C. is not yet decided, but I believe that the American gentleman will make a bid for at least an hour in order to give us an impression of high-speed entertainment as it is done across the Atlantic.

What he definitely seeks is an opportunity to study Broadcasting House, which in conjunction with Radio House in Berlin—also in his itinerary—is expected to offer ideas adaptable to the immense Radio City now under construction in New York.

I am glad to think that Americans can pick up ideas over here.

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The Mid-week "Epilogue."

The arrangement whereby the Rev. H. H. Elliott conducts the new mid-week "Epilogue" at St. Michael's, Chester Square, on Thursday evenings from 10.30 to 10.45 does not mean that he is in the running for the much-talked-of bishopric of broadcasting. If such a see were created, its first occupier would be the Rev. Dick Sheppard.

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A Clerical Suggestion.

Mr. Elliott is, nevertheless, one of the best broadcasting personalities in the religious world, and I understand that the B.B.C. are acting on his suggestion in broadcasting a mid-week service. The idea was submitted first to Mr. Whitley and Sir John Reith, who seized upon it with enthusiasm.

The church is open to the public during the service, and a collection is taken, but I understand that the B.B.C. pays for the heating and lighting of the building.

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A Famous Liverpool Organ.

On October 17th the first recital on the organ of St. George's Hall, Liverpool, will be relayed. This organ has been completely restored, and the organist, Mr. H. F. Ellingford, hopes that the recitals given on it will be as famous as they used to be. Mr. Ellingford has had a distinguished career as an organist, and has given recitals all over the country. He has composed a number of works, and in addition has written a book on "Transcribing for the Organ."

oooo

Good for Big Ben.

Here is what an Argentine listener wrote to the B.B.C. last week :—

"Just at the instant that Big Ben announced midnight in London my clock announced 8 o'clock in Ensenada. This evidence of Big Ben's accuracy may interest you."

CORRESPONDENCE

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 TREND OF DESIGN.

Sir,—With Olympia just passed and other exhibitions upon us, and the release of many new sets, speakers, and components, etc., those interested in the progress of radio will be enquiring as to what has been the outstanding change, if any, during the past year, and, in the opinion of the writer, they will come to the conclusion that, except for the superheterodyne, there has been little of note but the important one of lower prices.

This raises a question of: How are lower prices possible? as, although the purchasing power of the community may have fallen during the last year, manufacturing costs for given apparatus cannot have done so to a degree to permit the low prices that are ruling in many directions.

To what, therefore, are these low prices due, after we have made allowance for the usual reasons, such as new factories, greatly increased plants and output, and so on? The answer, in the writer's view, is that they are largely due to the discovery by manufacturers that the public generally is very uncritical of good-quality reproduction, and that, in consequence, it is possible now to make compromises without end to obtain cheapness, whilst a few years ago the general tendency was to strive after quality, with the result that the horn speaker died, being followed by the cone speaker, and finally the high-grade moving-coil speaker, which last experts knew, and still know, gives the finest reproduction that can be had.

In the case of moving-coil speakers, the name moving coil having a somewhat magic effect on sales, we now find that speakers under this name are sold almost at give-away prices, regardless of the fact that the movement of the coil is negligible, that almost all the sound output is the result of resonances, and, in the finish, the complete speaker is really very little better than the old horn type.

The use of speakers of this kind is very desirable in many directions, amongst which one may cite the absence of high-note reproduction and, in consequence, heterodyne and needle scratch, and other extraneous noises, whilst the absence of bass reproduction removes difficulties regarding smoothing arrangements which may also be skimped. Further, the widespread use of speakers having characteristics of the kind indicated, confers the benefit on the public of not being able to notice very readily when receivers are overloaded; the fact that a large proportion of the music is lost in the process does not seem to matter very much to the public, who, presumably, deserve what they get.

In all the foregoing points apparently this country is merely following the Americans, where the process of the degradation of quality has been carried to such an extent that it is credibly reported that in very many cases, when a guest visits a house, the first thing he or she says is: "Shut the Radio off."

The moral of all this is that the purchaser of any complete receiver should take particular care to examine what is inside it, whilst it will be seen that the experimenter and constructor is now in a better position than he has ever been to secure good results by his own efforts, in that, although the complete receiver he builds may actually cost him more than the one he can buy, yet he has complete control of the parts he uses, and, if he chooses components of good design, he can in many cases secure a result, from a quality point of view at least, superior to that he could otherwise obtain from a complete receiver, except in certain instances, owing to the "cut-throat" competition which obviously exists between the many manufacturers of receivers in this and other countries.

Manchester. J. BAGGS.

GOOD REPRODUCTION.

Sir,—I was sorry to read in your issue of September 16th the letter from Mr. Berrage-Moulton on gramophone reproduction. It is just this sort of letter that does so much harm to the reputation of our manufacturers.

He claims to get *reproduction*—indistinguishable from the original—from gramophone records. Does he claim to do this from ordinary records as sold? If so, what does he do about the frequencies from 30 to 50 hertz? From 50 to 150, records fall off, but this can be got over by proper pick-up design; but records still cut off practicaly completely at about 50 hertz, and I do not know any pick-up that will not only "boost" what is weak but will also recreate what isn't on the record at all.

And what about 5,000 to 10,000 hertz? His pick-up amplifier, and loud speaker *may* cover this range, but with standard records the needle itself is too big to reproduce above 5,000, or even 4,000, towards the inside of the record.

Until Mr. Berrage-Moulton tells me how he gets over these two fundamental disabilities of present-day records, I shall still prefer the letters of the disinterested "so-called expert."

Windsor. P. K. TURNER.

Sir,—When B.M. and A., Ltd., read letters in the "technical Press" by "so-called great experts" it "makes them smile." B.M. and A.'s made me weep.

The amount of innuendo in this letter would, I feel sure, win a competition in any part of the world.

Did Mr. C. L. Yelland and Mr. Hartley declare themselves experts? Tut-tut! They must must not give themselves airs.

B.M. and A., Ltd., "desire people who really do know their job." Oh, Mr. Yelland! Mr. Hartley!! Fancy applying for a job with Messrs. B.M. and A., Ltd., and never telling us a word about it. And all this time we thought your letters seriously intended.

Next time you try, remember that a moving coil in the home (and a Mr. C. Berrage-Moulton to listen to it) is worth twice Ohm's Law in the brain.

Whatever has "Super Six's" letter to do with "100 per cent. reproduction"? He simply puts forward a plea for efficient technical service at the Wireless Exhibition, a plea which most of us support. He also asks for adequate printed technical data. Mr. C. Berrage-Moulton does not want "technical data," so what *is* he writing about?

Please continue to publish plenty more letters from so-called experts; the "public" (that's us!) like them. We also like the "beautifully written articles crammed full of technical data," which provide us with more practical knowledge than if you turned Dorset House into a showroom. It *would* be a rather large crowd if you had to invite all your readers there every Wednesday! That is, presumably, Mr. Berrage-Moulton's ideal. But one can only guess. I had to read his letter five times before I felt competent to reply to it.

In conclusion, this letter is not intended as a further contribution on the subject of "Good Reproduction," but a defence of the knowledgeable enthusiast.

Shortlands, Kent. HUGH A. RAMPTON.

READERS' PROBLEMS

Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

"Fierce" Reaction Control.

Since fitting a differential reaction condenser of 0.0003 mfd. to my receiver, I find that the control of regeneration is altogether too fierce; self-oscillation takes place when the rotor is engaged with the "live" stator to the extent of only 10 or 15 degrees.

I suppose that this trouble could be overcome by removing turns from the reaction winding, but I should like to avoid this, as the coils are not accessible. Would you recommend me to fit a small reaction condenser of about 0.0001 mfd., or is there some better way out of the difficulty?

By using a differential condenser of smaller capacity reaction control could almost certainly be improved, but there would probably be excessive anti-reaction feedback, and the set would be rather insensitive without the aid of positive reaction.

We think that the best way out of the difficulty is to connect an extra fixed condenser, of about 0.0002 or 0.0003 mfd., in parallel with the earthed section of the differential condenser; this means that the condenser should be joined between the rotor and the earthed stator.

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Frame Aerial Efficiency.

I am making a compact detector-L.F. portable set for use here (in Ireland), and wish the receiver to be as sensitive as possible in order that transmissions from the long-wave Daventry station may be received; would it be better to "load" the medium-wave frame with an ordinary coil, or to wind a separate long-wave section?

If matters are properly arranged, a separate long-wave frame would be more efficient, but we think it should be pointed out that in Ireland it is hardly to be anticipated that reasonably good signals will be obtained from Daventry with a detector-L.F. set working on a frame of conventional dimensions, however efficient it may be. This being so, it would appear certain that it will be necessary to supplement the pick-up of the frame by using an external aerial when the English station is to be received, and consequently there is no point in attempting to make this frame exceptionally efficient. We consider, therefore, that a loaded frame would be adequate, and this has the advantage that the efficiency of the medium-wave frame, which will presumably be used for local-station reception, will not be impaired in any way by the proximity of another winding.

oooo

Separate Output Circuits.

Referring to a published reply in the "Readers' Problems" section of your issue for September 23rd, would it be possible for you briefly to outline the "very special precautions" stated there to be necessary when adding a parallel low-power output valve to operate a second loud speaker?

I am sending you a circuit diagram of my present receiver, and should be obliged if you would show me how it could be modified in this way.

When adding a parallel output valve of a type capable of dealing with grid voltage swings of lower amplitude than that already included in the receiver, it is necessary both to isolate the grid—so that it may be suitably biased—and also to provide means for applying to it something less than the total available L.F. voltage.

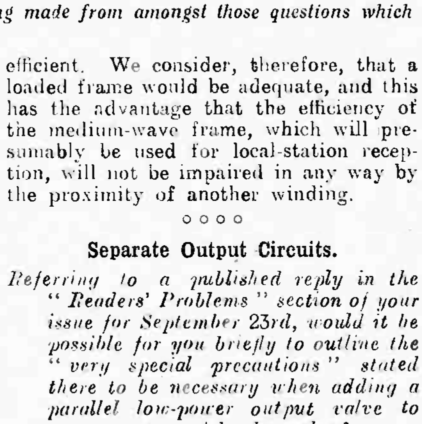

Fig. 1.—Parallel output valves of dissimilar characteristics, with adjustment of output, and grid bias voltages.

As your present set includes resistance-capacity L.F. coupling, it is possible to do this fairly simply and without running any grave risk of impairing performance. By using a separate coupling condenser for the extra valve, and by applying bias voltage to its grid through a potentiometer, the desired operating conditions are realised. A circuit diagram is given in Fig. 1.

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D.C. Pilot Light.

It seems that the most convenient position for a pilot light in a D.C. mains set with the new valves would be in series with the heaters. Is there any objection to this plan, and, if not, can you suggest a suitable form of lamp?

No ill effects can result from the insertion of an indicating lamp in the main heater circuit, and we consider that this is quite a suitable place for it.

A six-volt three-watt motor car lamp should be suitable: you should not forget to allow for the voltage absorbed by it when estimating the value of the mains series resistance.

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Looser Coupling Needed.

In an attempt to improve selectivity I have just added to my 1-v-2 set a loosely coupled and separately tuned aerial circuit, adopting the arrangement suggested by one of your contributors about a year ago. Unfortunately the desired results have not been achieved; selectivity is no better than before, and tuning seems to be flat and indefinite.

Do you think that this might be due to the fact that I am using for the extra circuit a coil that is rather less efficient than those included in the receiver itself?

Provided that your aerial coil is reasonably good, it is most unlikely that it will be responsible for flat tuning. It seems much more likely that this will be due to an excessively close coupling between aerial and secondary circuits. If capacity coupling is used, perhaps the coupling condenser has too high a minimum value, or the coils are not properly screened. If, on the other hand, coupling is magnetic, then it may be that you have not made provision for moving the coils far enough apart, or arranging them in a suitable axial position.

Adding a Pre-Selector.

Will you please tell me what is the simplest way of adding a "pre-selector" to my four-valve receiver, of which I am sending you the circuit diagram as supplied by the makers? Ganged tuning is used, and I am afraid it would be impossible to link up another condenser for tuning the extra circuit.

The task of devising a satisfactory pre-selector for addition to an existing receiver with two H.F. stages and ganged tuning is hardly one that can be approached with a great deal of enthusiasm.

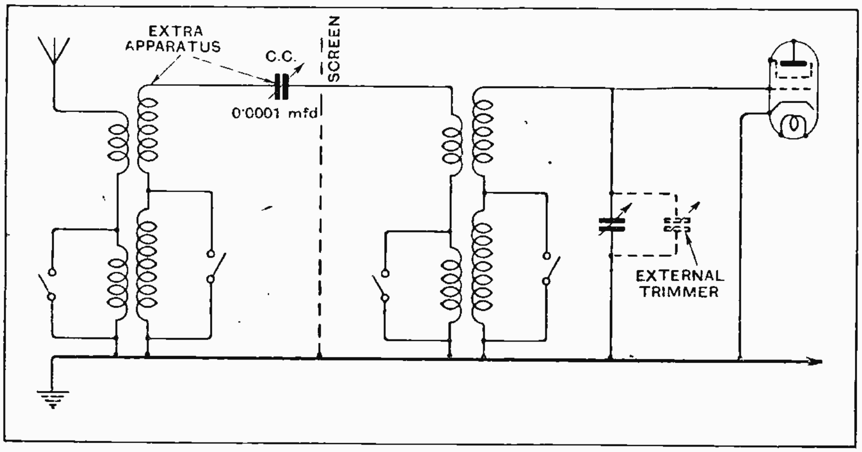

Fig. 2—Extra tuned aerial circuit added to an existing receiver.

For one thing, as the tuning control for the extra circuit cannot easily be ganged, a true band-pass filter is practically ruled out: you will have to satisfy yourself with a two-circuit aerial tuner. Further, there is the difficulty that the ganging of the receiver will inevitably be upset by the addition in question.

On the whole, we doubt if you could better the arrangement suggested in Fig. 2. In order to compensate for disturbance of tuning due to variations of coupling capacity, etc., it is suggested that an external trimming condenser should be joined across the input tuning condenser of the receiver itself.

The screen shown in the diagram will only be necessary if the coils in the set itself are unscreened.

○○○○

Coupling Capacity; Its Effect on Tuning.

In order to improve selectivity over certain sections of the wave-range scale, I have been thinking of obtaining a high-capacity variable condenser to replace the fixed coupling capacity at present used in my band-pass filter. Both circuits of this filter are controlled by a two-gang condenser, and, after having taken a good deal of trouble to match the inductance of the coils, etc., I find that the ganged tuning system works as well as could be wished. Do you think that this would be upset if a variable coupling capacity were fitted?

No. Although the tuning of both filter circuits will be disturbed, capacity changes in each component circuit will be similar, and so relative tuning will be unaffected.

○○○○

Resistance Coupling and Pentode.

So far as I can remember, no circuit diagram of a pentode output valve following a resistance-coupled stage has been published in "The Wireless World." Can it be assumed that there is some inherent drawback in this arrangement?

There is no basic reason why a pentode should not be used in conjunction with resistance coupling; indeed, this type of valve, with its natural tendency to over-accentuate the higher frequencies, would rather tend to compensate for the loss of these frequencies that may take place with resistance coupling, particularly when high amplification is aimed at. We cannot, however, see any outstanding advantage in this form of coupling—at any rate, so far as the types of receiver circuit most popular at the present time are concerned.

○○○○

Atmospherics or Local Interference?

My new receiver (circuit diagram enclosed) is, generally speaking, highly satisfactory, but reception in the daytime is sometimes impaired by background noises, which, I suppose, are atmospherics. At night time there is as a rule very little to complain of, and a very wide choice of programmes is available.

Can you suggest any way in which the circuit might be modified in order to overcome this trouble?

We think that you are quite wrong in ascribing the interference to atmospherics: except during electrical storms these are invariably more prevalent during the hours of darkness. We feel sure that the interference is due entirely to local electrical machinery, etc., which is operative only during the daytime.

Your circuit arrangement is a good one, and we do not think that it could readily be modified in any way that is likely to effect an improvement.

An Indication of Softness.

It is noticed that the milliammeter included in the anode circuit of my detector valve changes considerably when operating the gramophone volume control, which is in the form of a high-resistance potentiometer across the pick-up. I cannot see why this change of anode current should take place, and should be glad to have your opinion as to whether it indicates that something is wrong.

Provided that your detector valve, when acting as an amplifier, is properly biased, it must be assumed that the effect you describe is an indication that the valve is "soft." If so, reversed grid current will be flowing, and the standing voltage developed across the grid circuit will vary with the amount of resistance included in it.

○○○○

Matching Inductances.

It has been suggested that when matching inductance coils by the simple method of adjusting turns so that they should all resonate with the same amount of added parallel capacity there is a slight risk of error. Can you explain briefly in what circumstances this error is likely to arise?

By matching coils in this way no account is taken of differences in self-capacity, or in the capacity between the coil terminals, etc. Generally speaking, such differences do not exist, as it is unusual to attempt to match coils of widely different construction. But the method would fail if, for instance, one were to attempt to match, for ganging purposes, a frame aerial with spaced turns and a small and compact inductance.

FOREIGN BROADCAST GUIDE.

TOULOUSE (PTT)

(France).

Geographical position: 43° 36′ N., 1° 26′ E.

Approximate air line from London: 552 miles.

Wavelength: 255 m. Frequency: 1,175 kc. Power: 1 kW.

Time: Greenwich Mean Time (France adopts B.S.T.).

Standard Daily Transmissions.

10.00 B.S.T., gramophone records (Sun.); 12.45, concert; 14.00, relay of PTT Paris; 17.00, gramophone records; 21.00, relay of concert or play from PTT Paris, Lyons or Marseilles.

Man announcer. Call: *Allo! Allo! Ici la station d'Etat français de Radiodiffusion de Toulouse-Pyrénées*, abbreviated between items to: *Ici Toulouse-Pyrénées PTT*.

Closes down with usual French good-night greetings, followed by *La Marseillaise* or local patriotic march, *La Toulousaine*.

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AND RADIO REVIEW
(19th Year of Publication)

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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.

B.B.C. Enterprise.

ON several occasions we have drawn attention in *The Wirelesss World* to the multiplicity of Government Departments engaged in radio research and development and the apparent lack of centralisation of the work undertaken. The Post Office, the Army, the Navy, the Air Force, the Broadcasting Corporation and other Government organisations all maintain large staffs and laboratories engaged on radio development work. It is only reasonable to suppose that under such conditions a great deal of overlapping and wastage must occur.

In these days of necessity for Government economy, it would seem to us that more than ever there is need for an examination of the work done by these various authorities in order to discover how far it would be possible to centralise all the work except that which is special to the requirements of individual services.

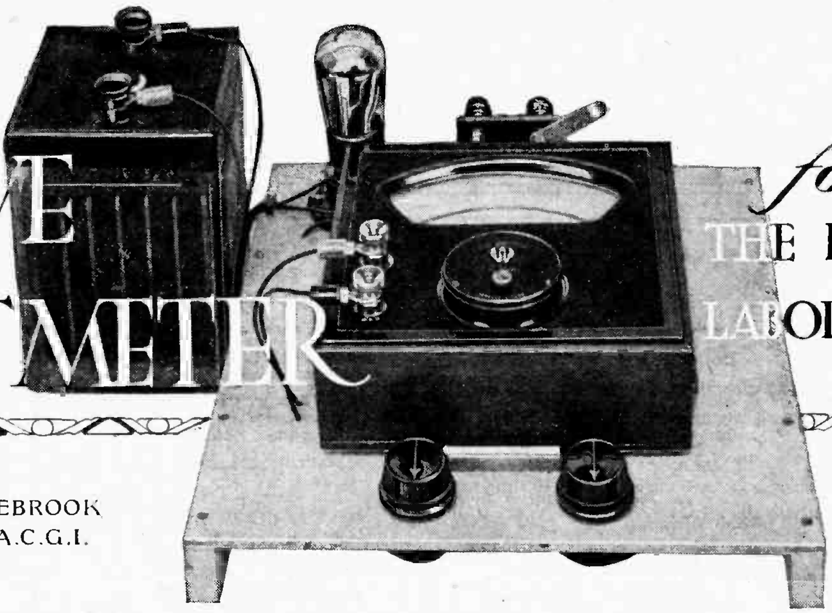
We feel compelled, therefore, to draw attention to the futility of a suggestion recently put forward publicly by our esteemed but provocative friend, Capt. P. P. Eckersley, who has suggested that the B.B.C. should show more enterprise. There are many directions in which the B.B.C. can, in our view, show legitimate enterprise, but Capt. Eckersley puts forward, as a serious proposal, that the B.B.C. should undertake technical research on the subject of reception, as well as transmission problems; that it should research on loud speakers, valves and circuits, and that the results should be published for all and sundry to incorporate in their products; he states that then we should have a better chance to make our sets better and better. This, he says, would benefit us, would benefit the B.B.C., and would take a burden off the shoulders of manufacturers and, most important, it would reabsorb lots of good British engineers now jobless.

In our view such a suggestion is entirely irresponsible; as we pointed out a few weeks ago, the B.B.C. has already meddled too much in the matter of design of receivers by continuing to advocate for the use of schools the curious sets recommended by the technical staff of the B.B.C., and we are glad that since our criticisms it is rumoured that a change of attitude has been adopted.

The B.B.C. ought not to spend public money on doing a job which is better done by the commercial firms, nor undertake research which is already being done by a number of other Government departments. If the B.B.C. has spare funds available, sufficient to establish worth-while research laboratories which would "take a large burden off the shoulders of manufacturers," then, in our view, this money should be devoted to the programmes or to the technical side in so far as the transmitters are concerned. As for research on loud speakers, valves, and circuits, we cannot imagine a less justifiable excuse for the expenditure of listeners' licence fees.

In This Issue

VALVE VOLTMETER *for* THE HOME LABORATORY



By F. M. COLEBROOK
B.Sc., D.I.C., A.C.G.I.

Designed for Calibration by Direct Current.

THE Moullin valve rectifier voltmeter has established itself as an almost indispensable instrument in quantitative work at radio frequencies. Its development in a variety of forms has already been the subject of a number of papers which are probably familiar to many of the readers of this journal. It is hardly necessary therefore to deal with the general principles underlying such instruments in the present article, which is confined to constructional and manipulative details of a particular type of valve voltmeter possessing certain features calculated to make it specially attractive to wireless amateurs.

THE most important feature of this instrument, from the amateur point of view, is that it can be calibrated by comparatively simple direct-current measurements alone, thus obviating the necessity for expensive and fragile thermo-junctions or any similar means of measuring an alternating current for calibration purposes. Other points of the design are (*a*) high input impedance, due to operation by anode characteristic curvature with a negative grid bias; (*b*) fairly high sensitivity, full-scale deflection being given on a pointer instrument by about one volt; (*c*) square-law operation, the indications being a measure of true root-mean-square value over the whole scale. In addition, the valve and indicating instrument used, which are the most expensive of the components required, are equally suitable for another type of valve voltmeter, also calibrated by D.C., which can be used for the measurement of higher voltages at audio frequencies. It is hoped to describe this further instrument at a later date.

It may surprise some readers to find the square-law operation described as an advantage, since this implies a square-law scale. It is certainly a drawback as far as the lower end of the scale is concerned, but this, in the writer's opinion, is completely outweighed by the fact that a definite physical meaning attaches to the indications, namely, root-mean-square value. This is generally the most useful measure of an alternating quantity, since all the usual definitions are based on it, and, moreover, it is a quantity which is independent of wave form in the sense that it does not depend at all on the relative phases of the harmonics of a complex wave. A fairly long experience in alternating-current measurement has bred in the writer a dislike of any instrument which has not a simple and uniform law for its indications, since, in general, the readings of such instruments will depend on wave form in a more or less complicated manner, and may give rise to quite misleading conclusions unless this fact is kept constantly in mind.

A final argument in favour of the square-law scale is its suitability for the plotting of resonance curves. There may be an opportunity of discussing this more fully in a later article.

Having thus tried to dispose of prejudice against a square-law scale, we can proceed to the description of this particular square-law voltmeter. For clearness of explanation, the circuit is shown in its simplest possible form in Fig. 1. It is seen to consist of a rectifying valve biased to the curved foot of the anode characteristic by the grid bias battery (V_C), and with a galvanometer or indicating instrument in the anode circuit. The initial small anode current (I_A) is balanced out of the galvanometer by the equal but reverse direction current supplied by the filament battery (V_B) through the resistance R. This makes the whole scale and the full sensitivity of the galvanometer available for the measurement of the small increase in anode current due to the rectification of the applied alternating voltage *e*.

This general type of balanced circuit can, of course, be realised in practice in a variety of ways. The form

Valve Voltmeter for the Home Laboratory.—

adopted for the instrument now described is shown in Fig. 2. The details of the various components and the reasons for their use are as follows:—(V) The valve. This must be such as to give square-law rectification over the range of anode current change indicated by the galvanometer. Modern 2-volt power valves will satisfy this requirement for anode current changes of two to three hundred microamperes, corresponding to alternating voltages of 1.0 to 1.5 volts. The valve used in the present instance is a PM252: (V_A) Anode battery. Any good-quality dry battery of about 15 volts can be used. As the current is very small, less than half a milliampere, a grid bias type of battery will have ample capacity: (V_B) 2-volt filament accumulator: (V_C) Grid bias battery. Actually about −3 volts is required, and a standard flash-lamp type of grid bias battery can therefore be used: (C_1) Anode circuit bypass condenser. A 0.1-mfd. condenser with mica dielectric is recommended, since it is important that the insulation resistance be very high: (C_2) Grid circuit by-pass condenser. The insulation resistance is less important in this case, and a paper dielectric condenser of 1 or 2 mfds. can be used, preferably of the so-called non-inductive type, though this is not essential: (R_1) Balancing circuit resistance. With the valve specified, it is found that about 100 microamperes is a suitable initial current value, for it gives good rectification sensitivity and, what is even more important, it corresponds to a grid bias sufficiently negative to prevent the flow of convective grid current at the positive peak of the maximum applied radio-frequency voltage. The appropriate value of R_1 is therefore about 20,000 ohms, since the current through it due to the filament accumulator will be 100 microamperes. It is not essential for this resistance to be non-inductive, and the cartridge type of wire-wound resistance is very suitable for the purpose: (R_2, R_3). This combination of resistances gives a fine adjustment of grid-bias to enable the initial value of anode current to be set to the same value as the balancing current. R_2 is a variable resistance of about 10 ohms, and R_3 a potentiometer of about 100 ohms. They are connected in series across the filament. The potentiometer alone would give the necessary adjustment, but it will be found rather coarse, and the series resistance gives a very convenient fine adjustment. The values of these resistances are not at all critical, as long as R_2 is not more than a tenth of R_3. Thus 20 ohms and 400 ohms would be equally suitable:

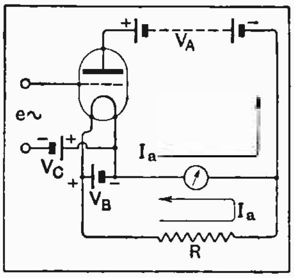


Fig. 1.—Schematic diagram showing method of balancing out the initial anode current.

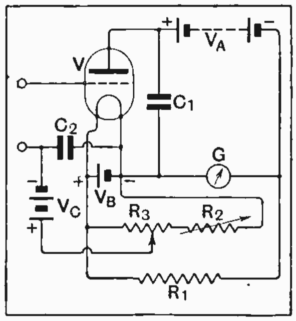


Fig. 2.—Complete circuit diagram of square-law valve voltmeter. V, PM252 valve; V_A, 15-volt H.T. battery; V_B, 2-volt accumulator; V_C, 3-volt grid bias battery; C_1, 2 mfds; C_2, 0.1 mfd; R_1, 20,000 ohms; R_2, 10 ohms; R_3, 100 ohms; G, galvanometer; 0 - 120 microamps.

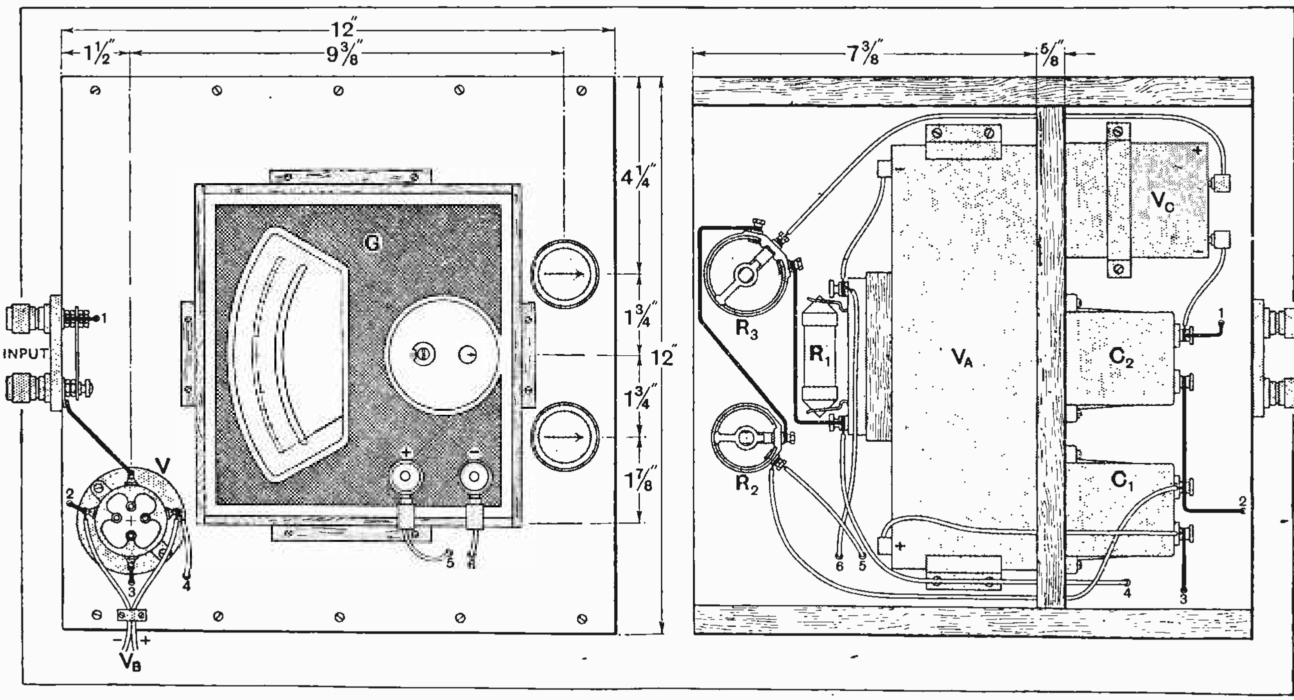


Fig. 3—Dimensioned layout and wiring plan. A 3-ply baseboard ½ in. in thickness is used and the depth of the battens on the underside is 1⅜ ins.

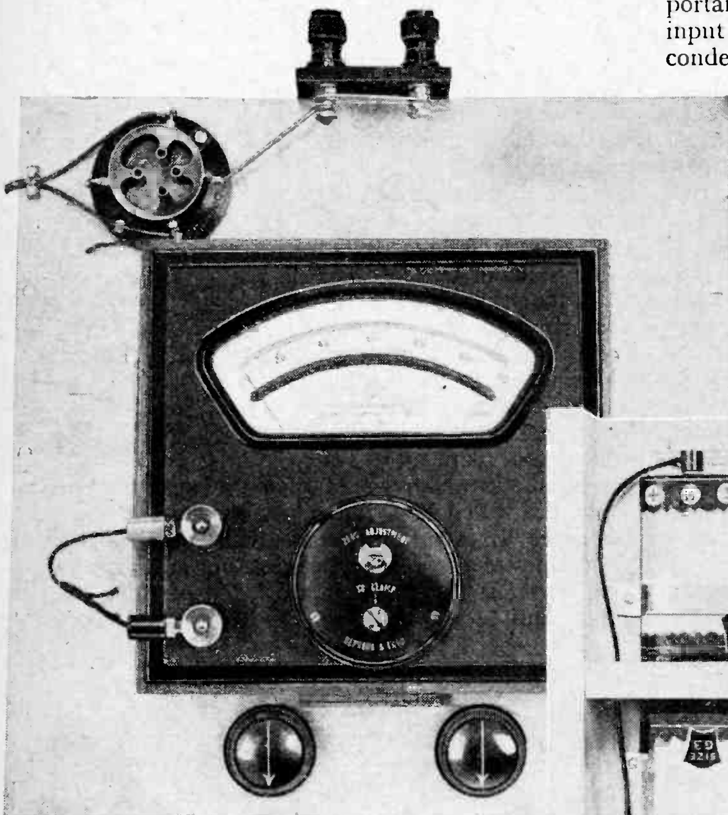
Valve Voltmeter for the Home Laboratory.—

(G) The galvanometer or indicating instrument. The requirements to be satisfied are: (*a*) a linear scale for current, (*b*) full-scale deflection for a current not exceeding about 300 μA. In the model actually constructed in the *Wireless World* laboratory, a Cambridge Unipivot millivoltmeter, resistance 500 ohms, full scale for 240 μA, has been used as it happened to be available, but the 120 μA instrument of the same type with a resistance of about 50 ohms would be even more suitable. Such instruments are, of course, expensive, being of high sensitivity and refined construction. It may be pointed out, however, that an instrument of this kind has such a wide range of utility for wireless experimental work of all kinds that it is well worth its cost. Very little manipulative skill or knowedge is required to adapt it to the measurement of all currents and voltages likely to be used by the wireless experimenter, and its suitability for various types of valve voltmeter such as the one now described and another to be described later, is a very valuable feature. Those for whom cost is a primary consideration should note that there are other types of microammeter commercially available giving comparable sensitivity at appreciably lower cost, but with a somewhat shorter scale length.

Constructional Notes.

In the assembling of the components the most important points are as follows. The leads from the input terminals to the grid and through the by-pass condenser C_2 to the filament should be kept as short as possible. The same applies to the anode circuit by-pass path. Apart from these two circuits, the remainder of the wiring carries direct current only, and no special precautions are required beyond the provision of the high insulation appropriate to an instrument of microampere sensitivity. In the *Wireless World* model a wooden framework has been used and has been found satisfactory, but the use of a bakelite or keramot panel might commend itself to some constructors. To minimise the possibility of faulty contacts in the L.T. circuit, no switch has been included, and to switch off it will be necessary to remove one of the leads from the accumulator.

Ideally speaking, the valve should be used decapped, and without a holder, for only under these conditions



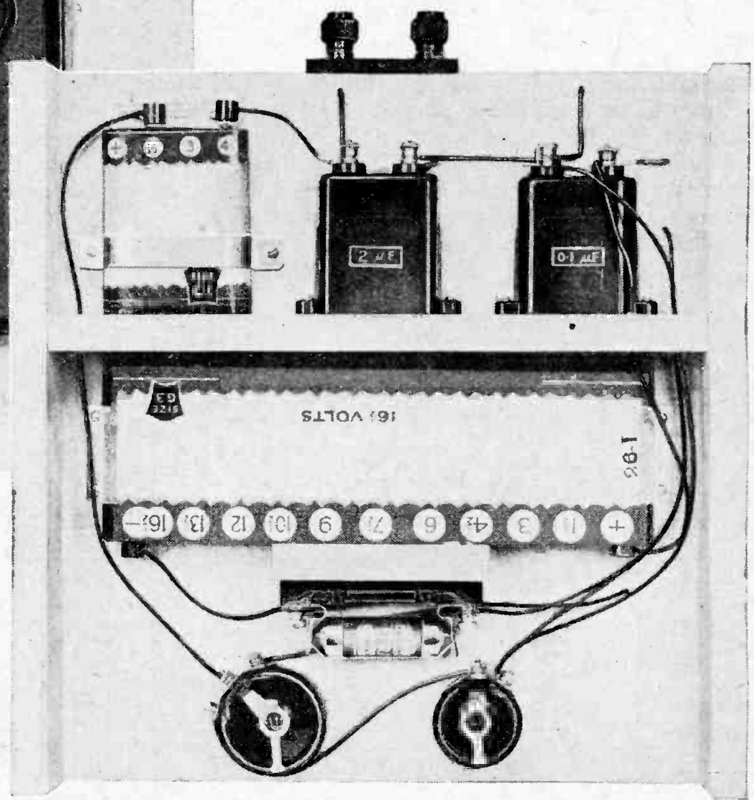


Fig. 4.—Plan and underside views of the finished instrument. The valve-holder is off-set to shorten the wiring of the by-pass condensers under the baseboard.

1 Unipivot galvanometer, Type L, 120 microamps (Cambridge Instrument Co., Ltd.).
1 Valve, Type PM252 (Mullard).
1 Valve-holder (Aermonic, Type "K").
1 Wire-wound potentiometer, 100 ohms (Colvern).
1 Wire-wound rheostat, 10 ohms (Colvern).
1 Wire-wound resistance, 20,000 ohms, and holder (Ferranti).
1 Fixed condenser, 0.1 mfd. mica dielectric (Dubilier).
1 Fixed condenser, 2 mfds., paper dielectric (Dubilier).
1 Grid bias battery, 16½ volts. Type G3 (Siemens).
1 Grid bias battery, 1½ volts, Type G1 (Siemens).
2 "Input" ebonite-shrouded terminals (Belling Lee).
1 3-ply baseboard, 12in. × 12in. × ¼in.
Batten wood (1⅜in. × ⅝in.), high-grade insulated wire, wander plugs, spade terminals, etc.

Valve Voltmeter for the Home Laboratory.—
is the maximum input impedance obtained, even with an anode circuit rectifier. This complicates the construction, however, and ties up the valve in the one instrument. Those who seek the highest possible standard in this respect may feel disposed to modify the construction in this detail, but for most purposes the use of a skeleton type of valve-holder of good quality is preferable from the point of view of convenience.

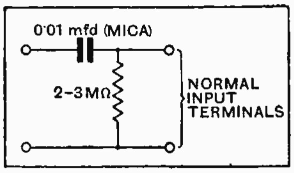


Fig. 5.—Modified input circuit for measurements involving a superimposed D.C. current.

Again, ideally speaking, the highest constancy of calibration in this type of instrument requires that the initial anode current be set to a definite constant value each time before use. The present arrangement is a compromise in this matter, the constancy of initial setting being dependent on the constancy of the voltage of the filament accumulator. For this reason it is advisable that the accumulator should not be used when freshly charged without being given a sufficient discharge to bring the voltage down to normal. Those who would prefer the more exact adjustment can obtain it by including a switch and a variable resistance of about 2,000 ohms in the balancing circuit. The balancing circuit can then be opened and the anode current set to a value of, say, 95 μA by means of the grid bias adjustments, and the zero balance obtained by adjustment of the variable element in the balancing circuit, this being closed, of course. The compromise in the circuit described eliminates this further adjustment.

The model constructed in the *Wireless World* laboratory in accordance with the above principles is illustrated in the constructional drawings as given in Fig. 3 and photographs of Fig. 4. It will be noted that the input terminals are provided with a short-circuiting link at the back. This should normally be kept closed and not opened until the voltmeter is actually connected to the circuit to be measured, as otherwise the grid circuit is open and an excessive anode current will flow through the galvanometer. (It may be mentioned in this connection that a shunt circuit of about a tenth of the resistance of the galvanometer, with a switch or link for breaking it, is a very useful adjunct to a sensitive instrument of this character. It is not essential, and is not for this reason included in the present design, but constructors who would like this additional precaution can easily insert it.)

If there is not a closed conducting circuit connecting the measurement points, or if there is a D.C. potential between them, then the usual capacity and grid leak arrangement, shown in Fig. 5, must be used instead of the direct connection. A capacity of about 0.01 μF and a grid leak of about 2 to 3 megohms can be used. This input arrangement will, of course, slightly increase the damping effect of the voltmeter on a tuned circuit, and is not normally used for this reason. A small auxiliary panel carrying these additional components can easily be made for attachment when required.

Method of Calibration by D.C.

We can now proceed to the description of the method of D.C. calibration. In general terms it is as follows: The instrument must first be carefully set to zero by adjustment of the balancing controls, with the input terminals short-circuited. Apply a small positive voltage v to the input terminals, of such a value as to give approximately full-scale deflection. Note this deflection θ_1. Reverse the input voltage, and, of course, the galvanometer connections. This will give a smaller deflection θ_2. Divide the difference $\theta_1 - \theta_2$ by $2v^2$. Calling this quantity b, it will be found that b is a constant for all values of v. The calibration of the voltmeter is given by $\theta = bE^2$, E being the root-mean-square value of the applied radio-frequency voltage and θ the corresponding deflection.

Considering the process more in detail, the actual D.C. voltages required will be up to about 0.7 volt.

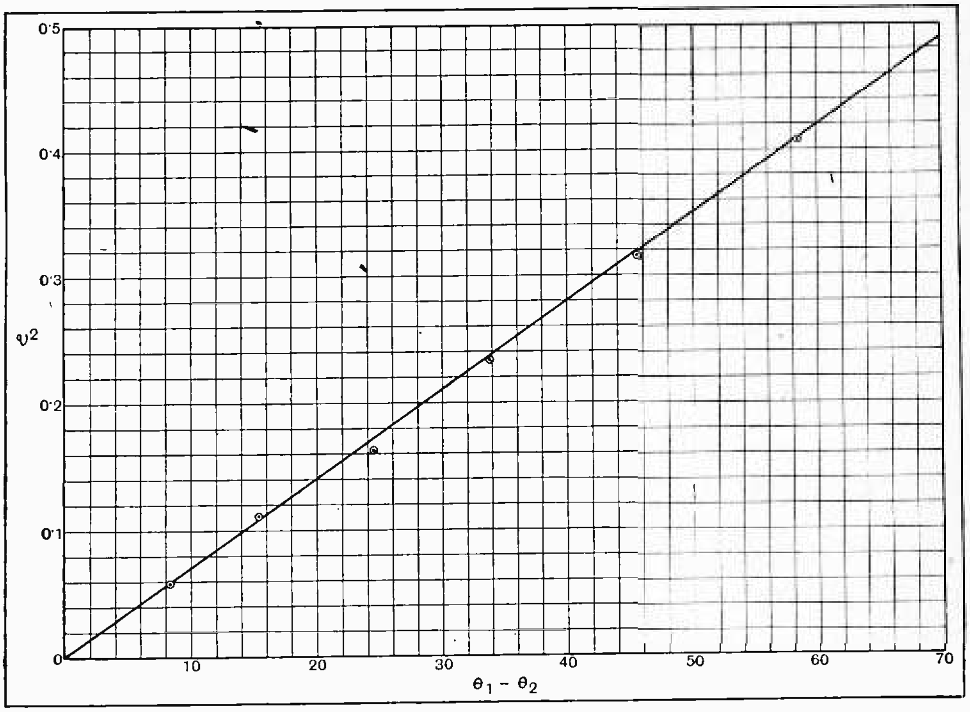


Fig. 6.—Graphical method of determining the voltmeter constant b from a series of D.C. input voltage readings.

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The method of producing these known voltages will, of course, depend on the apparatus available. Suppose, for example, that we have nothing but the millivoltmeter actually shown in the photograph of the instrument, reading up to 0.12 volt. Then a comparatively simple way of producing the known voltages would be to take twenty equal lengths of resistance wire, giving a total resistance of, say, 100 ohms or so; connect these in series with means of making contact to the joins, and connect the ends to a 2-volt cell. The potential across one of the lengths (or across each of them if there is any doubt of their equality) can then be measured by means of the millivoltmeter, and the known voltage tappings can then be used for the calibration. Other means will suggest themselves to any capable experimenter.

The quantity b should be found as the average of a number of readings for a range of values of v. The best method of averaging is to plot $\theta_1 - \theta_2$ against v^2, when the result should be a straight line through the origin, the slope of the line being equal to $2b$. This serves as a check on the square-law character of the instrument. Fig. 6 shows the line for the instrument illustrated, using the 500-ohm galvanometer. The calibration calculated in this way by direct-current measurements was compared with the A.C. calibration taken at 50 cycles per second by means of measured alternating voltages, and the agreement was found to be within 2 per cent. over the whole range. Another example is afforded by a similar instrument constructed by the writer, using a 50-ohm, 120 μA unipivot as the galvanometer. The D.C. process gave $\theta = 98.5\ E^2$ as the calibration. The instrument was then calibrated at a million cycles per second, using a thermo-junction to measure current passed through a fine wire resistance of about 20 ohms, to provide the known input voltages, and the constant so determined was again 98.5. The accuracy obtained will, of course, depend on the skill of the experimenter and the instruments he has available, but it should not be difficult to keep it within 2 per cent., and a valve instrument is not generally good to better than this. Incidentally the agreement between the D.C. and the million-cycle calibration is a striking proof that the valve characteristics involved do not depend on frequency within these limits.

One final note on operation. In warm, dry weather it may be found that the pointer of the galvanometer has tilted up towards the glass top of the instrument, as if the movement had been displaced from its bearing. This may, and probably will be, due to the glass cover plate having acquired a charge and thus attracting the very finely balanced pointer. It will be sufficient to breathe on the glass and thus remove the charge.

GRID BIAS AND THE BAND-PASS FILTER.

Applying Grid Bias with a Capacity-coupled Filter.

WHEN using a capacity-coupled band-pass filter, the grid bias to the H.F. stage cannot be applied directly through the tuning coil in the usual manner, since the coupling capacity isolates the lower end of the coil from earth.

It is the common practice, therefore, to fit a grid leak directly between the grid and earth for biasing purposes, but this has certain disadvantages. The grid leak damps the tuned circuit slightly, thus lowering its efficiency and selectivity to a small extent; a more serious cause of trouble, however, is the likelihood of increasing valve hiss.

It is often advisable, therefore, to use, instead of a grid leak, a resistance in parallel with the filter coupling capacity. A suitable value of resistance will exercise no appreciable effect upon the filter characteristics, and will allow of the bias being applied without giving rise to valve hiss.

Avoid an Inductively Wound Resistance.

With the average values of coupling capacity a resistance of about 2,000 ohms will be satisfactory, and it is worthy of note that self-capacity in the resistance is of no importance whatever, since it is merely in shunt with the large-capacity coupling condenser.

Inductance in the resistance, however, is highly important, and must at all costs be avoided; even 0.5 μH. will be quite sufficient to upset the filter entirely. The wire-wound type of resistance, therefore, must be very carefully chosen if it is to give satisfactory results, and it is usually safer to use one of the grid-leak type.

Such resistances are not always easy to obtain in the low values required, but it should be remembered that the current-carrying capacity needed is very small; in the case of an H.F. valve it is zero, or should be, and in the case of a grid detector it will rarely if ever exceed 20 microamperes. W. T. C.

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"THE WIRELESS WORLD" DIARY.

THE 1932 edition of this well-known diary, which is now on sale, fully keeps up the reputation established in previous years. The list of European broadcasting stations has been carefully revised and a useful addition to this is a diagram showing the approximate dial settings for the principal stations. The list of short-wave broadcasting stations has been considerably enlarged, and now comprises practically all stations which can be heard in this country, with the approximate times of their transmissions. The "Abacs," which were found such a useful feature in previous issues, have been added to and the number of circuit diagrams considerably increased. In this section it was thought that as the diagrams are self-explanatory our readers would prefer only short captions with each drawing, rather than a page of description.

Coil Construction Data give useful information on the winding of coils for broadcast receivers, and the hints on Matching Output Valve and Loud Speaker will be of service to those aiming at the best quality of reproduction.

The Useful Formulæ have been entirely revised and rewritten, and the invaluable tables of Valve Data contain all the latest information concerning the newest types of valve.

The Diary is published by Iliffe and Sons Ltd., and may be obtained from all bookstalls, bound in leather, price 1s. 6d.

Manchester's Share in Wireless Progress.

Some Notes on the Past and the Present.

THIS week wireless interest in this country centres largely around Manchester, for the reason that, following closely upon the Olympia Wireless Show in London, the Manchester All-British Exhibition is opened to display to the Midlands and the North the progress which has been made in the development of new receivers and components during the past twelve months.

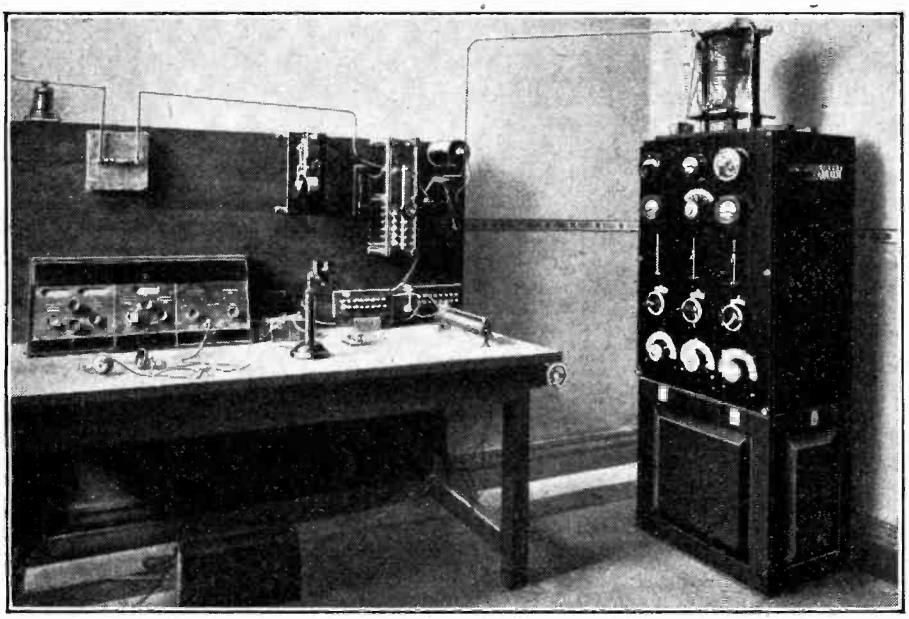
This year is one of outstanding importance to the Manchester area, and it is natural that the Exhibition should be attracting far greater crowds than any previous Exhibition in the history of Manchester, for the reason that this is the first Exhibition to be held since the opening of Moorside Edge, the North Regional programme transmitter.

Early Days of Broadcasting.

This station was only completed and opened this year, and has contributed enormously towards stimulating public interest in broadcasting in the Midlands. Thousands of people who have hitherto had no interest in reception have been introduced to broadcasting since Moorside Edge began to transmit.

Although at the moment the area covered by the North Regional Station is especially enthusiastic upon the subject of broadcasting, it is interesting to recollect that, even prior to the days of broadcasting, London and Manchester competed hotly with one another for the title to be regarded as the centre of wireless interest. Wireless amateurs of Manchester district have often set the pace by their enthusiasm and successful exploits, even in spite of the greater number of amateurs in the metropolis, and the first Manchester Wireless Exhibition, which was held in March, 1923, was made possible largely through the support and co-operation of the Manchester Wireless Society.

The present imposing building which constitutes the B.B.C. Headquarters in Manchester.



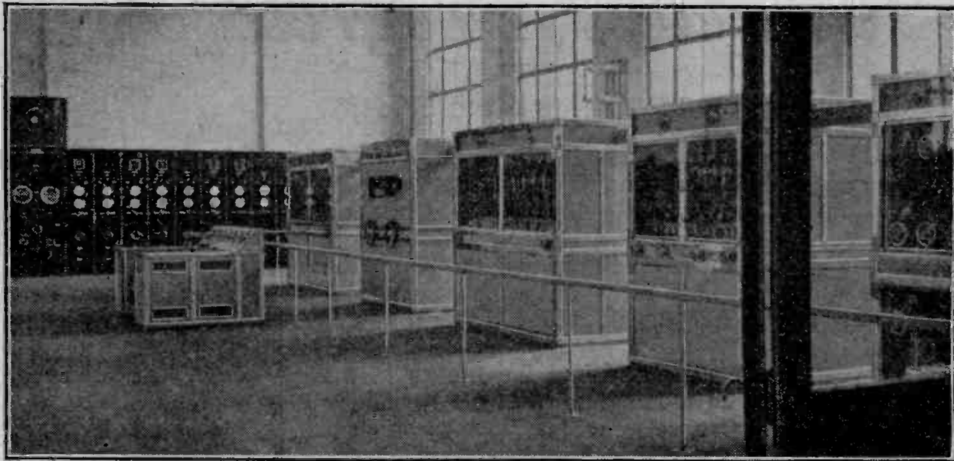
Transmitter panel and control of the first Manchester broadcasting station erected by Metropolitan-Vickers in 1922.

In 1923 the Manchester Radio Society erected a transmitting station of their own, through the joint efforts of members, and the station had the satisfaction of succeeding in getting signals across to

Manchester's Share in Wireless Progress.—

America on a wavelength of 270 metres, with a primary energy of less than 1 kW. This, in those days, was a very great achievement, and contributed largely to opening the eyes of the world to the possibilities of the shorter wavelengths for long-distance communication.

The Manchester amateurs, jointly with the Radio Society of Great Britain, petitioned the Postmaster-General, prior to the days of official broadcasting, for permission for regular telephony transmissions to take place daily, to assist them in experimental work. This was the prelude to regular broadcasting transmissions.

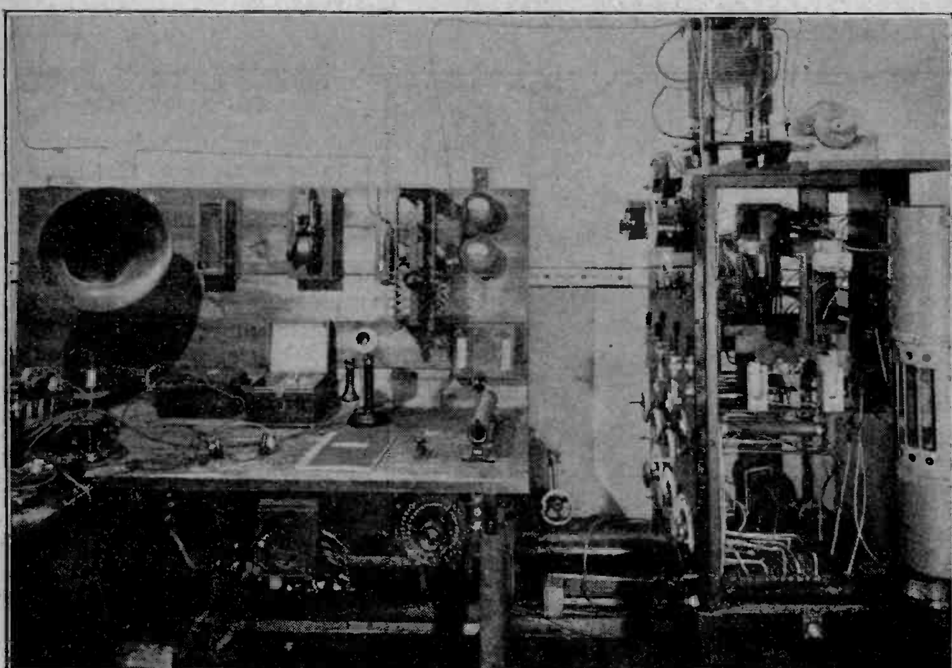


The present transmitter panels and control at the North Regional station at Moorside Edge.

The first official broadcasting stations to be erected in this country were those at London, Manchester, and Birmingham. The first Manchester station was installed at the end of 1922, and the equipment was described in *The Wireless World* of December 30th of that year. Judged by present-day standards, the transmitter was a very small affair, for at first it operated normally on a power of only 800 watts, though later the power was increased to something nearer 1½ kW., this being the full power for which it was licensed at that time by the Post Office.

It is interesting to look back and compare conditions then with what they are to-day, for in the description of the station published in *The Wireless World* of that date we read "The broadcasting station is at present being operated each evening from 6 p.m. till 10 p.m., and it is anticipated that transmissions will shortly commence on Sundays. Great care is exercised in the selection of suitable programmes and the choice of artists. It is found that artists with a good reputation for ordinary stage and concert work are not necessarily successful from the point of view of broadcasting, and it is anticipated that the demand will be meet sooner or later by the provision of training schools, where the peculiar technique necessary may be acquired."

The first broadcasting station at Manchester was installed by Metropolitan-Vickers, and later a transmitter was put up at Trafford Park with call sign 2AC, and experiments were carried out at this station in rebroadcasting the American short-wave transmitter KDKA with what at that time were regarded as most satisfactory results.



The early transmitter, 2AC, at Trafford Park, which became famous for early relaying of the American station KDKA.

Amazing Progress.

It is interesting to compare, by means of the photographs which we reproduce, the first transmitter at Manchester with the equipment of Moorside Edge, the North Regional dual station, which employs two transmitters, each of the power of 100 kW. This equipment makes the original station appear small indeed, and indicates the amazing progress which has been made over a comparatively short space of time.

THE RÔLE OF THE RECORD IN BROADCASTING

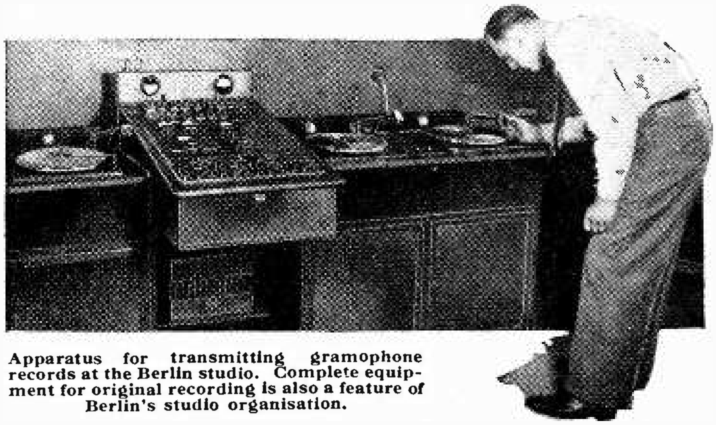
When Should the Record Replace Direct Performance ?

THAT the gramophone record has its proper place in broadcasting there can be little doubt, but there is much room for controversy as to when and where the record becomes a proper substitute for direct reproduction through the microphone.

Gramophone-record concerts have undoubtedly been popular in this country when from time to time they have been given through the broadcasting stations, but it would seem that it is an easy matter to overdo the use of records and so spoil the charm of broadcasting to the listener which comes from the knowledge that the performance is taking place at the precise moment that he is listening.

In Germany at the present time a heated argument is going on between certain sections of the Press and the broadcasting authorities on this subject, the Press adopting the attitude that records can seldom, if ever, be justified except to repeat an historical event. Dr. Flesch, Director of Broadcasting in Berlin, in a talk with *The Wireless World* recently, expressed at some length his own views on this subject, which are that wherever a performance can be better rendered by means of a record, then the broadcasting authorities should have no hesitation in conducting their transmissions in this way. Dr. Flesch has a number of arguments which he puts forward; particularly does he stress the case of broadcasting a play, where he believes it is not satisfactory to depend upon the rendering by the performers being ideal on the one occasion on which the broadcast is made. Many little things may occur to mar the rendering; one of the speakers may have a cold, or some other little circumstance may arise to spoil the microphone performance. In such a case he believes that it is better to rehearse and record repeatedly and to give the public the benefit of the pick of the records, which must give, he argues, the best rendering possible. Dr. Flesch does not support the general use of records already purchasable by the public. He proposes to do his own original recording at the broadcasting studios.

The antagonists of Dr. Flesch, who are becoming almost personal in the bitterness of their attacks against his policy, appear to be taking an extremist point of view, in that they contend that any broadcast of recorded music or speech is nothing short of a deception, because the public, from the very nature of broadcasting, have been led to believe that the actual performance is taking place at the microphone. It is surely more reasonable to take up the attitude that any adjunct to broadcasting is valuable if it improves the performances which are broadcast, and if the art of recording can be usefully brought in to assist, then there seems to be no logical reason for excluding it. Where gramophone records are made use of simply because original performances cost more and the record is a cheap way of filling up broadcasting time, then there is every reason for objecting to it, and it is, perhaps, for fear that broadcasting might eventually degenerate into performances mainly comprised of gramophone records that the feeling against the policy of Dr. Flesch is becoming so strong. If records are used in order to be certain that the public has the advantage of the best rendering, then this policy is fully justified, provided that the process of transformation of the original performance through the medium of recording does not eventually mar the rendering because of any shortcomings of recording methods.



Apparatus for transmitting gramophone records at the Berlin studio. Complete equipment for original recording is also a feature of Berlin's studio organisation.

Let us look at the matter from another aspect. It may be impossible to get together certain performers for a particular evening's entertainment, yet in compiling programmes efficiently the programme authorities ought to have at their disposal almost unlimited material, and if some of this material is obtained from an original, that is to say, "hitherto unpublished record," it is surely better to have it than to be deprived of the performance which may be valuable as providing an appropriate item in the compilation of any particular evening's programme. It would require unlimited funds to ensure that every evening's performance could command before the microphone just those artists which the programme compiler wished to utilise, but records can undoubtedly come to the rescue in such cases as these, when it is surely legitimate to utilise them for the purpose.

CURRENT TOPICS

Events of the Week in Brief Review.

QUARTERLY PAYMENTS IMPRACTICABLE.

The Postmaster-General, replying to a question in the House of Commons, recently stated that there were now more than 3,750,000 wireless licences in force, and the cost of collecting the fees and securing the renewals was already considerable. The substitution of quarterly for annual licences would practically quadruple the work, and the additional expense would, he thought, be out of proportion to the benefit derived by the public.

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THE LORD MAYOR'S SHOW.

A feature of the next Lord Mayor's Show will probably be a Pageant of Science, in which the development of motor transport, aviation and wireless will play a conspicuous part.

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BRIGHTENING THE RAILWAYS.

We hear, with somewhat mixed feelings, of an advertisement scheme whereby railway travellers in the near future will hear the actual voices of advertisers addressing them from loud speakers. It is stated that the number will be limited to thirty and that the slogans will be emitted in station booking offices every two minutes for eleven hours each day.

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TRANSATLANTIC TELEPHONE COMPANIES' BUSY TIME.

The present financial unrest has led to so many telephone calls between England and the United States that the American Telephone and Telegraph Company had to obtain leave from the Federal Radio Commission to use its South American radio-telephone wavelengths for the European service for a period of ten days.

SALUTES BY LOUD SPEAKERS?

Our Paris correspondent tells us that in the Marine Arsenal at Toulon trumpet calls are recorded on discs and transmitted through a powerful loud speaker to all ships in the roadsteads, thereby reducing the required number of ships' trumpeters. It is suggested that this economy scheme should be carried still farther, and records kept of ceremonial gunfire, which could be transmitted when required for formal salutes through super loud speakers.

"ANY TIME AND ANYWHERE."

We acknowledge the courtesy of our contemporary, "Amateur Wireless," in expressing, in their issue of October 10th, regret for having claimed a record in size for their Show Number and having overlooked the prior claims of "The Wireless World."

There appears to be, however, still a little confusion in the mind of our contemporary on the subject of records, for in their paragraph of apology they state that their real purpose had been to point out that they had made "an absolute record for a 3d. wireless weekly published any time and anywhere," in producing an issue of 116 pages.

If their claim turns on the price of the journal, then we must remind them that at any rate the Show issues of "The Wireless World" of 1928 and 1929 were far beyond their total of pages, and the price of "The Wireless World" at that time was 3d!

Incidentally, if it is a matter of price, we ought to claim that "The Wireless World" constitutes a record every week, as we believe it is the only wireless paper in this country published at 4d!

THE IRISH HIGH-POWER STATION.

In his speech at the opening of the Wireless and Gramophone Exhibition in Dublin on September 29th, Mr. Heffernan, the Parliamentary Secretary to the Ministry of Posts and Telegraphs stated that the enquiries and examinations regarding the establishment of the proposed high-power station had practically been brought to a close, and it was hoped that the work would soon be started. He wished to make it quite clear that the full capital and revenue cost would be defrayed from the revenue derived from wireless licences and the import duty on wireless apparatus.

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BROADCASTING FINANCES IN I.F.S.

The Post Office Department of the Irish Free State cannot, therefore, see its way to the abolition of the duty on imported wireless sets. It is pointed out that there are only 26,500 licensed receivers which bring in an annual income of about £13,000, while the duty on imported sets brings in £34,000 annually.

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PROBABLE TELEVISION BROADCAST FROM DUBLIN.

The Philco Radio and Television Company of America will broadcast a programme from the Dublin station on October 23rd, and we understand that this will probably include television. It is stated that the Columbia Broadcasting Co. of America anticipates that during the next two years five million television sets will be sold in the United States.

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833-METRE TELEPHONY.

Telephony weather reports on the unusual wavelength of 833 metres can now be picked up from the Heston aerodrome transmitter at the following times: 8.45, 9.30, 10.30, 11.30, 12.30, 14.45, 15.30, 16.30. Reports will be gladly welcomed by the Wireless Officer at the Aerodrome, Heston, Middlesex.

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COLASSION COMPETITION RESULT.

The Wireless World witnessed an exciting event last week when, at the offices of the scale manufacturers, Messrs. T. and W. Avory, Ltd., the Colassion "Golden Unit," which was the subject of a guessing competition at Olympia, was weighed first on a beam balance and then on a semi-automatic weigher. The weight was found to be 21lb. 15$\frac{3}{16}$oz.—approximately eight times that of the standard unit—and thus Mr. W. H. Thomas, of 18, Culross Road, West Green, Tottenham, N.15, whose estimate came nearest, receives a Colassion Super Hyper Pedestal loud speaker, presented by the directors of Colassion, Ltd.

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"RADIO MAGIC" IN MANCHESTER.

Manchester listeners now have the opportunity of witnessing the first presentation outside London of "Radio Magic"—the highly ingenious entertainment staged by the Marconiphone Company, in which radio gramophones and sets indulge in dialogue and give strange effects.

Through the co-operation of Messrs. Kendal, Milne and Co., Ltd., Deansgate, Manchester, performances are being given daily in their "Kendal Galleries."

R.S.G.B. SIXTH ANNUAL CONVENTION.—A record number of members attended the sixth annual convention of the Radio Society of Great Britain which was held on September 25th and 26th. The group reproduced above includes the President, Mr. H. Bevan Swift (6th from the left), with Mr. E. D. Ostermeyer (Hon. Treasurer) and Mr. H. B. Old (District Representative) on his right and Mr. A. E. Watts (Acting Vice-President) and Mr. J. Clarricoats (Hon. Secretary) on his left. Mr. Gerald Marcuse (Past President) stands just behind his successor.

Record Breaking at Manchester.

Impressions of the Northern National Radio Show.

LORD GAINFORD struck exactly the right note in his opening speech at the Northern National Radio Exhibition on Wednesday last when he declared that the display in the Manchester City Hall, if not so large as the Olympia Show, was certainly its equal in quality and variety.

The Exhibition now shepherded by the Radio Manufacturers' Association in conjunction with Provincial Exhibitions, Ltd., can be truly described as the Olympia of the North. Northern listeners are regarding it as such. Although the available floor space is considerably greater than last year—with a special "viaduct" carrying an overflow of stands—the Exhibition is being thronged daily, and there seems to be less elbow room than ever. Viewed from the balcony the City Hall has now assumed that air of animated vastness which has usually been peculiar to Olympia. The effect may be due partly to the increased size of the Exhibition, but the principal cause is undoubtedly the superiority of this year's lighting arrangements. There is also the increased latitude allowed to manufacturers in the design of stands. The place has been transformed by the disappearance of those monotonous rows of box-like structures, all of the same size, which have generally masqueraded as "stands" at previous shows. Mancunians are responding to these enterprising methods with all the eagerness that one has been led to expect from the "radio-minded North." Technical curiosity is evident on all sides, but nowhere more than at *The Wireless World* stand, No. 23, where the stream of enquirers is constant.

As we stated last week, the radio manufacturers' exhibits are practically identical with those shown at Olympia; visitors to the City Hall are, therefore, secure in the knowledge that they are missing none of the latest developments.

A new and dominating factor this year is the inclusion of Lancashire and the surrounding counties in the B.B.C.'s Regional scheme, brought about by the opening of the Northern Regional station at the beginning of the year. The nearness of the two high-power stations at Slaithwaite has considerably changed the outlook of Northern listeners, who now demand more sensitive and more selective receivers than were necessary a year ago. In this respect their requirements are now precisely the same as those of listeners in the South—a fact which furnishes an additional argument for transferring Olympia lock, stock and barrel to the North.

The Rt. Hon. Lord Gainford, P.C., Vice-Chairman of the B.B.C., giving the inaugural speech in the City Hall, Manchester, on Wednesday last.

It would be wrong to suggest, however, that the Manchester Show lacks distinctive features of its own. Thanks to the enterprise of the *Manchester Evening Chronicle*, which has always played such a prominent part in fostering radio interest in the North, the home constructor is given an opportunity to display his own work in the City Hall and compete for prizes.

Visitors to the Show have been heard to regret the abandonment of broadcasts from the Exhibition itself—a much appreciated feature in past years. On the other hand, there is general admiration for the quality of broadcast and gramophone music supplied by the B.B.C.

The glamour of foreign reception is perhaps insufficiently stressed, particularly when it is remembered that Northern listeners have always shown special keenness in roaming the Continental ether; possibly it is felt that the opening of the Moorside Edge station has blunted the popular taste for anything but the programmes of the B.B.C.!

The success of the Exhibition seems assured. In an interview, Mr. Moody, Exhibition organiser of the Radio Manufacturers' Association, informed *The Wireless World* that the attendance on the first day was between forty and fifty per cent. in excess of that in 1930. The exhibitors are delighted by the eagerness of the Mancunians, who, in their turn, are enjoying the satisfaction of knowing that the Eighth Northern National Radio Show has beaten all records for any Exhibition ever held in their City Hall.

PHOTO CELLS AND THEIR APPLICATIONS

No. 1

Counting and Timing Devices

Installations Now in Operation in Newspaper Offices and at Greyhound Tracks.

By R. C. WALKER, B.Sc.

THE circuits described in the previous article can be very conveniently modified to operate counting devices where mechanical or electrical recorders operated by contacts are unsuitable.

For instance, if the articles to be counted are irregular in shape and size, or light in weight, the successful operation of a counter by mechanical contacts may present some difficulty. A mechanical contact in such cases will generally be either too light to give positive action or too heavy to enable the articles to operate it successfully.

THE principles underlying the action of the modern photo-cell were fully explained in a previous article in the issue dated September 23rd.

The present article is the first of a series dealing with the practical applications of photo-cells to a variety of commercial and industrial problems and includes a description of an ingenious relay system for counting objects moving in one direction only.

The photo-electric equipment obviously cannot compete in cost with a simple contact system, but it is frequently the only method which can be successfully employed. Fig. 1 is an illustration of the equipment[1] installed at the Manchester offices of the *Daily Herald*. The adoption of the photo-electric equipment was decided upon by the *Daily Herald* after numerous other methods had proved unsatisfactory for accurately recording the output of the printing presses in the publishing and despatch room. Copies of newspapers as delivered by the machines are placed in five-quire bundles on moving belts traversing the length of the machine room. These conveyor belts carry their load at the rate of 120ft. per minute into the despatch department.

The photo-cell circuit used is the one shown in Fig. 4, page 321, of the previous article, using the standard Osram C.M.G.8 photo-cell. The relay, operated by the interruption of the beam of light directed on to the photo-cell, controls a contactor which, in turn, completes a local circuit, including the actual recorders, the latter being of the Veeder magnetic type. The recorders are installed in the departmental offices, and are as much as fifty yards away from the machine room. Bundles of newspapers at certain periods intercept the beam of light fairly rapidly when consecutive ones are deposited on the conveyor in close formation, the fastest time being about 0.05 second. The source of illumination is a 6-volt lamp operated from A.C. mains through a step-down transformer, and the light from this lamp is directed on to the photo-cell in a parallel beam by means of a small convex lens. The great advantage of this method of recording is that it allows the overseers to remain in their offices if necessary, and yet still be in close touch with the progress of the presses.

Not only is this a highly satisfactory method of counting the actual output of a manufacturing process, but it will conveniently record the extent to which the output schedule is being maintained. For instance, generally the manufactured article, after delivery from a machine, will be fed on to a conveyor, the regular output of the machine enabling the conveyor to deliver the articles equally spaced along its length. It may happen, however, that, owing to inexperience or inefficiency, the operator cannot feed the machine at the proper speed, and there are accordingly a number of misses on the output conveyor. The photo-cell can then be used to differentiate the "full" and the "empties," and the modification of the standard circuit is shown in Fig. 2. Reference should be made to Fig. 4 of the previous article, page 321, for full description of the operation of the circuit. The switch A is closed mechanically by an attachment to the machine which comes into

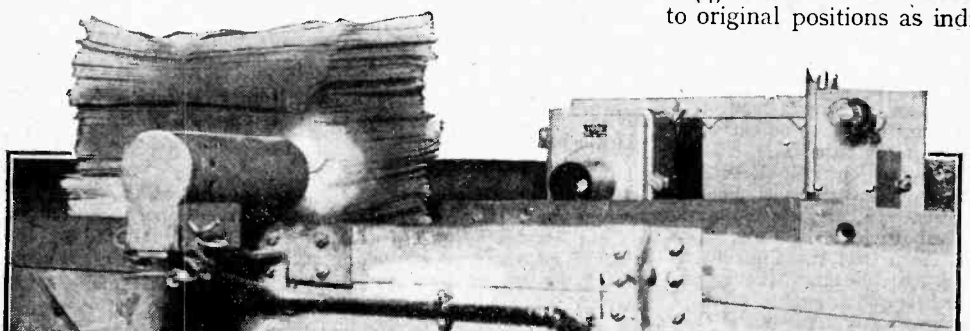
[1] Installation by the General Electric Co., Ltd.

Photo Cells and Their Applications.—

operation when the conveyor pocket is passing underneath the beam of light. At this instant one of two things happens—if the conveyor pocket is empty the beam of light is not interrupted, contacts TM remain closed, and meter C records the fact. If the conveyor pocket is full, the beam of light is interrupted, the relay winding D energised, and contacts ST closed. In this case meter F records the event. In this way it is easy to have an additional check on output, not the least advantage being that the equipment operates only when the machine is working, and therefore obviates the guesswork which occurs in correcting for stoppages of a machine working to a time schedule. The resistance shown across switch A is merely to prevent the anode circuit being broken. Its value, say 500,000 ohms, is too high to prevent the relay operating unless the switch is closed.

Counting Objects Moving in One Direction.

Another interesting and useful photo-electric counting device is that which records objects passing in one direction only and neglects those passing in the reverse direction. Incidentally, this apparatus is useful for many other purposes than counting. The equipment consists of two photo-cells mounted so that the shadow of the object covers both of them in turn. In their anode circuits are two interconnected relays, each having two separate sets of contacts, as shown in Fig. 3. The energising of any given relay changes its contact positions from closed to open, or vice versa. The relay coils L and M are of high resistance compared with coil P, or, alternatively, have high resistances connected in series with them to secure this condition. L and M are control relays determining by sequence of operation whether the relay P which actuates the indicator X is energised or not. The line AB indicates the passage of the interrupting shadow. The photo-cells connected to the grid circuit of the respective valves are referred to by the letters G and T.



[Courtesy: The Daily Herald.

Fig. 1.—Photo-cell counting device installed on the conveyor connecting the printing presses with the despatch room.

It can now be shown that if the object passes in the direction AB it will escape detection, but if it passes in the direction BA it will be recorded on the counter X. Considering the direction AB, the following sequence occurs:

(1) *T dark, G illuminated.*—Contact L_1 opens, L_2 closes.

(2) *T dark, G dark.*—Contacts M_1 and M_2 close. Coil of L is now fed partly from anode of G through the closed contacts M_2 and L_2.

(3) *T illuminated, G dark.*—Contacts remain as in (2).

(4) *T illuminated, G illuminated.*—Original conditions restored.

In neither of these cases has the recorder X been operated. Now consider the direction BA; the operations now occur in the following sequence:

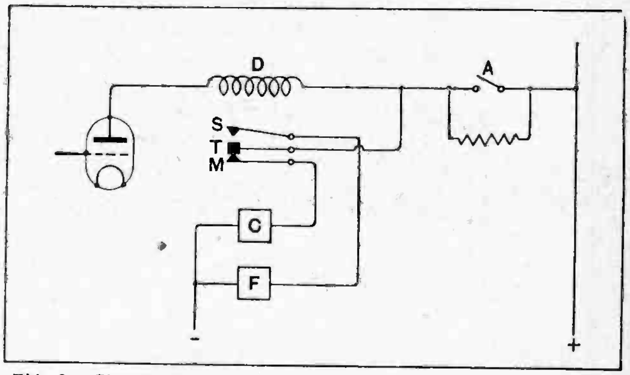


Fig. 2.—Circuit diagram of conveyor-belt counting device. A is a contact operated by each pocket of the conveyor belt. The meter F records "full" pockets and C "empties."

(1) *G dark, T illuminated.*—Coil M is energised, and contacts M_1 and M_2 close.

(2) *G and T both dark.*—Current flows in anode circuit of valve T, but, since resistance of P is low compared with L, the current through L is insufficient to work the relay, and the contacts L_1 and L_2 remain unchanged. Consequently, the main anode current of valve T passes through P *via* the contacts M_1 and L_1, and causes P_1 to close, thus operating the indicator X.

(3) *G illuminated, T dark.*—Contacts M_1 and M_2 open, the former releasing contacts P_1. L becomes energised, opening L_1 and closing L_2, but these changes are only incidental.

(4) *G and T both illuminated.*—Relay contacts revert to original positions as indicated earlier.

In state (2) the indicator has been operated, showing that the arrangement records only objects passing in the direction BA, and not in the direction AB.

Not the least important use of the photo-cell as a recorder is that in which it is employed for the automatic timing of races. In timing by hand, it not infrequently happens that there is some discrepancy between the times of the judges, of whom there are usually several. This is, of course, due to the human element, and the difficulty of recording intervals of time to a hundredth of a second under such conditions. The photo-electric device rules out the human element, and, while it is obvious that no recording instrument can be instantaneous in operation, it is claimed that the photo-cell recording is far

Photo Cells and Their Applications.—

superior to hand timing. In addition, the time lag of the instrument can always be measured, and, as this is constant, a correction can be applied accordingly.

The Dunmore racing track, Belfast, is equipped with the McKee-Scott timing gear, incorporating an Osram photo-cell amplifier. The exciting lamp is housed at one side of the track and the photo-cell amplifier at the other side on the finishing line. A cylindrical tube is fitted over the aperture covering the photo-cell in the amplifier, so that the apparatus is not affected by changes in daylight, and only operates by interruption of the direct beam from the lamp. As soon as the beam of light is interrupted by the passage of the winning animal across the finishing line, the photo-cell relay, which controls the timing clock in the judges' box, actuates the mechanism which stops the clock, and the time of the winner can then be read at leisure.

In apparatus of this type it is frequently desirable to arrange the relay so that, as soon as it operates, the contacts are locked together until released by an independent control. The successful operation of the apparatus does not then depend on the momentary contact of the spring of the relay, and makes the movement positive in action. The clock mechanism is usually set in motion by a push-button at the starting point, or, in the case of greyhound racing, by a contact which is closed as soon as the trap-door is raised. An independent switch is also usually provided for resetting the clock. The amplifier, together with all the auxiliary equipment, operates from either A.C. or D.C. supply mains.

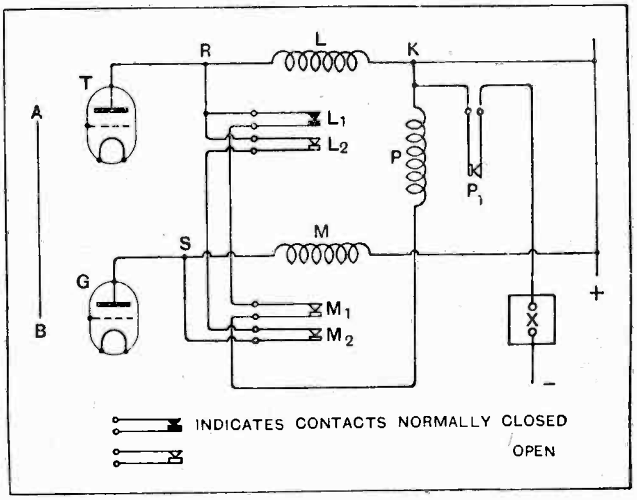


Fig. 3.—Two photo-cell amplifiers and associated relays arranged to record objects moving only in the direction BA. If the object travels from A to B the sequence of operations fails to actuate the indicator relay P as is explained in the text.

NEW BOOKS.

The Radio Handbook. By James A. Moyer and John F. Wostrel. Pp. x+886, with Figures. (McGraw-Hill Publishing Co., Ltd., 1931. 25s. net.)

Wireless science has now such widely extended boundaries that any "compendium" such as this book cannot, of necessity, treat every topic with text-book adequacy. Nevertheless, the volume is remarkably complete, though for British readers the American terminology and references may present some difficulties.

In the preliminary chapter on Fundamental Units and Glossary of Radio Engineering Terms a little more care might have been taken to ensure that the definitions given were in accordance with current radio usage. For instance, the "B" Battery (corresponding in American parlance to our English "H.T.") is never connected between plate and grid, as stated, while the Pitch of a sound is certainly not "the intensity of a tone depending upon the rate of the vibrations producing the tone." Little exception could, however, be taken to the statement that the Slope of a Line "refers to the slant of a line or curve, or its inclination with reference to an arbitrary axis!"

Subsequent chapters deal in summary fashion with elementary electrical theory, wireless accessories and measuring instruments, power supply, valves and their circuits, and complete receivers, including a description of some typical American circuits. The treatment is curiously uneven, and much that the English experimenter might look for is omitted. For instance, the system of band-pass tuning which has been brought to such a pitch of perfection in this country receives scarcely any attention. Again, there is no mention of the indirectly heated valve, while in dealing with the power output of valves the question of the limits set by anode dissipation is entirely omitted. In a subsequent edition of this book more care might well be devoted to the logical order of presentation of the material. Thus, Part 3 of Section VII is devoted to audio-frequency amplification, while Part 4 of the same section—under the heading "Radio-frequency amplification"—contains the detailed treatment of Power Output!

Further chapters on Transmitting Circuits and Marine Commercial Transmitters are followed by sections dealing with Laboratory Equipment and Methods. These include a brief introduction to attenuation networks and frequency filters, in which connection it is curious to find the term "decibel" is hardly mentioned. It is possible that the most interesting and useful part of the book for British readers will be the last sections, dealing with Photo-electric Cells, Television, Sound Motion Pictures, and Industrial Applications of Vacuum Tubes. Such topics as Prospecting for Minerals, Radio Fish Screens, Main-Line Train Operation and Direction Finding are lucidly and interestingly discussed.

It must be regretfully stated that the book abounds with misprints, especially in the formulæ. This, in a work intended for reference, is much to be deplored. The book bears the words "First Edition" on its title-page. A Second Edition, with more careful proof-reading, would be very welcome.

W. A. B.

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Automatic Volume Control for Aircraft Radio Receivers (Research Paper No. 330), by W. S. Hinman, Jr. Pp. 10, with 11 diagrams.

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Theory of Design and Calibration of Vibrating-Reed Indicators for Radio Range Beacons (Research Paper No. 338) by G. L. Davies. Pp. 17, with 10 diagrams. Published by the Bureau of Standards, Washington, D.C., U.S.A., price 10 cents each.

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Ralph Stranger's Wireless Library for the "Man in the Street."

No. 13. Detection of Wireless Signals by Crystal and Valve.
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Unbiased.

By FREE GRID.

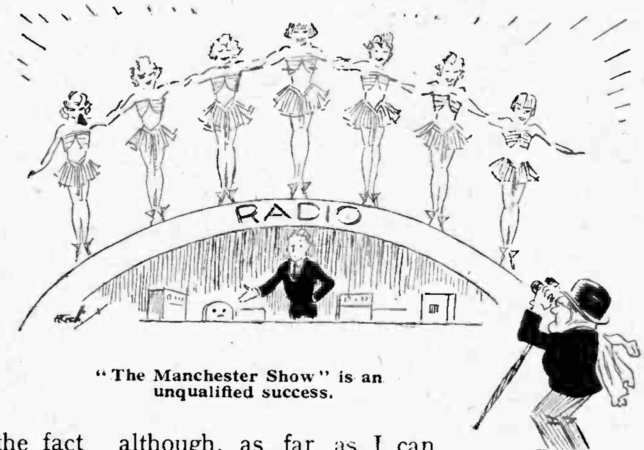
Manchester!

PROFITING by my experience at Olympia, where I found on entering the hall at the opening hour that the exhibits on most of the stands consisted of nothing but charwomen in various stages of decrepitude, I kept away from the Manchester show on the opening day. I arranged to arrive in the city at a time when night had enveloped it in her kindly mantle, as the old movie sub-titles used to say. Upon reaching my hotel the chief warder immediately handed me over to one of his underlings, who conducted me to the cell I had reserved, and I retired to rest.

Came the dawn, and I was awakened by the rhythmic music of clogs clattering over cobble stones, and after bolting my skilly I left my dungeon and hastened through the sepulchral gloom of the streets to the City Hall. An endeavour on my part to get in by the early doors failed miserably, mainly due to the language difficulty, so I repaired to the house of a bilingual friend who, though not interested in radio, unselfishly promised to come and act as my interpreter when the show opened. While on the subject of unselfishness, I feel that I ought to place on record the fact that whatever may have been said concerning the city of Manchester, its climate and its sabbath keeping, I have invariably found that the *people* of Manchester—or Mancunians, as I believe they call themselves—are the most unselfish, cheerful, good-humoured and hospitable people that I have ever come across, Wiganites excepted.

The Technical North.

After an excellent lunch my friend and I donned oilskins and sallied forth. We pushed our way through the cheerful crowd, but had not got much beyond the entrance before concrete evidence presented itself before my eyes that the Manchester show authorities had *not* decided to exclude from the stands the figurantes from the Folies Bergeres concerning whom I complained at Olympia. At the same time, a great tribute must be paid to the Manchester exhibitors for the technical information that is available at several stands this year. Up North the technical side of radio is catered for rather than its social side; that is to say, that while in the South there is a tendency to sell only a musical instrument in a "posh" cabinet, this just won't wash in the North, because although, as far as I can judge, the people in the North are fully as musical, if not more so, than the Southerners, they are certainly more technically minded. I should imagine that components sell much better at Manchester than they do at Olympia. One does not mind the ladies in attendance if one gets some pukka technical information as well; a chance acquaintance in the exhibition, with whom I was discussing the matter, summed it up very neatly by saying "One does not mind that fool 'Free Grid' blathering every week, provided that *The Wireless World* keeps up the standard of its articles."



"The Manchester Show" is an unqualified success.

All British?

With regard to the exhibition itself, there is very little to say, because, as foreign firms are barred this year, practically all the stuff on show had been seen at Olympia and was, therefore, rather stale from my point of view. I did not neglect to examine every stand thoroughly, however, and poked well into every receiver, more especially in the case of one on the stand of a wholesaler, some of the components of which I strongly suspected were not of British origin. My examination confirmed me in my suspicions, and beckoning to a varlet in attendance, I said rather facetiously to him, "Some of the components appear to have been made by the good old Anglo-Saxon firm of A. Gesellschaft."

"Yes, that is perfectly correct, sir," he agreed, "You see we only handle sets which employ high-class components of British make."

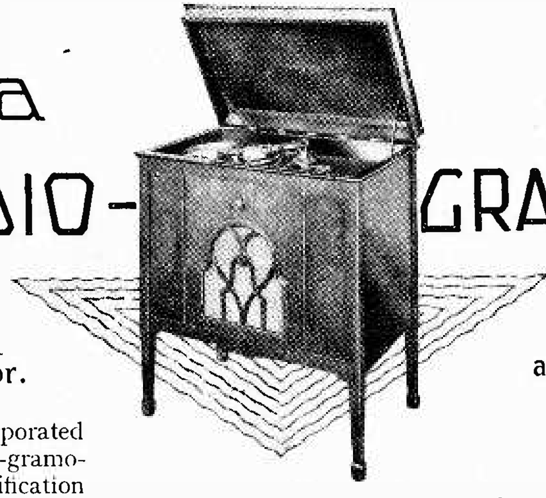
Zoological Radio.

The habit of naming commercial sets after animals appears to be spreading, and those who visited the Exhibition will doubtless have observed that both "panthers" and "tigers" were on view, while the "nightingale" has been with us for many years. I am distinctly surprised, though, that one large firm, namely, Kolster-Brandes, openly admit—as they did last year—that they are selling the public a "pup." A motoring acquaintance of mine told me that this was commercial candour of a type with which it would be impossible for any exhibitor in the Motor Show to compete; it was "truth in advertising" with a vengeance, he added. I hastened to reassure him on this point, as the set is one of the best examples of value for money of its kind.

However, I don't think this zoological nomenclature should be encouraged. Animals are not naturally musical; and, from a broadcasting point of view, I have never associated them with anything more romantic than the Fat Stock prices.

Columbia RADIO-GRAMOPHONE

MODEL 602



Band-pass Tuning, Screen-grid Detector.

Combined Radio and Gramophone Volume Control.

THE receiver chassis incorporated in the Model 602 radio-gramophone has a circuit specification which places it in the front rank of the numerous receivers of advanced design which were the outstanding feature of this year's Olympia Show. For a three-valve set the performance is remarkably good, the selectivity in particular being exceptional. On the gramophone side the volume and quality of reproduction are quite up to the standard one expects from Columbia products. The controls are easy to handle and smooth in action, and no more skill is required to obtain the maximum performance from the wireless section of the instrument than from the gramophone equipment. In fact, from every point of view, including appearance and price, the Model 602 represents all that is best in radio-gramophone design.

The three stages in the receiver chassis are arranged on the customary H.F.-det.-L.F. plan, but the employment of a screen-grid valve in the detector as well as in the H.F. stage is a novelty in a set designed for commercial production. The possibilities of the screen-grid detector have already been discussed in this journal.[1] In a ganged circuit the practically constant input impedance of the screen-grid detector is of the greatest possible value, since it is much easier to maintain accurate alignment of the ganged circuits over the whole of the tuning range. The sensitivity when worked as a grid detector is excellent, and the L.F. voltage developed in the anode circuit is much higher than in the case of the triode detector. The high overall amplification provided by the screen-grid detector and the pentode output valve obviates the necessity of providing a voltage step-up between the detector and output stages. Choke coupling is employed, and to obtain adequate low-note response with the comparatively high A.C. resistance of the detector valve, the choke has been assigned an inductance of 300 henrys. To keep the dimensions down a nickel-iron core is used, and to reduce self-capacity the winding is sectionalised.

SPECIFICATION.

CIRCUIT: Three valves and rectifier. Metallised screen-grid H.F. valve with transformer coupling and band-pass input filter. Metallised screen-grid detector, choke-coupled to power pentode output valve. Combined radio and gramophone volume control.
CONTROLS. (1) Triple-gang tuning control. (2) Reaction. (3) Wave-range and gram. switch. (4) Combined volume control and mains on-off switch.
GENERAL: Moving-coil loud speaker. Induction-type gramophone motor with automatic stop switch.
PRICE; 32 guineas.
MAKERS: The Columbia Graphophone Co., Ltd., 98/108, Clerkenwell Road, London, E.C.1.

The moving-coil loud speaker—of Columbia design—is mounted separately from the chassis, to which it is connected by a four-pin socket fitting into a valve-holder near the rectifier valve. Two of the pins carry the field current, which is taken through a limiting resistance from the rectifier, i.e., in parallel with the H.T. supply to the set. The remaining pins take the output from the AC/PEN valve to the transformer attached to the loud speaker chassis. A resistance-capacity shunt inside the set itself limits the current in the transformer primary at very high frequencies.

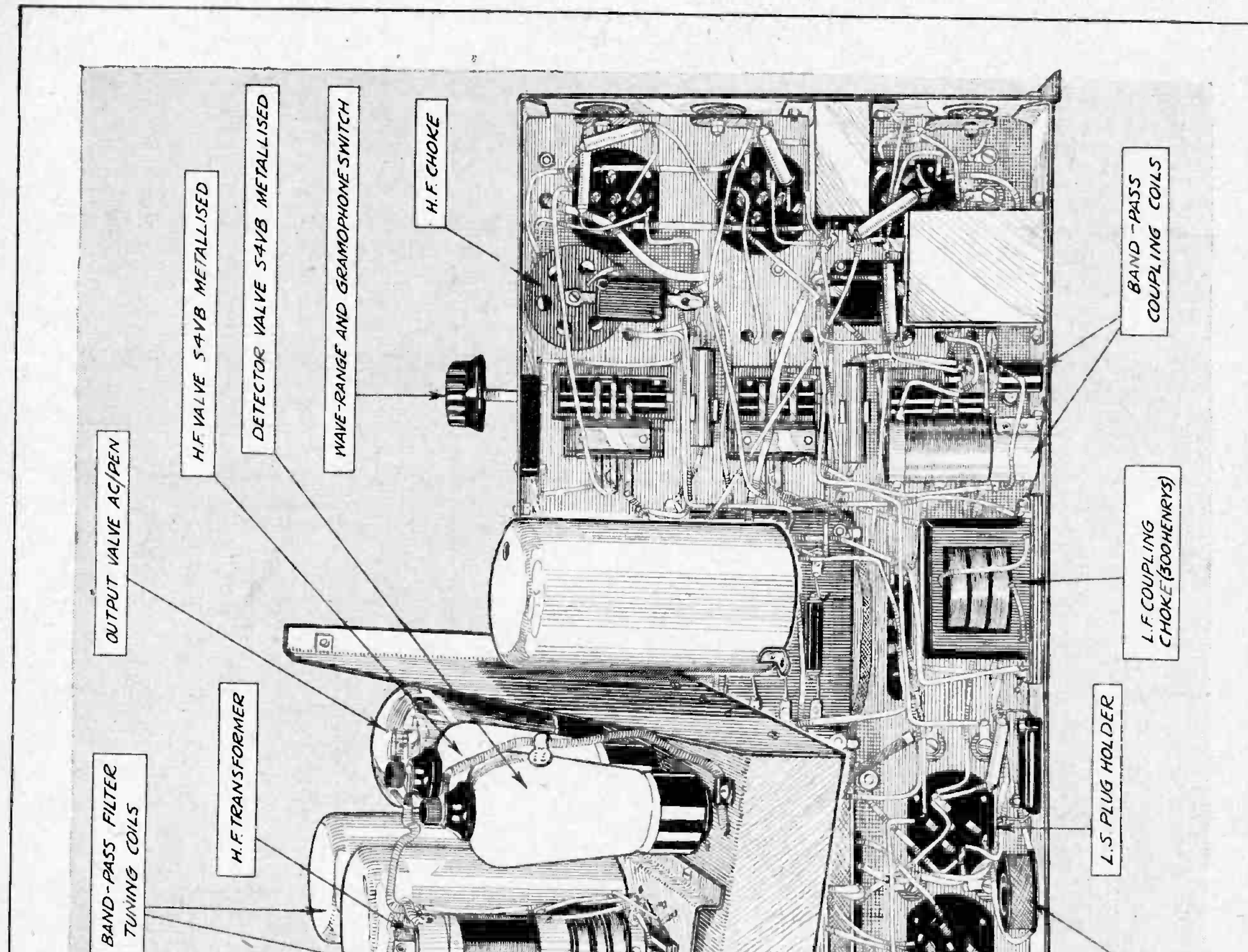
Mixed Filter Circuit.

The rectifier valve is a Marconi U.12, and is connected in the normal manner. The method of adjusting the primary of the mains transformer to the supply voltage is, however, noteworthy. Three coarse tappings are provided for 195, 215, and 235 volts, and there are, in addition, two separate tappings (0 and +10), giving a further 10 volts for intermediate voltages. The connections are made by means of brass shorting plugs and the aerial lead A_1 may be detached from the back of the aerial terminal panel and connected under either of these plugs for mains aerial reception.

Reverting for a moment to the high-frequency stage, it will be observed that a band-pass filter precedes the screen-grid valve. The coupling is "mixed," i.e., a combination of inductance and capacity. To preserve the ganging of the grid and anode-tuned circuits a condenser of similar capacity to that employed for coupling is connected in the earth return lead of the H.F. transformer secondary circuit.

The principle of the volume control is interesting. A single 50,000-ohm potentiometer serves for both radio and gramophone control. When the switch is in the radio position the potentiometer

[1] *The Wireless World*, August 12th, 1931, page 153.



Constructional details of the all-metal chassis in the Columbia Model 602 radio-gramophone.

Columbia Model 602 Radio-Gramophone.—

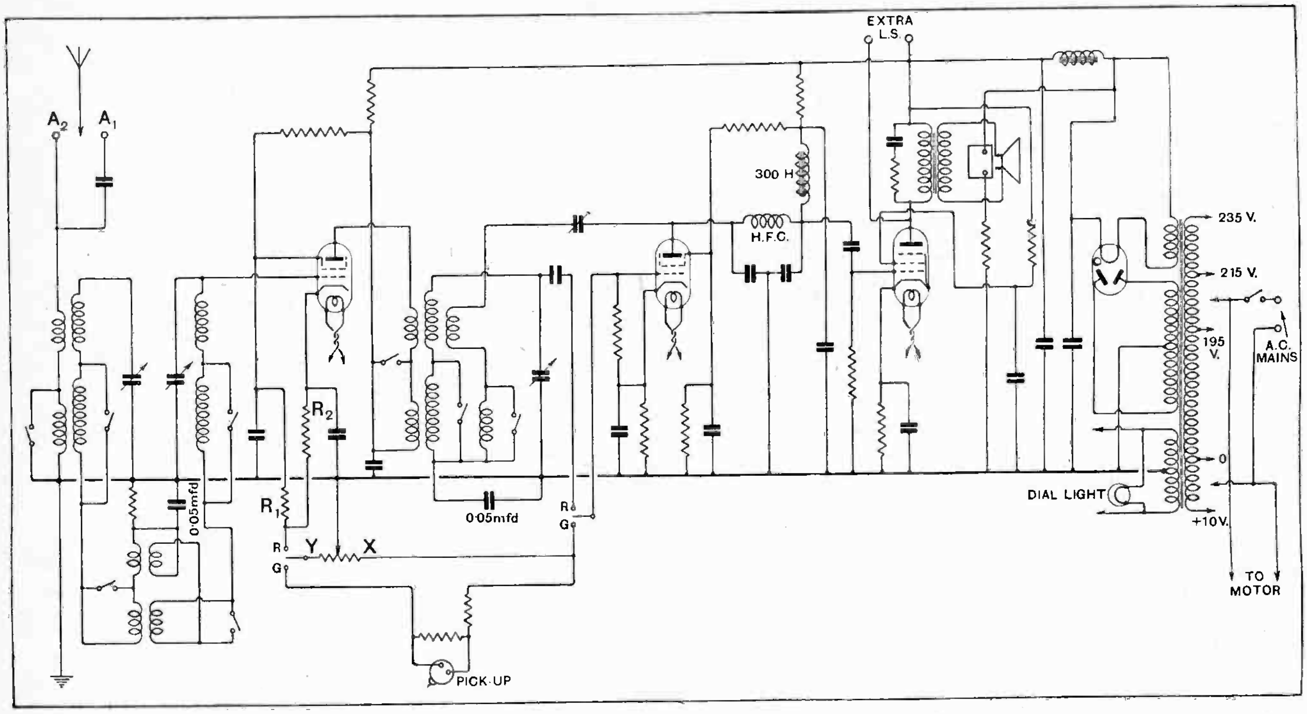
functions as a variable resistance in series with the grid bias resistance R_2. At Y the valve receives its normal bias, but as the slider approaches X the bias is increased and the sensitivity is reduced. It will be noticed that the lower half of the screen-grid potentiometer is also in series with the control resistance. The effect of this is slightly to increase the anode current flowing through the grid-bias resistance, an arrangement which has been found to give a more even distribution of volume over the range of the control. Incidentally, the volume is reduced absolutely to zero in the minimum position. A further slight movement of the control switches off the set, as a quick-break switch is incorporated with the potentiometer.

The performance on the radio side is fully in keeping

Northern National, Bordeaux-Lafayette, Cardiff, Cracow, Paris (Radio Vitus), and Göteborg. There was also a considerable clear space below London National, and five stations were received between 245 metres and the lower end of the scale. As further proof of selectivity, it may be mentioned that Sottens is easily separated from Midland Regional.

Absence of Needle Scratch.

Mains hum is noticeable when the receiver is tuned to a silent point on the dial, and is slightly more prominent on long than on medium waves. By comparison with other receivers in its class, however, it does not offend in this respect beyond the average, and no annoyance is experienced when listening to programmes of normal strength.



Circuit diagram of the Columbia Model 602 radio-gramophone.

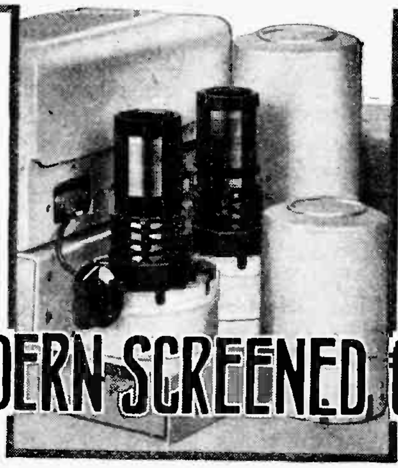
with the advanced design of the circuit. The range is excellent, and 30 stations were logged on medium waves and 8 on long waves in just under an hour after dark. Of these, at least 12 required the use of the volume control to bring them down to a comfortable output level. In daylight, Hilversum, Sottens, Langenberg, and the Northern National were reliable stations on medium waves, in addition to the local B.B.C. transmissions and Midland Regional.

Tests of selectivity were made at a distance of five miles from Brookmans Park within sight of the aerials. Nevertheless, a band no less than 50 metres wide between the London Regional and National transmissions was absolutely clear of interference from either station. In this region the following stations were successfully received: Heilsberg, the British relays, Turin, Huizen,

The reproduction of gramophone records is very good indeed. The quality is round and full, and there is no lack of high-note response, yet needle scratch is entirely absent. An automatic stop is fitted to the induction-type A.C. motor, which is of massive construction and is assembled in a die-cast chassis.

Altogether, the Model 602 is a soundly constructed instrument with a performance that should satisfy the most fastidious.

Next Week's Set Review:—H.M.V. TABLE RADIO-GRAMOPHONE



The MODERN SCREENED COIL

By A. L. M. SOWERBY, M.Sc.

Is a Large Screen Worth While?

AT the end of the preceding instalment of this article, winding data were given for several coils yielding an inductance of 200 microhenrys when enclosed in a screening box 2⅝in. in diameter and 4in. in length, together with their high-frequency resistances measured at 300 metres. Of these coils the most convenient from the practical point of view was wound on a 1½in. former with 106 turns of No. 30 double silk-covered wire.

The performance of this selected coil at a number of wavelengths within the broadcast band is given in Table 6, in which the figures for high-frequency resistance relate to the complete tuned circuit used during the measurements, and not to the coil by itself.

TABLE 6.

Wavelength (Metres)	Equiv. series res. (Ohms).	Equiv. Parallel res. (Ohms).	Magnification.
200	27.4	130,000	69
225	22.2	127,000	76
250	18.8	122,000	80½
300	14.5	109,000	87
400	10.2	87,000	92½
550	7.85	60,000	87½

In the tuned circuit used, dielectric losses were kept low—perhaps unusually low. Apart from the tuning condenser, the main source of dielectric loss was the valve voltmeter, in which a decapped valve is used. The very appreciable losses due to a valve-holder and the composition base of the valve itself were therefore absent.

The smallness of the dielectric loss is perhaps most eloquently shown by the shape of the curve (Curve A of Fig. 1), which reproduces, in perhaps more convenient form, the numerical values of Table 6. Since dielectric losses have most effect at the lower wavelengths, it is usual for a curve of dynamic resistance to have a definite maximum at a wavelength depending on the inductance of the coil, but being, in the case of a 200-microhenry coil, somewhere in the region of 250 metres. Below this wavelength these losses cause the dynamic resistance to drop again. No such effect is seen in Curve A, for R is still continuing to rise, even down to 200 metres; dielectric losses, therefore, are unusually low.

IN the last article of this series it was shown that the most efficient 200-microhenry coil for a screen of 2⅝ inch diameter should be wound on a 1½ inch former giving an average dynamic resistance of some 80,000 ohms. Is there any substantial increase of amplification likely to result from the use of, say, a 4-inch screening can with a coil of 2¼ inch diameter? The relative efficiency of these two coils and a general summary of the effects of coil screening form the subject matter of this concluding instalment.

To provide measurements of a circuit more fairly reproducing those likely to be encountered in a normal set, a valve-holder and a base were added in parallel with the tuning condenser, and a fresh set of resistance-values were obtained. These values are set out in Table 7, and are exhibited in Curve B of Fig. 1.

The dielectric losses introduced by the valve-base and holder are seen to depress the dynamic resistance at all parts of the waveband, but the difference is greatest at the shortest wavelengths, with the result that the expected maximum in the curve appears at about 230 metres. The valve-holder chosen introduces losses rather below than above the average of such components; if it had been replaced by a holder built up from a solid lump of the usual moulded material the difference between Curves A and B would have been much more marked. The maximum would have moved, too, so that the tuned circuit would have shown greatest efficiency at perhaps 275, or even 300 metres.

TABLE 7.

Wavelength (Metres).	Equiv. series res. (Ohms).	Equiv. parallel res. (Ohms.)	Magnification.
200	36	98,000	52½
225	27.1	103,000	62
250	22.2	102,000	68
300	16.5	95,000	76
400	11.3	79,000	83½
550	8.1	58,000	85

Taking the values of Table 7 and Curve B as they stand, we see that the screened coil will give fair amplification and selectivity when used with a good modern screen-grid valve, and will prove satisfactory in receivers, especially mains-driven receivers, using a single stage of high-frequency amplification. It may be used with some confidence in two-stage amplifiers employing battery valves, but in a two-stage mains set it will probably be found uncomfortably efficient. The type of screening which is implied by the use of tuning coils in small pots does not of necessity lend itself to more than rather incomplete protection against stray feed-back effects (since the various leads and small components are exposed), and with the high overall gain of two stages using modern high-efficiency mains valves there may be some difficulty in stabilising a set with coils of efficiency only as high as that under

The Modern Screened Coil.—
discussion. Imperfections in ganging, however, will often step in to stabilise a set that would oscillate if accurately tuned with separate condensers to each stage.

Although, judged by the standards which have been set up in this country by *The Wireless World*, this small "potted" coil is of rather low dynamic resistance, yet it will well bear comparison with a coil which the writer recently abstracted from an American all-mains receiver with two high-frequency stages. Details of this coil are given in Fig. 2, the numerical values of which were obtained using the coil in a tuned circuit of low dielectric losses. Curve A, from Fig. 1, is redrawn on this diagram to facilitate comparison; apart from the coil and screening box, the two tuned circuits were identical. Inspection of the original set suggested that the dielectric losses in the tuned circuits were very high, so that the curve for the American coil does it a good deal more than justice, especially at the lower end of the wave range.

In studying this coil, it should be borne in mind that it was intended to be used with valves which, by British standards, are of woefully low efficiency. Though mains valves, they fall appreciably short of the best of our own battery-operated valves.

A Coil for a Four-inch Screening Box.

Having found how to make the most efficient coil when the screening box in which it is to be housed is limited to a diameter of 2⅝in., it becomes interesting to know whether any very great advantage can be had by using a larger box with a larger coil inside it. Or rather, since a larger box must necessarily permit the construction of a more efficient coil, whether the increased amplification is likely to be adequate compensation for the greater bulk.

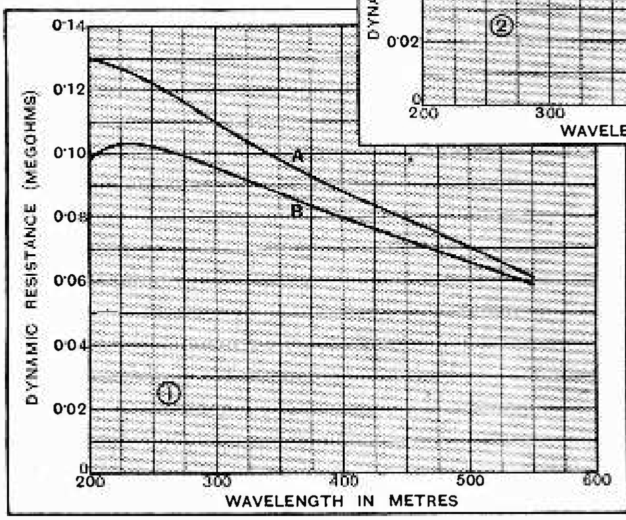


Fig. 1.—Curve A. Variation with wavelength of dynamic resistance of a tuned circuit of low dielectric loss containing a 1½ ins. coil in screen. Curve B as curve A but with valve-base and valve-holder added in parallel.

TABLE 8.

No. of coil.	Diameter (Inches).	Length (Inches)	Turns.	Wire.
1	2	1.0	62	28 enam.
2	2	1.38	67	28 s.c.c.
3	2	2.05	80	28 d.c.c.
4	2¼	1.5	63	28 d.s.c.
5	2½	1.25	55	26 d.s.c.
6	2½	1.61	60	24 d.s.c.
7	2½	2.6	68	24 d.c.c.
8	2¾	1.97	57	24 d.c.c.
9	3	1.45	51	24 s.c.c.
10	3	2.36	56	22 d.c.c.
11	3	3.10	62	22 d.c.c.

In going into this question, a screening box 4in. in diameter was chosen as being the largest that would be likely to find favour in any set. Since previous experiments have shown that the diameter of the box is a more potent factor than the length, this new box, like the last, was 4in. in height.

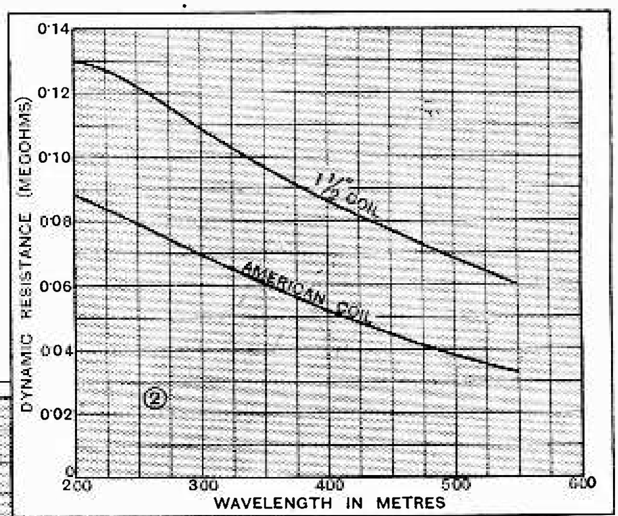


Fig 2.—Screened coil from American receiver compared with 1½ ins. screened coil. American Coil:—Diameter 1¼ ins. in screening box 2¼ ins. diam. by 3 ins. long; inductance in screen 164 μH.

As a preliminary, the resistance of a number of coils, of inductance 200 microhenrys when unscreened, was measured within the new box. A description of the coils is given in Table 8, and their properties when screened in Table 9.

Looking down the last column of Table 9, in which are given the values for the magnification of the screened coils, it is seen that even if we ignore No. 7, which is a very long coil, the highest magnifications appear round about coil diameters of 2½ in. Further, we see, in confirmation of our experience with the smaller screen, that a long coil gives a higher efficiency than a short one, even though its extra length, which in an unscreened coil would be an unmixed blessing, means that it must approach more closely to the metal at the ends of the box.

It follows, therefore, that in trying to find the winding that, when in the screen, will give the most efficient coil, we shall choose diameters of former in the neighbourhood of 2½in., and we shall make the coils as long as convenience permits. Bearing in mind that the screen will almost certainly have to house a long-wave coil as well, it was decided to limit the length of coils wound to 2in. or thereabouts.

Working along these lines, one or two coils were made up and adjusted by trial and error to give an induct-

The Modern Screened Coil.—
ance of 200 microhenrys when in the screen, after which their resistance was measured at 300 metres. It would be wearisome, but neither interesting nor uplifting, to go through the measurements in order, showing how each coil measured was used as a basis on which to calculate the dimensions likely to be most favourable for the next trial; instead, the results will be presented baldly, leaving out all reference to the several blind alleys up which the writer hopefully trotted.

TABLE 9.
Properties of Coils of Table 8 in Screening Box 4 in. in diameter, 4 in. long.

No. of Coil	L_s micro-henrys.	r_s ohms.	R_s megohms.	m_s
1	179	14.0	0.090	80.4
2	174	11.6	0.103	94.4
3	168	10.4	0.107	101.5
4	163	11.2	0.094	91.5
5	153	10.6	0.087	90.5
6	151	10.0	0.090	95
7	140	8.3	0.093	106
8	132	8.35	0.082	99.5
9	120	9.25	0.062	81.5
10	107	7.9	0.051	85
11	101	7.0	0.058	90.5

All the above measured at 300 metres.

Table 10 gives descriptions and winding data of the more successful coils wound for the 4in. screening box, their properties, as measured at 300 metres, being given in Table 11. All coils had an inductance of 200 microhenrys when in the screen.

This last Table allows us to pick out the most efficient coil from all those wound up for measurement. It will be seen that the best coil of all (No. 25) is rather inconveniently long, exceeding slightly our limit of 2in. No. 30, the second best, is even longer, while the third in order of merit, No. 27, is less than 2in. in length, and falls a bare 2 per cent. in performance behind the best. This coil was therefore chosen as the most likely to suit the designer of a set, and its behaviour, still in the screening box, was examined over the whole broadcast band of wavelengths.

TABLE 10.

No. of Coil.	Diameter (inches).	Length (inches).	Turns.	Wire.
21	2½	1.85	75	24 d.s.c.
22	2½	1.78	73	28 d.c.c.
23	2½	2.00	76	26 d.c.c.
25	2¼	2.15	82	26 d.c.c.
26	2¼	1.98	80	24 d.s.c.
27	2¼	1.90	78	28 d.c.c.
28	2¼	1.45	72	26 d.s.c.
30	2	2.53	94	26 d.c.c.
32	2	2.35	92	24 d.s.c.
29	2	2.20	89	28 d.c.c.
31	2	1.73	82	26 d.s.c.

The result of these measurements is given in Table 12, and is shown, so far as the dynamic resistance is concerned, as Curve A of Fig. 3. From the fact that the curve rises steadily all the way down to 200 metres,

TABLE 11.
Properties of the Coils of Table 10, measured at 300 metres in a screening box of diameter 4in. and length 4in.

No. of Coil.	r_s ohms.	R_s megohms.	m_s
21	14.2	0.112	88.5
22	13.3	0.119	94.5
23	12.7	0.124	99
25	11.8	0.134	106
26	12.8	0.124	98
27	12.1	0.131	104
28	14.2	0.111	88.5
30	12.0	0.132	105
32	13.0	0.121	97
29	12.3	0.128	102
31	13.8	0.114	91

it will be inferred that the supplementary dielectric losses in the form of valve-holder and valve-base were not added.

This fact, however, does not debar us from comparing this larger coil with the smaller one designed for the smaller screening box. Curve B of Fig. 3 repeats Curve A of Fig. 1, and gives the dynamic resistance of the small coil under the same conditions.

The two curves run practically parallel throughout their length, and show, as was only to be expected, that the larger coil is the better at all wavelengths. The difference, however, is not overwhelmingly large, and it is rather doubtful whether the higher dynamic resistance of the larger coil is sufficient recompense for having to accommodate much larger screening boxes in the set. In figures, the superiority of the larger coil is about 15 per cent., while the volume occupied by the larger screening box is the greater by 131 per cent.

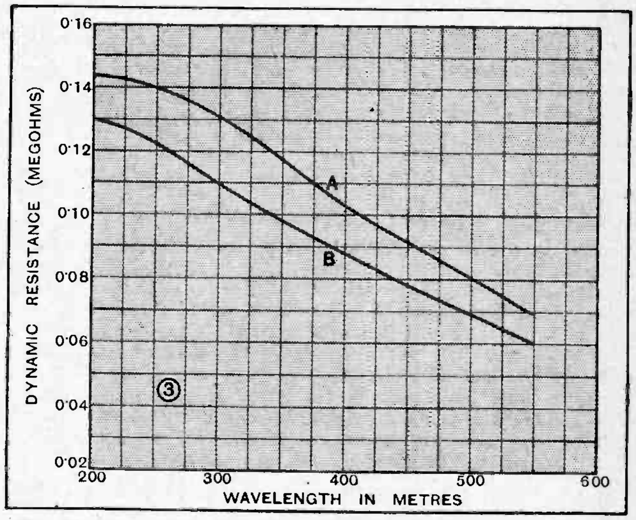


Fig. 3.—Comparison between best coil in 2½ ins. screen (B) and best coil in 4 ins. screen (A) under conditions likely to accentuate the difference. It is very doubtful whether the small extra efficiency justifies the large extra bulk.

The Modern Screened Coil.—

Although it has loosely been stated that the dynamic resistance of one coil is about 15 per cent. higher than that of the other, it must be realised that this is not strictly true. The correct statement is that by replacing one coil by the other an improvement of some 15 per cent. is made in the dynamic resistance of the particular tuned circuit in which the measurements were made. Incidental conductor losses, together with dielectric losses, naturally remain unchanged by the substitution. It is probable that if we could measure the true copper losses of the coil by itself, the improvement would be of the order of 30 per cent. at least. But from the practical point of view, treating the coil as a component to be incorporated in a set, it would be better to point out that in a tuned circuit in which the losses were larger, as is the case in most sets, the difference between the coils would provide a gain of less, and certainly not more, than the 15 per cent. found in these measurements.

TABLE 12.

Coil: 78 turns of No. 28 D.C.C. wire on 2¼in. former; enclosed in screening box 4in. diameter, 4in. long.

Inductance of coil, in screen, 200 microhenrys.

Wavelength (metres).	Equiv. series resistance (ohms)	Equiv. parallel res. (megohm)	Magnification.
200	24.6	0.144	76.5
225	19.7	0.142	85
250	16.2	0.140	93
300	12.1	0.131	104
400	8.60	0.103	109
550	6.71	0.070	102

CORRESPONDENCE.

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., and must be accompanied by the writer's name and address.

EMPIRE BROADCASTING.

Sir,—In your issue of August 12th, and on page 158, under the heading of "Current Topics," you quote *African World* as saying that the Soviet authorities will endeavour to reach the masses in Johannesburg, Cape Town, etc. It might be of interest to you to know that the Moscow station has been picked up by hundreds of short-wave enthusiasts for some months—in fact, as early as 7 p.m. (local time), full loud speaker strength is always obtainable. At the present time this is the only station which can be regularly heard, and it is a great pity that 5SW do not bestir themselves and follow along similar lines as are being carried out to-day by Moscow.

Of all the short-wave stations on the air to-day, I think I am right in saying that 5SW is the most disappointing of the lot, and when tests are being made for the new Empire transmitter I sincerely trust that Saturdays and Sundays will be included in their schedule. C. R. SLINGSBY.

Claremont, South Africa.

BAND PASS OR TONE CORRECTION?

Sir,—My article on "Band Pass or Tone Correction," published in your issue of September 2nd, described a receiving circuit which could be expected to have an audio-frequency output characteristic substantially level up to 10 kc. or so, in spite of the fact that it employed a single-tuned circuit of very high selectivity. It was assumed in the article that such a characteristic is a desirable feature in a circuit for broadcast reception, but, judging from his letter in your issue of September 30th, Mr. N. G. Scroggie is quite horrified at the idea. He complains that with broadcast stations spaced 9 kc. apart, such a circuit would receive "not only the station we want, but two other stations at full strength, with rather more than one side-band each." As Mr. Scroggie has already contradicted himself in part (for how can one receive a station at "full strength" with only "rather more than one side-band"?), he will, I hope, be the more ready to forgive me for contradicting him still further. Even in a bad case in which the adjacent stations were of the same field strength as the desired station, the modulation output of the interfering stations would be very greatly reduced by the circuit described, compared with that of the station to which the circuit was tuned. The matter is rather too complicated to explain in full in the restricted space of the correspondence column, but I will try to find an opportunity of discussing it more fully in a later publication. In the meantime, I can only assure Mr. Scroggie, and also Mr. Lewis, who raises a similar query, that the high selectivity of the tuned circuit is not impaired, at least as far as the modulation of interfering stations is concerned, by the subsequent audio-frequency correction.

It is true that in certain unfavourable locations it may be found necessary to obtain a sort of artificially enhanced selectivity by the deliberate sacrifice of the higher audio frequencies, particularly where interference in these frequencies is due to the heterodyning of the wanted carrier with adjacent transmissions, but this is a *pis aller* at best, and the idea that audio-frequency reproduction should cut off at, say, 5 kc., is not one that music lovers can be expected to regard with favour.

I must apologise to Mr. Willans for being unaware of his early anticipation of the correcting circuit described in my article. As a matter of fact, I thought it so unlikely that such a simple and attractive idea should have been missed up to this time that I carefully avoided any claim to originality, though I had not actually seen any previous description of that particular arrangement. F. M. COLEBROOK.

Hampton Hill.

THE LIFE OF THE VALVE.

Sir,—In your issue of September 2nd, 1931, your correspondent, "Free Grid," mentions the comparison between the lives of the old bright emitters and modern valves.

I believe I am right in saying that there is an analogy with the lives of present-day dry batteries. The high-temperature Tungsten filament maintains its original emission for a fairly short period, and then a steady decline sets in, and the emission falls gradually to zero. This is comparable with the voltage-working hours characteristic of an old-fashioned dry battery.

The modern low-temperature oxide-coated filament—or cathode—maintains its original emission for the greater part of its life—something of the order of 1,000 hours. Then the emitting surface rapidly disintegrates, and the emission vanishes. Again, there is the similarity with the discharge curve of a modern dry battery.

Surely we are all agreed that the modern form is, in practice, much more satisfactory than its predecessor, on these grounds alone.

Hence, I venture to disagree with "Free Grid"—although he *says* he writes for your sister journal *The Wireless Engineer*—when he attributes the shorter life of modern valves to the stomachs of the wives and children of the manufacturer.

London, N.4. CHAS. F. BROCKLESBY.

...dcast Brevities

By Our Special Correspondent.

...—Dialogue Befogged by "Atmosphere."—A Musical Disappointment.—Still Some Hope for Football Broadcasts.

...s Park.

...who manage to obtain ... the Brookmans Park ...ow compare the appearance, ... the performance, of the new ...tters with that of the original ... at Marconi House. The original ...ear has been re-erected in the main building.

oooo

Primitive Man and his Radio.

Visitors to last year's Olympia Show may remember that the same apparatus was on view on the B.B.C. stand, looking rather primitive but otherwise not much the worse for wear. In a few years' time, if broadcasting continues to develop, I expect it will be mistaken for a wavemeter.

oooo

Stop, Thief!

The first Italian drama written specially for broadcasting, and already transmitted from the Milan and Turin stations, is to be given by the B.B.C. in an English adaptation in November. The play—"The Ring of Teodosio," by Luigi Chiarelli—has been adapted by Mr. Peter Cresswell under the title "Stop, Thief," and will be broadcast nationally on November 5th and regionally on November 7th.

Signor Chiarelli described his work as "a radio comedy in thirty phono-tableaux."

oooo

Paul Robeson.

Because the author's terms were unacceptable to the B.B.C., Paul Robeson will not broadcast in "The Emperor Jones," on October 23rd and 24th, as originally announced. The famous negro will be heard, however, on the same dates in a composite programme, consisting of a revival of "God's Trombones" and an attempt to portray the development of negro music from the sentimental plantation songs to the jazz of to-day.

oooo

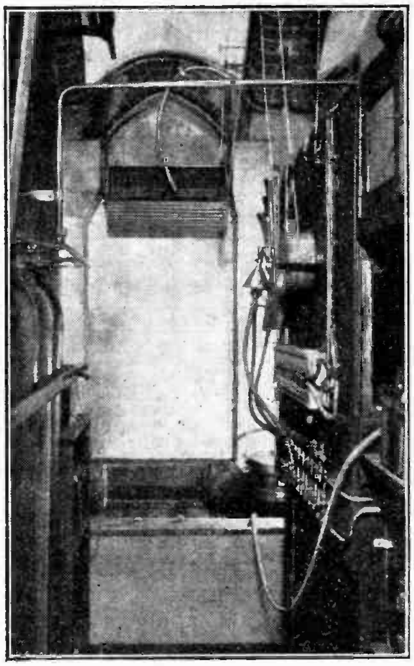
Too Much Atmosphere.

Apropos the sound machine in the Hamburg station, of which an illustration appears on this page, there seems a tendency to make too much of "noises off" in modern radio drama. It is, of course, often necessary to introduce sounds to enable the listener to imagine what is going on and to take the place of visible action, but I think the sound effects are sometimes too much in evidence, and the "atmosphere" created becomes so dense that the dialogue finds difficulty in penetrating the fog.

oooo

West Regional Station.

The erection of the West Regional station will soon begin. A twenty-three-acre site has been secured near Washford Cross, Somerset, and I understand that the design of the station will be similar to that of the other Regional stations now in operation.



The "noise machine" at the Hamburg station of "Novag" used for producing the various sounds required in radio drama, etc.

No Broadcast of Paderewski Recitals.

I understand that no arrangements can be made for broadcasting any of the recitals which M. Paderewski will give while in this country. He will only fulfil the engagements already fixed, and it has not been found practicable to broadcast any of these. It seems a pity that this should be the case, as there must be thousands of the older generation who would welcome a chance of hearing again the musical idol of their youth, and the rising generation will miss an opportunity of hearing Chopin's music played by its greatest exponent.

oooo

A Deferred Talk.

The talk by His Highness the Aga Khan in the series "What I would do with the world," which we announced for Thursday, October 8th, has been postponed until October 22nd, when it will be given at 9.20 p.m. in the National programme.

oooo

Football Broadcasts?

Listeners may be resigned to the thought that there are to be no running commentaries on football matches this winter, but the B.B.C. still hopes that the negotiations with the Football Association will soon assume quite a new complexion.

I am able to state that the B.B.C. is still fighting hard for the desired facilities.

oooo

Getting Their Own Way.

It is curious to notice that the B.B.C.'s ideas on a variety of interests—theatrical, musical, and political—generally gain acceptance in the end. Without arguing whether this is a Good Thing or a Bad Thing (to adopt the classification of the history books) the fact augurs well for the success of the football negotiations.

I believe the experts have "found a way."

oooo

Armistice Day.

Already arrangements are in hand for commemorating Armistice Day. The Cenotaph service on November 11th will be relayed nationally.

In the evening the British Legion concert at the Albert Hall will be heard, and this will be followed by a special programme in the studio.

oooo

In Other Words...

In future the B.B.C. Technical Correspondence Department will be known as the "Engineering Information Section." The change is welcome and might be copied in other directions as, for instance, "Corpulent Cattle Quotations."

WIRELESS ENCYCLO

OCTOP.

N

Brief Defin
Expanded Ex

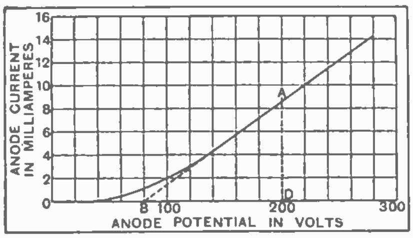
A.C. RESISTANCE (of Valve). The internal opposition or resistance offered to the alternating component of the anode current of a valve under working conditions. Its numerical value in ohms is defined as the ratio of a small change in anode voltage to the resulting change of current with specified values of grid potential and initial anode potential.

WHEN a current is passed between the anode and cathode of a thermionic valve energy is drawn from the source of high-tension supply, and the anode of the valve becomes heated, in some circumstances to a red heat. Now, since the bulb is evacuated to the highest possible degree the current passing between the anode and cathode (or filament) must be a pure electron current, and no heat can be generated in the intervening space. The heat is actually produced at the anode itself, which, being a metal conductor, could not possibly have a resistance of thousands of ohms as indicated by appearances.

Actually the heating which appears at the anode of the valve *is not due to resistance at all*. It is the result of the collision with the anode of enormous numbers of high-velocity electrons. The energy drawn from the H.T. supply is first utilised in accelerating the electrons as they leave the cathode, the energy thus being converted into kinetic energy, or energy of motion, in the moving electrons. As each electron strikes the anode it gives up its kinetic energy, which is converted into heat.

But even though the heat generated at the anode is not due to resistance as ordinarily defined, the power consumed can be defined in terms of an *apparent resistance*. If P is the power in watts when the anode current is I amperes, the apparent anode resistance is $R_0 = P/I^2$ ohms, or, since the whole of the energy is converted into heat, the apparent resistance or "D.C. resistance," is obtained from Ohm's law by dividing the voltage between the anode and cathode by the current.

For an ordinary constant resistance the graph connecting the voltage and current is a straight line passing through the zero point, but the graph showing the relation between the anode voltage and anode current of a valve is by no means a straight line. In the figure a typical curve is given for a certain class of valve, the grid voltage being maintained constant at a slightly negative value. From the curve it is quite evident that the ratio of voltage to current (apparent resistance) is not a constant, but decreases as the voltage is raised. For instance, at 100 volts the current in 2 milliamps. and the apparent resistance is therefore 50,000 ohms, whereas at 200 volts the current is 8.5 milliamps. and the apparent resistance thus only 23,500 ohms.



The full-line curve is an anode voltage/anode current characteristic of a valve for one value of grid voltage. The broken lines indicate how the normal A.C. resistance is found, being simply the ratio $\frac{BD}{AD}$ ohms.

Under operating conditions, however, we are not so much concerned with the D.C. relationships as with those of the alternating quantities, the direct current supply being more in the nature of a necessary evil. In normal circumstances the anode circuit contains an alternating component of current whose amplitude is usually small compared with the value of the steady direct current. This alternating component is set up by action of the valve grid when an alternating voltage is applied to it.

Now, an examination of the curve in the figure shows at a gla the upper part is practically and that, therefore, with ately high value of anod any small change of voltage produce a change of current exac proportional to it. Thus, over th linear part of the curve the ratio of the change of voltage to the change of current is a constant, and it is this ratio which constitutes the A.C. resistance of the valve. It is widely referred to as the "differential resistance" because it is the ratio of the difference between two voltages to the difference between two currents. "Slope resistance" is another term commonly used by mathematical writers. Some valve manufacturers refer to the A.C. resistance merely as the "impedance," but this is inclined to be misleading because the A.C. resistance is more or less independent of frequency. The term A.C. resistance is justified because relatively small values of alternating voltage and current in the anode circuit fulfil the condition of the ratio of small differences between the limits of voltage and current reached.

The best way to obtain the normal A.C. resistance for the valve is to produce the straight part of the curve back to meet the voltage axis at B and to drop a perpendicular AD on to the base line, as shown. Then the A.C. resistance is equal to the ratio of BD in volts to AD in amperes. In the present case $R_0 = 120/0.0085 = 14,100$ ohms.

When the valve is operated at a point on the bottom bend of the anode voltage/anode current curve, the slope of the curve at that point will be less than that of the straight part, with the result that the effective A.C. resistance becomes greater. This condition applies when a valve is used as an anode bend detector.

Readers' Problems.

Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

"Super-Selective Six" Switch.

Is there any objection to my fitting a switch in the mains lead of the Super-Selective Six? I ask because such a switch would be convenient, and I see that it is fitted to both the battery and the D.C. mains models. I should, of course, use a quick make-and-break type switch.

There is no objection at all to the use of a mains switch, provided that care be taken in the wiring. A single pole switch can be used, and it can be fitted in the position adopted in the D.C. mains model. Twisted leads should be used for the connections, and these should be kept as far away from other wires as possible.

○○○○

I.F. Amplifier Selectivity.

Although the selectivity of my newly constructed superheterodyne receiver is extraordinarily good, judged by ordinary standards, it is hardly sufficient for my own receiving conditions, which are particularly bad, and I should be glad of a word or two of advice with regard to the I.F. amplifier.

Although no published design has been followed in the construction of the set, I am using a conventional inductively coupled band-pass filter in the I.F. amplifier; do you think that it would be worth while to try the effect of altering the band width by changing the relative positions of the filter coils? Should they be placed nearer together than at present?

In order to increase the selectivity of the I.F. amplifier, its resonance curve must, as you say, be made narrower, but this is done by moving the coils farther apart—not closer together.

It is for yourself to decide whether the loss of sidebands which will result from this procedure is tolerable or not; there is, of course, the possibility that the overall characteristics of the set will not be impaired by making this alteration, providing it is done judiciously.

○○○○

Oscillator Anode Current.

As I use dry-cell H.T. batteries, economy of anode current is important, and so I should like to know what is the irreducible minimum that can be allowed for the oscillator valve of a superheterodyne receiver.

We are afraid that it is impossible to make a definite pronouncement in this case without having full details of the set. But it may be stated that there is no reason why a superheterodyne oscillator should be unduly extravagant of current, and it should be an easy matter for you yourself to determine exactly how far this may be reduced without impairing the performance.

Adjustments can take the form of alterations in negative bias and of anode voltage. Further regulation can be effected by changing reaction coupling, but matters must, of course, always be so arranged that self-oscillation is maintained over the whole frequency band covered by the oscillator.

○○○○

Pick-up for the "Wireless World Three."

Will you please show me how to connect a gramophone pick-up to the "Wireless World Three" (battery model). If possible, I should like to use a simple single-pole on-off switch for changing over from "radio" to "gramophone" and vice versa.

The simplest form of connection is that shown in Fig. 1; by adopting it you will be able to use the switch mentioned.

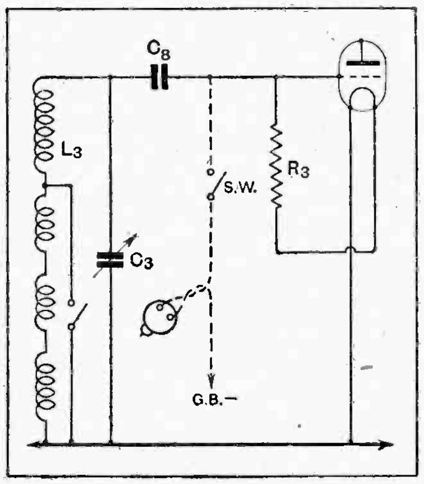


Fig. 1.—How to connect a pick-up in the detector grid circuit of the "Wireless World Three." Extra wiring in dotted lines.

○○○○

Cutting High Notes.

I am sending you a circuit diagram of my three-valve set, and should be glad of your opinion as to why reproduction of gramophone records is "dull," although the quality of broadcasting is excellent, and quite as brilliant as one could wish.

We see from your diagram that the pick-up is connected in such a way that it is shunted by the 0.0003 mfd. grid condenser; with certain types of pick-up, the addition of this capacity may be harmful.

The volume control potentiometer shunted across the pick-up is another potential source of high-note loss. You do not assign any value to this resistance in your diagram, but if it is of less than 50,000 ohms, it will probably be worth while to replace it with a component of at least that value.

○○○○

Grid Circuit Decoupling.

Is it likely that any advantage will be gained by decoupling the grid circuits of a battery-fed receiver?

We assume that you refer to a set in which grid bias potentials are derived from a tapped battery and not from a "free" bias device. Provided that this battery is of reasonably low internal resistance, it may be stated definitely that little, if any, advantage is likely to result from the addition of decoupling resistances and condensers; exceptions might possibly exist in cases where the H.F. valve (or valves) were biased from a common battery placed in such a position that long leads were necessary.

Generally speaking, the strongest argument against the use of decoupling is that bias batteries are relatively cheap, and so it is probably more economical to replace them as soon as their internal resistance becomes considerable, rather than to buy the necessary decoupling resistances and by-pass condensers.

○○○○

Replacing Old Valves.

I have a somewhat out-of-date four-valve receiver, and think that the time has come to replace the valves. On enquiring from my dealer, I find that the types originally supplied with the set are no longer manufactured; do you think that it would be safe to obtain modern counterparts with characteristics as nearly as possible the same as those of the original valves?

It is almost certain that your replacement valves will be considerably more efficient that those originally fitted, and consequently there is a real risk that as a result of making the change, instability will become evident.

Possibly the manufacturers of your set will be able to give you some definite advice on this question, but if they are unable to do so, it should be realised that stability with the new valves should be obtainable by reducing the amount of H.F. and L.F. amplification given by the receiver. To do this is in many cases fairly simple; for instance, if H.F. transformer coupling is used, it will merely be necessary to remove primary turns. Reduction of L.F. magnification is sometimes rather more difficult, as there is a risk of impairing the frequency characteristics of the amplifier. But if resistance coupling is used, no harm will be done by making reduction in the values of the coupling resistances. Of course, this can be done without disturbing the existing connections by joining extra resistances in parallel.

"A New Development in Power Grid Detection."

With reference to the article under the above heading in your issue of June 10th, I should like to try the principle of "straight" detection in my own receiver, which includes a single stage of H.F. amplification, coupled by the tuned grid method.

Will you please let me have a circuit diagram showing how the method suggested in Fig. 7 (b) of that article may be applied to my receiver; that is, of course, if the system is applicable to sets with H.F. amplification.

The principle of making one valve operate purely as a detector and not as a combined detector-amplifier, as in the more conventional circuits, is certainly applicable when there is a preceding H.F. amplifier. The appropriate connections are given in Fig. 2.

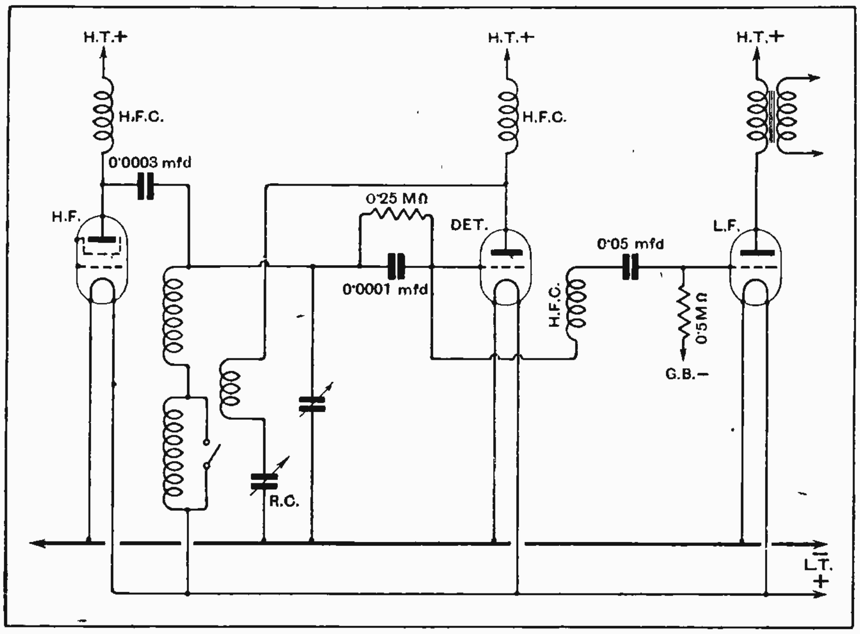


Fig. 2.—Avoiding anode characteristic limitations: a power detector, acting purely as a rectifier, with associated H.F and L.F. amplifying stages.

A Long-wave Problem.

My 1-v-1 receiver (A.C. mains operated) is almost entirely free from hum on the medium waveband, but this is by no means the case when receiving long wavelengths. Can you suggest a possible cause for this trouble? It should perhaps be added that the general performance of the set on long waves is not altogether satisfactory.

A circuit diagram is enclosed.

The inclusion of a high resistance in a grid circuit generally tends to increase hum, but the difference of ohmic resistance of a long-wave winding, as compared with a medium-wave coil, is usually almost negligible from this aspect. It may be, however, your long-wave coils are wound with unusually fine wire, or perhaps there is a high-resistance connection.

It seems much more likely that A.C. potentials are being conveyed to the grid circuits through the wave-range switching system. You can check this by temporarily removing the switch connections and then observing whether there is greater freedom from hum on the long-wave band. If the trouble is traced to this cause, it will obviously be necessary to rearrange the positions of the wave-range switches, or of the wiring.

oooo

"Boomy" Reproduction.

Although the quality of reproduction of my receiver is reasonably good, there seems to be a certain amount of "boominess" in the bass register. This is not due to the loud speaker itself, as the instrument has been tested on another set.

Can you give me a word of advice as to where the trouble is most likely to lie?

Imperfections of reproduction of this nature are almost invariably caused by L.F. reaction: although there may be no actual motor-boating, this reaction will generally tend to over-accentuate a narrow band of frequencies.

The remedy, of course, is to look to the decoupling arrangements at present included in the set. Although it may not be convenient to increase the value of the decoupling resistances, a good deal may be done by using larger by-pass condensers.

oooo

Danger of Cross-modulation..

I can only erect a very poor aerial, and I am doubtful whether the sensitivity of the Super-Selective Six will be sufficient. Would you advise me to add a preliminary stage of H.F.?

A stage of preliminary H.F. amplification can be added, and it can be made to give good results. Cross-modulation difficulties are so great, however, that we do not advise this addition if the set is to be used anywhere within about twenty-five miles of the local station. We think that the standard receiver will prove satisfactory, as tests have shown that even on a small indoor aerial large numbers of foreign stations can be received at loud speaker strength.

We would advise you, therefore, to build the receiver as described, and to make no alterations until you have proved them to be necessary. We do not think that you will need to make any.

oooo

Converting a Short-wave Set.

I have been attempting to modify my short-wave receiver for reception of the local station, which operates on the medium broadcast waveband. Unfortunately, although the receiver works, reaction control is most unsatisfactory, as under certain conditions self-oscillation can be provoked by decreasing the capacity of the reaction control condenser.

The receiver circuit is a conventional combination of regenerative detector and one L.F. stage. What do you think is the cause of the erratic behaviour on the medium band?

In all probability a special short-wave choke with an inductance of some few hundred microhenrys is used, and this, in conjunction with the capacity of the reaction condenser and other incidental capacities, forms a resonant circuit of a frequency lying within the medium broadcast band. If this is so, it is quite natural that the reaction circuit should fail to work in the normal way.

Your difficulty should disappear entirely if you connect a normal H.F. choke in series with the short-wave choke.

FOREIGN BROADCAST GUIDE.

JUAN-les-PINS

(France).

Geographical position: 43° 31′ N., 7° 06′ 56″ E.

Approximate air line from London: 640

Wavelength: 249 m. Frequency: 1,205 kc. Power: 0.8 kW.

Time: Greenwich Mean Time.

Standard Daily Transmissions.

12.30 G.M.T., news, play or concert; 20.30, news, play or relay of concert from the Palais de la Meditérranée (Nice); dance music (Sat.).

Man announcer. Call: *Allo! Allo! Ici le poste de Nice-Cannes et Juan-les-Pins, Emissions de la Société Radio Côte d'Azur;* between items: *Ici Nice-Cannes et Juan-les-Pins.*

Closes down with usual French good-night greetings, followed by *La Marseillaise.*

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Editorial Comment.

The B.B.C. and Standard English.

IN *The Wireless World* of September 23rd we included an article dealing with the subject of the B.B.C.'s attack on dialects and the effect that standard pronunciation on the part of announcers is likely to have on the speech of the British Isles.

Since that article appeared there has been much discussion and correspondence in various sections of the daily Press on the subject, and it is quite apparent that the effect of standardisation which is being brought about through the medium of the B.B.C. is strongly resented in many quarters, and we think that the problem is one which should be taken to heart seriously by the B.B.C., with the object of endeavouring to counteract such influences as they appear to be at present exerting, perhaps unintentionally, in the direction of eliminating local accent and dialects from the speech of these Islands.

Much of the trouble probably arises from simultaneous broadcasting, usually from London as a centre, and this could be counteracted if far more attention were paid to the choice of announcers for various stations who, whilst speaking correct English, would, nevertheless, in their pronunciation and delivery be typically representative in their speech of the local dialect.

The B.B.C. pronouncing dictionary was, we believe, compiled with purely laudable objects in view, but it has been denounced in many quarters as being far too dogmatic and as representing forms of pronunciation much too standardised to be acceptable, unless the purpose of the B.B.C. is definitely to standardise pronunciation throughout the United Kingdom, which would, in our opinion, be a form of coercive education such as the B.B.C. ought not to be in a position to bring about.

Make Sure of Next Week's Issue.

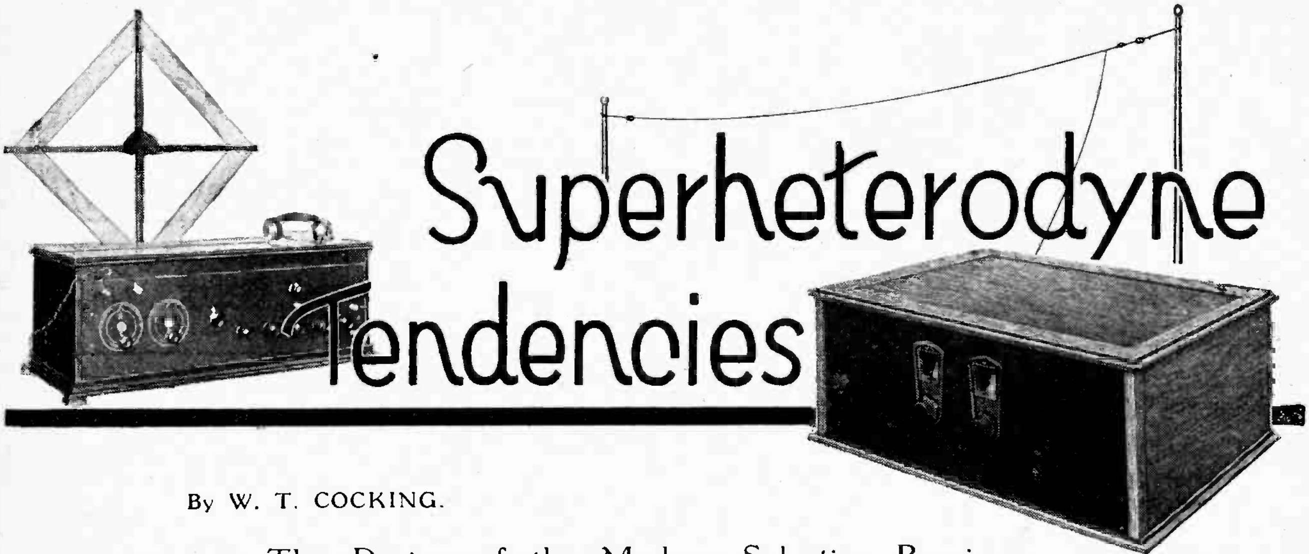
NEXT week's issue is to be a New Readers' Number, with special features for those who are taking *The Wireless World* for the first time.

The issue will contain a Special Supplement in the form of a Foreign Station Tuning Chart on a folded sheet, in colours. This chart has been designed to make station identification easy, and gives alternative tuning positions on 180° and 100-division condenser scales, as well as much other information of value.

Two special designs for receivers are included, which are especially up to date and have the advantage of being easy to construct, even by those who have little or no experience in set building. A number of articles of special appeal will be included. It is our intention to continue to meet the requirements of new readers in succeeding issues, with special articles in keeping with their standard of experience and knowledge of wireless.

We hope that all our readers will make a point of introducing *The Wireless World* to their friends with this number.

In This Issue



Superheterodyne Tendencies

By W. T. COCKING.

The Design of the Modern Selective Receiver.

THE superheterodyne, or frequency-changing method of reception, was invented during the war, when the need for receivers giving high amplification at short wavelengths became imperative. Judged by modern standards, the three-electrode valve was very inefficient in those days, and the technique for high-frequency circuit design had hardly been developed at all.

Straight H.F. amplification at wavelengths of 200 metres or so was impossible, whereas a useful degree of amplification could readily be obtained on wavelengths longer than 3,000 metres. An amplifier designed to work at a fixed long wavelength was used, therefore, and the wavelength of the incoming signal was changed to that of the amplifier. The scheme worked well, but several drawbacks associated with it prevented it from coming into universal use.

When broadcasting first commenced there was still the same difficulty in obtaining efficient H.F. amplification at short wavelengths, and the superheterodyne was commonly employed where a sensitive receiver was necessary. Its early popularity, however, was succeeded by a long spell of neglect, until it was revived by *The Wireless World* in November, 1930, because of certain inherent properties which rendered it pre-eminently suitable for modern broadcasting conditions. The reasons which led to its neglect were due to the same cause as those which have led to its revival, and before its curious history can be appreciated, certain basic properties must be understood.

SO rapid has been the advance of the superheterodyne receiver during recent months that it may have become difficult to acquire a complete understanding of the principles now involved. This article, by the designer of several successful superheterodynes recently described in these pages, summarises the salient features and gives valuable help on the practical details of design.

In general, the lower the frequency which any given valve is called upon to amplify, the greater will be the amplification. This is due, not to properties of the valve but of the circuits used for coupling valves, as these can be made much more efficient at low frequencies than at high, and this, of course, was the original reason for the development of the superheterodyne. Now, partly due to the increased circuit efficiency, and partly to lowering the frequency of the incoming signal, the selectivity also becomes greater the lower the frequency; in fact, unless the proper precaution be taken, it can become so great that it will destroy the characteristics of speech and music and create horrible distortion.

In the early days of broadcasting, quality was usually considered of little importance, while high selectivity was unnecessary, owing to the few stations then in operation. The whole aim of the set designer was to get amplification, and this could most easily be obtained with the superheterodyne. Among long-distance listeners and experimenters it enjoyed quite a large degree of popularity, and was frequently called the Rolls-Royce of radio.

Owing to the large number of valves employed, few sets using less than eight, and to the high current consumption of the only valve available, the running costs were very high indeed. An early superheterodyne would often require 5 amperes at 6 volts for the filament supply, or a total of 30 watts, while the H.T. current consumption was altogether excessive for the small-capacity dry batteries then universally used. More economical valves were developed as time went on, and the running costs were correspondingly reduced, but improvements in the electrical efficiency of the valve, and developments in circuit design, in particular the invention of the neutralised H.F. amplifier, sent the superheterodyne definitely out of favour.

Design Tendencies.

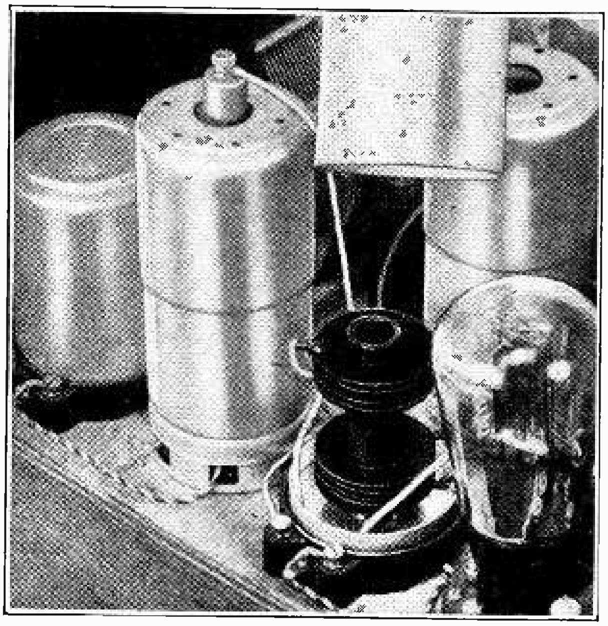
Real H.F. amplification could readily be obtained by the use of highly efficient neutralised circuits, and as a

Superheterodyne Tendencies.—
high order of selectivity was still unnecessary, receivers of this type gave every satisfaction. Two events mark the next stage in the history of radio—the introduction of the screen-grid valve, which has led to the decease of the neutralised circuit; and the increase, both in number and in power, of broadcasting stations.

The ease with which high amplification could then be obtained led to the use of very sensitive, but unselective, receivers, while the increase in broadcasting stations made the need for selectivity greater than ever. This state of affairs continued for some time, and only minor improvements were made in selectivity until the band-pass filter was introduced by *The Wireless World* late in 1929. This led to a great improvement in both selectivity and quality, in fact, so much so that the old indictment of the sensitive long-distance receiver being unsuited for local station reception no longer held good.

Even with the aid of band-pass filters, however, the selectivity problem was by no means solved, for the local station could still cause a great deal of interference unless the receiver were unduly large and expensive. It was at this stage that the old and neglected property of the superheterodyne was revived, namely, its high selectivity. Experience showed the receiver to possess many faults; the sensitivity and selectivity, indeed, were all that could be desired, but the quality of reproduction was very poor and the receiver was quite difficult to tune.

Investigation showed that these faults were not fundamental properties of the superheterodyne, but were due to the design being many years out of date. Investigation further showed that the superheterodyne was capable of giving as good quality as any other receiver, while the amplification and selectivity were much greater than that given by any straight H.F. set of equal cost. Most of the tuning difficulties and special interference problems could be overcome by the proper choice of valves and circuit constants.



A Modern Band-pass I.F. Amplifier.

Early in the investigation into the properties of the superheterodyne it was found that it provided the most economical means of obtaining the extremely high selectivity necessary for distant reception under modern broadcasting conditions. Attention was, therefore, paid to the following points: quality, ease of handling, cost, and certain special interference problems.

For the purposes of description, the ordinary receiver may be divided into three parts, the H.F. circuits, the detector, and the L.F. circuits; the superheterodyne, however, is divided into five parts, the H.F. circuits, the first detector, the I.F. circuits, the second detector, and the L.F. circuits.

Fundamentally, the second detector and L.F. circuits are the same in the two methods of reception, and the same design considerations apply. A slight difference is introduced into the detector circuits, however, owing to the different frequency at which it must operate. The H.F. circuits, too, are substantially the same, although quite a number of special precautions must be observed.

The Intermediate Frequency.

The conditions governing the choice of the intermediate frequency have been thoroughly discussed in previous articles,[1] and it is sufficient to point out here that the lower the frequency the greater the adjacent channel selectivity, but the greater the liability to second channel interference. Limits are set to the choice of frequency by the highest audio-frequency which it is desired to reproduce, and by the lowest radio-frequency which must be received; these considerations at once restrict the intermediate frequency in this country to a band between 20 kc. and 130 kc. maximum.

Considerations of second-channel interference render it inadvisable to employ a frequency lower than about 80 kc., while beat interference also rules out certain frequencies within this remaining band of 80 kc. to 130 kc. The frequency chosen should not be within 10 kc. of the difference between the frequencies of two high-power stations situated fairly close together. A case in point is the London Regional and the Midland Regional; the difference between their frequencies is 90 kc., and so the intermediate frequency must not be between 80 kc. and 100 kc. Again, the frequency difference between the Midland Regional and the North Regional is 126 kc., so that the range of 116 kc. to 136 kc. is also ruled out. Thus we are left only to choose from the band of 100 kc. to 116 kc., and we are jockeyed into using a frequency of about 110 kc.

By the proper choice of the frequency, many of the past troubles of the superheterodyne immediately disappear. It is often thought that the intermediate frequency used is not important, but this is not the case, for it is one of the most important factors influencing the performance of the receiver in a congested district. In this country, owing to the present spacing and disposition of broadcasting stations, 110 kc. is the most satisfactory frequency for economical operation.

[1] "The Selectivity of the Superheterodyne," *The Wireless World*, May 13th and 20th, 1931.

Superheterodyne Tendencies.—

Having decided upon the intermediate frequency, the design of the I.F. intervalve couplings is the most important point requiring attention. Both theory and practice show that if the full selectivity is to be obtained, it is absolutely essential to employ band-pass filters, as shown in Fig. 1, for only then can sideband cutting be avoided and first-class quality be obtained. The use of such filters reduces the efficiency somewhat, but

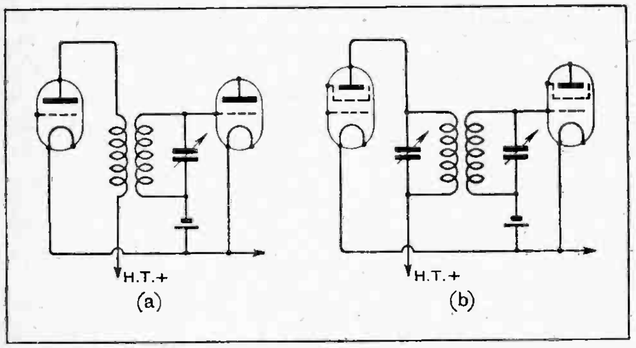


Fig. 1.—The old single tuned transformer circuit is shown on the left, while the modern band-pass filter coupling appears on the right. The latter circuit gives higher selectivity and better quality, but has a somewhat lower efficiency.

that this is not serious is shown by the fact that a single I.F. valve will still provide all the ampification normally required. This is achieved by careful attention to the filter design and choosing the optimum ratio of inductance to capacity in the tuned circuits.

The Frequency Changer.

The next important point is the design of the frequency changer, and this must be considered in conjunction with the H.F. circuits. In the frequency changer itself, harmonics of the oscillator must be kept low, otherwise stations can be tuned in at many different points on the tuning dial, so that the operation becomes difficult and the selectivity is reduced. In order to avoid this state of affairs it is necessary to eschew single-valve frequency-changer circuits, and to use separate valves for the detector and oscillator, and, in addition, to tune the anode circuit of the oscillator.

During the course of a series of experiments with superheterodynes, the writer found that a five-valve receiver, consisting of a two-valve frequency changer, a single stage of I.F. amplification, a second detector, and a power output valve, would give sufficient amplification to enable any musically worth while station to be received, provided that an outdoor aerial was employed. Difficulties then commenced, as such a receiver could not be used with an outdoor aerial, owing to the risk of radiation. This could be avoided in two ways—a stage of screen grid H.F. amplification could be interposed between the aerial and the frequency changer, or a frame aerial could be used.

An extra stage of amplification was considered undesirable for many reasons; in the first place, the amplification was unnecessary and wasteful, as it increased the cost and size of the set; furthermore, it introduced many interference problems due to cross-modulation. A frame aerial proved unsatisfactory, for the normal amplification was too little, and the extra stage of H.F. was really required; in addition, it made ganging of the H.F. circuits very difficult.

The difficulty was got over by the development of a new non-radiating frequency changer[2] shown in Fig. 2. Instead of coupling the oscillator to the grid circuit of the first detector, the whole anode coil of the oscillator is included in the anode circuit of the first detector; the screen grid first detector is interposed between the oscillator and the aerial, and so radiation is eliminated. Furthermore, by the particular arrangement which can be employed, special coupling coils are eliminated and waveband switching is greatly simplified.

Special Interference Problems.

Even at this stage of the design work, many problems still awaited solution. The first and most important of these was second channel interference. This was kept low by the choice of the high intermediate frequency, and it was found that a band-pass filter preceding the first detector gave perfectly satisfactory results. For a long time a type of interference peculiar to the superheterodyne proved very troublesome; continuous-wave telegraphy stations working with frequencies within plus or minus 5 kc. of the intermediate frequency found their way to the grid of the first detector, and then they were, of course, passed by the

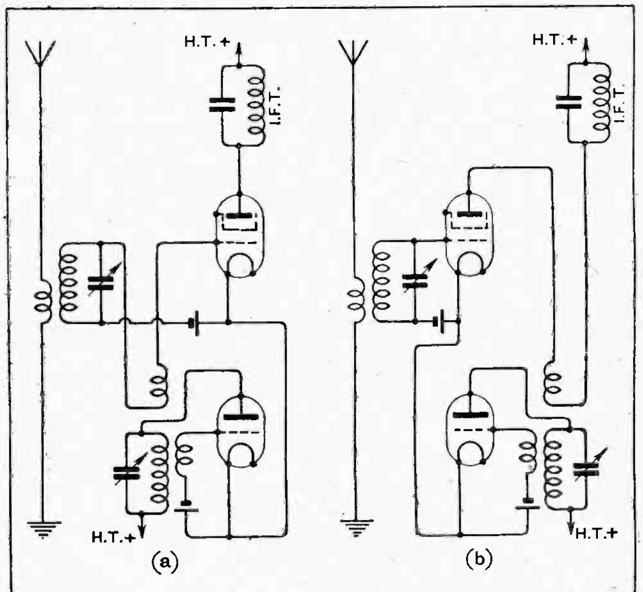


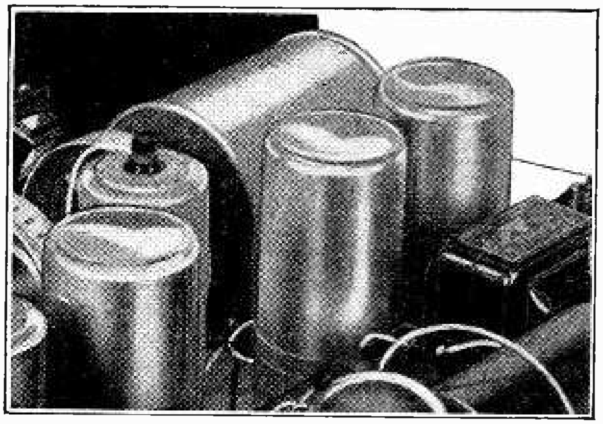
Fig. 2.—The circuit of a normal frequency changer is shown on the left; the oscillator is coupled to the grid circuit of the first detector and radiation from the aerial is probable. In the frequency changer on the right, however, the oscillator is coupled to the anode circuit of the screen-grid first detector and all radiation is avoided.

intermediate frequency circuits and caused annoying interference on all stations being received.

This interference is readily recognised by being audible only when a station is tuned in, and by the fact that the note changes as the oscillator condenser setting is varied slightly. It was found that this interference was eliminated on the medium waveband when

[2] "Frequency Changers," *The Wireless World*, May 6th, 1931

Superheterodyne Tendencies.—
inductive coupling was employed in the H.F. band-pass filter. On the long waveband, however, interference was still present, for the reason that the intermediate frequency was close to the received frequency, and the signal was passed, although inefficiently, by the filter. A special circuit was at length devised for its elimination, and it proved eminently satisfactory. An acceptor circuit tuned to the intermediate frequency of 110 kc. was connected across the aerial and earth terminals to by-pass the interference to earth. This was embodied in the "Super-Selective" series of receivers described in this journal, and finally removed all interference troubles, and the more detailed design of the circuits could, therefore, be proceeded with.



The well-screened first detector tuning circuits.

A really effective and distortionless volume control is an essential part of a superhterodyne; most existing controls either introduced distortion or were not sufficiently effective. After considerable experiment, the best control was found to be two entirely separate controls ganged together and operated by a single knob. One potentiometer, connected to control the input from the aerial, was ganged to another potentiometer which varied the voltage on the screen grid of the I.F. valve. This type of control was found to be distortionless, and at the same time to give a sufficiently wide range of control to reduce a strong local station to a whisper.

The chief design troubles had by this time disappeared, and such details as had to be decided upon were the layout of components and the arrangement of the voltage dropping and decoupling resistances and condensers. These, of course, followed well-known practice, but the extra frequency, i.e., the intermediate frequency, present in the superheterodyne necessitated more careful consideration of certain aspects of the case. One of the chief problems was to avoid feed-back to the first detector of the second and third harmonics of the intermediate frequency which are present in the second detector output. This was largely a matter of the choice of components in the filter in the second detector output, and of the layout of the receiver as a whole.

Leading Features in Design.

This research into the properties of the superheterodyne which has been outlined occupied some nine months, and resulted in the production of the Super-

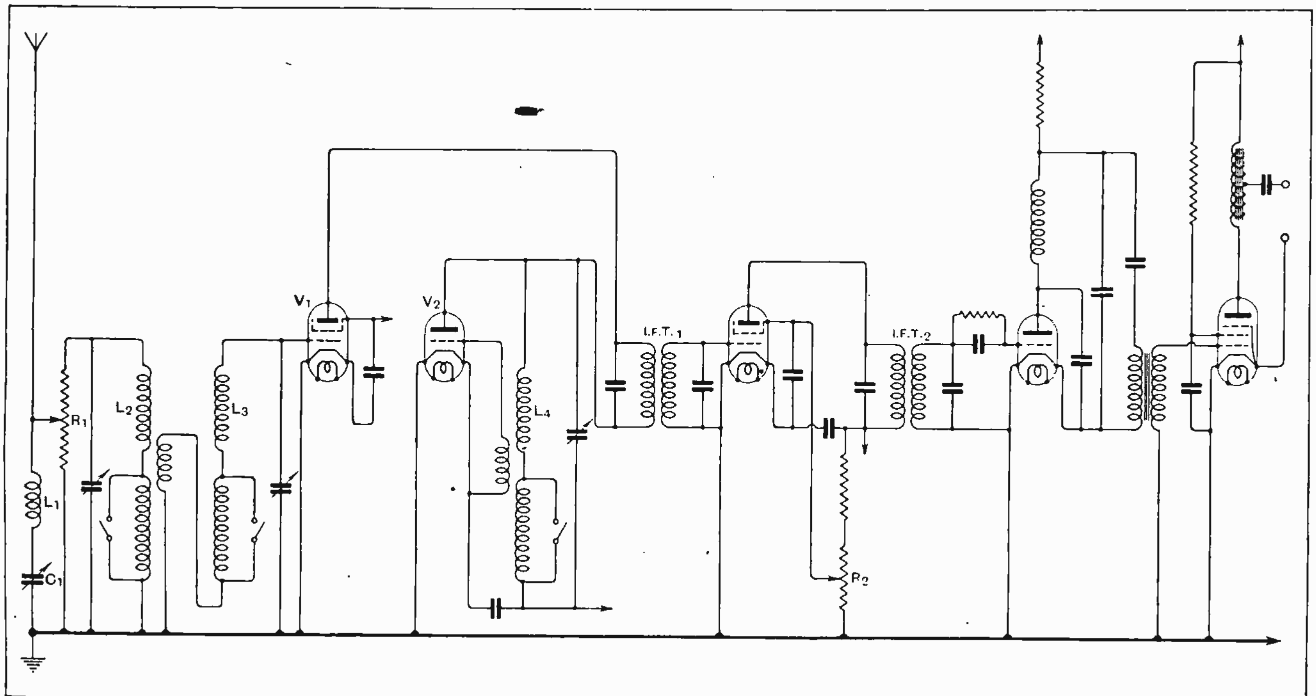


Fig. 3.—The skeleton circuit of the "Super-Selective" receivers; for simplicity all grid bias and H.T. connections are omitted. The special points to note are the I.F. acceptor circuit L_1C_1, the dual ganged volume control R_1R_2, the inductively coupled band-pass filter L_2L_3, the two I.F. band-pass filters I.F.T.₁, I.F.T.₂, and the special frequency changer comprising V_1, V_2, L_4, I.F.T.₁.

Superheterodyne Tendencies.—

Selective Six[3], a five-valve receiver for all A.C. mains operation. This was followed shortly afterwards by the Super-Selective Five[4], for operation from batteries, and to complete the range the D.C. Super-Selective Five[5], for operation from D.C. lighting mains, has recently been produced.

The chief features of all these receivers are similar, and the differences lie mainly in the voltage dropping and decoupling arrangements and in the heater wiring. A skeleton circuit, therefore, can be given which is applicable to the main features of each model; it will be seen from Fig. 3 that screen-grid valves are employed for the first detector and the I.F. stage, triodes for the oscillator and second detector, and a pentode for the output valve, except in the case of the battery model, where a triode is used for the last valve.

Results.

The results from the two mains-driven models are practically identical, and well justify the description of the superheterodyne as the most selective receiver known. Within a few miles of a modern high-power broadcasting station it is possible to receive on a full-size outdoor aerial distant stations transmitting on any frequency not nearer to the local than 18 kc., while at a reasonable distance from the local, say 20 miles or so, it is possible to receive a station on an adjacent channel. The quality of reproduction is really good, and not in the least reminiscent of that associated with early superheterodynes, being, in fact, better than that of many special local-station quality receivers. The power output provided by the single pentode is amply sufficient for all ordinary purposes, since it feeds about 1,900 milliwatts into the loud speaker.

The sensitivity is about the same as that of the best four-valve screen-grid sets, with two H.F. stages and pentode output; with a reasonably good aerial it is possible to receive at full loud-speaker strength any station which is sufficiently stronger than the prevailing mush level to render its programme enjoyable. Extreme sensitivity was not aimed at, since its only use lies in bringing in very weak, low power transmissions, and nowadays these usually relay the stronger stations.

The results with the battery model are very similar, but naturally not quite so good in view of the limitations imposed by directly heated valves and the low power supply. The selectivity is of about the same order as in the mains models, while the quality is equally good provided that no attempt is made to overload the valves in order to extract a large volume output. The output is, of course, fixed by the last valve in the set, and is about 350 milliwatts; the maximum volume, therefore, is less than that given by the other models. Nevertheless, it is quite sufficient for the medium-sized room of the modern house. The sensitivity is also somewhat lower than that of the mains models, due to the poorer characteristics of battery-type valves; in spite of this, the range is surprisingly good, and on test as many stations were logged as with either of the other two.

In every case the tuning arrangements are identical, and consist of two dials for controlling the frequency received, a volume control, and a wave-range switch. No adjustment is critical, and so the operation of tuning is quite simple; there is no splitting of hairs in setting the dials.

[3] "The Super-Selective Six", *The Wireless World*, June 3rd and 10th, 1931.

[4] "The Super-Selective-Five," *The Wireless World*, July 15th and 22nd, 1931.

[5] "The D.C. Super-Selective Five," *The Wireless World*, August 12th and 19th, 1931.

CLUB NEWS.

Pick-Up with Edison Phonograph.

First class gramophone, radio and radiogramophone recitals, together with demonstrations of new inventions and apparatus, are to feature in the winter session of the City of London Phonograph and Radio Society. At the meeting this evening (Wednesday) at 6.30, Mr. A. Maskell will demonstrate an electrical pick-up for use with the Edison Phonograph. There are still many Edison enthusiasts who are reluctant to give up their instruments and those who are able should make a definite effort to attend this meeting, which will be held at the Food Reform Restaurant, Furnival Street, Holborn, E.C.4.

Hon. Secretary: Mr. R. H. Clarke, 5a, Tynemouth Terrace, Tottenham, N.15.

Radio Tours on Saturdays.

Fortnightly meetings throughout the winter session have been arranged by the Northwood Radio and Gramophone Society and the first meeting was held on October 6th when a representative of Messrs. Wright and Weaire, Ltd., lectured on "All Mains Superheterodyne Receivers."

An attractive syllabus has been prepared and arrangements have been made for several visits to places of interest on Saturday afternoons. All communications regarding membership should be addressed to the Hon. Secretary: Mr. D. B. Close, Cranleigh, Watford Road, Northwood, Mddx.

Members of 20 Years' Standing.

The Liverpool Wireless Society, which was founded over twenty years ago, has opened its winter session and meetings are being attended by many of the original members. A cordial invitation awaits newcomers and enquiries will be welcomed by Mr. R. Reid Jones, 24, Oak Leigh, The Brook, Liverpool.

Two Meetings a Week.

The Bec Radio Society intends to separate the sheep from the goats by holding two meetings each week, on Tuesdays for advanced members and on Thursdays for newcomers who wish to study the subject from the beginning. Meetings are held at the Bec School, Beechcroft Road, Balham, S.W.17. Enquiries should be addressed to the Hon. Secretary: Mr. A. L. Odell, 9, Westway, Grand Drive, Raynes Park, S.W.20.

New Session in Derby.

The Derby Wireless Club has resumed meetings in the Lecture Room, Peartree Branch Library, and an interesting programme of fortnightly meetings has been prepared for the coming session.

Hon. Secretary: Mr. R. H. Hodkinson, Field House, Allestree, near Derby.

Dr. McLachlan in Newcastle.

On Friday, November 6th, Dr. N. W. McLachlan, the authority on loud speakers, will lecture before the Newcastle-upon-Tyne Radio Society on "Recent Research on the Moving-coil Loud Speaker and its Bearing on Design." The Chair will be taken by the Society's President, Professor W. M. Thornton.

A campaign has been opened to enquire into and deal with interference caused to wireless receivers by electrical devices. Interference in parts of the Newcastle district is very bad and taking the hint thrown out by *The Wireless World*, the Society has decided to make a move.

Hon. Secretary: Mr. W. W. Pope, 9, Kimberley Gardens, Jesmond, Newcastle.

The Tenth Year.

The optimistic spirit with which the Thornton Heath Radio Society embarks upon its tenth year of activity was referred to by Mr. E. Scratchley, the Vice President, at the 9th Annual General Meeting held recently at St. Paul's Hall, Norfolk Road. Over seventy-five per cent. of the members were in attendance.

Hon. Secretary: Mr. C. H. Piper, 77, Torridge Road, Thornton Heath.

The Danzey Green Mystery.

Has a "blind spot" been discovered by members of Slade Radio (Birmingham)? The question arose at last week's meeting when the recent direction finding test gave scope for a fascinating discussion. Each of the competitors read his log and gave details of his experiences. A particular note was made of the fact that in and around a spot known as Danzey Green no reliable bearings could be taken. The mystery has challenged the curiosity of members and the district is to be explored.

Full particulars regarding membership of the Slade Radio Society may be obtained from the Hon. Secretary: 110, Hillaries Road, Gravelly Hill, Birmingham.

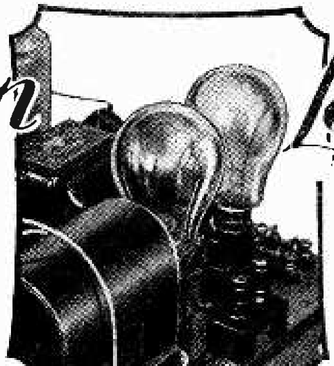
As the Operator Sees It.

Life as seen by a ship's wireless operator was vividly described by Mr. C. L. S. Cooper at a meeting of the Bristol and District Radio and Television Society on October 9th. Mr. Cooper described his varied experiences in all kinds of ships—from liners to tramps.

On Friday next, October 23rd, a lecture on "Valve Developments of Special Interest" will be given by Mr. Quarrington of Messrs. A. C. Cossor, Ltd.

Hon. Secretary: Mr. G. E. Benskin, 12, Maurice Road, St. Andrews Park, Bristol.

Carbon Lamp Resistances



The carbon-filament lamp provides a simple and inexpensive mains resistance to drop the necessary voltage in a D.C. receiver. Furthermore, it possesses the advantage that heater current is applied gradually as the resistance decreases with increase of temperature. There are some 42 carbon lamps listed as standard, and a table in the article gives the necessary data for the choice of a lamp for practically every requirement in a D.C. set.

Voltage Dropping in D.C. Mains Sets.

IT is the standard practice in D.C. mains receivers to connect all the valve filaments, or heaters, in series with one another, and with a resistance whose purpose it is to drop the mains voltage to a suitable value for heating the valves. The value of this resistance must be quite high, and it must dissipate quite a large amount of power in the form of heat; the choice of a suitable type, therefore, is by no means easy.

The earlier Mazda range of D.C. valves, for instance, require a current of 0.5 ampere, and as the total voltage required for a three-valve set may be only 20 volts, in the case of 200 volts mains, some 180 volts must be dropped in the resistance. This means that the resistance must dissipate 90 watts and have a value of 360 ohms. While a wire-wound resistance of this type is quite practicable, it is not always the simplest; and it is often very convenient to use an electric light lamp.

There are two main types of lamp—the metal filament and the carbon filament. The former of these is now almost universally used for lighting purposes, but it is quite unsuitable for voltage dropping in a wireless set. The resistance of a lamp is not a constant quantity, but depends upon the temperature of the filament; in the case of the metal-filament lamp, the resistance increases with an increase in temperature, but in the carbon-filament type the resistance actually *decreases*.

Obviously, the metal-filament type is dangerous in a filament circuit, for the resistance is low when the lamp is cold, and an excessive current is passed when the set is switched on. With the carbon-filament type, on the other hand, the resistance is high when cold, and the current at the moment of switching on is below normal, but rises gradually to normal as the lamp warms up.

This is a desirable characteristic, for the heater current is applied gradually, the effect being rather as if a rheostat were used instead of a mains switch, and the life of the valves should be prolonged. A lamp, too, is a convenient form of resistance, since it is cheap, easily obtainable, and compact, and, furthermore, is constructed to dissipate the required amount of heat.

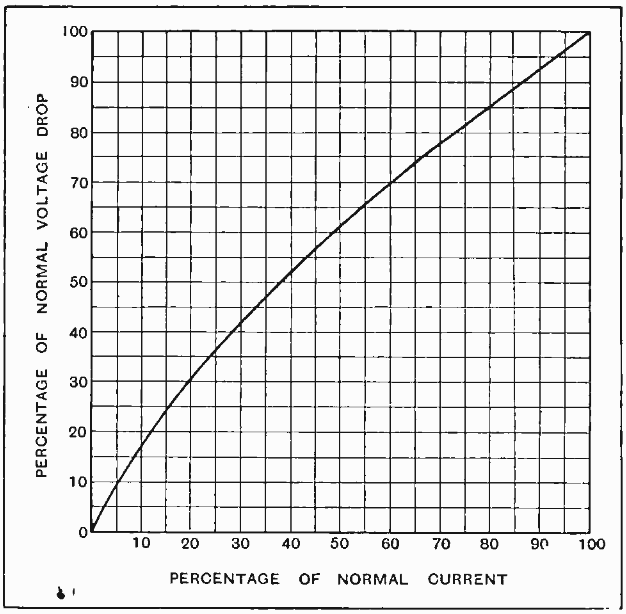


Fig. 1.—The curve shows the non-linear change in the voltage drop across a carbon lamp with a change in the current through the lamp. The scales are plotted in percentages so as to render it applicable to any lamp,

Choosing the Lamp.

The choice of a suitable lamp for a given receiver, however, is by no means simple; as just explained, the lamp resistance depends upon its temperature, but the temperature depends upon the current flowing through it, and so we find that the resistance actually depends upon the current. A curve is given in Fig. 1,[1] therefore, which shows the relation between the percentage of the normal lamp current and the percentage of the normal voltage drop across it; and with its aid it is readily possible to calculate the lamp resistance for any given current.

There are some 42 Robertson[2] carbon lamps listed as standard, and the characteristics of these are given in the Table. Columns 1 and 2 show the maker's voltage and watts rating, and provide the means of identifying any particular lamp. Column 3 shows the current drawn by the lamp when operated at its rated

[1] *Radio Broadcast*, September 1929.

[2] The General Electric Co., Ltd.

Carbon Lamp Resistances.—

voltage, and Column 4 shows the resistance at this current.

Among the modern indirectly heated D.C. valves there are types which draw either 0.5 ampere or 0.25 ampere, and a glance down Column 3 shows that there is not a single lamp which draws either of these currents at its normal working voltage. It is necessary, therefore, to underrun the lamp, and so both the voltage drop and the resistance will be different from the figures shown in Columns 1 and 4. Columns 5 to 8 have been added, therefore, and show the voltage drop and resistance at the two different values of reduced current which meet most modern requirements.

Columns 5 and 6 respectively show the voltage drop and resistance of the various lamps when a current of 0.25 ampere is passing, while Columns 7 and 8 give the same information for a current of 0.5 ampere. The choice of a lamp for any given case is thus reduced to its simplest terms, for it is merely necessary to calculate the voltage which must be dropped across the lamp, and then to look down Column 5 or 7, according to whether 0.25 ampere valves or 0.5 ampere are used, and select the lamp, or combination of lamps, which gives the voltage drop nearest to the figure required.

CARBON LAMP CHARACTERISTICS.

Maker's Rating.				At 0.25 amp.		At 0.5 amp.	
Volts. (1)	Watts. (2)	Amps. (3)	Resistance. (4)	Voltage drop. (5)	Resistance in ohms. (6)	Voltage drop. (7)	Resistance in ohms. (8)
100	30	0.3	333	88	352	—	—
105	30	0.286	367	95.2	381	—	—
110	30	0.273	404	103	413	—	—
115	30	0.262	440	111	445	—	—
120	30	0.25	480	120	480	—	—
125	30	0.241	520	—	—	—	—
130	30	0.231	564	—	—	—	—
200	36	0.18	1,110	—	—	—	—
210	36	0.172	1,220	—	—	—	—
220	36	0.164	1,345	—	—	—	—
230	36	0.157	1,470	—	—	—	—
240	36	0.15	1,600	—	—	—	—
250	36	0.144	1,735	—	—	—	—
260	36	0.139	1,870	—	—	—	—
100	56	0.56	178.5	53.5	214	92	184
105	56	0.535	197	61.5	246	100	200
110	56	0.51	215.5	66	264	108	216
115	56	0.488	236	72	286	—	—
120	56	0.466	257.5	76.8	306	—	—
125	56	0.45	279	82.5	330	—	—
130	56	0.431	302	88.4	353	—	—
200	66	0.33	606	165	660	—	—
210	66	0.315	666	178.5	715	—	—
220	66	0.3	735	193.5	775	—	—
230	66	0.286	805	209	835	—	—
240	66	0.275	872	223	892	—	—
250	66	0.265	946	240	960	—	—
260	66	0.255	1,020	256	1,025	—	—
100	115	1.15	87	31.5	126	55.2	110
105	115	1.1	95.6	34.2	137	60	120
110	115	1.05	105	37.4	149	65	130
115	115	1	115	40.8	163	70,6	141
120	115	0.962	125	43.9	175	75.6	151
125	115	0.925	135	47	187.5	81.3	162.5
130	115	0.885	147	51.4	205	87	174
200	136	0.68	294	97	388	161	322
210	136	0.65	324	105	420	175	350
220	136	0.62	356	115	460	189	378
230	136	0.59	390	124	496	204	408
240	136	0.57	422	132.5	531	218	436
250	136	0.544	460	143.5	570	235	470
260	136	0.525	496	154	616	251	502

A Practical Case.

As an example, suppose we wish to run a three-valve set from 200 volts mains, and that Mazda DC/SG, DC/HL, and DC/Pen. valves will be used. The total voltage required by the valves, therefore, is 20 volts, and the current is 0.5 ampere; and so we must drop 200 − 20 = 180 volts in the lamp resistance. We look down Column 7, therefore, and find that there is no lamp giving a voltage drop of exactly 180 volts; the nearest is a "210 volts, 136 watts" lamp, which gives a voltage drop of 175 volts. This would be quite near enough were we sure that the lamp would actually have its calculated resistance. The figures in the Table, however, are all based upon the makers' listed figures for voltage and watts, and as these are only approximate, the figures for voltage drop and resistance are themselves only approximate.

It has been the writer's experience that the figures for resistance are somewhat higher than those actually found in practice, and, consequently, the figures for voltage drop are also somewhat on the high side. The error is usually about 10 per cent., and so it may be allowed for in choosing the lamp.

To take the above example, we require a lamp to drop 180 volts at 0.5 ampere; add 10 per cent. to the voltage drop, making 198 volts, and look down Column 7 for the most suitable lamp. The nearest is a "230 volts, 136 watts" lamp for which the calculated voltage drop is 204 volts, and it will probably be found in practice that this gives just about the correct current.

Owing to the necessarily approximate figures in the Table, which are due to the possibility of variations between different lamps of the same rated value, it is unwise to set up a receiver without measuring the current and making sure that it is within plus or minus 5 per cent. of the rated value for the valves. A suitable ammeter is not always available, and so as an alternative the voltage across one or more of the valves may be measured with a high-resistance voltmeter. It is also advisable to check the current occasionally, say, after every 1,000 hours' use, to make sure that the lamp resistance has remained unchanged.

In some cases it will be found that no single lamp will give the required voltage drop, and it is then necessary to use two in series, the requirement being that the sum of the voltage drop across each equals the total voltage drop needed.

It will often be found desirable to use two lamps, even when a single one with the required characteristics can be found. It will be obvious that as the total watts dissipated is the same in the two cases, a single lamp will run much hotter than two in series. The total amount of heat, of course, is the same, but as it is spread over two lamps instead of one, each lamp is cooler and requires less ventilation.

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AMERICA ADOPTS HALF-WAVE AERIALS.

THE vertical type of half-wave radiator has been adopted by the Columbia Broadcasting System of America for use by its new 50-kW. transmitter which is rapidly nearing completion near New York.

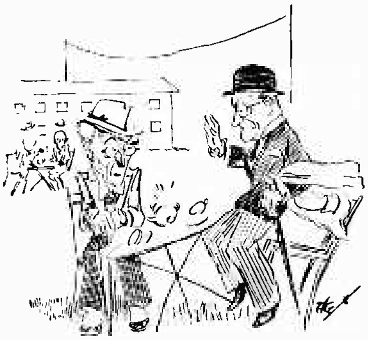
The new aerial, which is the supporting tower itself, is a steel lattice-work structure, pointed at both ends and tapering from the ends to the thickest point, half way up the tower, from which the supporting insulated guy wires run. The tower is 665ft. high, the topmost 75ft. being arranged so that it can be raised or lowered during the initial tuning adjustment. The bottom of the tower rests on an insulator which has been subjected to a compression test of 500 tons.

Unbiased —"by FREE GRID"—

Scandal at the N.P.L.

I WAS rather scandalised a few weeks ago, when attending a "Tea Party" at the National Physical Laboratory at Teddington, to hear a very well-known doctor of science (who otherwise commands my greatest respect) making an exhibition of himself by declaring, in the course of a friendly chat, that the "H.T. positive" end of the plate circuit of an ordinary valve "hook up" was the high potential end of that circuit. His statement showed evidence of a lack of clear thinking and a general haziness concerning fundamental wireless principles which is all too prevalent to-day; indeed, had the N.P.L. been providing us with anything stronger than tea I should have been inclined to lead him gently by the arm to my car and drive him home.

I put the position rather crudely to him by suggesting that he climb to the top of a tall factory chimney and see if he had any difficulty in deciding which was the high and which was the low potential end of it. He countered by saying that if by this I meant that the low potential end of the plate circuit was the earthed end, then he was right, and I was wrong, because it is the negative end of the H.T. battery which is at earth potential and not the H.T. positive end. I came back at him by stating that his set would perform equally well if he earthed the positive end of the



Rather scandalised.

H.T. battery instead of the negative end, and in any case, what about people who use an H.T. battery eliminator on D.C. mains where the positive wire is earthed? After an hour's hard talking on my part he finally gave in and promised to come quietly. I wonder if any readers of *Wireless World* labour under any delusion on what is quite an elementary point.

❖ ❖ ❖

The Vanishing Frame.

AT last it appears that a definite move has been made to end the inefficient and unsightly frame aerial, except, of course, in its obviously proper sphere of the portable set. I cannot see that, apart from portable sets and certain types of commercial direction finders, it is of any advantage to anyone nowadays. It is always an eyesore in any room, and even if hidden away in a cabinet it is cumbersome, and the knob for rotating it means an extra control for our receivers.

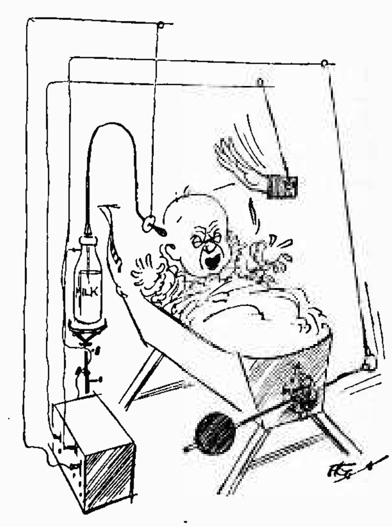
The only reason that could legitimately be advanced for its existence in the old days was that if employed with a fairly sensitive receiver, such as a superheterodyne, use could be made of its directional properties to enable us to receive distant stations better whose direction was at right angles—or thereabouts—to that of the interfering local station.

Modern systems of tuning such as those advocated by this journal have knocked this slight advantage on the head, for we can obtain all the selectivity we want without calling upon the directional properties of the frame, and we can cut out the local station and get that desired "Continental" irrespective of the direction in which it lies. As for sensitivity, the frame aerial was always the world's worst collector of energy, and even the largest of them can easily be bettered by half a dozen yards of flexible wire, tucked out of sight behind a picture rail. It is not without significance that the three extremely popular superheterodyne receivers, constructional details of which have recently appeared in *The Wireless World*, dispensed entirely with this ugly and inefficient device.

Cradle Rocking by Radio.

I WAS astonished to read the other day, in a journal originating on the Pacific coast of America, that a man claimed to have invented an apparatus for rocking the baby by radio or performing other services for it during the temporary absence of its parents on an automobile tour. It appears that the receiving and rocking apparatus is situated at the side of the baby's cradle and that a microphone is suspended over the baby's head. In the car is a portable transmitter and a receiver.

Apparently the microphone over the cradle enables the fond mother



. . . . or clout it on the head.

to judge whether the baby requires rocking, refreshment, or any other service. By suitably modulating the carrier wave of the transmitter in the car, the apparatus at the home end can be caused to rock the cradle, fill the baby up with milk, or clout it on the head, as its mother may deem necessary.

Presumably, as television develops, it will be added to the apparatus, so that the careful mother can make sure that, due to some maladjustment of grid bias, the baby is not being overloaded in the matter of milk. The only fly in the ointment, so far as I can see, is jamming, which might result in the baby getting a heavy clout instead of its milk supply. Apart from this, surely it would be cheaper to leave the child in charge of a nursemaid.

Table Radio-Gramophone

H.M.V. Model 501

A Compact Instrument with the Performance of a Full-sized Console Radio-Gramophone.

WE have become so accustomed to thinking of radio-gramophones in association with large pedestal cabinets that it is at first difficult to believe that this table model is indeed a fully fledged radio-gramophone. A brief test, however, soon dispels any idea that its performance has been scaled down in proportion to its size. The moving-coil loud speaker is capable of giving far more volume from gramophone records than can be tolerated in the average room, while the radio receiver is no less lively and can be relied upon to provide a wide variety of British and Continental programmes, even when worked from the mains aerial.

The specification is, in fact, quite as generous as that of the average pedestal or console radio-gramophone, but the principal components have been assembled with such skill that the overall dimensions of the complete instrument do not exceed 19¾in. × 17⅜in. × 14¼in. Considerable space has been saved by building the moving-coil loud speaker into the receiver chassis itself. For this purpose a supporting ring is formed in the main member of the chassis to which the loud speaker is bolted. Although the field magnet penetrates well back among the components in the set the ends of the chassis are open, and there is free egress for sound waves emitted from the back of the diaphragm. In this connection it is noteworthy that the bottom and sides of the cabinet, as well as the back, are provided with gauze-covered holes to minimise internal reflection and to dissipate the heat generated by the indirectly heated valves.

The induction-type gramophone motor is of shallow build and leaves plenty of space at the back of the cabinet so that no difficulty is experienced in gaining access to the valves. The motor is fitted with an automatic stop switch designed to be operated with eccentric throw-off grooves, and the pick-up is the new H.M.V. type No. 15.

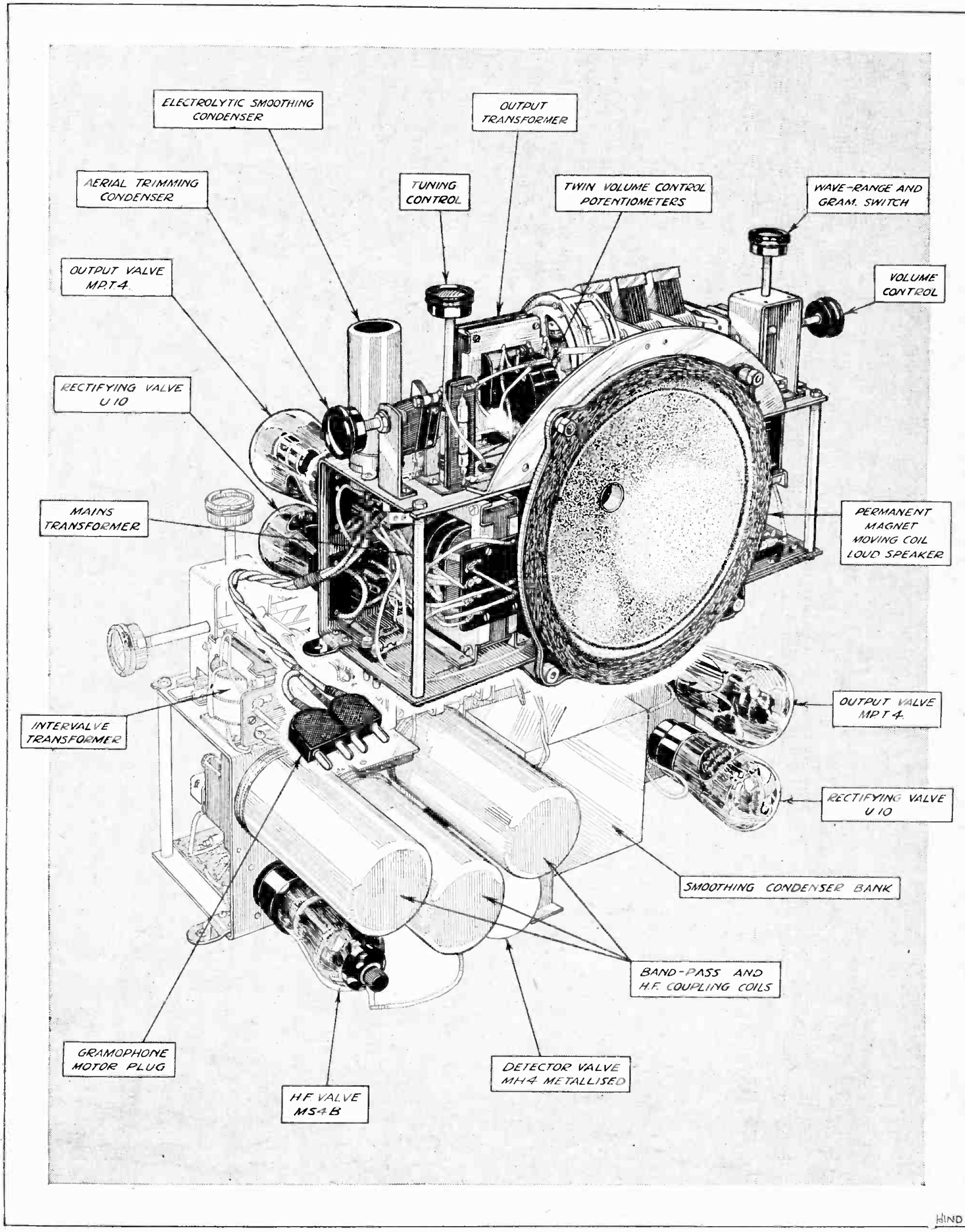
SPECIFICATION.

CIRCUIT: Three valves. Screen-grid H.F. valve with band-pass input filter, grid detector, power pentode output valve. Full-wave valve rectifier.
CONTROLS: (1) Ganged tuning control. Illuminated dial calibrated in wavelengths. (2) Aerial trimming control. (3) Combined reaction and volume control. (4) Wave range, gramophone and mains on-off switch.
GENERAL: Permanent magnet moving-coil loud speaker. Slow-speed induction motor. Combined radio and gramophone volume control. Provision for mains aerial.
PRICE: 29 guineas.
MAKERS: The Gramophone Co., Ltd., Hayes, Middlesex.

The three-valve circuit includes a capacity-coupled band-pass filter preceding the screen-grid H.F. valve, which is, in turn, coupled to the grid detector by a parallel-fed tuned auto-transformer. Volume is controlled by a specially graded potentiometer, which controls simultaneously the screen-grid voltage and the reaction feed-back. Coupled mechanically to the radio volume control is a logarithmic potentiometer connected across the gramophone pick-up. The coupling between the detector and the power-pentode output valve is by means of a 7:1 high-permeability transformer, resistance-capacity fed from the detector anode circuit. The permanent-magnet moving-coil loud speaker has a low-resistance winding and is transformer-coupled to the pentode valve. A full-wave valve rectifier supplies H.T. current to the valves, and an electrolytic condenser is incorporated in the smoothing circuit.

In all there are four controls. Two of these, the main tuning control and the combined wave-range, gramophone, and mains switch, are mounted near the front edge of the motor board under the lid of the cabinet. The combined radio and gramophone volume control is recessed into the right-hand side of the cabinet and can be operated with the lid closed. It is matched on the left-hand side by the aerial trimming condenser control. With regard to the main tuning control, it is at first difficult to get used to the fact that it is on the left of the indicator dial, and one is apt occasionally to make unsuccessful attempts to tune with the wave-range switch on the right.

After a few preliminary experiments to determine the average settings of the aerial trimmer and reaction controls, all the more powerful B.B.C. and Continental transmissions may be tuned in simply by rotating the main tuning dial to the wavelength required. In this way ten foreign stations on medium



Two views showing constructional details of the H.M.V. Model 501 chassis. The loud speaker dust cover has been removed for the purpose of this illustration.

Table Radio-Gramophone.—
waves and seven on long waves could be chosen at will with the greatest of ease. At first this may seem a conservative estimate for so obviously sensitive a set, but a little experience with the controls will enable the number of stations to be considerably augmented. It will be found when adjusting the receiver for maximum sensitivity that the setting of the aerial trimming control will have an important effect. In the particular model tested the position of the control for absolutely accurate alignment of the aerial circuit varied by about sixty degrees over the medium-wave tuning scale. The setting of the reaction control at its most sensitive position, just below the oscillation point, also depends on the setting of the aerial trimmer, so that for distant reception it is essential to adjust these controls simultaneously for every fresh setting of the main tuning control. Thus, with a little skill, it is possible to extract a performance which is not inferior to that of any three-valve set on the market, yet no special skill is required to obtain the ten or fifteen foreign stations whose programmes can be enjoyed at full loud speaker strength after dark. In daylight, Hilversum is easily tuned in on medium waves, while the long-wave stations are all quite as reliable as at night-time.

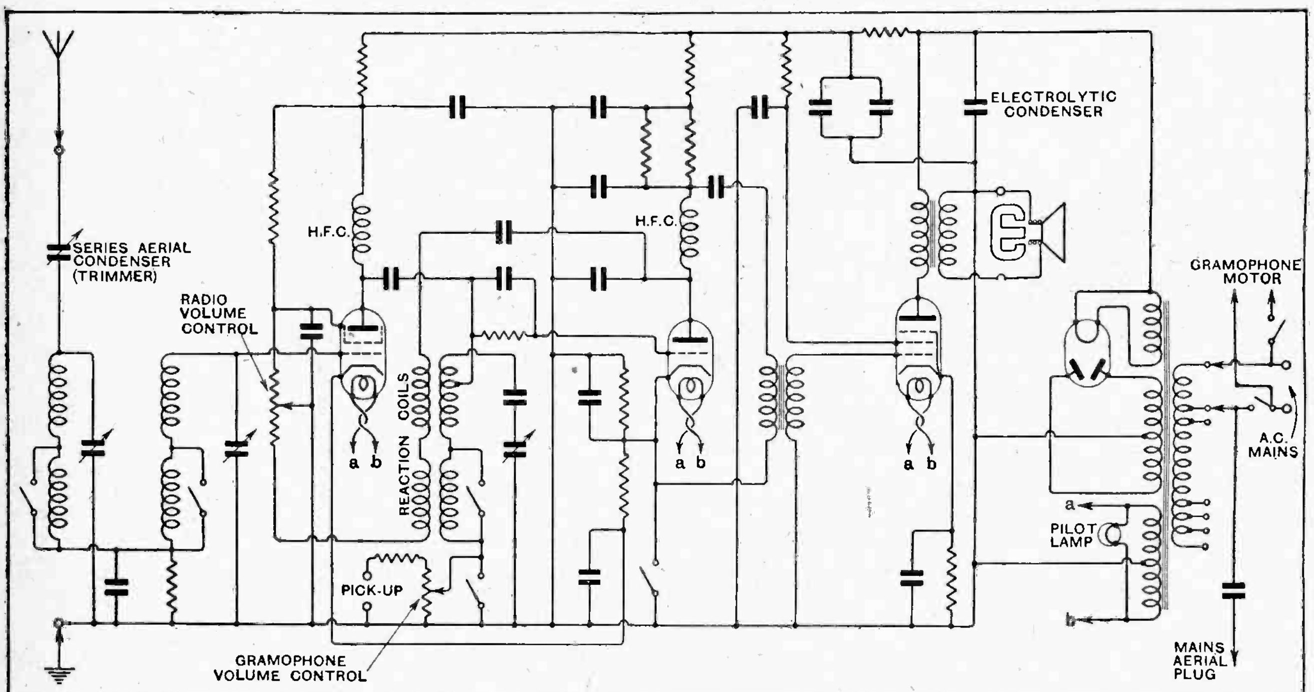
The selectivity, without being outstandingly good, is adequate, and is quite equal to the average standard of this class of three-valve circuit. At a distance of five miles from Brookmans Park the National transmitter spreads from the bottom of the scale (240 metres) to 295 metres, while the band occupied by the Regional transmitter is from 310 to 390 metres. Thus it was possible to receive Bordeaux-Lafayette (304 metres) and Hilversum (298.8 metres), as well as the Northern National transmitter, without background from either of the local programmes. On long waves, Radio Paris and Daventry were easily received without mutual interference, but a slight background from both stations could be heard when listening to Königswusterhausen.

The quality of reproduction of both broadcasting and gramophone records is of the high standard which one expects from H.M.V. products. A full round bass is balanced by crispness in the upper register without over-emphasis of sibilants or objectionable needle scratch. The last valve is capable of supplying an undistorted output of 1.4 watts, and the volume from gramophone records is such that most people will find the volume control an indispensable accessory. Incidentally, no mechanical noise from the pick-up can be heard with the lid closed, as this year all H.M.V. gramophones are fitted with a baize-lined lid.

Mains hum is just audible during intervals in broadcasting, but in no way interferes with the enjoyment of programmes of moderate strength. Incidentally, the hum level is not increased by reaction.

It goes without saying that the quality of materials and standard of workmanship in the chassis is irreproachable, while the finish of the cabinet work is of the customary H.M.V. excellence.

The Model 501 should make a strong appeal to those who require the performance of a full-sized radio-gramophone, but who are unable to provide the space necessary for the conventional console cabinet.



Circuit diagram of receiver chassis in the H.M.V. Model 501 radio-gramophone.

Next Week's Set Review:—
McMICHAEL COLONIAL RECEIVER.

CURRENT TOPICS

Events of the Week in Brief Review.

FRENCH BID FOR RADIO DOMINATION.

The identity of the sponsor of the huge "propaganda broadcasting station" now under construction in Luxembourg is revealed in the French *Journal Officiel*. The journal explains that the grade of Officer of the Legion of Honour has been conferred upon M. Fernandez, director of "Avenir Publicité," for creating in Luxembourg, under the absolute control of France, "the most powerful station in Europe."

The Luxembourg station will open shortly, and we understand that its programmes will be sponsored almost entirely by commercial advertisers.

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WANTED BY THE POLICE.

The French radio police ask for reports in the transmissions from FPC, the 2 kW. station attached to the Ministère de l'Interieur in Paris. The daily schedule is as follows: At 9.0 a.m., on 1,050 metres; at 11.45 a.m. and 5.15 p.m., on 1,140 metres, and at 5.30 p.m., on 1,200 metres. Short waves are transmitted at 10.0 a.m. and 4.0 p.m. (44.75 metres); at 10.15 a.m. and 4.15 p.m. (59 metres), and at 10.30 a.m. and 4.30 p.m., on 84 metres. All times are G.M.T.

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A FOLDING STUDIO.

Double walls excluding all noises are a feature of a new portable studio which has been evolved by the Prague station authorities for certain "O.B." work.

It is quite small, and its great advantage, we imagine, is that there is no room for a studio audience!

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A TRANSMITTER ADRIFT.

Professor Moltchanov, of the Soviet Arctic Institute, has designed a radio transmitter which will automatically broadcast meteorological data from the Behring Straits when cast adrift on a buoy. The first test is to be made next spring.

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INDIAN BROADCASTING: A WISE MOVE?

It was officially announced on October 9th that the Indian State Broadcasting Company would close down at an early date. This regrettable move has been decided upon on the advice of the retrenchment advisory committee, but it is difficult to believe that India will not feel the loss of those energetic transmitters at Bombay and Calcutta. The European population will undoubtedly suffer, and for their sake we hope that the service will soon be resumed.

oooo

MORE POWER FROM KALUNDBORG.

Danish listeners in North Jutland have protested that the Oslo station is upsetting their reception of the Kalundborg transmissions. As a result, writes our Copenhagen correspondent, it has been decided to increase Kalundborg's power. The station is already familiar to listeners all over Europe.

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PRIZE LETTERS FOR LISTENERS.

To the twenty-five listeners who submit to Mr. Adams, U.S. Secretary of State for the U.S. Navy, the best copies of his Navy Day speech broadcast on short waves *via* Arlington, NAA, he will send letters of commendation. The transmissions will be made on October 27th on 71.2, 35.6, and 23.9 metres. Our political broadcasters might copy this idea and thus be sure of an audience.

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FIVE NEW STATIONS FOR HUNGARY.

Hungary has chosen her broadcast wavelengths with a fine regard for listeners with unselective receivers, the two official wavelengths being 210 and 550.6 metres. Up till now only the latter wavelength has been used, but a Budapest correspondent informs us that the Hungarian State Broadcasting Company has now ordered a 120 kW. transmitter to work on the shorter wavelength, together with four low-powered relay stations, which will probably be synchronised with the parent station.

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SOTTENS IS ONLY TESTING!

We learn that the powerful Swiss broadcasting station at Sottens, which is heard so clearly in this country, is still only in the testing stage. Reports from foreign listeners are gladly welcomed by the Société Romande de Radiodiffusion, Lausanne.

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A WORD FOR THE LOUD SPEAKER.

An anti-loud speaker "war" in France has brought about a reactionary movement in favour of loudness. "Don't complain of noise," writes a pro-loud speaker correspondent in a Paris paper. "A city without noise would be dead, differing in no way from a cemetery. We are all living, so long live noise!" This is hardly complimentary to the loud speaker, but the writer means well.

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TELEVISION AT WATERLOO?

The moulding of women's "colour-consciousness" is one of the future rôles of television, according to Mr. Edward H. Symonds, president of the British Fashions and Fabrics Bureau. With a fertility of imagination which comes more naturally to the prophet than to the technician, Mr. Symonds told the Halifax Textile Society that "the perfection of colour photography, which is well on its way, will be brought within the scope of television. This particular feature of this new invention will increase the fashion educational power of television, because by reproduction of exact colours of the materials employed in the styles, season by season, women's colour-consciousness will be regulated and moulded."

Meanwhile, to get back to earth, we are told that "a new cinema at Waterloo, Huddersfield, has been provided with accommodation for housing television apparatus in readiness for the possible arrival of this refinement."

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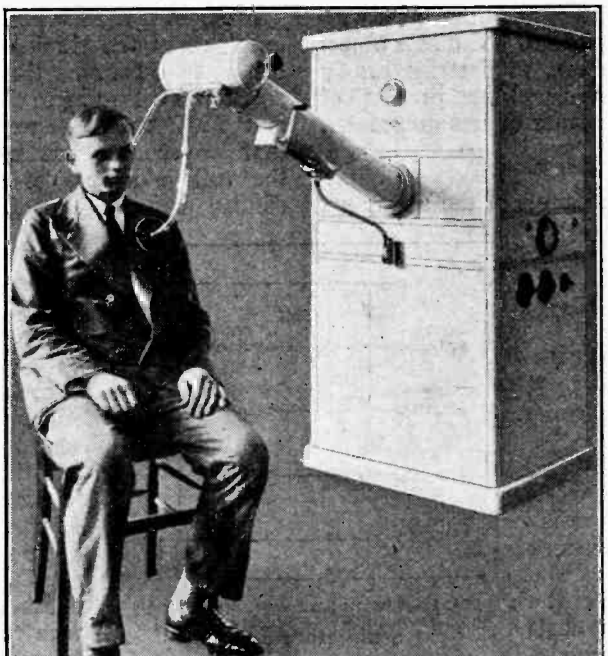
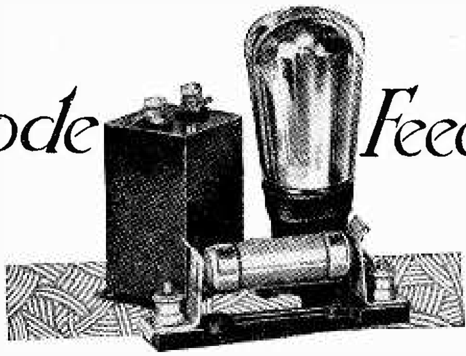
EX-NAVAL W/T MEN.

A reunion dinner of the "Ex-Naval Wireless Telegraphists' Active Service Association, 1918," is to be held in London on Saturday next, October 24th. Full particulars can be obtained from Mr. F. Johnson, 84, Hawthorn Road, Hornsey, London, N.8.



THE HIGH-FREQUENCY CURE. The use of ultra-short wavelengths between 4 and 8 metres in this new "Irradiating Equipment" produced by the firm of Siemens and Halske, is said to avert troublesome subsidiary effects caused by ordinary diathermy apparatus operating on 600 metres. It remains for physicians to discover new medical applications for these ultra-short waves, which have the advantage that they can be easily directed while the depth of penetration can be regulated by changes of wavelength.

Choosing Anode Feed Resistances



A Simple Alignment Chart.

By W. A. BARCLAY, M.A.

THE principle of dropping volts in the anode-feed circuits of valves fed from a common source of H.T. is now so well known and universally adopted as to be almost commonplace. Such resistances have, in general, either of two functions, (*a*) the straightforward dropping of volts between the H.T. source and a valve anode which requires a smaller mean potential, and (*b*) when used in conjunction with a condenser of low reactance to effect "decoupling" of signals. The whole subject of the proper selection of anode-feed resistances for different valves when using H.T. eliminators has been dealt with many times previously in this journal. The sole object of the present article is, therefore, to describe briefly an alignment chart which renders the process of choosing such resistance values more or less automatic.

Anode-feed Resistance Chart.

The chart itself is a simple example of the alignment of four variables. These are:—

(1) The anode current i_a taken by the valve.

(2) The actual mean anode voltage, v_a.

(3) The voltage of the supply, V.

(4) The anode-feed resistance, R ohms, necessary to effect the voltage drop from (3) to (2).

The chart consists essentially of two upright scales on either side, for anode current and anode voltage respectively. Between these lies a network of slanting and vertical lines. The slant lines correspond to values of the supply voltage V, while the verticals are numbered with values of anode-feed resistance R. To every point on the network thus corresponds certain definite values of V and R, the amounts of which are given by the intersection of the appropriate slant and vertical lines through the point. The manner of using the chart may now be summarised by the statement that *any straight line drawn through any such* (V, R) *point will meet the two outer scales for i_a and v_a in corresponding values.* It will be seen that the converse also is true, and, in fact, that when any three of the four variables are known the unknown fourth may be immediately found by simply placing an index line across the diagram.

An Example.

Let us suppose we are faced with the problem of supplying current from a battery eliminator to a five-valve set embodying one stage of H.F. amplification (screen-grid), leaky-grid detector, one L.F. stage, followed by two power valves in push-pull. The following requirements are obtained from the data supplied with the valves it is proposed to use:—

(*a*) Screening grid requires 80 volts.
(*b*) Anode of S.G. valve requires 4 mA. at 100 volts.
(*c*) Anode of detector requires 3 mA. at 80 volts.
(*d*) Anode of L.F. valve requires 7 mA. at 140 volts.
(*e*) Each power valve requires 20 mA. at 180 volts.

From Fig. 1, in which X and Y represent the output terminals of the eliminator, we can see that our problem is to determine the values of the feed resistances A, B, and C leading to the anodes of the H.F., detector, and L.F. valves respectively. (It will be observed that no account has been taken in this diagram of the voltage supply to the screening grid. It is, of course, assumed that this will be by potentiometer, either across the whole supply or between the anode and filament of the S.G. valve.)

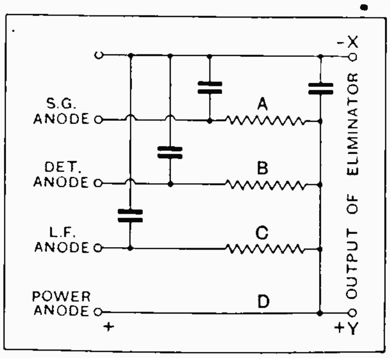


Fig. 1.—Circuit arrangement showing voltage-reducing resistances for multi-valve receiver.

Our first step is to add together the separate anode currents taken by each valve, in order to ascertain the total current to be taken from the eliminator. Allowing, say, 6 mA. of extra current for the S.G. potentiometer, we find that an output of 60 mA. is necessary, and we must therefore use an eliminator which will supply this amount of current at the highest voltage required, viz., 180 volts. If the eliminator chosen has a greater wattage than this—that is, if it supplies this current at a higher voltage—we could insert an additional resistance D into the anode supply leads of the power valves. If, however, this extra voltage is not of very great amount, it will be as well to utilise the whole of it on the power anodes, provided always that the anode dissipation limit of the valves is not exceeded.

Assuming, then, that the eliminator used can supply the necessary current at 180 volts, we pick out the slanting line corresponding to this value on Fig. 2. To find the value of the resistance A we now place a ruler on the diagram to join the values 4 mA. and 100 volts on the outer scales (these being the working values for the S.G. anode) and note the point at which it meets the slanting line aforesaid. Now, this point of intersection also lies on the vertical line for 20,000

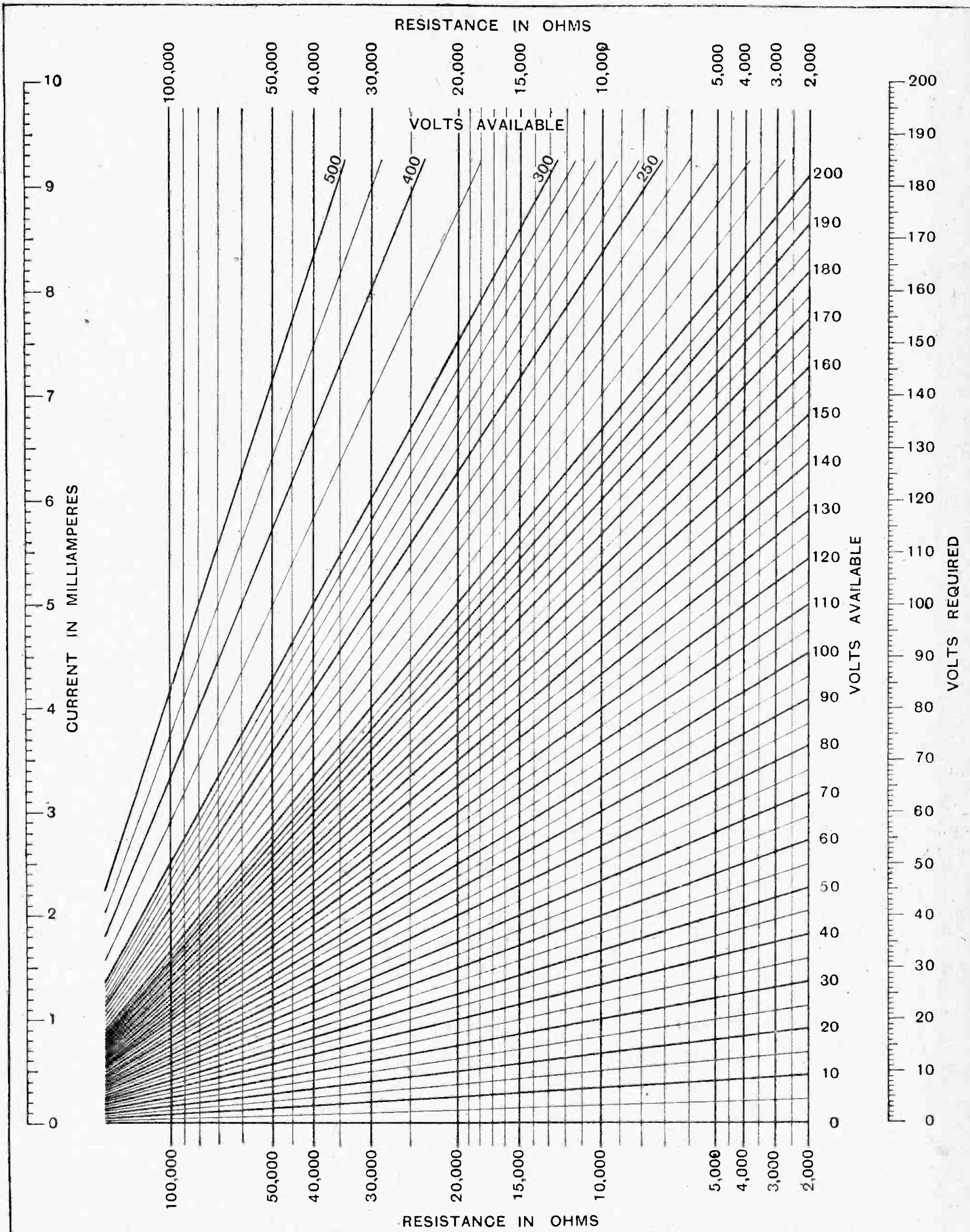


Fig. 2.—Alignment chart for rapid calculation of the value of an anode-feed resistance.

Choosing Anode-feed Resistances.—
ohms, and this, accordingly, is the desired value of A. To find B we similarly join 3 mA. to 80 volts on the outer scales, and again note the point in which this new index meets the slant line for 180 volts. This point lies between the resistance values 30,000 and 35,000 ohms. The precise value is not critical, and the nearest commercial value, 30,000 ohms, will be quite sufficient for practical requirements.

In the same manner, by joining 7 mA. to 140 volts we readily find the value of C to be between 5,000 and 6,000 ohms.

Measuring Anode Voltages.

It was said above that this chart enables us to find the value of any one of the four variables with which it deals when the other three are known. Among the various uses to which it can thus be put, one in particular deserves mention as being of service to the experimenter. It is well known that the direct measurement of anode voltage by use of a voltmeter is subject to inaccuracies which depend upon the current-consuming properties of the instrument. Only voltmeters of comparatively high resistance should be employed for this work, and, even so, there is always a certain modicum of error. As has often been pointed out in *The Wireless World*, an inexpensive method of overcoming the difficulty is to provide for the inclusion of a milliammeter in the anode leads of the valves. If the supply voltage is known, and also the value of the ohmic resistance in any one lead, it is then a simple matter to calculate the voltage drop across the resistance due to the passage of the current, and hence, by subtraction, to find the actual voltage on the anode in question.

The calculation, however, can be very simply dispensed with by the aid of Fig. 2. The point (V, R) in the centre network corresponding to the known values of supply voltage and anode-feed resistance is readily found. Thereafter, any straight line through it and the value of anode current taken will also meet the anode voltage scale in the required value of v_a.

The utility of this procedure is especially marked when, as is often the case, the output of the eliminator can be varied so that the most suitable output voltage can be chosen. As an example, if a feed resistance of 20,000 ohms supply a current of 3.7 mA. from an H.T. supply of 200 volts, the actual voltage at the valve anode is easily read off as 126 v. If the H.T. supply be now raised to 220 v., and the milliammeter reading be simultaneously observed to increase to 4.1 mA., this will correspond to an actual anode voltage of 138.

It will be seen that this method depends upon the accurate calibration of the resistances employed, but in these days of precision work this is a simple matter which, when once accomplished, will well repay the little trouble involved.

NEW BOOKS.

From Telegraphy to Television.—The Story of Electrical Communications. By Lt.-Col. Chetwode Crawley, M.I.E.E. With 44 illustrations. Price 6s. net. Published by F. Warne and Co., Ltd., London and New York.

This eminently readable book does not profess to enter into any technical description, but the author confines himself to the historical and personal side of the development of electrical communication from early line telegraphy to the present time and, incidentally, brings out the fact that much of the initial development of telegraphy was due to amateurs—a point recently emphasised in *The Wireless World*. The earliest suggestion for the use of electric currents in transmission of signals was made by an amateur in the *Scotsman's Magazine* in 1753; Wheatstone and Cooke were both amateurs in 1837, when practical telegraphy was first seriously considered. Samuel Morse was a painter and sculptor until he was over forty years of age, and many other names are mentioned of inventors whose contributions towards the advance of science started in their amateur days.

After a brief account of the early history of telegraphy, the author takes us through Duplex and Multiplex working to a description of the Central Telegraph Office in London and its daily work. Cables and cable-laying form an interesting part of the chapters devoted to submarine telegraphy and telephony, and more than half of the book is devoted to the development of wireless telegraphy, telephony, phototelegraphy and television, concluding with a chapter of the author's personal reminiscences in the very early days of naval wireless, his visits to Poldhu station when the Fleming valve was in its experimental stage and the receiver containing it was known as "the locked box of Poldhu," his experiences at the old Gibraltar station and during the War, all told in an easy and interesting manner.

W. H. M.

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Electrical Machinery and Apparatus Manufacture. Edited by Philip Kemp, M.Sc., M.I.E.E., to be issued in about thirty weekly parts, giving actual methods of the manufacture of Generators, Motors, Rectifiers, Switch Gear, Instruments, etc., etc. Part 1 (published on October 7th) begins Section 1 on D.C. Machines, by H. V. Shove, B.Sc. Pp. 64, with 46 illustrations and diagrams. Published by Sir Isaac Pitman and Sons, Ltd., London, price 1s each part.

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Arithmetic for the Practical Man. Including Powers and Roots, Logarithms, Progressions, Latitude, Longitude and Time, Graphs, etc. Pp. 269+xiii.

Algebra for the Practical Man. Including Cubic and Quadratic Equations, Logarithms, Exponential Equations, Ratio, Proportions, Progressions, Combinations, Probability, etc. Pp. 291+xviii.

Trigonometry for the Practical Man. Including Properties and Problems of Oblique Triangles, etc. Pp. 204+x.

The Calculus for the Practical Man. Including Graphical Applications of Integration, the Natural Law of Growth, and "e," etc. Pp. 323+x.

All by J. E. Thompson, B.S. in E.E., A.M., of the Pratt Institute, Brooklyn, N.Y., and published by George Routledge and Sons, Ltd., London. Price 7s. 6d. each.

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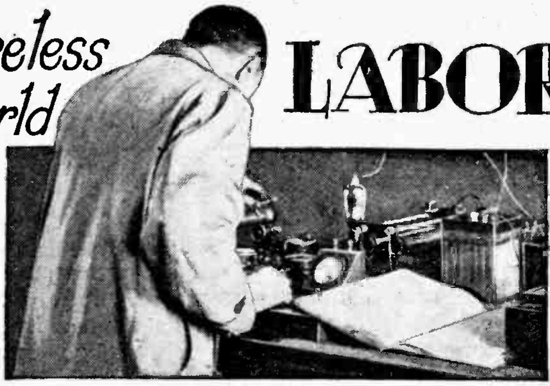
The True Road to Radio (3rd Edition), with chapters on the Operation of a Receiver, H.F. Amplification, Detection, L.F. Amplification, Properties of Transformers, The Loud Speaker, Calculations and Tables relating to Radio Reproduction. Pp. 244, with 135 diagrams and 10 whole-page illustrations. Issued by Ferranti, Ltd., Hollinwood, Lancs, price 5s.

We have received from Marconi's Wireless Telegraph Co., Ltd., a description of their new Marconi-Adcock direction-finder, type D.F.G.8, which, it is claimed, prevents the reception of abnormally polarised rays and enables accurate bearings to be obtained even during the hours of sunset and sunrise, when D.F. bearings generally are likely to be inaccurate.

Also their new combined long- and short-wave telegraph and telephony transmitter, type T.N.10, designed specially for use in submarines and to operate on wavelengths between 20 and 65 metres and 400 to 1,400 metres.

Wireless World LABORATORY TESTS



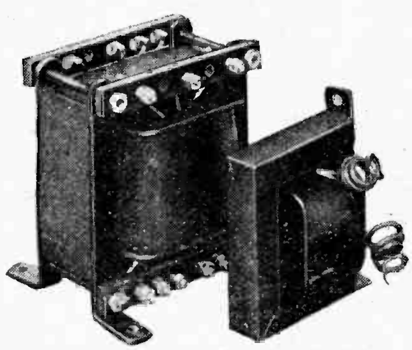
Review of New Radio Products.

TRANSFORMER AND CHOKE FOR "W.W.3 A.C. MODEL."

W. B. Savage, 292, Bishopsgate, London, E.C.2, have gone into production with the special mains transformer required for building the "Wireless World Three."

In overall dimensions it coincides with the one shown in the original drawings, and no modification is required to the layout of the components. The four input terminals provide for voltages from 200 to 240, while the outputs are 4 volts $2\frac{1}{2}$ amps., 4 volts 3 amps., and 350+350 volts at 60 mA. This transformer has been tested in "The Wireless World Three" A.C. Model, and, after several hours' continuous running, showed an inappreciable temperature rise.

In addition to this transformer, a smoothing choke has been produced of equivalent resistance to that specified and shown as L_5 in the circuit diagrams. It is a compact model, and again can be accommodated in the space provided. It has an inductance value of 29 henrys at 20 mA., and therefore can be relied upon to be entirely effective when employed in building "Wireless World Three" receivers.



Mains transformer and smoothing choke for "The Wireless World Three" set by W. B. Savage.

The price of the transformer is 32s., and the choke 9s.

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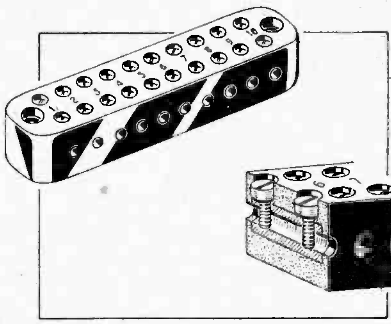
INSULATED CONNECTOR.

A useful connector in which all metal parts are completely insulated has just been placed on the market by Wilburn and Co., 23, Bride Lane, London, E.C.4. It is made of bakelite, and has moulded-in brass insets, the screws of which are sunk well below the face of the bakelite. There are numerous uses for a connector of this type, possibly the most important being in connection with mains equipment. When dealing with high voltages it is an advantage to fit insulated connectors in place of terminals, thus minimising the possibility of accidental shocks.



Wilburn ten-way insulated connector.

These connectors are made in five- and ten-way types, the prices being 2s. 6d. and 5s. respectively.

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WEARITE DUAL-RANGE FRAME AERIAL.

The flat dweller rarely has facilities for erecting an outside aerial, so that the use of an indoor substitute is imperative even for reception of the local station. This need not be an eyesore; a well-made frame aerial finished to tone with the style of furniture can be very attractive.

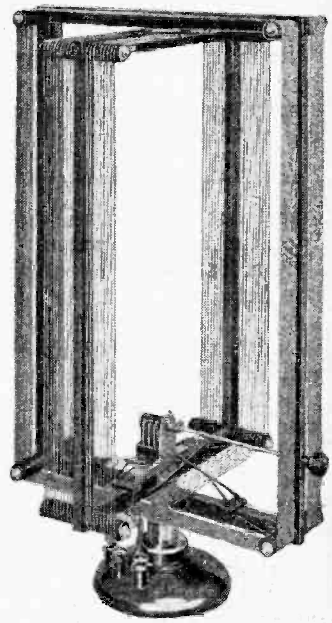
The Wearite Dual-Range Frame Aerial is a case in point, as it can be obtained finished either in polished oak or polished mahogany. It measures 20in. high and is approximately 12in. square, as the medium- and long-wave sections are entirely separate and arranged at right-angles to each other. Both windings are centre tapped, and a three-pole two-way switch is fitted, which makes the required change from medium- to long-wave frames.

Stranded wire is used throughout, seventeen turns of 27/42 Litz forming the medium-wave section, while forty-nine turns of 9/40 Litz constitute the long-wave portion. The windings are carried on grooved ebonite supports eccentrically mounted, and these can be adjusted should the windings become slack.

Wavelength measurements were made with the frame tuned by a 0.0005 mfd. condenser; the medium-wave portion tuned from 230 metres to 599 metres, while the long-wave section covered a waveband of from 790 metres to 2,010 metres. The minimum capacity was 40 micromfds. in each case. By using a condenser with a smaller minimum the frame would tune to a somewhat lower wavelength on each range.

During these tests it was noticed that the open-circuited long-wave frame resonated, by virtue of its inductance and self-capacity, at 331 metres. Although the windings are placed at right-angles, this resulted in a slight decrease in the efficiency of the medium-wave portion when it was tuned to this wavelength. The mutual interaction extended over a small waveband only, the effect being noticed between 326 and 334 metres. By short-circuiting the long-wave section normal conditions were restored. In practice the effect will be that over this small waveband more reaction will be required to cause self-oscillation of the circuit where reaction is applied to the frame. It is not a serious matter, however, as the decrease in efficiency is quite small.

We would suggest that the makers consider the practicability of fitting a switch with another set of contacts, so that when receiving on the medium waveband the idle section could be short-circuited.



Wearite Dual-Range Frame Aerial with separate windings for medium and long waves.

The design has been well thought out, and the workmanship is above criticism; in every respect it reflects the high standard attained by all Wearite components.

The makers are Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17., and the price is 42s. complete. A kit of parts for home construction is available at 30s.

INTERPRETING VALVE CHARACTERISTICS.

What they Denote and how they are Determined.

By H. B. DENT.

THOSE who have only recently commenced to take an interest in the technical aspect of wireless must occasionally find themselves in deep water when pursuing the latest technique since, in many cases, it is assumed that various fundamental facts are common knowledge. The thermionic valve is familiar to every wireless listener, but there must be many who do not fully appreciate the significance of the various characteristics assigned to it. It is hoped that the notes to follow will help to clarify the position in the minds of those commencing to take an interest in this most fascinating of hobbies.

The principal characteristics of a valve are: A.C. resistance, amplification factor and mutual conductance. There are a few alternative expressions, such as anode impedance or impedance for the first mentioned of these, and occasionally the mutual conductance is referred to as the slope. The A.C. resistance is the impedance which a valve imposes to the passage of an alternating current between the anode and the filament, or cathode if the valve is of the indirectly heated type, inside the valve, and is determined principally by the construction and spacing of the electrodes.

A.C. and D.C. Resistance of Valve.

It must not be confused with the D.C. resistance of the valve, which is purely a feature of the conducting medium between the anode and the filament. For example, a valve which, with 150 volts on its anode, may allow 2 mA. to flow from the H T. battery, thus indicating a D.C. resistance of 75,000 ohms, might quite possibly possess an A.C. resistance of 250,000 ohms or more. Indeed, this condition will be found to apply to all screen-grid valves in everyday use.

The A.C. resistance is determined by the change in anode voltage divided by the change in anode current for any given fixed value of grid bias. It can be determined from the familiar curves connecting anode voltage with grid voltage, such as is shown in Fig. 1.

Suppose we wish to find the A.C. resistance of a valve under different operating conditions from those given by the makers, let us say with the normal operating voltage on the anode and the grid. In the present case this would be with 150 volts on the anode—not the battery voltage—and −12 volts grid bias. A small triangle ABC is drawn in the position shown, so that a vertical line drawn from the −12 volts grid bias intersects the base line AB. The change in anode voltage is 150−130=20 volts, and the change in anode current is the difference in milliamperes represented by the line BC; this is 21−12.5 or 8.5 mA. Therefore, the valve's A.C. resistance is determined by dividing 8.5 into 20 and multiplying by 1,000 to convert milliamps into amperes.

The equation becomes:—

$$\frac{20 \times 1{,}000}{8.5} = 2{,}360 \text{ ohms.}$$

The amplification factor is the relationship between the change in grid volts and the corresponding change in anode volts. This means that if we change the potential of the grid by one volt the anode voltage will have to be changed by one volt multiplied by the valve's amplification factor to bring the anode current back to its former value. We determine this by dividing the change in grid volts, represented by the line AB, into the corresponding change in anode voltage, i.e., 150−130 or 20 volts.

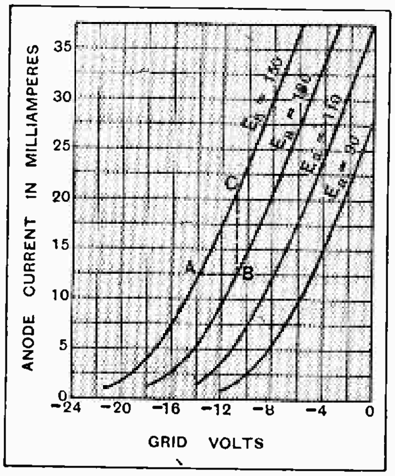


Fig 1.—These curves which are supplied by all valve manufacturers give the necessary data for calculation of the three most important characteristics, namely, A.C. resistance, amplification factor, and mutual conductance.

This gives us the following equation:—

$$\frac{20}{3} = 6.6 \text{ times.}$$

Mutual Conductance Calculated by Two Different Methods.

The mutual conductance is the change in anode current that occurs for every one volt change in grid bias, and is determined by dividing the grid voltage corresponding to the line AB into the anode current change as shown by BC. It is the relationship between the amplification factor and the A.C. resistance, and indicates the slope of the anode current-grid voltage curves. The mutual conductance is given, also, by dividing the amplification factor multiplied by 1,000 by the valve's A.C. resistance.

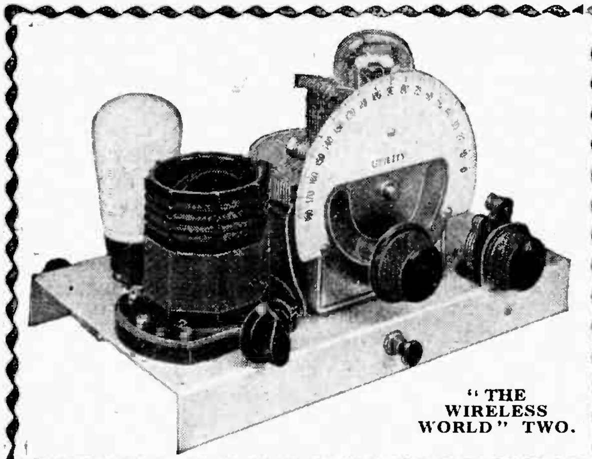
The recognised symbols used to denote the various characteristics of a valve are:—

μ for amplification factor.
R_o for A.C. resistance, and
g for mutual conductance.

Conductance is the antithesis of resistance, and the unit of conductance is the mho (the word "ohm" reversed) and some foreign valve makers, particularly the American, express the mutual conductance in micromhos. To convert this to milliamps per volt it is necessary only to divide by 1,000, 950 micromhos, for instance, being equal to 0.95 mA./volt.

Next Week—NEW READERS' NUMBER.

Notes on Some Attractive Features.



"THE WIRELESS WORLD" TWO.

Foreign Station Tuning Chart.

A special large folding chart in colour will be included as a supplement with the issue, providing a useful tuning guide applicable to all types of receivers and giving much additional information of value.

"The Wireless World" Two.

Full constructional details for a new two-valve set which has the special advantage of taking less than half the usual H.T. current for its output, and is outstandingly sensitive. The receiver gives high quality reproduction, and the selectivity is arranged to be adjustable. A system of automatic grid bias is used, thus dispensing with a grid bias battery.

A special feature is the ease with which the set can be constructed, with no soldering or drilling, and no risk of failures in performance.

The set employs the new type power pentode, Mazda PEN.220, or the Marconi or Osram PT2, and the generous output is tone-corrected, whilst the total H.T. current consumption for the set is 6 mA. at 150 volts.

"THE WIRELESS WORLD" TWO.

LIST OF PARTS

1 Tuning condenser with 2 nickelled countersunk fixing screws and 1 round head, ½in. × 4BA, and flat slow motion knob and dial (Utility Type, W 305/1, Wilkins & Wright)
1 Two range coil (Colvern Type RM2S with 4 under base terminals and straight through switch rod)
2 5-Pin Valve-holders ...... (Telsen Type W106)
1 Differential reaction condenser, 0.0003 mfd. .... (Telsen)
1 Intervalve transformer .. (Igranic "Midget")
1 Aluminium chassis to specification with 1 doz. nickelled raised-headed screws, 6BA, 1½ doz. 6BA nuts and 3 ebonite half bushes for terminals. 4 spacing collars with holes to clear, 6BA screws, $\frac{3}{16}$in. in length. Also insulating bush for reaction condenser (H & B. Radio)
1 On-and-off switch ...... (Telsen, single type)
1 Condenser, 0.0002 mfd. .... (T.C.C., M Type)
1 Condenser, 0.002 mfd. .... (T.C.C., M Type)
1 Condenser, 1 mfd. (T.C.C., Type 50, non-inductive)
1 Resistance, 1 megohm (Loewe with wire terminations)
1 Resistance, 0.1 megohm (Loewe with wire terminations)
1 Resistance, 75,000 ohms. (Loewe with wire terminations)
1 Resistance, 750 ohms. (Lewcos Spaghetti Type)
4 Terminals, aerial, earth, L.S.+, L.S.− (Belling-Lee, Type B)
1 Cable, with L.T.+, L.T.−, H.T.−, H.T.+1, H.T.+2, H.T.+3 .... (H. & B. Radio)
Tinned copper wire No. 24 SWG, small quantity ½ mm. silk sleeving.

Accessories:

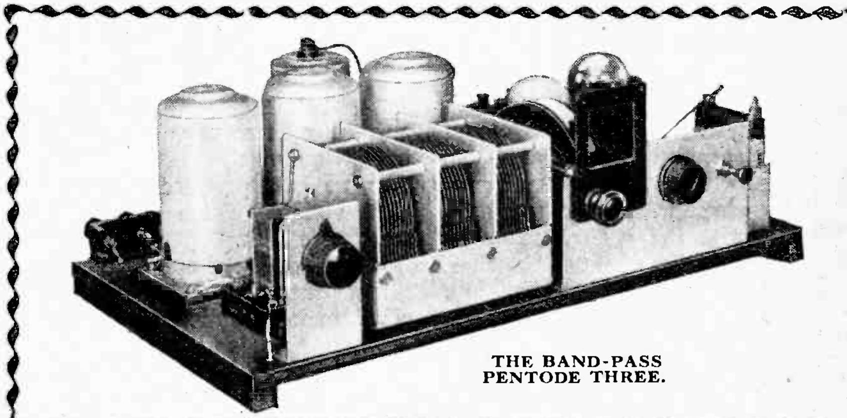
2-Volt accumulator; 120 or 150 Volt H.T. battery; 2-Volt metallised detector (Mazda H.L.2); 2-Volt pentode (Mazda Type Pen. 220, or Osram or Marconi Type P.T.2); Loud speaker, matched to output pentode (Ormond special type, No. 1Z Board Chassis or Celestion); Cabinet (C. A. Osborn, Regent Works, Arlington Street, London, N.1.)

The Band-pass Pentode Three.

This is another battery pentode receiver, but employing three valves, and is remarkably simple and straightforward to build, and provides considerable latitude in the choice of parts, except for special "key" components.

A pentode output valve provides the maximum undistorted volume economically obtainable, and high and constant selectivity on both wavebands is assured by the employment of up-to-date band-pass circuits. The volume control is by a capacity potentiometer, thus producing no interference with tuning.

In spite of the high quality and volume attainable with this set, its total H.T. consumption need not exceed 10 mA.



THE BAND-PASS PENTODE THREE.

BAND-PASS PENTODE THREE.

LIST OF PARTS.

1 3-Gang condenser, 0.0005 mfd. (Utility, Type W. 006/3)
1 Slow-motion dial (Utility. Type W. 296; 4in.)
1 Differential condenser; 0.0003 mfd., air dielectric .... (Utility)
1 Differential condenser; 0.0003 mfd., bakelite dielectric .... (Telsen)
3 Fixed condensers, 2 mfds. .... (Helsby)
1 Fixed condenser, 1 mfd. .... (Helsby)
1 Fixed condenser, 0.0005 mfd. ...... (Telsen)
1 Fixed condenser, 0.0002 mfd. ...... (Telsen)
1 Fixed condenser, 0.001 mfd. ...... (Telsen)
1 Semi-variable condenser, 0.0003 mfd. (Formo, Type "J.")
1 H.F. choke .... (Lewcos)
1 H.F. choke .... (Telsen)
1 Resistance, 80 ohms. .... (Watmel)
1 Resistance, 1,000 ohms. .... (Watmel)
1 Resistance, spaghetti type, 50,000 ohms. .... (Lewcos)
1 Resistance, 50,000 ohms, with holder (Ferranti, moulded type)
1 Resistance, grid leak, 1 megohm, with holder .... (Ferranti, moulded type)
1 Resistance, 0.25 megohm, with holder (Ferranti, moulded type)
1 Valve-holder, 5-pin, with large type base (W.B.)
2 Valve-holders, 1 four-pin, 1 five-pin ... (Telsen)
1 Valve screen .... (Colvern)
1 Set "Square Peak" tuning coils ...... (Varley)
1 L.F. transformer .... (R.I. "Dux.")
2 Terminal mounts .... (Belling-Lee)
4 Indicating terminals: "Aerial," "Earth," L.S.+, L.S.− (Belling-Lee, shrouded)
1 On-off switch .... (Telsen)
1 Grid bias battery, 4½ volts .... (Siemens)
1 Pair grid bias battery clips .... (Bulgin)
7 Wander plugs .... (Clix)
2 Spade terminals .... (Clix)
1 Special output choke (Varley: "Pentode Nichoke")

Accessories:

2-Volt accumulator; 120-150 volt H.T. battery; 1 Marconi screen-grid valve, Type S.22; 1 Mazda detector valve, Type H.L.2; 1 Mazda output valve, Type PEN. 220; Loud speaker (any type), or, if filter is omitted, special Celestion or Ormond loud speaker; Cabinet (Peto Scott).

The Issue will also contain a number of additional Special Articles suited to the requirements of the new reader.

PRACTICAL HINTS AND TIPS.

AIDS TO BETTER RECEPTION.

FILTER COUPLING CONDENSERS.

ONE of the advantages of the type of "constant width" band-pass filter in which coupling between component circuits is effected by a very small condenser between the high-potential ends, is that almost any types of coil, provided they are matched, and mutually screened, may be used successfully.

A recent development in condenser manufacture—the segmented vane—may be applied with advantage to the design of the single-plate variable condenser which, when "ganged" to the main tuning condenser spindle, is sometimes used as a coupling in filters of this type. The shape of condenser plate that is customarily used, although reasonably satisfactory for this purpose, has the disadvantage that it does not give absolutely constant broadness of tuning over the whole range of angular settings. True, a plate of the correct shape could be designed, but its performance might well be spoilt, particularly at the lower end of the tuning scale, by incidental stray capacities which, in spite of all precautions, are certain to be fairly large in relation to the correct value of coupling capacity.

By using a plate with radial slots on the lines shown in the accompanying sketch, this drawback may be

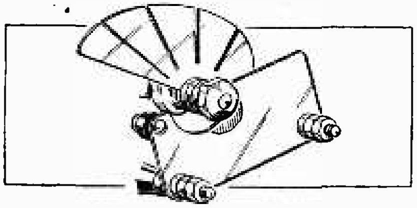


Fig. 1.—The "segmented vane" principle applied to a small filter coupling condenser; capacity may be suitably adjusted at a number of points.

almost entirely overcome in the simplest possible way. Spacing between the single fixed and moving vanes would be set initially to give a rather greater capacity than necessary, and the condenser would be adjusted by bending the segments at each of, say, five angular positions, so that a band of the required width is embraced by the filter.

A word of warning should be offered against attempting to adjust the segments unless it is certain that filter circuit tuning is accurately "ganged"; rather than run any risk of making a mistake, it is worth while to "re-gang" at each point where the initial adjustments are made.

POSITIVE BIAS FOR A.C. VALVES.

AN indirectly heated valve, when operating as a grid detector, is usually arranged so that its grid works at zero voltage, or at any rate, would do so were it not for the fact that grid current in these valves, which starts to flow before the grid is made positive, tends to produce a less positive bias voltage which is developed across the leak.

When, due perhaps to the use of rather inadequate smoothing devices, mains hum is noticeable in an A.C. receiver with valves of this type, it is useful to know that a quieter background may often be obtained by applying artificially a small positive bias (a volt or so).

The source of this extra voltage may be a dry cell, or the necessary pressure may be obtainable by making a tapping on one of the bias resistances included in the receiver. As a result of making this change there will be a tendency for detector anode current to increase, and if the valve is being run anywhere near its safety limit, a reduction in anode voltage is clearly indicated as a protective measure.

ECONOMICAL FIELD CURRENT.

IT is becoming more and more the common practice to include the field winding of a moving-coil speaker in the H.T. smoothing circuit of an A.C. mains set. In this way the field current can be obtained economically, for the field winding itself acts as a very efficient smoothing choke, and a choke proper may be saved in the set.

The position in which the speaker field is connected is of considerable importance, however, for hum may be introduced directly into the moving coil itself. It is a safe rule, therefore, always to connect the field

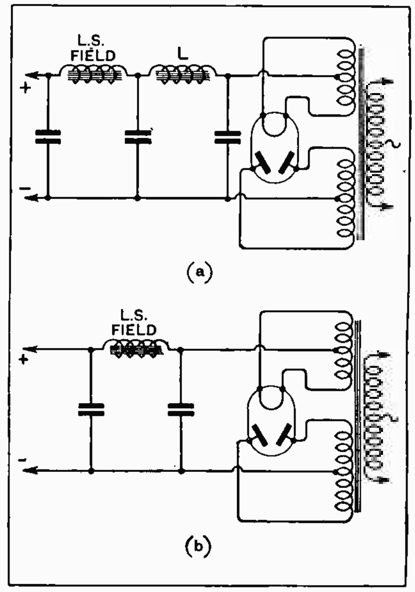


Fig. 2.—Literally something for nothing: Magnetising current for a loud speaker field is obtained by using the field winding as a smoothing choke.

after a smoothing choke, as shown in Fig. 2(a), since this prevents an excessive hum ripple from passing through the field. Quite a small choke is suitable for L, and the condenser following it can have a capacity of 2 mfd. or so.

With some speakers, however, it is satisfactory to connect the speaker field directly after the rectifier, as in Fig. 2(b), and sometimes it can provide all the smoothing required by the receiver. Whether any particular speaker is suitable for connecting in this manner is usually a matter for experiment, as it depends almost entirely upon its design.

Broadcast Brevities.

By Our Special Correspondent.

The "Chief's" Notebook.

While Mr. Noel Ashbridge was packing his trunk for the Rome Conference (which, by the way, opened on Monday last), the engineers at Tatsfield were carrying out a special survey to discover which stations on the Continent are already treading on the toes of the B.B.C. transmitters.

Here are some of the notes that Mr. Ashbridge took to the Eternal City.

How London Suffers.

London National is being badly jogged every night by Leipzig on the one side and Moravska-Ostrava on the other. Although these are comparatively low-powered stations, Leipzig will shortly increase its power to 150 kW.

London Regional is still being swamped by its near neighbour, Stuttgart ("Muhlacker" of blessed memory!), and in this case the 9 kc. separation is definitely not enough.

A Russian Paradox.

Midland Regional is suffering from the wavelength wobbles of Bucharest, while Northern Regional is unable to escape from the influence of two Russian stations, one of which is unidentified. The other is Simferopol, which gets stronger and stronger every night, although its official power is only 1.2 kW! Glasgow, too, is interfered with by Russians.

Turkey Worries 5XX.

Distance fails to save Belfast from the mush created by at least five stations, including Stavanger (official power, 0.63 kW!), Radio Beziers, and Bordeaux Sud-Ouest. Cardiff is acutely conscious of Radio Vitus, and is occasionally heterodyned by Marseilles, P.T.T.

Ankara, in Turkey, seems unable to avoid clashing with Daventry 5XX, which already suffers from the vagaries of several Russian stations.

Reckless Russian Stations.

This is the experience of the B.B.C. before the winter has really started! No doubt even worse conditions are observable in Central Europe, particularly in districts where the Russians can make themselves truly felt. No wonder Poland decided to have a 158 kW transmitter!

Jack Payne and the Savoy Band.

The return of the Savoy Orpheans band to the B.B.C. microphone helps to explain the rumours of a few months ago to the effect that the B.B.C. intended engaging a new official dance band which was to supplement the efforts of Jack Payne. The rumours got afloat just at the time when this new arrangement first came under discussion. Another illustration of the truth of the old adage: "Where there is smoke there is fire."

An Unnecessary Expense.

It always seemed unlikely, however, that the B.B.C. would go to the expense of establishing a new dance combination which would have cost at least £250 per week—an unnecessary commitment which the B.B.C. would scarcely have undertaken in any circumstances. Certainly it would have been ruled out of court in these hard times.

"What He Would Do with the World."

A correspondent asks when we may expect Sir John Reith himself to come to the microphone and talk on "What I would do with the world."

The Director-General's views would certainly arouse interest, for I believe that, unlike the speakers who have already addressed us, Sir John pins his faith less on the League of Nations than on broadcasting itself. His attitude is summed up in the B.B.C.'s official motto.

Political Broadcasting Mysteries.

A good deal of mystery has centred round the arrangements for the General Election broadcasts. It has been vaguely imagined that the political parties themselves drew up their programme by agreement and presented it to the B.B.C., who merely arranged the times. I should not be surprised to learn that it was not such a simple matter after all. Statements since published by spokesmen of the different parties hardly suggest that the agreement was amicable.

The Position of the B.B.C.

Sir John Reith is too jealous of the independent position of the B.B.C. to relish being dragged into the wordy arguments which develop between the various parties before a broadcasting programme can be mapped out. The lesson to be gained from what went on behind the scenes ten days ago is that the whole question of political broadcasting should be tackled afresh when the new Parliament has time to deal with it.

The officials at Savoy Hill feel that it is hardly fair that the B.B.C. should be involved in negotiations between the various factions. In any case, the position of the Corporation in political matters should be clearly outlined.

And Why Not?

A red hot election meeting with all the parties represented would make fine material for a running commentary. A few additional microphones for the use of hecklers could be carried round by "O.B." engineers, who would, of course, be armed with substantial volume controls!

Good Diction Week.

Next week has been chosen by the American Academy of Arts and Letters as Good Diction Week for Radio. It is the period set aside by the Academy to judge the announcers of America and decide who is eligible to receive the special medal for the best professional microphone voice. This is the third year of the competition. The previous winners were M. J. Cross and A. W. Bach, both of the National Broadcasting Co.

INTERVIEWS AT THE MICROPHONE. Here is a test in progress at WGY, Schenectady, with a new portable microphone equipment for "outside" interviews.

WIRELESS ENCYCLOPEDIA

NO. 3

Brief Definitions with Expanded Explanations.

***AMPLIFICATION CONSTANT or AMPLIFICATION FACTOR.** The theoretical limit of amplification which a thermionic valve would give under ideal circuit conditions. It is defined numerically as the ratio of the change of anode voltage to the change of grid potential required to produce a given small change of anode current.*

TAKING as an example a three-electrode valve with the cathode maintained at a constant temperature, there are two ways of varying the anode current, namely (a) by changing the anode voltage, and (b) by changing the grid voltage. The action of the valve as an amplifier depends on the very important property that a given change of grid potential has the same effect on the anode current as a relatively large change of anode potential, and it is the relationship between these changes which constitutes the amplification factor. The amplification factor may be defined as the rise of anode voltage required to maintain the anode current unchanged when the grid potential is lowered by one volt.

An Example.

In the accompanying graph of Fig. 1 two anode voltage/anode current characteristic curves are given for a typical three-electrode

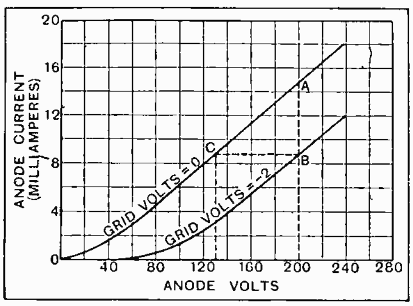


Fig. 1.—Anode voltage/anode current curves for a three-electrode valve with grid voltages of 0 and —2 respectively. Changing the anode voltage by 70 volts has the same effect on the anode current as changing the grid potential by 2 volts. The amplification factor is therefore $\mu = 70/2 = 35$.

valve of the indirectly heated cathode class (A.C. valve); the upper curve is for a grid potential of zero and the lower one for a grid potential of -2 volts relative to the cathode. From the curves we see that, with the anode potential at 200 volts, the anode current is 14.8 milliamperes at zero grid potential and 8.6 milliamperes with the grid at -2 volts. Thus lowering the grid potential by two volts reduces the anode current by 6 milliamperes.

Now let us see what change of anode voltage would be required to produce the same change of 6 milliamperes in the anode current, with the grid potential kept constant at zero. From the upper curve, the current is 14.8 milliamps. at 200 volts, and 8.8 milliamps. (i.e., 6 milliamps. less) at 130 volts. Hence reducing the anode potential by 70 volts has the same effect as lowering the grid potential by 2 volts. The amplification factor is, therefore, $70 \div 2 = 35$. This simply means that a variation of one volt at the grid has the same effect on the anode current as a change of 35 volts at the anode.

So if an alternating E.M.F. of one volt is applied to the grid of this valve the anode current will fluctuate exactly as though an alternating voltage of 35 were connected in series with the H.T. lead to the anode. In other words, the anode current will contain an alternating component.

Stage Amplification.

Now, when a valve is used as a stage amplifier its function is to give a gain in voltage, and so some form of impedance or a resistance is connected in the anode circuit in the manner shown by Fig. 2. The alternating component of current flowing in the anode circuit sets up an alternating voltage between the ends of the external impedance (in this case the resistance R), and this is the amplified voltage given by the combination. How does this voltage amplification compare with the amplification factor? Assuming 1 volt to be applied to the grid, and that the amplification factor is 35, the limit of alternating voltage theoretically available in the anode circuit is

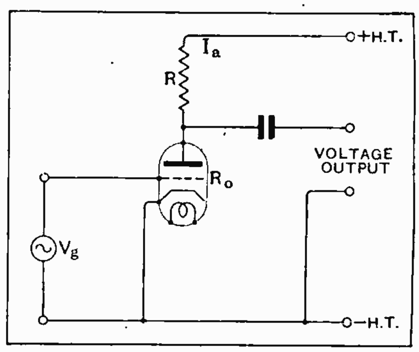


Fig. 2.—Simple arrangement of three-electrode valve as an amplifier with a resistance R in the anode circuit. If μ is the amplification factor and the A.C. resistance R_0 the voltage amplification is $\mu R/R + R_0$.

then 35. But this is utilised in driving the alternating current not only through the external resistance R, but also through the A.C. resistance R_0 of the valve. Consequently, only a fraction of it will be available across the ends of R, and the voltage amplification must always be less than the amplification factor (providing that no transformer is employed to produce an additional step-up effect).

The actual stage gain obtained is equal to the amplification factor multiplied by the ratio of the external impedance to the total impedance of the anode circuit, including the A.C. resistance of the valve. From this it follows that the higher the ratio of the external anode impedance or "load" to the A.C. resistance of the valve the nearer will the actual amplification approach to theoretical limit, namely, the value of the amplification factor.

READERS' PROBLEMS

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

Replies to Readers' Questions of General Interest.

Straight Set or Superheterodyne?

My present receiver—a 2-v-1 combination—is somewhat out of date, and I am thinking of remodelling it. I should like to adopt the superheterodyne principle, but feel that, even with modern circuit arrangements, quality is unlikely to be as good as that obtainable from a straightforward circuit. Can you confirm this?

At one time there was a certain amount of justification for the opinion that superheterodynes were deficient in the matter of quality, but nowadays there is not the slightest reason why they should be condemned on this score. Thanks largely to the general use of band-pass tuning, both in the signal-frequency and intermediate-frequency circuits, quality can be every bit as good as that provided by a "straight" set.

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Filter Circuit Screening.

I realise that it is essential that filter circuit coils should be carefully screened. Is it equally necessary that the associated tuning condensers should be well screened? I ask this question because I am about to add a filter to an existing receiver, and in my case it would be inconvenient to fit a modern screened condenser.

The operation of a filter is often affected adversely by an electrostatic coupling between tuning condensers, and it is certainly unwise to omit some form of screening. This, however, need not be so comprehensive as that for the coils: a simple metal plate between the high-potential vanes of the two condensers is generally adequate.

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The "Super-Selective Six."

Will you please tell me how to connect a frame aerial to the Super-Selective Six? I have no room to erect an outdoor aerial; also, I am close to the local station, and can do with the extra selectivity.

We do not recommend you to use a frame aerial with this receiver. Apart from its directional properties, the use of a frame would lead to a lowering of the selectivity, since it would be necessary to omit the band-pass filter preceding the first detector. The present method of volume control could not be used, and you would probably have trouble from distortion at low volume levels.

We fear also that you would be disappointed with the range of the receiver, since a frame is likely to be less efficient than an indoor aerial. The directional property is really the only advantage conferred, and even this is somewhat problematical.

We advise you, therefore, to use the standard receiver with as good an aerial as you can arrange. Excellent results can often be obtained with 12ft. or 15ft. of wire strung across a room; a good earth must, of course, always be used.

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Metallised Valves: Two Points Cleared Up.

Will you please tell me which filament pin of a metallised battery-fed valve should be connected to negative L.T. and thus directly to earth? I understand that the external metal coating is joined internally to that side of the filament which should be earthed.

By the way, my own valve seems to be defective, as there appears to be a connection between both filament pins and the metal coating.

The correct connections for a valve-holder into which a metallised valve is to be inserted are shown in Fig. 1; this, of course, is a sketch of the valve-holder as seen from above.

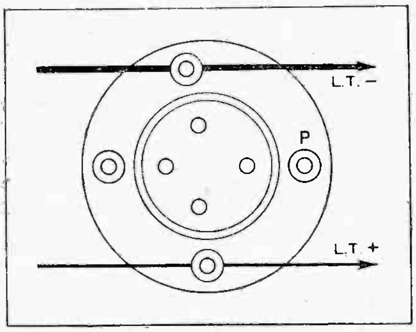

Fig. 1.—Filament terminal connection for a metallised battery valve.

With regard to your second point, we think you must have forgotten that, as there is a conductive path through the filament of the valve, continuity will naturally be shown between either end of the filament and the metal coating. But measurement would show a higher resistance between the end of the filament that we have indicated as being connected to L.T.+ and the metal coating than between it and the negative filament pin.

Self-adjusting.

Now that I have made an H.T. battery eliminator, and can be more liberal with anode current, I propose to fit an extra parallel output valve, in order to get greater undistorted volume. A choke output filter is included in my set; and, as the current through this choke will be approximately doubled, I suppose that its inductance will go down to such an extent that it will no longer be suitable.

Is there any way of avoiding the need for buying a new choke?

A good deal depends on the design of your choke, but it should be realised that its impedance will tend to adjust itself to the new conditions. True, its effective inductance will be reduced, but the optimum load required for parallel valves will always be less than that required for a single valve.

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Pentode Compensation.

It is noticed that the majority of receivers with a pentode output valve which have been described in your journal include a corrector device consisting of a resistance and condenser shunted across the output choke. Can it be assumed that this corrector is purely for the purpose of tone control, or does it contribute anything towards the matching of valve and loud speaker impedances.

The resistance-capacity corrector is used partly to ensure that the impedances of the output circuit shall not rise to an excessive value at high frequencies. Assuming the valve and loud speaker to be properly matched at a relatively low frequency, the corrector may be considered as a device which ensures that this matching may be maintained with sufficient accuracy over the whole range of audible frequencies.

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Potentiometer Recommended.

What is the correct value of resistance to insert in series with the screening grid of a S.215 valve, in order to reduce the voltage to the makers' rating of 80 volts?

Anode current for my receiver is obtained from an accumulator battery of 140 volts.

It is practically impossible to give you a definite answer, because the screening grid current of an H.F. valve is always small, and varies considerably between different specimens. If you object to a separate feed lead direct to the appropriate terminal of the battery, we suggest that you would be wise to use a potentiometer rather than a plain series resistance.

The New Variable-Mu Valve.

I am obtaining one of the new variable-mu H.F. valves for use in my three-valve A.C. receiver, of which I am sending you a circuit diagram. In order to obtain the necessary control of bias for regulating sensitivity, I propose to replace the existing bias resistance for the output valve—a P.625 working at 24 volts grid negative—with a wire-wound potentiometer of the same value. The grid circuit of the H.F. valve will be returned through a decoupling resistance to the slider of this potentiometer.

Will this plan be satisfactory?

We are afraid not; the method of bias used in your existing set is such that, by doing as you propose, the grid of the H.F. valve will always be more positive, and not more negative, than its cathode.

It is suggested that if you wish to make use of this plan, the simplest way is to modify the output valve circuit in the manner shown in Fig. 2. At the same time, it might be pointed out that a maximum negative bias of 24 volts as provided in this way may be insufficient to reduce an extremely strong signal to inaudibility; but the scheme is likely to be perfectly satisfactory in your case, as you live at a considerable distance from the nearest station, and have only one stage H.F. amplification.

As a result of making the suggested alteration, it will be found that some reduction of the grid bias resistance value will be needed, as it will be carrying the anode current of all three valves.

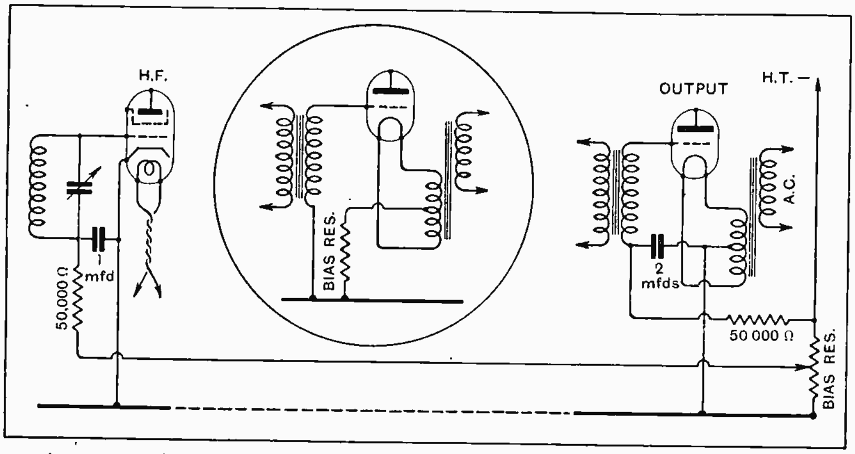

Fig. 2.—Altering an automatic bias circuit in order to obtain negative grid voltage for a variable-mu valve. (Inset) Circuit arrangement originally used by the querist.

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Super-efficient Coils Unnecessary.

I am designing a new receiver with two H.F. stages, and am aiming at the maximum possible sensitivity. Do you think that it would be worth while to use considerably larger and more efficient coils than those commonly specified nowadays for this type of circuit?

No; modern valves are so efficient that with two H.F. stages it is almost impossible to handle more amplification than is provided by tuned circuits of the present average dynamic resistance.

Mains Voltage Adjustment.

Through an unfortunate error I have just obtained a power transformer designed for a 240-volt supply, although my own mains are rated at 250 volts. I suppose it is practicable to absorb the excess voltage in a series resistance? If so, can you give me any idea as to what ohmic value will be required? As I have no A.C. measuring instruments, it is proposed to adjust the series primary resistance until the average anode current taken by the valves is that specified by the makers.

You will doubtless realise that the necessary value of resistance will depend on such factors as the load on the transformer secondaries and on the design of the instrument, and so we fear that it is quite impossible to give a definite figure. Very roughly, a resistance between fifty and two hundred ohms is likely to be needed, and we suggest that you should obtain a good wire-wound rheostat of about that value, capable of carrying at least 0.25 amp.; this can be adjusted in the way you describe, of course, starting from the highest value.

It may be added that this small excess voltage is in any case unlikely to do much harm, and that these precautions are hardly necessary unless there is an excess voltage of at least ten per cent.

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Modulation Hum.

My 2-v-1 receiver (A.C. mains-operated) is almost entirely free from hum when used for the reproduction of gramophone records, but this is by no means the case when the H.F. stages are in operation. Can you offer any suggestions as to what is the cause of this trouble, bearing in mind that my smoothing arrangements are generous, and all components are of the best possible type?

It would hardly be possible to enumerate all the possible causes of hum, and we would ask you to read an article, "Tracing Hum in Mains Sets," in our issue of February 11th, 1931.

From the symptoms you describe, it is clear that the "hum" voltages are being introduced into the H.F. stages, and it would be well worth while to try the effect of connecting a condenser of about 0.001 mfd. between one of the power-transformer primary terminals and earth.

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Double Volume Control.

Is there any particular advantage in using an L.F. volume control as well as an H.F. input control in a receiver with a power grid detector?

Practically speaking, no. A power grid detector works well with small inputs; the advantage of using both H.F. and L.F. volume controls is only apparent in a receiver with anode bend rectification, which needs a fairly considerable signal voltage for best results.

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External Tone Corrector.

My receiver is fitted with a pentode output valve coupled by a transformer to the loud speaker, and there is no compensating device. Tone is rather too shrill for my taste, and I am thinking of adding the usual corrector consisting of a 0.01 mfd. condenser in series with a 25,000-ohm variable resistance. Will it be satisfactory to connect this directly across the loud speaker terminals, which can be reached quite easily? The transformer itself is inaccessible.

It is possible to connect a tone-control device of this sort across the transformer secondary, but the conventional values will need some modification. The resistance value should be divided by the square of the transformer ratio, while the correct capacity must be multiplied by the same figure.

FOREIGN BROADCAST GUIDE.

TRIESTE

(Italy).

Geographical position: 45° 39′ N., 13° 45′ E.

Approximate air line from London: 754 miles.

Wavelength: 247.7m. Frequency: 1,211 kc. Power: 15 kW.

Time: Central European.

Standard Daily Transmissions.

12.50 G.M.T., gramophone records; 18.00, concert; 19.00, news, talks; 19.45, main evening entertainment. Exchanges programmes with Milan, Turin and Genoa.

Woman announcer. Call: EIAR (phon.: *Eh-yah*) Radio Trieste (phon.: *Tree-ess-tay*).

Opening Signal: gramophone record: organ, bells, orchestra, choir.

Interval Signal: Nightingale.

Closes down with the words: *Fine della trasmissione. Buona notte a tutti* (End of transmission. Good-night, everybody), followed by Fascist hymn and Italian National Anthem.

The Wireless World

AND RADIO REVIEW
(19th Year of Publication)

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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.

Editorial Comment.

Our Show Competition Results.

THE Olympia Show Competition, conducted by *The Wireless World,* this year has proved to be even more popular with our readers than in preceding years. We anticipated an increase in the number of entries, and accordingly made special arrangements to cope with the sorting out of the results, which, in view of the rather complicated nature of the analysis required to arrive at the winning items in each class, necessitates a considerable amount of labour, time and care.

It will be remembered that, as in previous years, the apparatus exhibited by manufacturers at Olympia was divided into various classes for the purpose of the Competition, and, in addition, entrants were asked to vote for what they considered to be the single outstanding exhibit at the Show.

Details of the result of the ballot are included in this issue, on page 494, and we also give there the names of the readers whose voting papers have been successful. Only one entrant has succeeded in producing a completely correct ballot paper, and he accordingly, receives the first prize of £50. The remaining prizes, which consist of vouchers for the purchase of apparatus to a total of a further £50, must this year be divided between seventeen entrants, all of whom tie for second place. The firms who are the manufacturers of the apparatus which has been voted best in its class have already been notified by letter of their successes, and a cheque for £50 has been sent to the reader whose ballot paper earns for him first place. Those readers who have gained the remaining prizes have also been notified of the results.

In next week's issue it is our intention, as in previous years, to illustrate and describe the winning apparatus, so that all readers may have the opportunity of learning more about those items which our readers collectively have selected.

This Issue.

THIS "New Readers' Number" of *The Wireless World* has been compiled taking into consideration especially the requirements of those who have joined us as new readers in past weeks, and we hope that all regular readers will take the opportunity of introducing the paper to their friends with this issue.

It is our intention to continue to cater for the requirements of some of the less advanced of our readers by the inclusion in the future of regular contributions which, although fully up to the standard which *The Wireless World* has set in the past, in the soundness of the information they will provide, will yet be prepared in a form more readily understandable by the less technical reader.

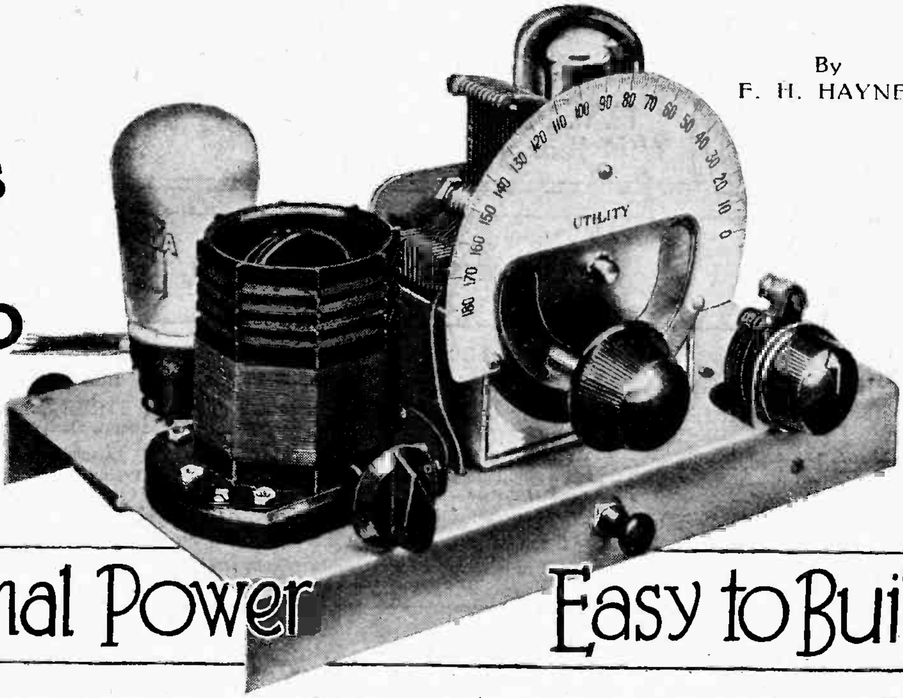
Designs for receivers will be prepared with simplicity of construction as a special feature, although every design will embody thoroughly up-to-date principles.

Suggestions from readers as to their own particular requirements in regard to articles in the future will always be welcomed.

In This Issue

THE Wireless World TWO

By
F. H. HAYNES.



Exceptional Power — Easy to Build

In putting forward a set which is one of the simplest ever described in the pages of this journal it will be noted that the same care has been taken to produce the most efficient circuit conditions as would apply to a more ambitious outfit. So many readers have expressed a desire for the continuance of the use of the ready drilled metal baseboard assembly, as was first adopted in the design of "The Wireless World Three," that this simplified and attractive method of construction is here continued. Economy both in the materials used and the battery running costs have been effected while a high standard of performance is maintained. This set is expressly designed for the reception of Regional programmes and therefore probably meets the needs of a vast number of listeners.

THE Regional scheme of broadcasting aims at giving easy radio reception all over the country. Looking over the range of receiving sets available to-day, we find that the majority of them are for long-range reception. They contain a great deal of equipment, are fairly costly, and the chances of difficulty increase with the complication. The B.B.C., by the setting up of Regional stations, aimed at making radio reception easy, and the set here described has been developed to give reliable reception of the home programmes. All the components for building the set have been standardised so as to form a unit producing the desired effect without complication. Where programmes are wanted for their programme value, little else is required.

Specification.

Suitability to particular requirements can be judged from the following details.

The total cost is less than 50s., excluding batteries and valves, a figure which represents, probably, the lowest at which a set can be obtained. Components are of the highest quality, nothing has been sacrificed to price, and all desirable circuit features have been retained. In appearance the set has a good professional built finish, and is not dependent upon the skill of the constructor. Specimen sets have been built within an hour, and one can be sure of being able to put a set together in the course of an evening. There is no drilling or soldering, neither are facilities needed for the shaping of wood nor the scaling out with square and dividers the location of the components. A stiff and well-finished aluminium base plate is prepared ready for attaching the parts, and wiring up consists of a few leads, run by the shortest routes, all wiring being hidden away on the underside of the plate.

Special attention has been given to H.T. current consumption, combined with quality detection and generous power output. A current of only some 6 mA. is consumed, which is less than half that normally taken by a battery set, while the power output equals that of a set fitted with a generous 2-volt triode output valve. Quality of reproduction has received careful attention, and tone correction is applied. Provision is made for reception on both medium and long wave ranges, reaction is provided, and selectivity is adjustable to suit conditions, so that the two programmes from a Regional are capable of separation anywhere. Intervalve coupling is by L.F. transformer, and a useful feature is the avoidance of a grid bias battery. Correct bias for the output valve is obtained automatically, and is self-compensating as the voltage of the H.T. battery falls. Moreover, opening

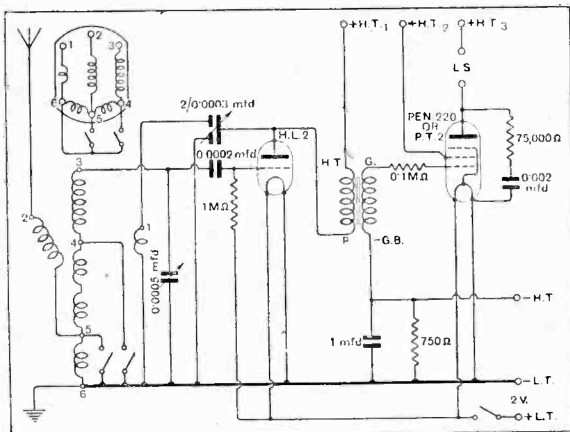
The Wireless World Two.—

of the grid bias circuit with consequent damage to the output pentode valve, as may readily occur when using a tapped grid bias battery, is obviated.

The Circuit.

Consisting of a detector and one L.F. arrangement the following details explain the essential features.

A swing-about aerial coupling permits of a balance being obtained between volume and selectivity. Where there is no H.F. amplifier, adjustment of coupling between aerial and tuned circuit must be considered an essential. A change in the amount of aerial coupling is required when switching over to the long waves, and this is automatically effected by an additional pair of contacts on the wave-change switch. Differential capacity reaction control is used, so that there is always an adequate value of by-pass capacity on the anode of the detector to ensure good detection efficiency.



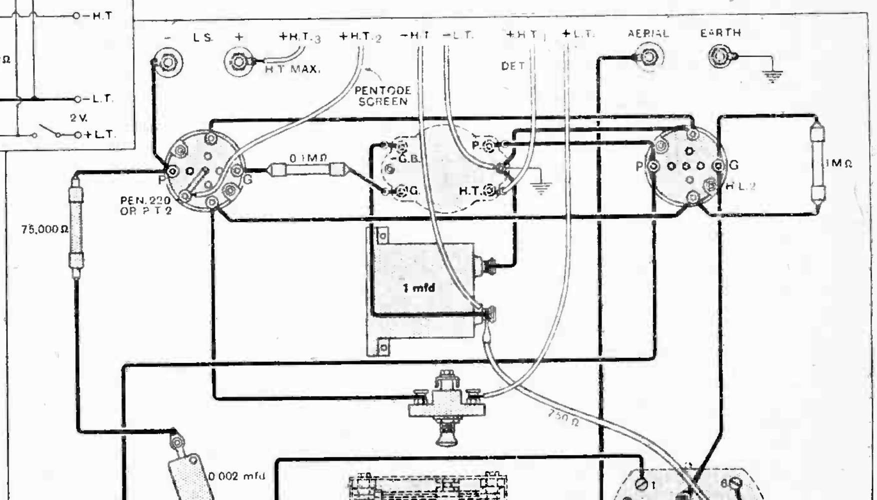
Circuit diagram giving details of the internal coil connections and showing the method of grid bias and tone correction.

Values of grid condenser and leak are employed to avoid detector distortion, while among battery valves that selected as the detector can handle a generous signal and gives considerable amplification. No H.F. choke is required in the anode circuit of the detector, while choice of the intervalve transformer turned on the desirable property of high primary inductance when passing a current of several milliamperes. Filter feeding of the intervalve transformer through a resistance, under the circumstances, is not an essential, while it is possible to dispense with decoupling in the battery feed circuit with entire safety. It might be mentioned here that it is always easy to add apparatus, but it is not always straightforward to produce a set free from trouble and in which the number of components has been cut down to a minimum in order to give easy construction.

SPECIFICATION:

Variable aerial coupling to give a control of volume and selectivity. Tunes to both medium and long wavelengths. Reaction provided. Quality detection using the Mazda HL.2. New type output pentode, the Mazda Pen.220 or Osram or Marconi PT.2. Grid bias by anode circuit resistance thus avoiding the use of grid cells. L.F. transformer coupling. Tone corrected output. Current consumption, L.T. 0·3 ampere at 2 volts. H.T. up to 6 mA at 150 volts. Power output, about 350 milliwatts. Chassis assembly. Easy construction, no soldering, measuring or drilling, only screwdriver and pliers needed. Cost, excluding valves, 50/-

To guard against H.F. voltages reaching the grid of the pentode output valve, a resistance is interposed in the grid lead. This resistance, in conjunction with the capacity acting on the grid, produces what is similar to a decoupling circuit to high-frequency currents. The value of 0.1 megohm specified should not be exceeded, as possible grid current through this resistance produces negative bias, quickly reaching a value in excess of the maximum permissible. Under ordinary circumstances this might be advantageous, but the specially sensitive output valve used is particularly susceptible to any change in the value of applied bias. Connection between the H.T. negative terminal and the negative filament lead is made by a resistance through which is passed the H.T. current taken by both valves. The voltage which is derived across this resistance as a result of the current flowing through it renders available the grid biasing potential for the pentode. Owing to the special nature



Connecting up may be quickly carried out with the aid of this practical wiring diagram. Care is needed in correctly identifying the six ends of the battery cable.

of the output valve employed, somewhat critical control of the value of grid bias is desirable, or, on the other hand, the H.T. potential applied to the screen must be

The Wireless World Two.—
capable of adjustment in small steps. In addition, therefore, to taking the pentode screen lead to a separate tapping on the H.T. battery, the detector tapping is also adjustable which controls, to the limited extent required, the precise value of biasing voltage by varying the contribution to the total H.T. current through the biasing resistance made by the detector valve. A by-pass condenser shunts the biasing resistance. This must be of the non-inductive type specified, its value of 1 mfd. not being taken at random, but representing the minimum safe value that will remove L.F. oscillation, while avoiding unnecessary excess of capacity.

The loud-speaker circuit in the anode of the pentode presents special problems. As the value of anode current is very small, filter feeding or output transformer is unnecessary, except as regards the vital requirement of matching the loud speaker to the valve. Under the circumstances the cheapest proposition is that of using a specially wound loud speaker. Unfortunately, in the case of moving-iron loud speakers, the rise in impedance of the winding at the higher audio frequencies increases the load on the valve, accentuating the higher notes and producing a fluctuation in the working conditions of the valve. Taking into account the change of impedance of the special loud speaker winding designed to give the maximum permissible power, correction is necessary by way of including a by-pass condenser in series with the resistance arranged to act as a falling impedance as the frequency increases. This tone-correcting circuit connected between the anode and filament of the pentode is a shunt to the loud-speaker circuit, and a properly corrected, good-quality output results. No by-pass condenser is connected across the H.T. terminals, as a test with an old H.T. battery of high internal resistance revealed absence of L.F. oscillation trouble.

Constructional Hints.

The good appearance of the finished set is not dependent on the skill of the constructor.

To permit of under-baseplate wiring so as to remove the disfiguring effect of leads running between components across the face of a set, extension pieces are fitted to terminals 1, 2, 3, and 6 of the coil, after first having removed the normal screw terminals on the top side. Likewise, it is necessary to dismantle and reassemble the valve holders, so that the nut-headed terminals face downwards. The under nuts on the screws should be taken up as tightly as possible, carefully avoiding any tendency to drag the strip contacts out of place. Ebonite spacers are included in the set of parts for giving the valve holders clearance from the under-face of the metal. Three bushes are also specified for fitting behind the two loud-speaker terminals and the aerial terminal, while another bush insulates the spindle of the reaction condenser from the frame.

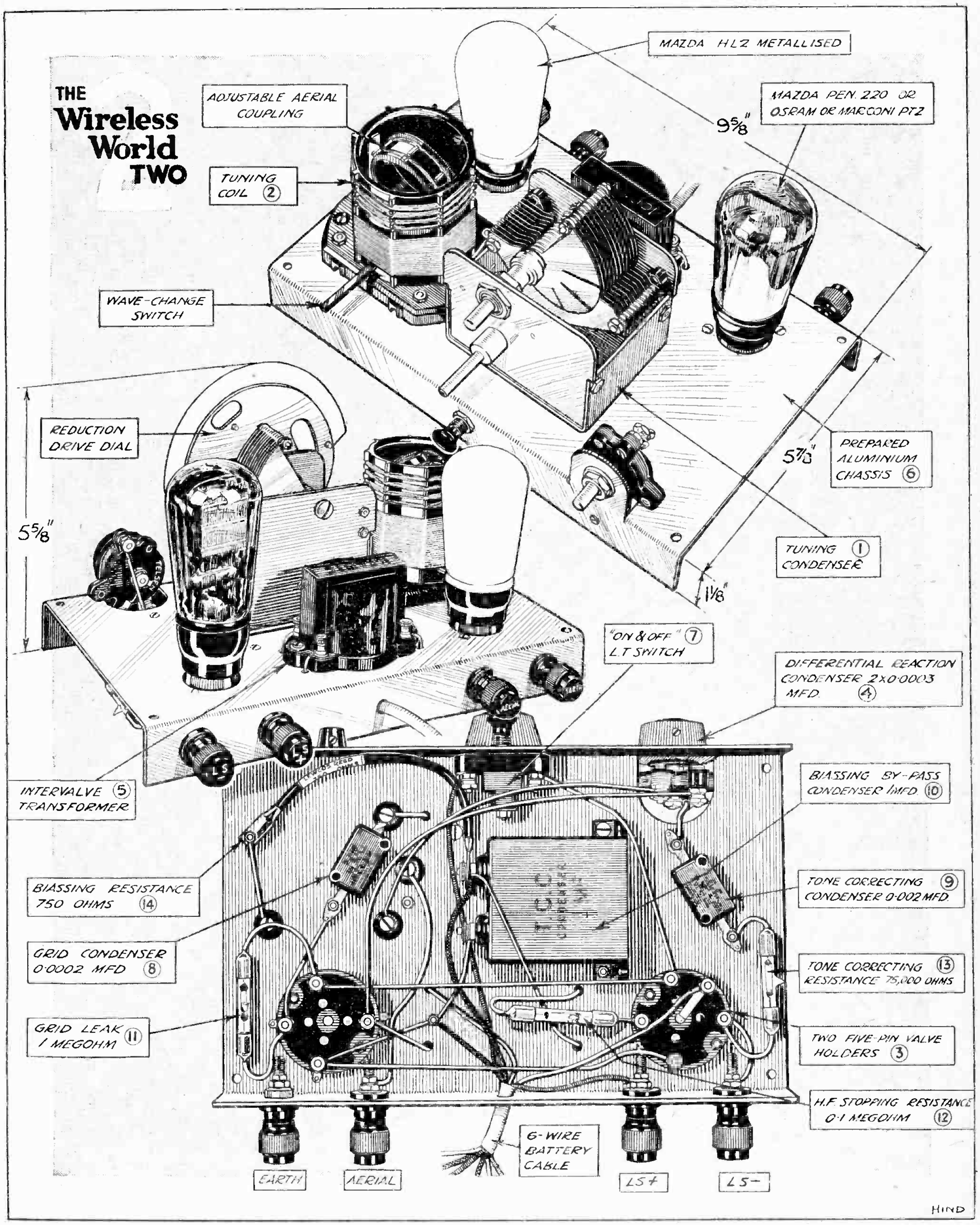
Of the several types of leak resistances available, care is necessary to see that those procured have end caps and running wires. The "on" and "off" switch is of a special type, in which the fixing bush is insulated from the circuit. The battery cable, consisting of six leads, may be home made, from good quality flex, or procured completely made up and fitted with eyeletted and terminal ends. The most convenient size of connecting wire is No. 24 tinned copper, and a particularly neat effect results by the use of ½ mm. silk sleeving, this being an unusually small gauge. As an aid to checking off all the materials, an illustration is given of the parts required, except the optional battery cable, and showing, in addition to screws and nuts, a set of connecting wires removed from the receiver.

Secure the valve holders first, noting that there is adequate clearance around the valve sockets. Fixing screws should be taken up as tightly as possible into the nuts, to avoid risk of a valve holder slipping out of place. Note that the valve holders are of the exact type specified with regard to their fixings. Terminals, "on" and "off" switch, and reaction condenser with bush, may next go on, as shown in the illustrations, taking the fixing nuts right home so as to prevent the possibility of turning. This remark particularly applies to the reaction condenser. Continuing with the heavier components, see that the coil extension terminals are tightly screwed home and adjust the position of the coil so that the terminal stems fall centrally in the holes in the base. It will be noted that one of the holding-down screws of the tuning condenser engages on the 1 mfd. condenser underneath.

With the L.F. transformer in position, the remaining small components are attached in the process of wiring. Measure off the length of sleeving required for a lead and run the wire through it, leaving it long at either end. Where two of the fixing screws are used as earthing terminals, additional nuts are fitted, and similarly in the mounting of the 0.002 mfd. condenser. Be specially careful as to the correct identity of the six leads in the battery connector. Note that the small resistances carried by the wiring are clear of possible contact with the metal.

Insert the valves, see that the valve holder clips are clear of the metal, and connect up the 2-volt L.T. battery. Leave the battery switch at "on," as this keeps the low-resistance battery shunted across the valve filaments and prevents the possibility of damage to the valves by accidental contact of the filament circuit with the H.T. supply. Connect the detector H.T. lead (H.T.1) to a potential of some 75 volts. The current passed by this lead will be about 2½ mA. The correct tapping for the screen voltage is 105 for anode potentials between 100 and 120 volts, and about 125 for potentials of 120 to 150 volts. On these values the bias is self-correcting, and ranges between 3 and 4.5 volts. Adjustment of the screen voltage is critical, and modifies quality as well as volume. It is most important not to open the maximum H.T. battery plug when the screen volts lead is connected, although the screen volts may be safely adjusted when the full H.T. voltage is applied to the anode lead.

If a specially wound loud speaker of the type referred to earlier is not available, a tapped choke should be connected across the loud speaker terminals and a loud speaker with normal winding connected to the tapping points giving the best results. It is pointed out, as an alternative, that this set will work quite well with almost any two-volt output valve, the tone corrector being left in circuit and having little effect under these circumstances. If it is intended to permanently use a triode



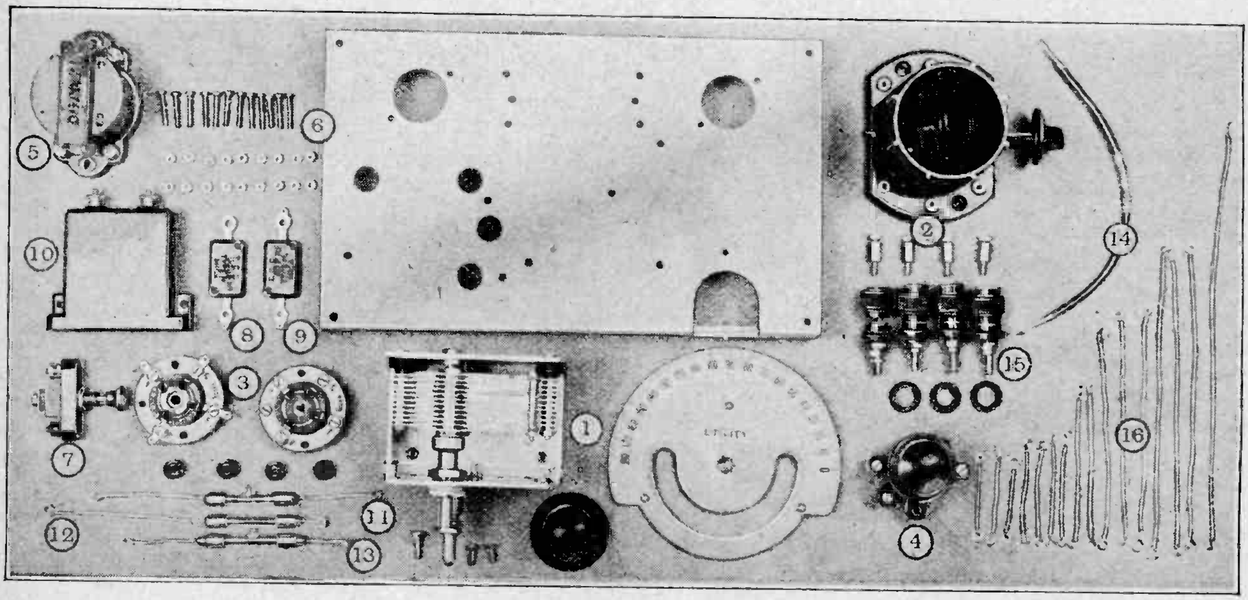
These drawings give all necessary details of assembly. The reference numbers reveal the identity of the components and are taken from the list of parts.

The Wireless World Two.—

in place of the pentode connecting a normally wound loud speaker direct to the L.S. terminals, then an increase of the biasing resistance to a value of 1,000 ohms will make the value of the resulting bias suitable for most triode output valves. One is cautioned against substituting an output valve in place of the detector when using the pentode, as the increased current through the 750-ohm resistance will bring about overbiasing and marked distortion.

As the use of the drilled metal panel precludes the inclusion of other components than those specified, it this receiver, as this can be left to individual requirements A special cabinet has, however, been produced, and to which reference has been made in the list of parts.

The correct position for the aerial coil is when held in the second pair of holes in the spring clips. Good selectivity, with ample signal strength, results with the coil nearly vertical. It is, perhaps, unnecessary to point out that the critical adjustment of reaction calls for slight modification in the tuning setting, and although designed only as a local station receiver, careful adjustment, on a modest aerial, gave fifteen foreign stations. Remember



LIST OF PARTS

(1)—1 Tuning condenser with 2 nickelled countersunk fixing screws and 1 round head, $\frac{1}{4}$in. × 4BA, and flat slow motion knob and dial (Utility, Type W.305/1, Wilkins & Wright)

(2)—1 Two-range coil (Colvern Type RM2S with 4 under base terminals and straight through switch rod)

(3)—2 5-Pin Valve-holders (Telsen, Type W.106)

(4)—1 Differential reaction condenser, 0.0003 mfd. .... (Telsen)

(5)—1 Intervalve transformer (Igranic "Midget")

(6)—1 Aluminium chassis to specification with 1 doz. nickelled raised-headed screws, 6BA, 1$\frac{1}{2}$ doz. 6BA nuts and 3 ebonite half bushes for terminals. 4 spacing collars $\frac{3}{16}$ in. in length, with holes to clear 6BA screws, Also insulating bush for reaction condenser (H. & B. Radio)

(7)—1 On-and-off switch .. (Telsen, single type

(8)—1 Condenser, 0.0002 mfd. (T.C.C., M Type)

(9)—1 Condenser, 0.002 mfd. (T.C.C., M Type)

(10)—1 Condenser, 1 mfd. (T.C.C., Type 50, non-inductive)

(11)—1 Resistance, 1 megohm (Loewe with end caps and wire terminations)

(12)—1 Resistance, 0.1 megohm (Loewe with end caps and wire terminations)

(13)—1 Resistance, 75,000 ohms (Loewe with end caps and wire terminations)

(14)—1 Resistance, 750 ohms (Lewcos, Spaghetti Type)

(15)—4 Terminals, Aerial, Earth, L.S.+, L.S.— (Belling-Lee, Type B)

(16)—Tinned copper wire No. 24 SWG, small quantity $\frac{1}{2}$ mm. silk sleeving.

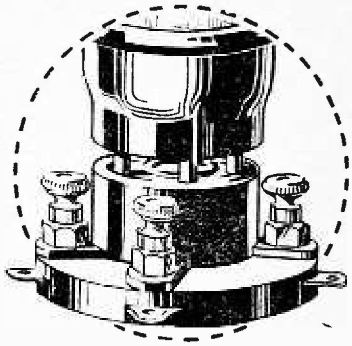
1 Cable, with L.T.+, L.T.—, H.T.—, H.T.+1, H.T.+2, H.T.+3 .... (H. & B. Radio)

Accessories:

2-volt accumulator; 120 or 150 volt H.T. battery; 2-volt metallised detector (Mazda HL.2); 2-volt pentode (Mazda Type Pen. 220, or Osram or Marconi Type PT.2); Loud speaker, matched to output pentode (Ormond special type, No. 1Z Board Chassis or Celestion); Cabinet (C. A. Osborn, Regent Works, Arlington Street, London, N.1.)

may be mentioned that the design given can, of course, be followed using a wooden baseboard. It is obvious in so simple a set that opportunities will arise to make use of components already to hand, and to permit of this dimensions have been given of the baseboard in order that a thin piece of ply-wood may be employed elevated on two 1$\frac{1}{8}$in. battens. When building the set in this way the valve-holder and coil connections may be run on the upper face of the base. All essential wiring and operating instructions as given here are likewise applicable to an improvised set using, no doubt, other components than those specified and assembled on the wooden baseboard A cabinet has not been shown in connection with that a good aerial is equal to the addition of an H.F. stage, as compared with a poor one. If used at only a short distance from a Regional transmitter, the local programme will be heard at the lower scale settings when switched over to long wave. Only band-pass tuning will remove this difficulty. The provision of such a refinement not only adds to cost and complication, but would serve little purpose, as the Daventry transmission is the same as one of the locals. The inclusion of long-wave tuning gives the listener who, owing to distance, prefers to tune to the National Daventry station, while the set is quite capable of tuning in the long-wave Radio Paris transmission, a requirement so often preferred.

The VOLTAGE ~III~III~ on the GRID



How the Signal Grows from Stage to Stage. Grid Swing and Negative Bias.

By W. I. G. PAGE, B.Sc.

THE newcomer to wireless usually finds some difficulty in understanding the terms employed in connection with grid voltage. Such expressions as grid swing, grid bias, signal volts and input peak volts are unfortunately used quite loosely, and there is reasonable excuse for some confusion of thought.

The thermionic valve magnifies the signal voltage applied between grid and filament in the case of battery valves, and between grid and cathode with the indirectly heated type, and we are not concerned here with signal current. In the output or the anode of the valve, however, we find that the current supplied by the H.T. battery changes in sympathy with the signal voltage on the grid. It is in the intervalve couplings, such as the tuned anode, tuned grid, the low-frequency transformer and resistance coupling, which are employed to create a high impedance or opposition to these currents, that the necessary amplified voltage for the grid of the succeeding valve is developed.

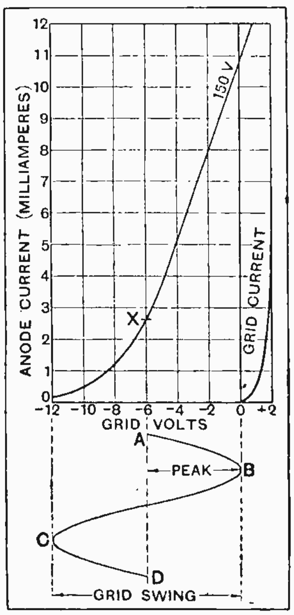
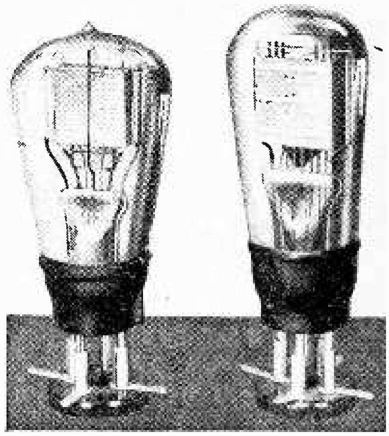


Fig. 1.—A typical signal grid swing and its application to the input of a valve. The peak volts which must not exceed the bias are half the grid swing.

We can say, very roughly, that in a multi-valve set each valve and its output circuit is arranged so as to accept signal volts, and to deliver greater signal volts by a relay action to the next grid. Before the detector this statement applies to the carrier wave with speech and music superimposed (modulated H.F.), and after detection to the speech or low frequencies only. The signal volts take the form of a wave, as shown in the lower part of Fig. 1, where A D is an imaginary zero line about which regular periodic changes take place. At B a maximum positive value has been reached, whilst C denotes the maximum negative value. The change from A to D through B and C is called a complete cycle, of which there will be, for instance, one million per second at 300 metres.

The horizontal distance between the maximum positive and negative points B and C represents in volts what is known as the total signal grid swing, and the signal peak volts are always half this value (see Fig. 1). Let us now take the upper part of the diagram, showing a typical valve characteristic, where the change of anode current due to change of grid volts is represented by a curve. Accepting the makers' figure for correct grid bias as 6 volts negative for an H.T. potential of 150 volts, the working position[1] on the curve becomes X, which means that the imaginary zero line of the signal grid swing is applied at this point.



A contrast—Past *versus* present. On the right is the new Mazda Pen. 220 which will give 370 milliwatts output for a signal of 4½ volts, whilst the Osram DE5A on the left—a valve which was popular some 3 years ago—required a signal of 18 volts to give 120 milliwatts.

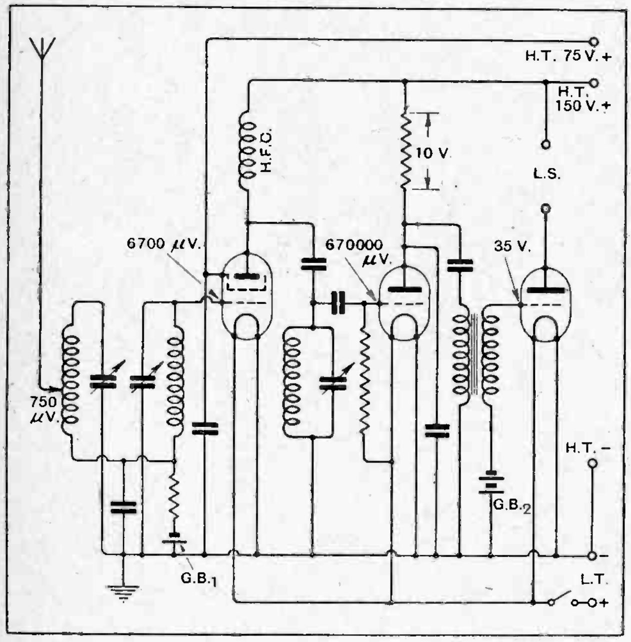
The question arises as to what are the limits of grid swing volts on either side of A D in the case under discussion. In order to prevent serious damping, the positive peak B must not encroach into any part of the grid current curve, which starts at about zero grid volts; on the left we are restricted by excessive curvature of the characteristic. By fixing B, however, we automatically fix C, since the positive and negative peak volts are equal, and we come to the important conclusion that the *signal peak volts may be less than, or equal to, but must never exceed the grid bias voltage* quoted by the valve maker.

It is the purpose of these notes to take a typical receiver and to trace the growth of the signal peak volts

[1]The valve curve and the operating point × are taken from the maker's catalogue. An impedance in the anode circuit would make the curve much straighter.

The Voltage on the Grid.—

from stage to stage, so as to facilitate the design of a receiver on scientific lines. Each valve and its coupling should be chosen with due regard to bias, and to the amplitude of the peak signal voltages which are likely to be developed. In Fig. 2 the popular combination of screen-grid H.F.-grid detector L.F. with modern coupling schemes is shown. A band-pass input filter is followed by a screen-grid valve, which in turn is linked to a power-grid detector by tuned-grid coupling. A parallel-fed L.F. transformer feeds the output of the detector to the power stage.



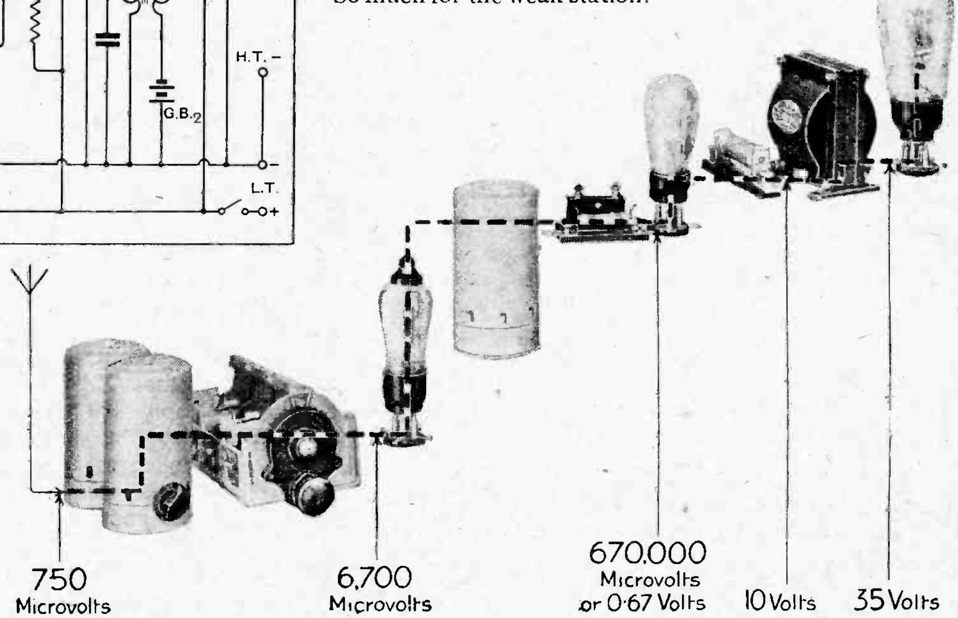


Fig. 2.—Showing how the peak signal volts from a distant station grow from stage to stage in a 3-valve receiver. With 750 microvolts at the aerial, 35 volts are developed on the grid of the output valve, representing a total magnification of about 47,000. This excludes the amplification of the last valve, the function of which is to deliver power to the loud speaker.

Measurement shows that we may expect with a good outside aerial about 750 peak microvolts (there are a million microvolts—μV—in a volt) between aerial and earth from some of the more easily received Continental stations. This voltage will be actually increased in the tuned band-pass circuit, depending upon the "goodness" of the latter, and whether the aerial is coupled in at the best point. A typical figure for a modern tuned circuit is about nine times, and we thus find 9×750 μV, or about 6,700 μV between grid and filament of the S.G. valve. Assuming that reaction is used (not shown in the diagram), the single H.F. stage gain may well be 100 with small screened coils, giving a detector peak voltage of $6{,}700 \times 100 = 670{,}000$ μV, or about $\frac{2}{3}$ volt. If the H.F. signal is not modulated there will be no detector output, but if modulated to the maximum of 100 per cent. there will be a large H.F. signal voltage developed across the anode resistance. We will assume 50 per cent. average modulation of the $\frac{2}{3}$-volt input, which will give, with a modern power-grid rectifier, about 10 volts peak across a 20,000-ohm resistance in the output circuit. If the L.F. transformer ratio is $3\frac{1}{2}$ to 1, the power valve must be biased to 35 volts (G.B.2) to accept (without overloading) the 35 signal volts (peak). Thus the total magnification is $35{,}000{,}000 \div 750 = 47{,}000$.

There are hardly any battery power valves which will handle 35 volts input, and either reaction would have to be reduced or a pre-H.F. volume control incorporated even for certain distant stations—such is the efficiency of modern valves and so great the field strength of transmissions. The negative bias for the grid detector, which must be treated as an L.F. amplifier, is obtained automatically without a local battery by the flow of grid current through the grid leak, and is further augmented by the signal voltage. For the grid of the H.F. valve a bias battery of over 6,700 μV. will suffice, so that the 0.9v. or the 1.5-volt variety may be pressed into service. So much for the weak station.

To take the other extreme—a local Regional transmitter if within, say, seven miles of our receiver, would probably develop some 550,000 μV. between aerial and earth, and the grid of the first valve would receive 5 volts peak. There is no S.G. valve, except the lately introduced variable-mu tetrode, which will accept more than about one-tenth of this input without overloading, and a pre-H.F. volume control becomes essential to reduce the peak volts below the value of the small bias battery $G.B._1$.

It is hoped that the foregoing will give some indication, be it ever so rough, of the likely signal voltages in a simple receiver, and the bias voltages which are necessary to accept them.

Wireless World

UNBIASED

BY FREE GRID

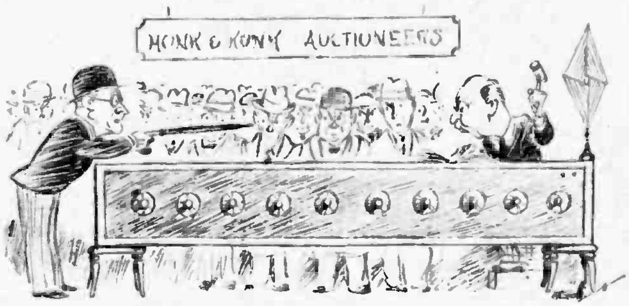
"Superhets" at Super Prices.

IT is notorious that sometimes a real bargain may be picked up amid the junk sold at the various auction rooms which exist in London. Being a collector of other things beside the emanations of the various broadcasting and amateur transmitting stations of the world, I not infrequently pay a visit to these places. It is quite common nowadays to see various lots of second-hand radio receivers and components in such places, but it is very seldom indeed that anything in the nature of a bargain is offered. I have noticed that wireless gear always fetches quite a good figure, judging by the price standards obtained at these places for other goods.

The ordinary dealer—I mean the general dealer and not the radio dealer—is far too cute to bid much for these lots, and it is always the unfortunate general public with little or no knowledge who put money in the auctioneer's pocket by vigorously bidding against each other. Provided it looks complicated enough, and possesses several valve-holders, there seems to be no limit to the price some people will pay for worthless goods, and the old receivers of 1923, with their terrifying number of switches and jacks, are never left on the shelf.

Just at present there is a great boom in superheterodynes owing to the fact that modernised versions of this type of receiver are now popular. Someone seems to have been carefully hoarding all the terribly inefficient sets which were on the market in the great superhet boom of 1925, and to have taken an opportune moment of sending them to various auction rooms. The unfortunate public are lapping them up greedily and paying quite fancy prices for second-hand superhets employing nine or ten valves, which will, of course, in every respect, be far below the standard attained by their modern counterparts employing five valves or so. Unfortunately, some people seem to learn nothing, and having been done once, metaphorically speaking, they apply the blue bag and then once more come up smiling and all ready to be stung again.

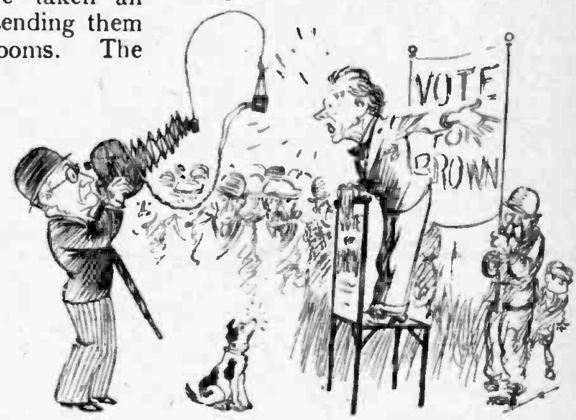
The other day I foolishly attempted to intervene and offer a timely word of advice to a couple of men who were eagerly bidding against each other for a beautiful-*looking* superhet whose value was simply not equal to the cost of carting it away. Not only did the auctioneer round on me, as might be expected, but the bidders whose pockets I was trying to protect appeared ready to tear me from limb to limb, and my plight was almost as bad as that of the person who attempts to intervene when a man is beating his wife.



Offering a timely word of advice.

My Wonder Machine.

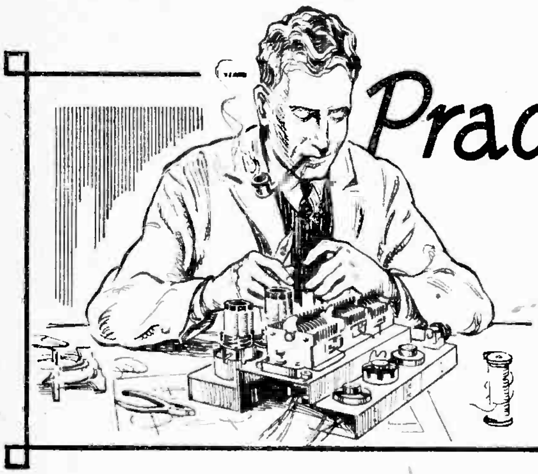
THE great industries and home entertainments represented by the silent film, the talkies, cinematography, gramophones, and wireless, not to mention television, are slowly but surely merging into one. I prophesy that eventually a complete "home entertainment" machine will be marketed which, according to the setting of a switch, will enable us to obtain a programme from almost any broadcasting station we like—the transmission, of course, being visual as well as aural—or to obtain our amusement from the "gramophone" side of the apparatus. And, since the gramophone record will be on a film instead of a disc, a visual as well as a sound record of the performers will emanate from our screen, for, needless to say, the gramophone will be an electric instrument with its loud speakers at the back of the screen; indeed, home talkies of this type have already obtained a fair measure of success in America, although, so far, all the machines at present on the market are of the sound-on-disc variety.



Our own efforts at talking picture-making.

Needless to say, we shall be able to delight(?) our friends with our own efforts at talking picture-making, and the ubiquitous folding camera of to-day will give place to a folding talkie recorder.

This wonder-machine of my dreams is really only waiting for the perfection of television. Need I add that it will be completely equipped with all the latest remote control gadgets? Moreover, the de luxe types will be in duplicate, or, rather, in multiplicate—or whatever the correct word is—so that Aunt Maria can tune in the talks on knitting while other members of the family tune in to dance bands



Practical Hints and Tips

Simplified Aids to Better Reception.

NOW that "H.F." receivers are generally constructed with separately screened coils and condensers which, so far as they go, provide almost perfect isolation, any trace of instability may be attributed, fairly definitely, either to unwanted conductive couplings or to interaction between exposed connecting wires.

SCREENED H.F. LEADS.

The bad effects of conductive couplings are easily offset by applying the well-known principles of decoupling, but the screening of leads is not so common, although the subject has been treated in these columns. Provided an accepted design, with a layout specially planned to give short connections, is adopted, there is little risk of trouble from this source, but nevertheless it is often responsible for uncontrollable self-oscillation when high stage gains are desired.

Reference to Fig. 1, which shows a conventional H.F. stage, will show the various leads that may be regarded as potential danger points; these wires are indicated in heavy lines.

Indiscriminate screening of leads should be avoided, as it is likely to result in an excessive stray capacity across the tuned circuits, thus lowering their effective wave-range, and furthermore there is the possibility that serious dielectric losses may be introduced. The rule should be to add screening only where it proves to be necessary.

Although screened wire is made by a number of manufacturers, it does not seem to be available in a form that is really suitable for use in H.F. circuits. What is required is a screened conductor with low self-capacity, and with low dielectric losses; both these conditions can be satisfied reasonably well if the wire and its metallic covering are to a great extent air-spaced. A practical method of screening is indicated in the inset to Fig. 1; in this case a wire of small diameter is enclosed in sleeving, and the whole is encased in a loosely fitted metal braided tube, which may be removed from screened wire of the type sold for use in L.F. circuits. It should be emphasised that capacity is kept within reasonable limits by using a very fine wire.

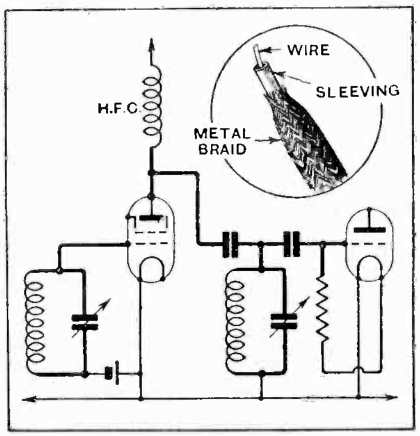


Fig. 1.—"Live" H.F. leads are shown in heavy lines. Inset: low-capacity screened wires for preventing interaction between exposed connectors carrying H.F. current.

Those who are deeply concerned with the appearance of their receivers, and at the same time are sticklers for efficiency, may be interested to know that a still better form of screened connector may be made by threading fine wire through lengths of ¼in. ebonite tube, which in turn is covered with metal braiding. Bends in the ebonite tube can be made by heating it with steam, or even with hot water.

UNLESS proper precautions are taken, a set with tuned anode H.F. coupling, designed for battery feed, is much more likely to "motor-boat" when connected to an H.T. eliminator than when one of the other methods of H.F. coupling—transformer or tuned-grid—is used.

A CURE FOR MOTOR-BOATING.

This is because L.F. voltages developed across the relatively high internal resistance of the eliminator may be passed back fairly freely, *via* the tuned anode coil and grid condenser, to the grid of the detector valve. In such cases, an inexpensive remedy is often to be found in the use of a smaller grid condenser than usual—say, 0.0001 mfd.

Incidentally, there is a tendency nowadays to regard the tuned anode coupling as obsolete; this is hardly justifiable, as it is as effective as any other form of coupling, and, now that filter-feeding of anode circuits is thoroughly understood, there is no reason why its only real disadvantage—that mentioned above—should not be successfully overcome. But it should be made quite clear that the values of "decoupling" components in the H.F. valve anode circuit should be chosen to act as a barrier to L.F. impulses; a resistance of some 20,000 ohms with a by-pass condenser of 2 mfds. would be effective. It will therefore be seen that a tuned anode coupling is hardly the right one to choose for a battery set, where there is unlikely to be any surplus anode voltage to dissipate in the decoupling resistance.

LONG-WAVE COILS.

A GREAT deal of attention has lately been paid to the design of medium-wave screened coils, and it may be wondered why equal importance has not been attached to windings for the long-wave band. Actually, there is very little point in endeavouring to obtain extreme efficiency from long-wave coils, and the conventional type of winding as commonly specified is as "good" as is generally needed. Indeed, one might go so far as to say that even more compact long-wave windings than are ordinarily specified are perfectly adequate, and by restricting their overall dimensions, it is often possible to find room for better medium-wave windings, or, alternatively, to improve the "goodness" of an existing medium-wave coil by allowing greater spacing between the two sections.

As an example of what may be done in this direction, it may be mentioned that the general performance of a commercial dual-range coil was improved to a noticeable extent by stripping the long-wave winding, which was originally in six sections, and rewinding in three-section form with finer wire.

A BASS BOOSTER.

IN an experimental receiver it is often convenient to have some method of controlling the amplification of the low notes, so that the tone may be exactly adjusted to suit the particular loud speaker used.

An easy method of arranging for this is shown in Fig. 2. The detector decoupling condenser C is returned, not to the detector cathode as usual, but to the slider of a potentiometer P, which forms the bias resistance of the output valve. This potentiometer replaces the normal bias resistance, and so it must have the same total resistance.

In many cases, however, a potentiometer of the correct resistance cannot be obtained, but one of higher resistance can then be employed, provided that it is shunted by another resistance of the correct value to bring the total resistance of the combination to the correct value for biasing purposes.

When the slider of the potentiometer is placed at the lower end the results are normal, for the decoupling condenser is still returned to the detector cathode. When it is placed at the upper end, however, the bass amplification is enormously increased, and in most cases motor-boating occurs. As the slider is moved from the lower position towards the upper, the strength of the bass increases until a point is reached at which the amplifier commences to motor-boat. The optimum working point will be found somewhere between the normal connection, with the slider at the bottom of the potentiometer, and the motor-boating point.

In order that the circuit may work in this manner it is necessary, of course, to make sure that the transformer is connected in circuit in the correct magnetic sense, otherwise reduced, not increased, low-note amplification will result. Before correct operation is obtained, therefore, it may be necessary to reverse the primary connections to the transformer. It should be noted that no increase of bass can be obtained when this circuit is used with resistance coupling, for then the phase of the fed-back currents is incorrect.

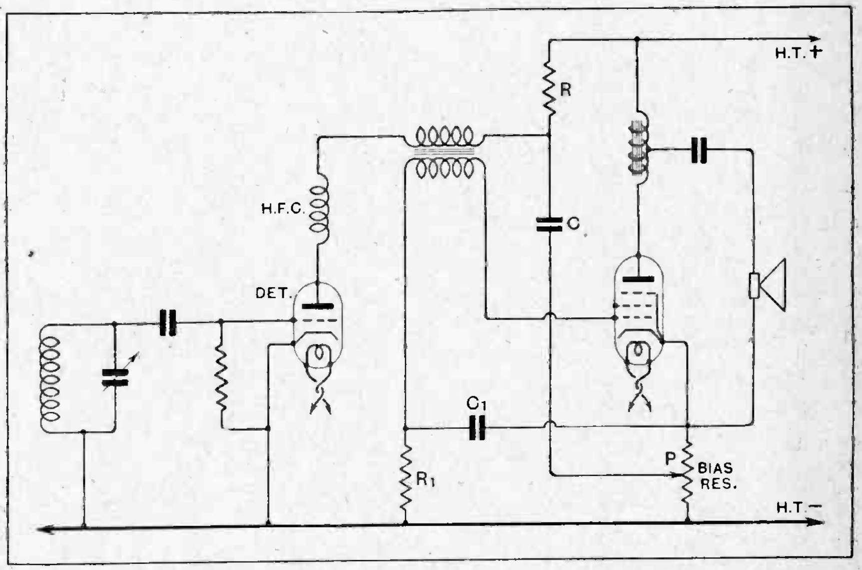


Fig. 2.—Intentional L.F. reaction. A method of introducing artificial interaction in order to over-accentuate low-note response. Reaction is controlled by varying the amount of resistance common to both circuits.

LOUD SPEAKER HUM: An Infallible Test.

WHEN a moving-coil speaker has its field winding supplied from rectified A.C., hum is often found which no amount of juggling with the receiver circuits will eliminate. This hum originates in the field supply itself, and consequently it is to the field supply that one must turn for its elimination.

A certain test for this type of hum is to connect the moving coil to the output transformer in the usual manner, and then completely to disconnect the primary winding. Any hum which is then audible is coming from the field supply, and can only be stopped by smoothing the field current.

In the case of a low-voltage winding fed from a metal rectifier, a 1,000 mfd. or 2,000 mfd. electrolytic condenser in parallel with the field is often efficacious. With a high-voltage winding fed from a valve rectifier, however, it is usually necessary to insert a smoothing choke in series with the field, in addition to the usual 2 mfd. condenser in parallel with the winding.

Our Show Competition.

PRIZE WINNERS AND BALLOT RESULT.

THE result of *The Wireless World* Olympia Show Ballot is now known, and we announce the results in the form of a reproduction of the chartered accountant's certificate which is included on this page.

It will be remembered that readers participating in the Ballot were asked to vote for what they regarded as the outstanding single exhibit at Olympia and, in addition, to vote for the best in a number of classes into which the exhibits as a whole were divided. The classification which we gave for the exhibits was as follows:—

Class 1.—Receivers employing four or more valves, including radio-gramophones.

Class 2.—Receivers employing three valves or less, including radio-gramophones.

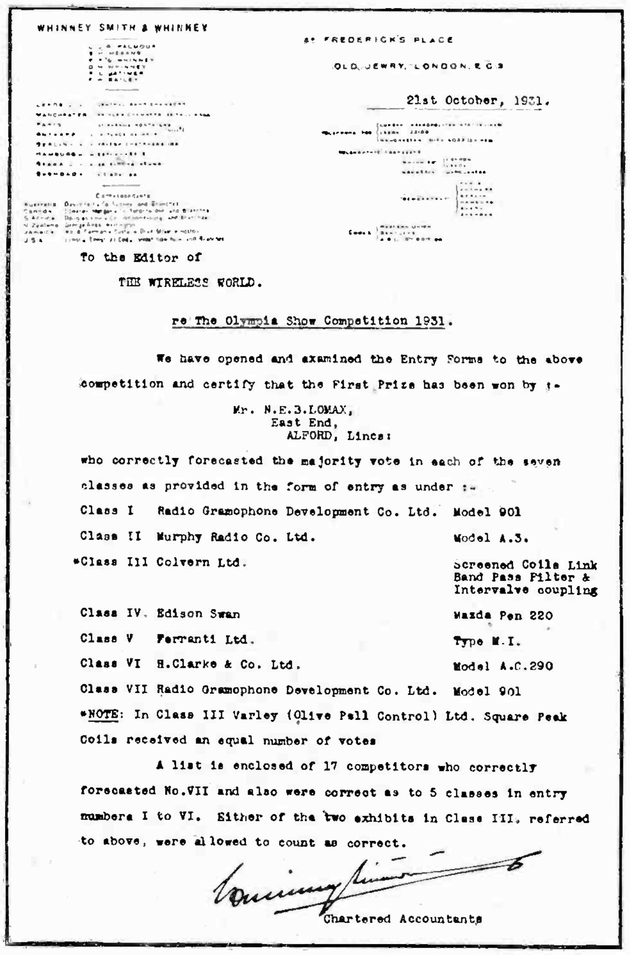
Class 3.—Component parts for home construction, including tuning coils, condensers, resistances, etc.

Class 4.—Valves.

Class 5.—Loud speakers of all types.

Class 6.—Accessories, such as pick-ups, gramophone motors. mains units, batteries, meters, etc.

Class 7.—The outstanding single exhibit at the Show, irrespective of the class to which it belongs.


WHINNEY SMITH & WHINNEY

FREDERICK'S PLACE
OLD JEWRY, LONDON, E.C.2

21st October, 1931.

To the Editor of
THE WIRELESS WORLD.

re The Olympia Show Competition 1931.

We have opened and examined the Entry Forms to the above competition and certify that the First Prize has been won by :-

Mr. N.E.B.LOMAX,
East End,
ALFORD, Lincs:

who correctly forecasted the majority vote in each of the seven classes as provided in the form of entry as under :-

Class I	Radio Gramophone Development Co. Ltd.	Model 901
Class II	Murphy Radio Co. Ltd.	Model A.3.
*Class III	Colvern Ltd.	Screened Coils Link Band Pass Filter & Intervalve coupling
Class IV	Edison Swan	Mazda Pen 220
Class V	Ferranti Ltd.	Type M.I.
Class VI	H.Clarke & Co. Ltd.	Model A.C.290
Class VII	Radio Gramophone Development Co. Ltd.	Model 901

*NOTE: In Class III Varley (Olive Pell Control) Ltd. Square Peak Coils received an equal number of votes

A list is enclosed of 17 competitors who correctly forecasted No.VII and also were correct as to 5 classes in entry numbers I to VI. Either of the two exhibits in Class III, referred to above, were allowed to count as correct.

Chartered Accountants

In Class 1 the radio-gramophone, type 901, by the Radio Gramophone Development Co., Ltd., wins first place. Class 2, the Murphy three-valve receiver, type A3. Class 3, the Varley Square Peak Canned Coil and the Colvern Link Circuit. These two components having tied with an equal number of votes are both regarded as having won in this section. Class 4, the new Mazda Pentode valve, the PEN.220. Class 5, the Ferranti M.1 moving-coil speaker. Class 6, the "Atlas" A.C. Eliminator, type 290. As the outstanding feature of the Show, the Radio Gramophone Development Company's radio-gramophone, type 901, as in Class 1 above, has been selected.

The reader whose vote agreed with the majority and who, in fact, had a perfect ballot paper, is Mr. N. E. B. Lomax, East End, Alford, Lincs, to whom we have already despatched a cheque for £50, being the amount of the first prize.

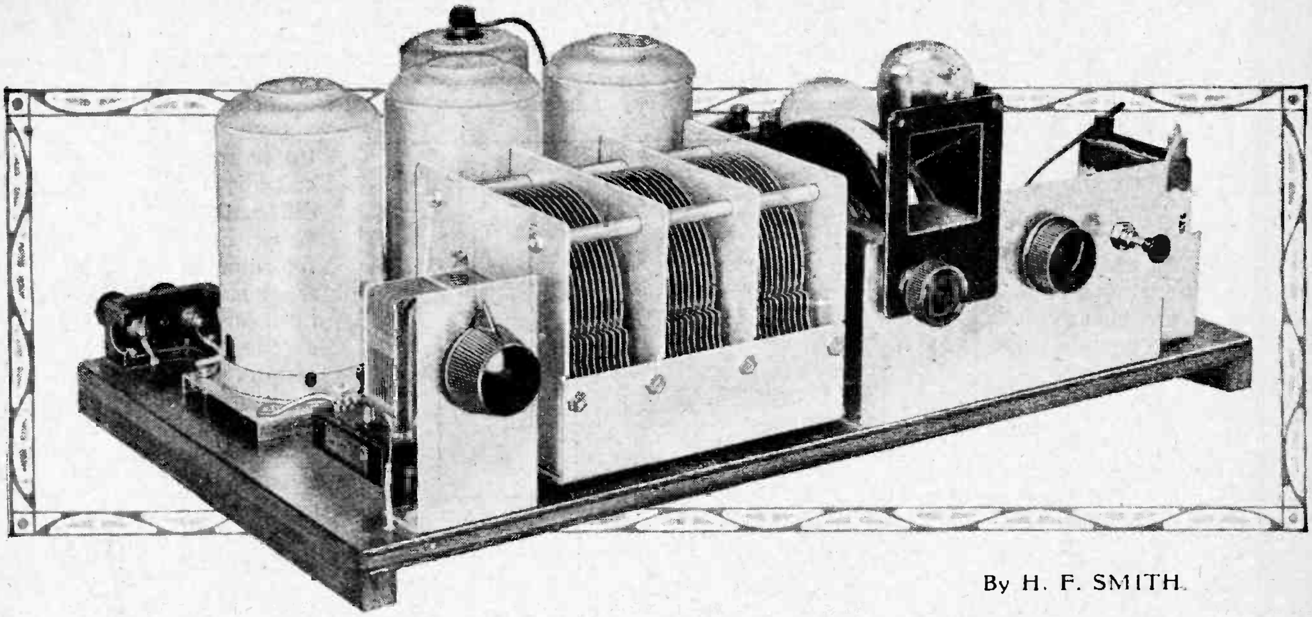
Seventeen entrants tied for second place and, therefore, the remaining prizes, which consisted of vouchers for the purchase of apparatus from firms exhibiting at Olympia, have been divided amongst them. A list of the names of these winners who have been notified of their success is as follows:—

Mr. E. Carolan, Broxburn, West Lothian; Mr. A. Buchanan, London, W.2; Mr. F. Haegele, Shirley, Southampton; Mr. F. C. Vize, Mildenhall, Marlborough, Wilts; Mr. H. Elliott, Nelson, Lancs; Mr. J. C. I. Williams, Bexley, Kent; Mr. H. Rowsby, Chapel Allerton, Leeds; Mr. D. Melton, Swinton, Manchester; Mr. J. E. Sayers, Stretford, Manchester; Mr. K. D. Shiels, Lewisham, London, S.E.13; Mr. J. D. Howe, West Hartlepool, Co. Durham; Mr. T. H. White, Swinton, Manchester; Mr. F. R. Williams, Hall Green, Birmingham; Mrs. D. Webster, Leamington Spa; Mr. T. Coulthard, Westgate, Co. Durham; Mr. J. E. Leacock, Ilford, Essex; Mr. H. T. C. Reading, Church End, Finchley, N.3.

In next week's issue we shall illustrate and describe the apparatus which has been voted first place in each class, so that readers will be able to see for themselves how their own votes have elected these items as outstanding products of the Olympia Show.

Large Increase in Competition Entries.

The interest of our readers in the competition increases year by year, and on this occasion the number of entries has exceeded those of last year by more than 50 per cent. The competition differs from most other ballots because the result represents the choice of voters competent to discriminate.



By H. F. SMITH.

Band-Pass Pentode Three

Large Undistorted Output, but Economical in First Cost and Upkeep.

DESPITE recent improvements in dry-battery manufacture, those whose receivers are fed with anode current from this source will have learned from bitter experience that maintenance becomes a costly affair if anode current be allowed to exceed, roughly, a round dozen milliamperes.

Take a "standard" three-valve set, and, for the sake of argument, let us agree to accept this somewhat arbitrary limit in consumption. The H.F. and detector valves between them will need at least four, and more probably over six, milliamperes, especially as it is now realised that, except for smooth reaction control, the rectifier works best with a relatively high anode voltage. This leaves us a maximum of 8 milliamperes for the output valve. However carefully this valve may be chosen, it was until recently impossible to obtain from it an undistorted output of more than about 160 milliwatts, even when working with a 150-volt battery.

Now, with the new high-efficiency pentodes, rather more than twice that output is attainable for a total consumption of only six milliamperes (five milliamperes for the anode and one milliampere in the screening grid circuit). Thus, by using the Mazda Pen. 220 valve, we can keep within our limit without being too niggardly with regard to the H.F. and detector valves.

This does not exhaust the possibilities of the new type of valve. If still greater economy be necessary total consumption of the output stage may be reduced to slightly under four milliamps. by applying 120 volts and 90 volts to anode and screen respectively; under these conditions output will still be considerably above that obtainable from an ordinary triode, even when operated with maximum rated voltage, and, of course, total magnification will be increased several times.

Should greater volume be needed there is the possibility of getting well over half a watt by applying 150 volts to both anode and screen. At this pressure anode consumption will rise to nine milliamps.—still quite a reasonable and economical figure.

Unfortunately, this high efficiency in the relationship between D.C. wattage dissipation and signal-frequency power output is not obtained without a little trouble. A distressing noise, and not even one of very great intensity, is almost certain to be the result of indiscriminately plugging one of the new valves into an existing set. It is the purpose of this article to describe a satisfactory way of using the high-efficiency pentode, and at the same time to discuss the design of a "standard" H.F.-det.-L.F. battery set in the constructional details of which there is a fair amount of latitude. An attempt has been made to include all worthwhile modern innovations without unduly complicating matters.

SPECIFICATION.

GENERAL: A battery-fed three-valve receiver for operation with an external aerial. High selectivity ensured by three tuned circuits. Ample magnification, both H.F. and L.F., for long-distance reception.

CIRCUIT: Constant-width band-pass filter; one H.F. stage, coupled by modified tuned grid system to grid detector: transformer-coupled pentode with corrected auto-transformer output.

CONTROLS: Input volume control; fully ganged tuning; differential reaction control; on-off switch.

Band-Pass Pentode Three.—

It will be easiest first to consider the simplified circuit diagram, Fig. 1, which shows that the aerial input is passed to the first valve through a "mixed" band-pass filter, of which the two component circuits are coupled by the combined action of the coupling condenser CC (which is common to both), and of the negative inductance coil L. Values are chosen so that correct coupling is maintained to give reasonably constant broadness of tuning over the whole wave range. A ready-made set of coils, fitted with built-in wave-range switches, is used, and so the home constructor's original objection to band-pass tuning—the need for making special coils—is no longer tenable. Inductance values are matched, and thus, by using the coils with a good modern gang condenser, single-knob tuning—the only satisfactory scheme for filter sets—presents no difficulty.

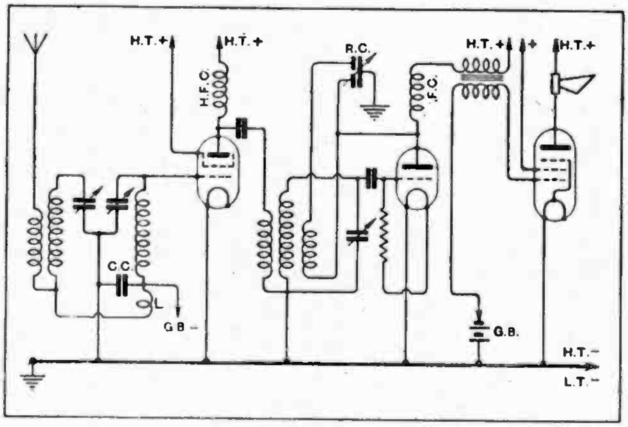


Fig. 1.—Basic circuit diagram, omitting wave-range switching, automatic bias, loud speaker feed device, etc.

The high-frequency amplifying valve is coupled to the detector by a choke-fed transformer—actually an auto-transformer on the long-wave side. True power grid detection is almost out of the question in a battery set, but the values associated with the rectifier, which operates on the grid circuit principle, are those giving what is probably the most satisfactory compromise.

Reaction between detector anode and grid circuits is controlled by a differential condenser, connected in such a way that the rotor may be earthed; the need for an insulated bush for the spindle is thus avoided. Detector-L.F. coupling, by means of a transformer, is entirely conventional.

Refinements and additions to the basic circuit are shown in Fig. 2. There is an aerial capacity potentiometer to control volume, which, with the help of a semi-variable balancing condenser, enables this operation to be effected without appreciable disturbance of tuning. In order that the H.F. stage may operate under the best possible conditions without the need for a special bias cell, the S.G. valve is biased automatically by the potential drop across R_5. Decoupling for the grid circuit is provided by the combined action of R and the coupling condenser C.C., which, it should be noted, is built into the coil assembly.

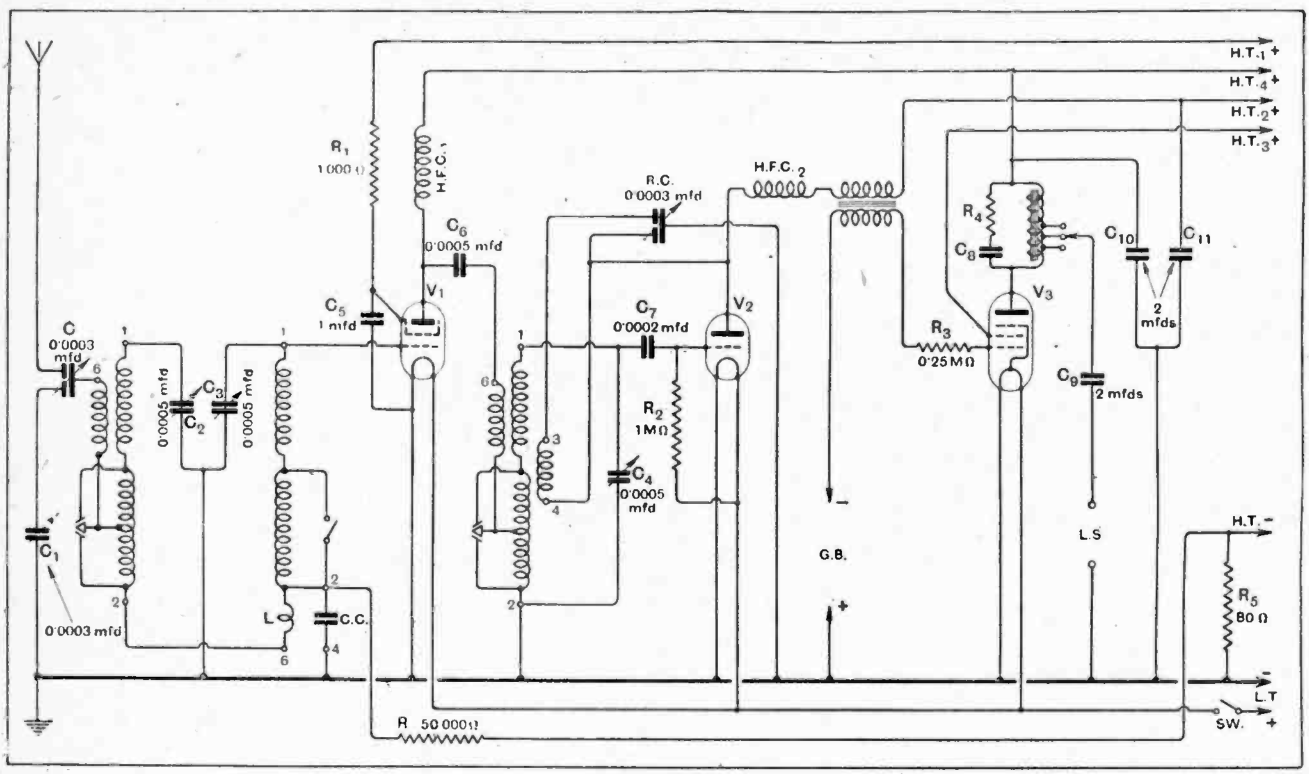
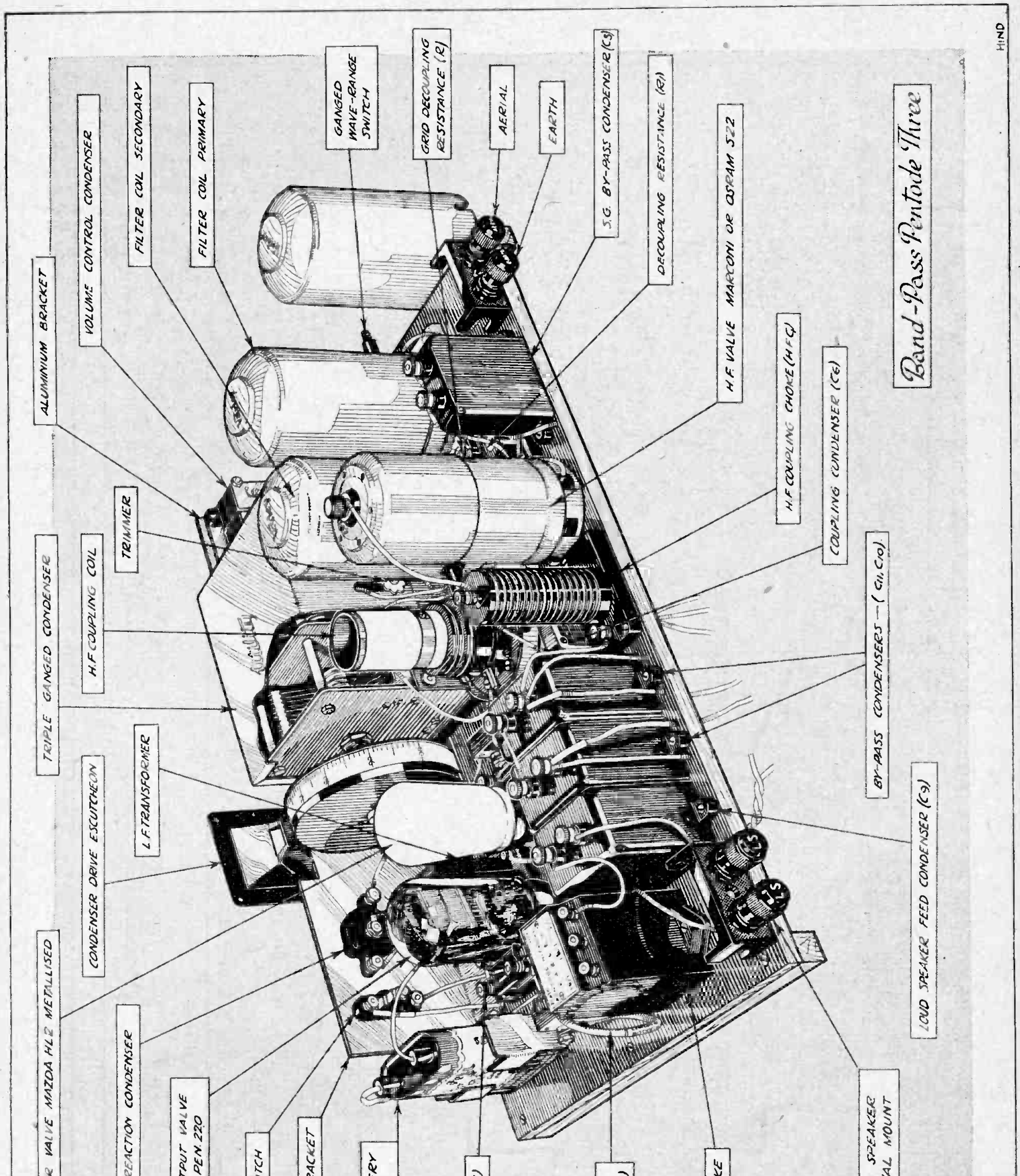


Fig. 2.—Complete circuit diagram, with component values. R_1 may be 50,000 ohms and C_9 0·001 mfd., but these values may need modification (see text).



The complete chassis, as seen from the rear. Types of valves for which the receiver is designed are indicated.

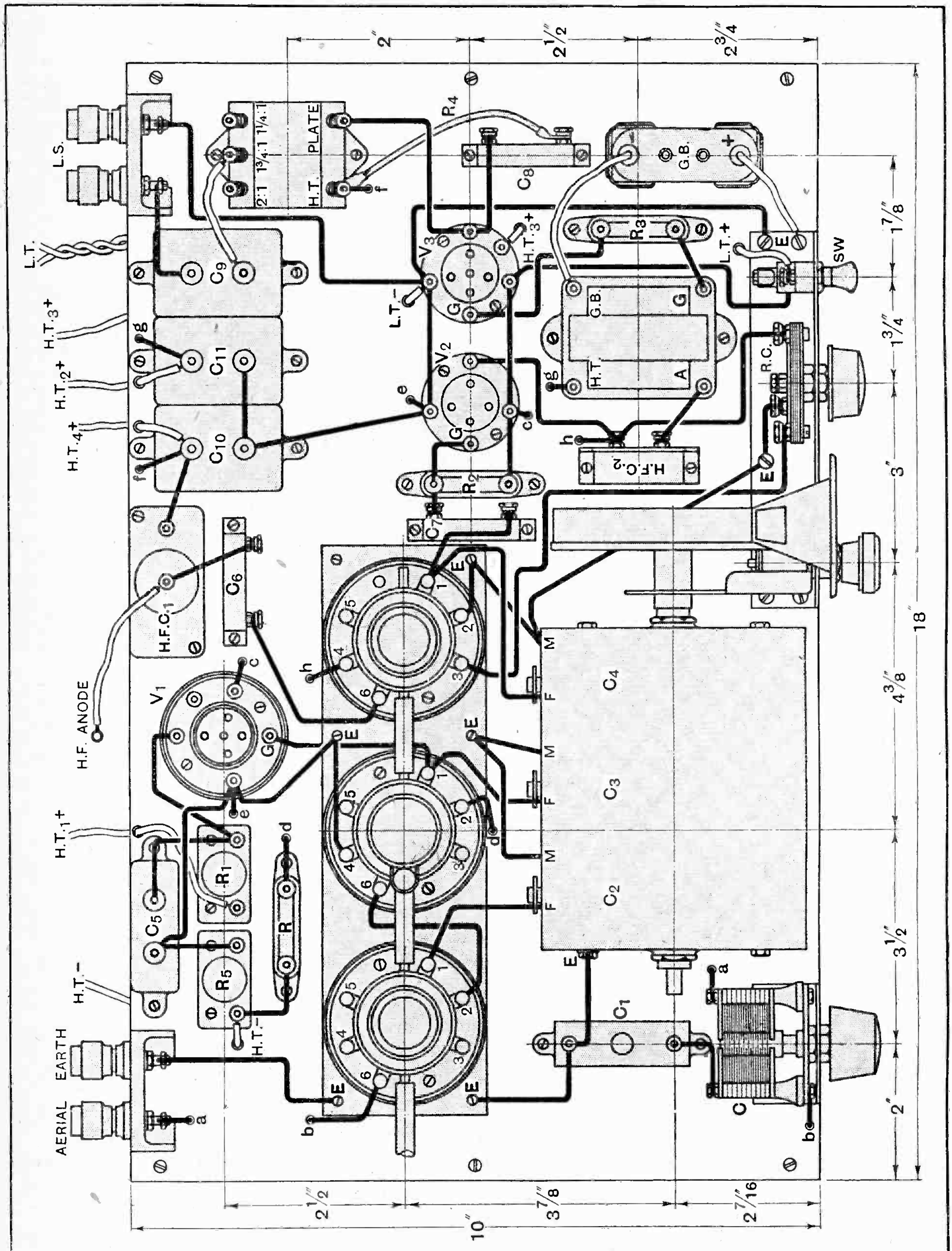


Fig. 3.—Layout and wiring of components. Connections to fixed and moving vanes of tuning condensers marked F and M; earthing points on metal-work marked E. Leads passing through the baseboard bear the same reference letter (a, a; b, b, etc.) at each end. Connections of flexible battery leads (e.g., H.T.+3) are marked, except where junction points are obvious.

LIST OF PARTS.

1 3-Gang condenser, 0.0005 mfd. (Utility, Type W. 306/3)
1 Slow-motion dial (Utility, Type W. 296; 4in.)
1 Differential condenser; 0.0003 mfd., air dielectric .... (Utility)
1 Differential condenser; 0.0003 mfd., bakelite dielectric .... (Telsen)
3 Fixed condensers, 2 mfds. .... (Helsby)
1 Fixed condenser, 1 mfd. .... (Helsby)
1 Fixed condenser, 0.0005 mfd. .... (Telsen)
1 Fixed condenser, 0.0002 mfd. .... (Telsen)
1 Fixed condenser, 0.001 mfd. .... (Telsen)
1 Semi-variable condenser, 0.0003 mfd. (Formo, Type "J.")
1 H.F. choke .... (Lewcos)
1 H.F. choke .... (Telsen)
1 Resistance, 80 ohms .... (Watmel)
1 Resistance, 1,000 ohms .... (Watmel)
1 Resistance, spaghetti type, 50,000 ohms .... (Lewcos)
1 Resistance, 50,000 ohms, with holder (Ferranti, moulded type)
1 Resistance, grid leak, 1 megohm, with holder .... (Ferranti, moulded type)
1 Resistance, 0.25 megohm, with holder (Ferranti, moulded type)
1 Valve-holder, 5-pin, with large type base (W.B.)
2 Valve-holders, 1 four-pin, 1 five-pin .. (Telsen)
1 Valve screen .... (Colvern)
1 Set "Square Peak Canned" coils (Varley; B.P. 13)
1 L.F. transformer .... (R.I. "Dux.")
2 Terminal mounts .... (Belling-Lee)
4 Indicating terminals: Aerial, Earth, L.S. +, L.S. – (Belling-Lee, shrouded)
1 On-off switch .... (Telsen)
1 Grid bias battery, 4½ volts .... (Siemens)
1 Pair grid bias battery clips .... (Bulgin)
7 Wander plugs .... (Clix)
2 Spade terminals .... (Clix)
1 Output choke (Varley: "Pentode Nichoke")
Baseboard, 18in. × 10in., ⅜in. thick; aluminium brackets, screws, wire, sleeving, etc.

Accessories:
2-Volt accumulator; 120-150 volt H.T. battery; 1 Marconi screen-grid valve, Type S.22; 1 Mazda detector valve, Type H.L.2 (metallised); 1 Mazda output valve, Type PEN. 220; Loud speaker (any type), or, if filter is omitted, special Celestion or Ormond loud speaker; Cabinet (Peto Scott).

An H.F. stopping resistance is inserted in series with the output grid, and in the anode circuit of this valve is to be found what is probably the most important part of the set—the loud-speaker matching and tone-controlling devices. A special choke (or auto-transformer) giving step-down ratios of between 1.25 : 1 and 2 : 1 is used, in order that the load may be adjusted to suit varying conditions, both with regard to loud-speaker impedance and valve operating characteristics.

It has been the aim of the designer to arrange for a layout that gives latitude in assembly, and except for such vital parts as the coils, tuning condenser, and output choke, in the choice of components. All the parts are assembled on a baseboard measuring 18in. by 10in. (a standard size, which fits into the popular type of cabinet), raised slightly by means of battens ½in. square in section, so that a few of the connecting wires may be passed under the base. Two simple brackets of bent aluminium sheet are necessary for supporting the control knobs; these are the only parts that are not regular commercial productions, but as these brackets will probably be made by some of the firms specialising in *Wireless World* apparatus, it may fairly be claimed that the amateur's task need be no more than that of assembly and wiring.

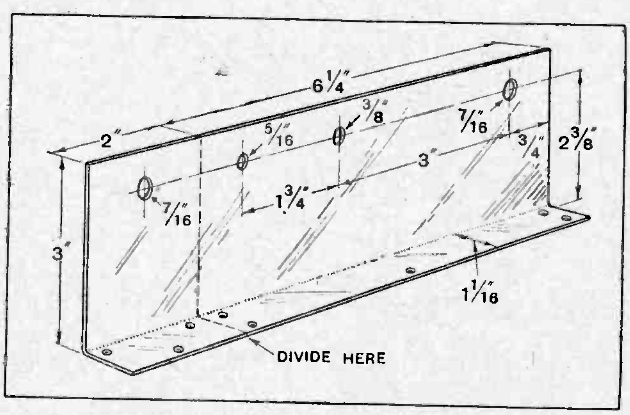


Fig. 4.—Construction of the supporting brackets, of sheet aluminium, $\frac{1}{16}$in. thick.

Max. H.T. Volts. Available.	H.F. Screen (H.T.+1).	Det. Anode (H.T.+2).	Pentode Screen (H.T.+3).	H.F. and Pentode Anodes (H.T.+4.)	Pentode Grid Bias. Volts.
100	75	60	90	100	–3
120	75	60	90	120	–3
120	75	60	105	120	–3
150	75	60	125	150	–4.5

Neither of these operations are particularly critical, and with the layout diagram given in Fig. 3 as a guide, there is little risk of making a mistake. It should be noted that all the more important dimensions are given, and that the layout suggested allows all those high-potential leads which might introduce undesirable inter-circuit reaction to be kept short, thus ensuring stability.

Suggested working anode voltages for the various H.T. feeds are given in the accompanying table. Detector anode pressure may be increased with advantage from the point of view of quality, but at the expense of a heavier consumption and smoothness of reaction control.

The second set of operating conditions for 120-volt supplies is rather less economical than the first; pentode anode current is entirely controlled by screen voltage, and, with an increase from 90 to 105 volts, will rise from three to five milliamps. As the inductance values of the coils may be taken as being accurately matched, preliminary adjustment of the H.F. circuits is relatively simple. First set all trimmers so that the moving vanes are spaced by about $\frac{1}{32}$in. from the fixed plates, and, with the volume control condenser set at maximum, tune in a weak transmission at 300 metres or rather less. Starting with the trimmer of C_2, adjust for maximum signal strength, at the same time retuning as necessary by means of the main condenser knob. The same procedure is then carried out with each of the other two trimmers. Though not essential, a milliammeter joined in series with the detector anode circuit is most useful; accurate tuning is, of course, indicated by maximum depression of the meter needle. A somewhat stronger signal than that required for adjusting by aural means is needed when the visual method is employed.

Matching of the loud speaker is effected by varying the connection of the lead between C_9 and one of the output transformer tappings until best results are obtained.

It is a peculiarity of the new pentode valve that its optimum working load is more than usually dependent on operating conditions, and so a different adjustment of the choke tapping will be called for if screen voltage is changed. Similarly, the corrector components (R_4 and C_8) will need some modification if valve impedance be reduced. Should reproduction be too shrill in tone the resistance specified should be halved and the condenser doubled in value.

Current Topics

EVENTS of the WEEK in BRIEF REVIEW

RADIO PARIS: A HITCH.

Cable laying seems to be the *bête noire* of the French Post Office, if we may judge from the fact that the inauguration ceremonies of new stations in France are nearly always delayed owing to a hitch in the land-line arrangements for communication between studios and transmitter. The new Radio-Paris 120 kW. transmitter is no exception; we learn that the Post Office has not yet completed the line between the transmitter at Saint-Remy-l'Honore and the Paris studio, and consequently the opening cannot take place until the middle of November.

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NEW MOROCCAN TRANSMITTER.

A new transmitter will be opened at Radio-Maroc at the end of November, the power being 5 kilowatts.

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BLACK SHEEP.

The prestige of the static-hunting parties recently formed in Germany to locate interference with broadcast reception has suffered a severe blow from the discovery that some of these ardent sleuths are nothing more than burglars in search of free electrical apparatus. Under the guise of public-spirited citizens these individuals have been able to enter workshops and private dwellings and collect their spoil under the very eyes of their victims. The public are being advised not to admit static-hunters who are unprovided with identity cards.

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THE PRINCE'S SET.

H.R.H. the Prince of Wales, who is a keen broadcast listener, has just purchased his second Portadyne Atlantic receiver.

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"TROGLODYTES'" APPEAL.

Three years ago the Rev. J. Ough, M.A., Vicar of St. Jude's, Bethnal Green, London, E., was able to start a wireless club for East End lads through the generosity of *Wireless World* readers, who contributed apparatus and various components. He now appeals for similar gifts, which will be gratefully received and faithfully applied, to the service of the "Troglodyte" Wireless Club. The members meet in the church crypt.

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SCOTTISH NATIONAL RADIO SHOW.

Scotland's first National Radio Exhibition will open in the Waverley Market, Edinburgh, on November 11th. A feature of the Show, which will be sponsored by the Radio Manufacturers' Association, will be a model B.B.C. studio, with glass walls through which the public will be able to witness broadcast concerts in progress.

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SHORT WAVES v. EARTHQUAKES.

Emergency short-wave transmitters have been installed in sixteen centres in New Zealand for use in case of earthquake. The Post Office has carried out this scheme in order to provide against the isolation of towns such as occurred in February last when Napier and Hastings were both cut off from the outside world until amateur radio operators came to the rescue.

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"B.B.C." FOR NEW ZEALAND.

On the expiration of the New Zealand Broadcasting Company's licence at the end of this year the Dominion's broadcasting service will be placed under the control of a body almost identical in constitution with the B.B.C. The Board, which will consist of a chairman and four other members, will take over the existing stations at Auckland (1YA), Wellington (2YA), Christchurch (3YA), and Dunedin (4YA).

Relay stations will probably be erected in the country towns, in which case the British radio industry should benefit by the demand for smaller and simpler sets than those now obtainable in New Zealand.

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GOAT GLANDS AND RADIO.

The Kansas goat-gland specialist, Dr. J. R. Brinkley, seems to be fomenting serious international complications among the three largest nations of North America by making good his threat to build a powerful broadcasting station just over the Mexican border in order to reach his old American audience. Our Washington correspondent reports that this 75 kW. station—the highest powered in the Western hemisphere—has already been testing on 408 metres with the call-sign XER.

Dr. Brinkley's appeal for an American wavelength was refused by the Federal Radio Commission on the grounds that the medical advice which he intended to broadcast was regarded as inimical to public health. Now it seems that the goat-gland doctrines will be diffused all over the Southern States, and a further complication lies in the fact that the wavelength of XER is only 5 cycles away from the American clear channel of 740 kc. and the Canadian clear channel of 730 kc., on both of which are stations owned by important newspapers.

THOMAS ALVA EDISON.
An autographed sketch of the great inventor, who died on October 18th.

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WILL NEWSPAPERS RULE U.S. BROADCASTING?

Having purchased broadcasting station WGBS, New York City, Mr. William Randolph Hearst, the American newspaper magnate, is expected shortly to acquire WCAE, Pittsburgh.

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P.O. VAN'S "FAIR COP."

A Post Office "mystery van" caught a wrongdoer at Buxton last month, but this time the culprit was a transmitter, Frank Wiseman, a bath attendant, in whose house a complete equipment was found together with a 60ft. aerial concealed in the loft. Wiseman was reported to have said, "It's a fair cop."

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INSTITUTE OF WIRELESS TECHNOLOGY.

Increasing interest is being shown in the examinations conducted annually by the Institute of Wireless Technology. We are asked to state that candidates desiring to take the 1932 Associate and Associate Membership examinations should forward application on Form E to the Secretary, 71, Kingsway, London, W.C.2, on or before March 31st next.

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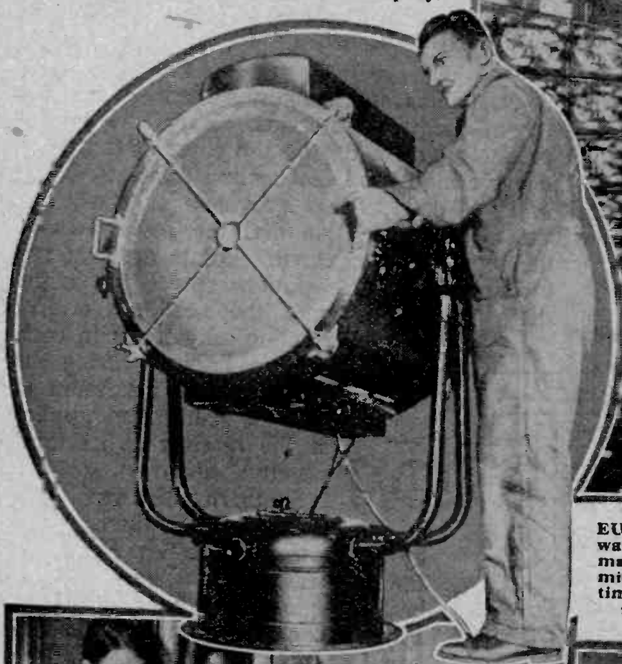
EDISON.

Although Thomas Alva Edison, the "electrical wizard" of America, who died at the age of eight-four on October 18th, was not, strictly speaking, a wireless engineer, his name will be perpetuated in the "Edison effect," the term still applied to his important discovery in 1883 of a *thermionic current* between the filament and a plate fitted inside an ordinary electric lamp. Considered unimportant at the time, the discovery was eventually turned to account in the invention of the thermionic valve. Telephony, too, owes a debt to Edison for the carbon microphone, while the "wired wireless" system now extensively employed in America has much in common with Edison's early railroad signalling device, superimposing messages on the telegraph wires without upsetting ordinary telegraphic traffic.

His inventive genius was a stimulating influence to other research workers, and while it is certainly true that he was not a specialist in radio, he contributed much for which the specialists will always be grateful.

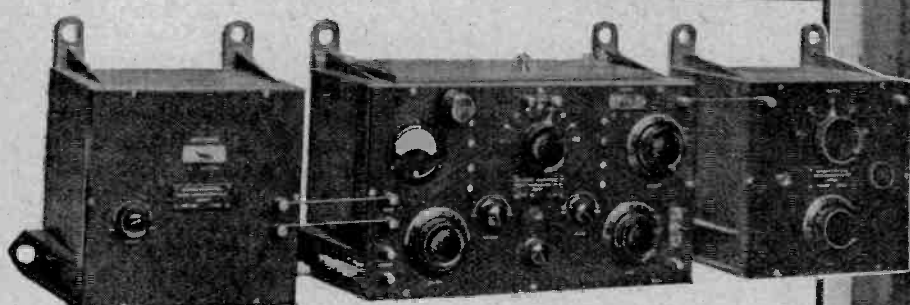
SEARCHLIGHTS ARE FASHIONABLE both for floodlighting and "flood-sounding"—to coin a new word descriptive of the service given by this new type of public address speaker developed by the Special Products Department of the Gramophone Company.

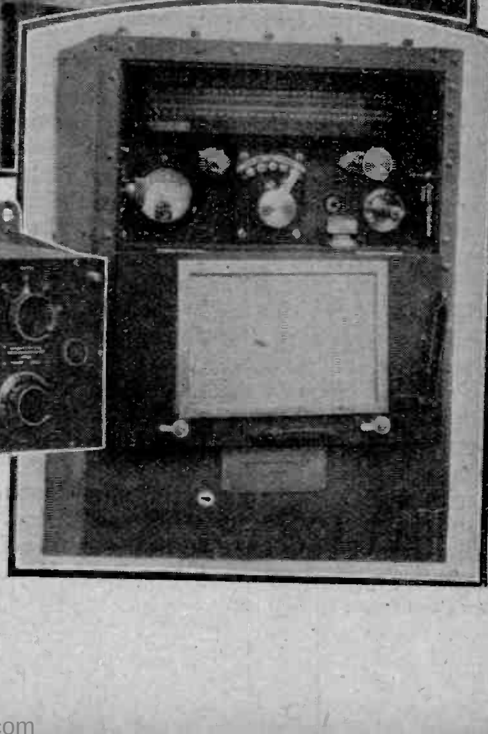


REMOTE CONTROL switchboard for stage lighting at the Chicago Civic Opera House, where the thyratron, a gas-filled rectifying valve replaces complex switching mechanism.

EUROPE'S ETHER POLICE are seen (in the picture below) at work in the wavelength-checking laboratory of the International Broadcasting Union. As many as 200 transmitters are sometimes checked in a single evening.

WHAT NEXT? German "O.B." engineers are racking their brains for new ideas. In desperation a few days ago they took the microphone into a hat shop!





THE LATEST IN SHIP RADIO. On the left is the new Marconi Marine receiver for 15-20,000-metre reception. The electrical fathoming device on the right gives a visual indication of the depth of water.

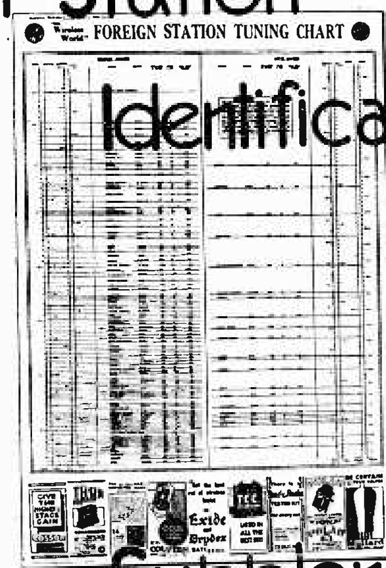
Hints on the FOREIGN STATION TUNING CHART

How to Station Calibrate the Tuning Dial.

SETS which will receive a dozen or more stations are common enough to-day, yet rarely is an endeavour made to station calibrate them. Stations are invariably tuned in at random and no record kept of dial settings, so that much of that which has been provided in a set by its designer by way of long-range reception is lost to the user.

The Foreign Station Tuning Chart which accompanies this issue is arranged to simplify the finding of particular stations, as well as identifying those heard. Identity signals and announcements given previously are now omitted owing to the need to leave the set tuned to a station, perhaps for an hour or more, before the identity signal occurs, and even then one may be led to a wrong conclusion. Identity signals in many cases are not sufficiently characteristic to fulfil their purpose, but the real difficulty is that several stations may be working on a single programme, and in this way confusion results.

Our Station Identification Supplement



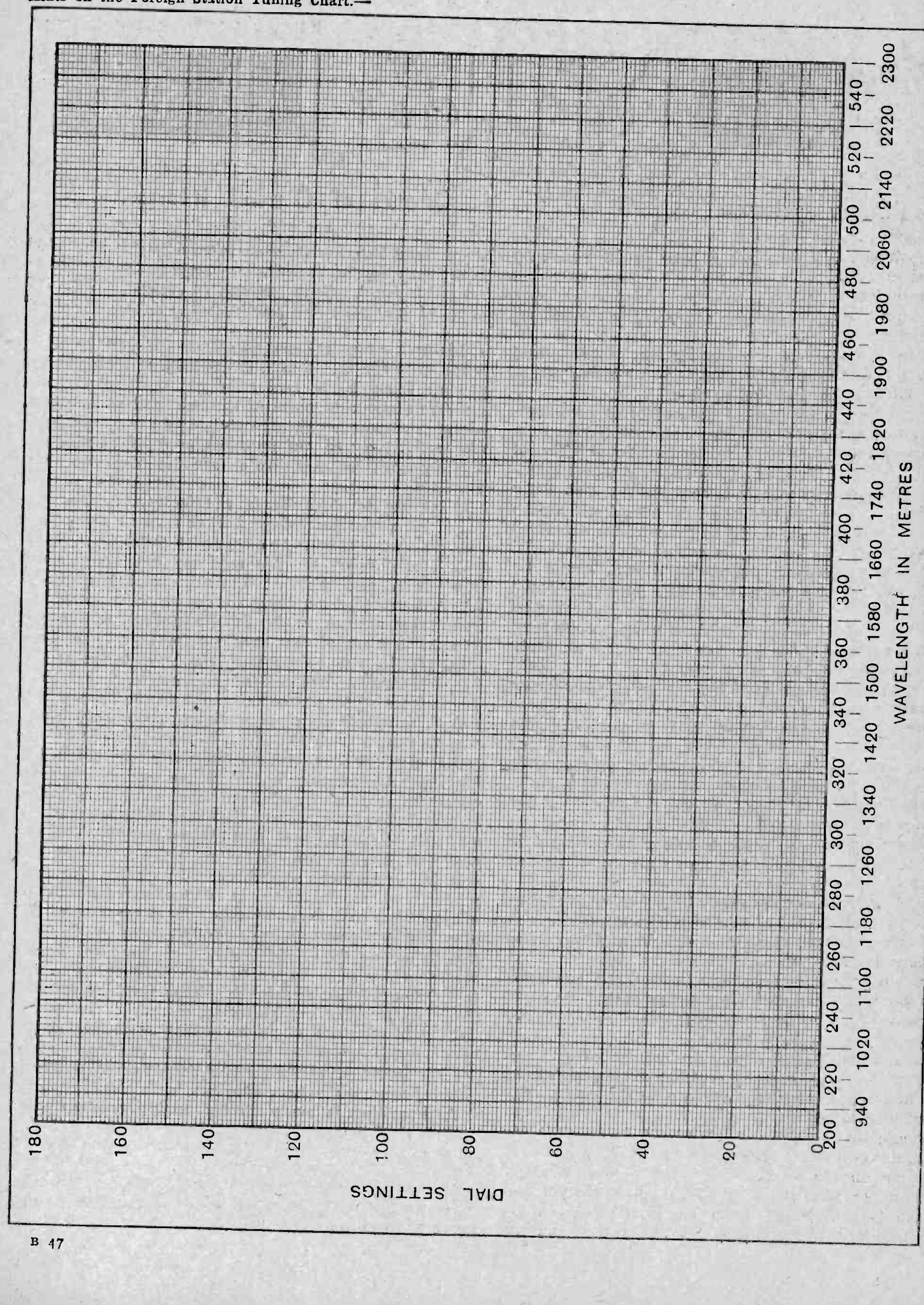
There is no better way of identifying foreign stations than by their wavelength. Wavelength scales are fitted to only a few sets, and there is sometimes difficulty in reading these scales with sufficient accuracy to reveal with certainty a particular transmission. Stations are best noted by the sequence in which they occur across the dial, and, from a few clues, stations are recognised by their relative tuning positions. Scales are given on the chart showing the approximate tuning settings on both 100-division and 180° dials, and while many receiver settings will differ from the figures shown the scales reveal, over limited range, the number of degrees or divisions in the interval between two given stations. The scales are actually those of the "Wireless World Three" recently described, the stations having been transferred to the dial from a station-calibrated wavemeter.

To put the chart to the most effective use it is well worth arriving at a true calibration of the set. The squared sheet shown here helps one to do this. Calibration should be carried out with the volume control at the maximum setting, bearing in mind that adjustment of volume on many sets shifts the tuning, while, if reaction is provided, it should be brought to the position of greatest sensitiveness. Tune to such a station as Radio Toulouse, which falls somewhere near the middle of the scale and which, unlike many stations, announces its identity at frequent intervals. Mark the tuning position precisely with a dot on the chart at the point where the wavelength and dial setting intersect. The vertical scale of dial settings provides for 180°, but in the case of a 100-division dial the 80 squares at the top may be ignored. Points are required for some half-dozen stations spread across the dial, bearing in mind the need for critical reaction adjustment in each case in order to bring the signal up to a maximum so that the calibration applies to the receiver in its most sensitive condition.

Southern listeners can readily obtain three points by tuning to the Northern Regional, the Northern National, and the Midland Regional, while Northern listeners can take the settings of the two London stations. Among the Continental stations one can readily recognise from their relative tuning positions, using the points already obtained as a guide, are Turin, just below the Northern National, Brussels (No. 2), below the London Regional, Rome and Beromunster, between the Midland and Northern Regionals, Brussels (No. 1) and Vienna, about midway between the Northern Regional and that easily recognised station near the top of the scale, Budapest. This selection of stations is made not entirely on the basis of strength of signal, though these stations are, of course, readily heard, but more particularly because the transmissions are not readily confused with nearby stations.

A curve swung through the plotting points reveals the precise dial setting required for other stations, and it is well worth the trouble of reading off from the curve and entering on the chart the dial setting for every station by reference to its wavelength. When dealing with the long-wave range, the stations most readily recognised are Hilversum, Radio Paris, Königswusterhausen, Daventry National, Eiffel Tower, and Motala. There is no reason for irregularity in the curve, and if it does not sweep precisely through the points made an error has occurred either in adjusting the dial or identifying the station. Four-valve sets and superheterodynes having single-dial tuning are easy to calibrate, and the trouble expended in plotting the tuning curve will well repay the listener.

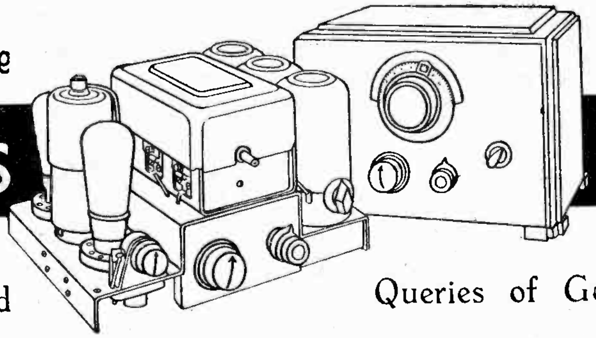
Hints on the Foreign Station Tuning Chart.—



This blank graph sheet will facilitate the wavelength calibration of a set using the more easily received stations as a guide. With 100 division dials ignore the upper section. Curves for both medium and long wavelengths may be plotted on this graph sheet.

Wireless World Three

Questions & Answers



Some Selected Queries of General Interest.

Queries commenced to pour in immediately following the publication of the description of the "Wireless World Three." They related, not to difficulty but to modification, principally with a view to making use of apparatus that readers had to hand. Questions are, in general, straightforward and easily dealt with and below answers are given to a few typical queries.

Q. *I am desirous of constructing my own tuning coils and I should be glad if you would pass to me the necessary winding data.*

A. While it was the aim of the author to give complete information as to the details of components it is useless to attempt to include constructional data of present-day coils. Particularly is this true where band-pass tuning is involved. It is thought that not many readers are in a position to build up the ganged switch action within the coils, whilst to procure the necessary screening containers, which, as copies of the originals, would need to be spun instead of drawn, would be more costly. The greatest difficulty, however, would be in arranging the precise disposition of the band-pass windings. Coil drawings and description would form an article in itself, leading the constructor, in all probability, in the direction of failure.

Q. *Kindly advise me as to the method of introducing a gramophone pick-up to the battery model.*

A. Provision for gramophone pick-up was avoided in respect of the battery set, for the electrical reproduction of gramophone records when consuming current from H.T. batteries is considered uneconomical. In a mains set the position is different, and the A.C. model shows the method of connection. A lead is taken from the grid of the detector to a single-pole switch, which, in turn, joins to the pick-up and on to a point of 1½ volt bias on the G.B. battery.

Q. *From the circuit diagram of the battery model on p. 273 it would appear that the reaction coil is short-circuited though the spindle of the reaction condenser* (C_4).

A. The list of parts on p. 274 states that the reaction condenser is fitted with an insulating bush. You will notice that the hole for securing the reaction condenser allows for inclusion of a bush.

Q. *What modifications are required for using a permanent-magnet or separately excited moving-coil loud speaker in place of the type specified for the A.C. model?*

A. Field excitation is provided in the smoothing circuit as this represents the cheapest and best system of obtaining the required magnetic flux. If your question arises from the fact that it is an existing loud speaker you are intending to use, then you must introduce a smoothing choke in place of the field coil connections, adding a resistance to bring the value up to 2,500 ohms. Alternative types of loud speakers having field windings of the correct resistance value are the Magnavox and the Rola.

Q. *Owing to difficulty in obtaining certain of the parts specified, please tell me where I can obtain an alternative type of mains transformer.*

A. Transformers for this receiver may be obtained from Rich and Bundy; Partridge and Mee, Ltd.; W. B. Savage. Smoothing chokes are also obtainable from these sources, while the Ferranti BI choke can be used in place of that specified for L_5.

Q. *Would you recommend the substitution of the Mazda Pen.220 or the Osram or Marconi PT.2 in place of the P2 output valve in the battery set?*

A. This substitution will result in an economy in the current drawn from the H.T. battery and will give a generous power output when quite a weak signal is fed to its grid. Against these considerations one must bear in mind that careful matching of the output stage will be required or the quality of the output will be impaired, while experience showed that the valves specified give good results with certainty following the H.F. amplifier and fairly generous detection. By using the new pentodes some reduction in anode current can be effected, but to be on the safe side as regards quality of output and economy in components you should hesitate in setting the triode aside. Full practical details of the method of using these battery pentode valves are to be found elsewhere in this issue, making it quite clear how to effect a substitution.

Q. *I would draw attention to the fact that when the condenser plates of the second condenser make contact at the maximum position the grid bias becomes short-circuited.*

A. Provision is made on the tuning condensers to avoid this difficulty by way of including an insulating stop. A few early condensers were not so fitted.

The "Wireless World Three" was described in the issue of this journal of September 16th and a note on the performance of the band-pass filter giving selectivity curves appeared in the issue of September 23rd. Constructional details of the A.C. model were included in the issue of September 30th. A station calibration dial may be obtained on application to the Editorial Offices, forwarding a stamp.

Broadcast Brevities

By Our Special Correspondent.

Music from the Warehouse.—The Economy Axe.—Plans for Music Dramas.

B.B.C.'s Best Studio.

It is difficult to judge the acoustics of a building by its appearance, but I shall be surprised if the big studio in "Broadcasting House" gives such splendid results as the old warehouse at Big Tree Wharf. I am all the more pleased, therefore, to hear that the warehouse will remain in service throughout the winter.

Faultless Echo.

As a studio it is almost ideal, and the point that impresses distant listeners as much as the audience within its walls is the presence of a natural echo which seems "just right."

Radio "Fan": New Version.

The homely atmosphere seems to have an exhilarating effect on the B.B.C. orchestra. Listeners who noticed how unusually long were the intervals in the Strauss concert on Sunday, October 18th, may be interested to know that the whole orchestra amused itself between items by tuning to the note emitted by a big synchronous motor fan! Needless to say, the fan works only at times when the microphone is dead! Its note is a quarter tone below A.

Engineers on Trek.

It is only fair to say that the B.B.C. engineers are doing all they can to get the best results from the studios in Portland Place. Acoustic measurements have been carried out in concert halls and churches in various parts of the country, and visits have even been paid to the private music rooms of large mansions and "baronial halls."

I hope these tactics will lead to success. The trouble is that when once the studios are completed it will be difficult to effect alterations. A chicken can't alter its egg.

What *is* Happening?

The B.B.C. is becoming quite frolicsome, a truth which is evident not only from the contemplated abolition of the Bach Cantata broadcasts in the name of economy, but from the introduction of two new dance bands within one week. On Monday next we shall hear for the first time "The Blue Lyres," and on the following Friday the Savoy Orpheans will make their welcome re-appearance.

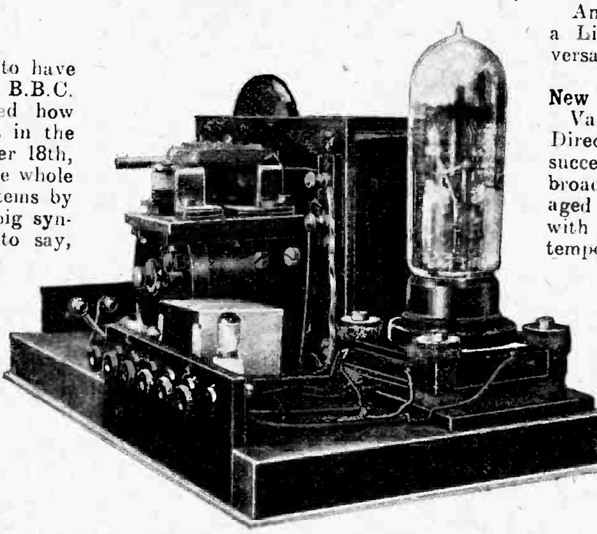
Ambrose in Charge.

"The Blue Lyres" are playing at the Dorchester Hotel, Park Lane, and the best testimony to their excellence is found in the fact that Ambrose, of May Fair Hotel fame, is their director.

That Quintet.

Getting back to the question of economy, the formation of the B.B.C. Quintet, which appeared (literally, because it was televised) for the first time on Saturday last, is another move in this direction. The Quintet is actually a rib taken from the National Orchestra, and comprises two violins, a viola, 'cello, and pianoforte.

We shall hear a good deal more from the Quintet during the winter, and correspondingly less from those private orchestras which have given delight in times past. The Economy Axe is no respecter of persons.



THERMIONIC INTERVAL SIGNAL. This audio oscillator is, we understand, to be used by the Rumanian broadcasting authorities to produce identifiable tunes during intervals. Whatever the result, it should be more attractive than the monotonous beat of the clock in the B.B.C. control room.

Is This *You*?

The National Anthem on the radio brings the British listener to his feet even in his own home, according to M. Michel Ferry, who has been analysing us in "L'Ami du Peuple." It seems that the British "fan" hardly ever listens to foreign stations. "He settles down on one of his own and follows the entire transmission without touching his condensers."

Oh, boy!

Silence!

M. Ferry continues: "The Englishman does not like the comic and other ditties so dear to the French heart. When an accordion plays, he cries, 'Oh! shocking!' (*sic*). He adores serious and grave, patriotic, war-like songs. A revue or a sketch fills him with inexpressible joy, but he remains impassive before his 'diffuser' while overflowing inside himself with endless laughter."

And I like this: "Neither a Lord nor a Liverpool docker would tolerate conversation during a reception."

New Plans for Musical Drama.

Val Gielgud, the B.B.C. Dramatic Director, tells me that the undoubted success of "Chopin"—the musical play broadcast on October 17th—has encouraged him to plan a similar effort dealing with the careers of those two contemporary giants, Mozart and Haydn.

"Chopin," which will certainly be repeated in the near future, was the work of Mr. Wilfred Rooke-Ley, who will undertake the new work and probably others of the same type.

The life stories of the great musicians are peculiarly adaptable to the art of the microphone. Why haven't we thought of this till now?

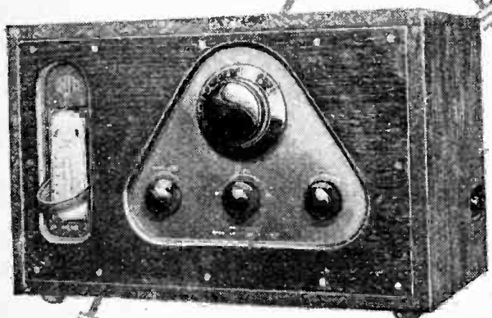
A Relay from Vienna.

One of the series of European concerts arranged internationally will be relayed to National listeners from Vienna, with the co-operation of the Austrian Broadcasting Company, on November 7th.

It will consist of extracts from the works of Franz Lebar, who will conduct the Vienna Philharmonic Orchestra, and the soloists will be Adele Kern and Koloman von Patsky, of the Vienna Opera.

Who Mentioned Heterodynes?

Have you noticed that the Scottish Regional station at Falkirk is scheduled to employ the wavelengths of 376.4 (Regional) and 288.5 metres (National)? The latter is the common wavelength for the relays and is also used by Newcastle.



THE McMICHAEL Colonial Receiver

A Set for the Reception of World-wide Short-wave Broadcasting.

THE most successful method of short-wave reception is by superheterodyne, and of the many arrangements which the short-wave superheterodyne may follow, the autodyne system has proved itself the most satisfactory. By autodyne is meant the use of a detector in an oscillating condition, a suitable beat frequency resulting from the amount of coupling between the windings in the grid and anode circuits. No separate oscillator valve is used, and such an additional valve is quite unnecessary for short-wave superheterodyne reception. The autodyne system is adopted in the new type McMichael Colonial Short-wave Receiver just issued.

From the circuit it will be seen that an H.F. choke coil in the anode circuit of the triode valve, a Cossor type 210 HL, allows for the necessary condition of regeneration, and the resultant beat frequency signal develops a potential across a tuned-anode circuit. A screen-grid valve, the Mazda 215 SG, is used as a single stage intermediate, again employing a straightforward tuned-anode coupling. The first detector is a leaky-grid triode, but we find that the second detector, while provided with grid leak and condenser of the customary values, is negatively biased. The valve is the screen-grid Mazda 215 SG, and the small negative bias suggests normal anode bend detection. Reaction coupling is provided in the anode circuit of the second detector in order to give the highest performance in the intermediate amplifier. Low frequency transformer coupling feeds the output valve, which is one of the latest type pentodes, the Mazda Pen. 220. A choke feed is provided for the loud speaker, and tone correction with resistance and condenser gives the required matching. Decoupling and voltage regulating resistances are associated with the first three valves.

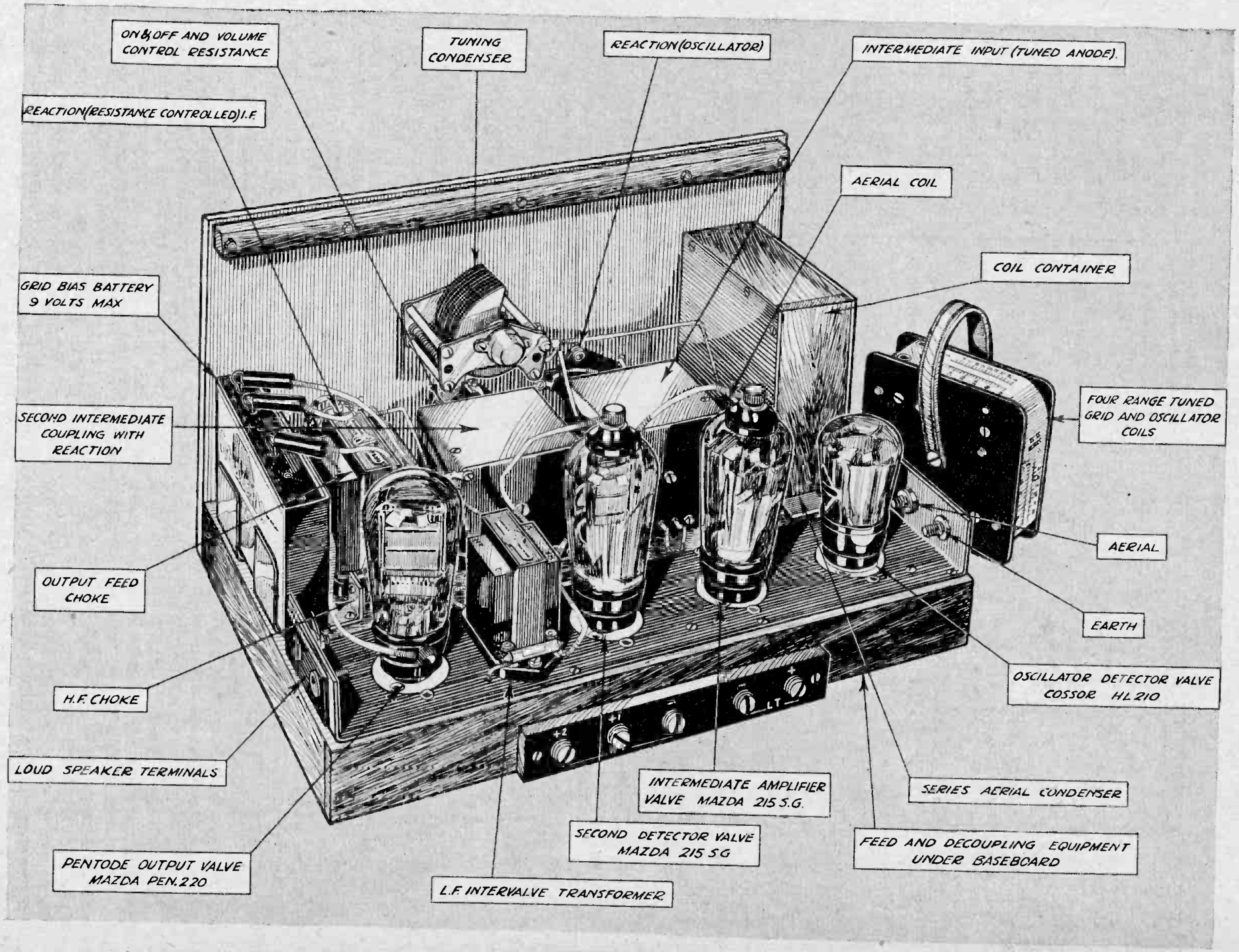
SPECIFICATION.

Short-wave receiver covering a tuning range of 14 to 90 metres and with provision for reception on the medium-wave broadcast range.
Autodyne oscillator followed by tuned-anode intermediate coupling with reaction.
Capacity control of autodyne reaction, resistance control of intermediate reaction.
Single stage intermediate amplifier followed by S.G. second detector.
Transformer L.F. coupling to output pentode.
Power pentode with generous tone-corrected filter-fed output.
Valves: Cossor 210 HL, two Mazda 215 SG and Mazda Pen. 220. Price: £15.

In regard to construction an outstanding feature is a simple wave changing arrangement. All the necessary coils for the reaction and grid circuit input tuning are assembled in a rectangular case, the four sides of which carry engraved wavelength scales. The coil unit is pressed into a recess after rotating it to expose on the front the required wave range. By this means the use of a collection of coils is avoided, and wavelength is changed without the need for gaining access to the interior of the receiver. The four spring blade contacts associated with each section of this coil unit are entirely reliable. The wavelength scales are 14 to 30, 25 to 55, 50 to 90, and 250 to 500 metres, calibration against dial settings being provided.

Assembly of the components is carried out on the upper and lower faces of the baseboard, and the front panel is of aluminium with a teak covering. Suitability for use under adverse climatic conditions has obviously been borne in mind in the development of the design. In addition to the tuning control there is a filament resistance labelled "volume," which provides at minimum an "off" position for the filaments. The essential adjustment of aerial reaction is brought to a control marked "oscillator," which is a small condenser of the solid dielectric type. Another control "reaction" is a shunt resistance across the reaction coil used on the intermediate amplifier, and enables the set to be brought up to a most sensitive condition.

Only a few straightforward connections are necessary to bring the set into operation, there being a pair of

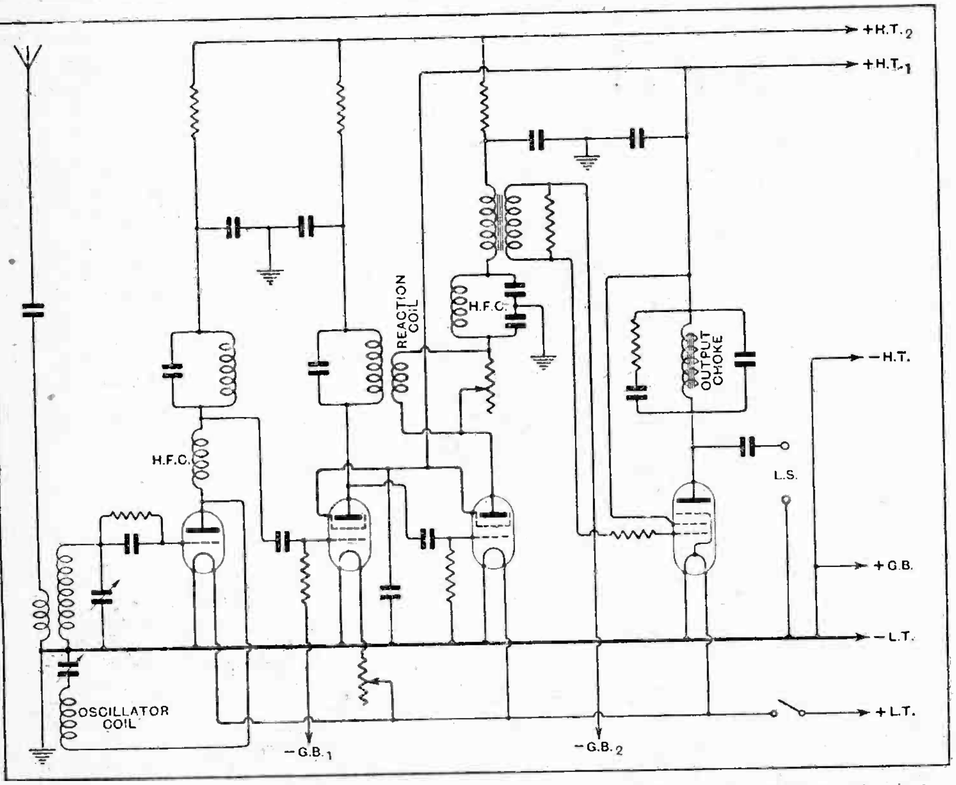


The H.F. and L.F. couplings together with the output feed are assembled with the valves above the baseboard.
The underside carries the decoupling feed resistances and shunt condensers.

The McMichael Colonial Receiver.—
tappings on the H.T. battery while the grid-bias cells are enclosed within the set. The L.T. current consumption is 0.6 ampere, and owing to the fact that the first triode detector operates on a low anode voltage and that two screen-grid valves are employed together with the new type Mazda pentode, the H.T. current consumption is as low as 12 mA. The working of the set is reasonably simple, and the provision of the several controls makes possible a most sensitive adjustment. As is usual with sets of this class, the tuning control is most critical, and care is necessary when searching for particular short-wave broadcasting stations. Best results are obtained by bringing the reaction control up to the point where the intermediate amplifier is in a condition of threshold oscillation, while the oscillator knob must not be turned any farther than is necessary to keep the set in an operating condition. In this way the carrier wave of a distant telephony transmitter may be found when, by slowly reducing the effect of the reaction control, a critical point is reached where the heterodyne whistle ceases. In the instructions it is stated that 120 volts maximum H.T. is required, but it was found that an increase in this potential up to 145 volts was desirable to give the best reception on the lowest but important wave range of 14 to 30 metres.

In the course of a single night's listening the New York programmes were heard from 2XAD and 2XAF. Rome and Moscow came in well, the latter with its customary English programme. The best American reception on this particular occasion was the Bound Brook station, New Jersey, working on a wavelength of 49.2 metres. The 25- to 55-metre range is the most sensitive, and with the particular aerial used, which was rather long, a 0.00005 mfd. condenser connected in the aerial lead produced a change in the properties of the aerial and improved the results. Hand capacity, changing the critical control of tuning when operating the set on its lowest wave range, was at first met with, but by shortening the earth lead this difficulty was removed. An outstanding merit is the entire freedom from background noise.

Although reception on the broadcast range is provided to extend the utility of the set, one should not regard this set as replacing the standard broadcast receiver when reception is normally wanted on wavelengths of 200 to 500 metres. The range 250 to 500 metres represents merely an improvisation. Short-wave reception is in many ways the highly specialised province of the amateur, and one's judgment on this set is that it possesses the liveness of the "hotted-up" set of the enthusiast.



Circuit features include autodyne oscillator, tuned-anode intermediate coupling with reaction and tone-corrected power-pentode output.

BROADCASTING A STANDARDISED PRONUNCIATION.

THE B.B.C., according to *The Listener* of October 21st, has always tried to make it clear that any recommendations it has made have been for the guidance of its announcers alone; that it has never wished to pose as arbiter of a "correct" standard. If it has acted like a dictator it has done so unwillingly, and the charge of uniformity could better be levelled at those listeners who allow their native pronunciation to be vitiated by contact with the supposedly uniform accents of the microphone. But are these accents indeed as uniform as many would like to think? It can surely be argued that the B.B.C. spreads diversity as much as uniformity. For instance, in the last few days the whole country has been able to hear the distinctive voices of Mr. MacDonald, Mr. Snowden, and Mr. Lloyd George—voices which clearly and delightfully proclaim the speaker's native district. We suspect, too, that in another way Mr. Baldwin really finds B.B.C. pronunciation more of an ally than an enemy. What he deplores most of all is the invasion of English by Hollywood American. The only proper safeguard against this is to raise the standard of our own pronunciation by encouraging good articulation in individual speakers.

Laboratory Tests on New Apparatus

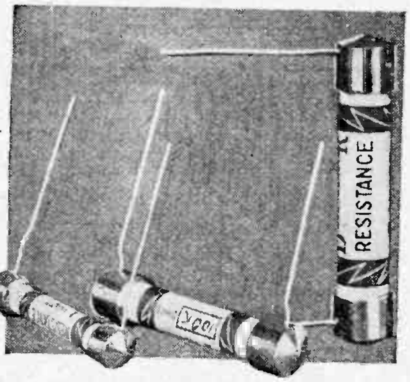
DUBILIER METALLISED RESISTANCES.

These resistances are made in one-, two- and three-watt types, and range in value from 100 ohms up to 500,000 ohms in the case of the one-watt style, but extend up to 200,000 ohms only in the two- and three-watt variety. They have been introduced to meet the demand for reliable components at a reasonable price.

They are conservatively rated, and will stand considerable overload without sustaining damage; however, this practice should not be encouraged, and it is wisest not to exceed the makers' rating.

The resistance element is encased in a synthetic porcelain rod fitted with massive end caps, to which are fixed short lengths of tinned copper wire for connecting purposes.

Some samples of each type were tested, and in every case the measured resistance was well within the makers' tolerance of 10 per cent. The largest error recorded was about 6 per cent., while in some cases the actual resistances were within one per cent. of the marked values.



Dubilier metallised resistances made in one-, two- and three-watt types.

When passing the maximum current the temperature of the resistance did not rise appreciably, and further measurements made immediately after this test showed very little change in the resistance. It was less than one per cent., and later when the resistance had returned to room temperature, the actual value was almost the same as the original figure.

The makers are the Dubilier Condenser Co. (1925) Ltd., Ducon Works, Victoria Road, North Acton, London, W.3, and the prices are 1s., 2s. and 3s. each, irrespective of resistance value for the one-, two- and three-watt types respectively.

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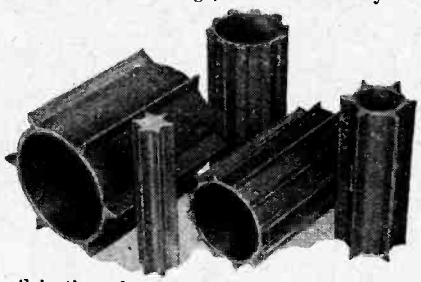
BECOL FORMERS.

For the 1932 season the British Ebonite Co., Ltd., Hanwell, London, W.7, are listing no fewer than twenty-six different types of Becol formers. These range in size from 1in. to 4in. in diameter. There are five different styles of the 1in. type, these being employed largely for the construction of H.F. chokes, but many other uses can be found for them. Of the various other sizes, some are provided with deep ribs, while others have comparatively shallow wings, and these vary in


Selection of new season's Becol formers.

number from six to twelve. There is a Becol former for every conceivable purpose in a wireless set.

Prices vary according to type and length of formers, which now are obtainable in 3in., 4in., and 6in. lengths.

A size which may prove popular in view of the present vogue in small-diameter coils is the No. 6, which is 1½in. in diameter, has six wings, and costs 4d. for a 3in. length.

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"TWISTOFLEX."

The special feature of "Twistoflex" is the ease with which the insulated covering can be removed and the wire exposed without the aid of tools. It is necessary only to twist the sleeving in opposite directions at the required position until the covering is severed.

This is achieved in a simple but exceedingly effective manner. The insulated sleeving is partially severed at close intervals, the cuts being spaced about ⅝in. apart. Normally the wire is not exposed, but, to assure perfect insulation where the wire passes through holes in metal panels, short lengths of a larger size of sleeving should be slipped over the wire.

"Twistoflex" insulated connecting wire.

"Twistoflex" is available in various colours, and the price is 6d. per coil. Each coil consists of two 3ft. lengths and four short pieces of large-size sleeving for use where mentioned above.

The makers are Fox Radio Service, 16, Bathurst Road, Ilford, Essex.

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EDISWAN ELECTRIC CLOCKS.

It will be remembered that the possibility of driving synchronous electric clocks from frequency-controlled A.C. mains was fully discussed in a recent issue of this journal.[1] The Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2, have now introduced a series of electric clocks in attractive moulded cases. A wide variety of colour schemes is available at the uniform price of 45s.

The motor is of the slow-speed Sangamo type, and is absolutely silent in action, being quite free from the slight gearing noise often associated with clocks of this type. Starting is effected by depressing and releasing a small lever at the back of the case. The mechanism is


Ediswan-Sangamo synchronous electric clock.

spring-loaded, and a small air brake ensures that the motor is turning exactly at synchronous speed just as the starting rack and pinion are on the point of disengaging. The centre portion of the clock dial rotates and takes the place of a seconds hand. It is provided with a prominent, red arrow, giving visual indication that the clock is functioning.

Dials with bronze or silver finish are available to match the colour scheme chosen.

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WILBURN CONNECTORS.

Owing to an unfortunate error the price of the ten-way connector reviewed in last week's issue was given as 5s.; the correct price is 3s. 6d.

[1] "Time from the Mains." *The Wireless World*, May 27th, 1931.

WIRELESS ENCYCLOPEDIA

ANODE BEND DETECTOR. ***A thermionic valve made to act as a detector or rectifier of high-frequency oscillations by operating it at the lower bend of one of its grid voltage/anode current characteristic curves.***

NO. 4

Brief Definitions with Expanded Explanations.

THE anode current passed by a three-electrode valve, with the anode maintained at a constant positive potential and with the cathode at normal temperature, depends on the grid voltage. When the anode current is plotted as a graph for various values of grid voltage relative to the cathode, a curve is obtained similar to that shown in the upper left-hand portion of Fig. 1, from which it will be observed that the current approaches zero as the potential of the grid is increased in the negative direction. The curve has a more or less pronounced bend or knee near the lower end, the upper portion being comparatively straight.

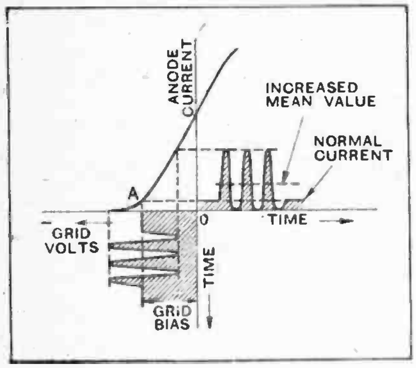

Fig. 1.—Composite diagram showing the action of an anode bend detector.

Increase of Anode Current.

When the valve is to be operated as a detector on the anode bend principle, the normal or mean grid potential is adjusted by means of a grid battery or other suitable device so that the corresponding point A occurs at the sharpest part of the bend in the anode characteristic curve. This always occurs with a negative value of grid potential, called the "grid bias." In such circumstances a given change of grid voltage in the positive direction (i.e., towards zero) will produce a moderately large increase of anode current, whereas an equal change in the opposite direction can cause only a very slight decrease of anode current, because the latter is already nearly zero, and cannot be reversed.

The high-frequency signal voltage to be rectified is applied to the grid in series with the steady bias voltage in the manner shown by Fig. 2, so that the actual grid potential fluctuates about the mean value fixed by the bias battery C. The grid potential will vary above and below this mean value by an amount equal to the amplitude of the impressed signal voltage E_g, and for each of the values through which the grid potential passes there is a corresponding value of anode current.

Graphical Illustration.

The rectifying action is clearly shown by Fig. 1, in which three separate graphs are incorporated. In the bottom left-hand section is a graph giving the variation of grid voltage with time when an unmodulated H.F. voltage is applied. From this the valve characteristic curve enables the resulting anode current fluctuations to be determined and shown as a graph on the right-hand side. It will be observed that the application of the H.F. voltage to the grid converts the normal steady anode current into a series of current pulsations fluctuating between zero and a certain maximum value which is determined by the amplitude of the grid voltage.

Now, the milliammeter in the anode circuit of Fig. 2 is far too sluggish to respond to the high-frequency pulsations of current, but, if it is of the moving-coil type, it will indicate the true mean value of the anode current. Thus, the incidence of the H.F. alternating voltage at the grid will cause the milliammeter reading to rise as shown by the graphical construction of Fig. 1.

The mean anode current is proportional to the amplitude of the pulsations, and this is, in turn, nearly proportional to the grid voltage when the latter is sufficiently large to operate well on to the straight part of the characteristic curve. Consequently, under favourable conditions the *change* of mean anode current is nearly proportional to the signal voltage applied to the grid. Thus, when the H.F. voltage wave at the grid is varied or modulated at an acoustic frequency, the amplitude of the anode current pulsations will vary in sympathy, and a telephone connected in place of the milliammeter in Fig. 2 would respond to the audio-frequency variations.

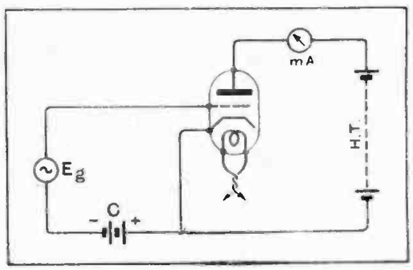

Fig. 2.—When an alternating voltage E_g is applied to the grid the milliammeter reading is increased if the valve is biased to operate at the bottom bend of the grid volts/anode current curve.

The detector valve is, however, usually succeeded by one or more amplifying stages, and the acoustic frequency current variations must, therefore, be converted into voltage variations. This is normally effected by one or other of the intervalve coupling arrangements, such as an intervalve transformer, resistance-capacity coupling, and so on.

Readers' Problems.

Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

Wiring and Ganged Tuning.

In wiring a receiver of which all tuned circuits are controlled by a ganged condenser, is it worth while taking special pains to ensure that all the "live" grid leads are of the same length, and have, as nearly as can be arranged, the same apparent capacity to earth?

It seems hardly worth while to take any special pains in this direction, as in most cases a trimmer is provided for balancing out small differences in capacity. It would be definitely wrong, for instance, to make a grid lead unnecessarily long merely in order to ensure that it had the same capacity as corresponding connections.

Inoperative H.F.-L.F. Filter.

I am sending you a circuit diagram of my three-valve battery-operated receiver, in the hope that you will be able to point out the reason for its poor performance, particularly on the long waves. On this band self-oscillation is produced when the circuit is tuned to the frequency of an incoming carrier wave.

Apart from this, neither sensitivity nor quality of reproduction is as good as anticipated.

Your circuit arrangement is a good one, and there is little to criticise, except for one detail. This is with regard to the detector anode circuit filter; we note that you have included an H.F. choke shunted by two by-pass condensers; but, by taking a lead to the coupling condenser of

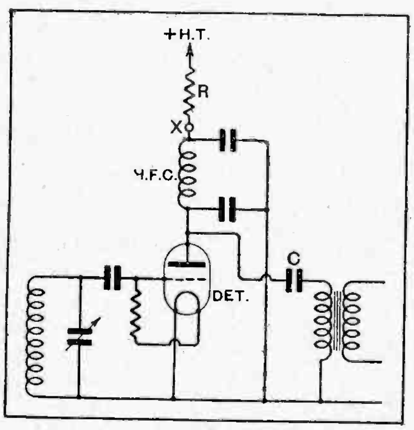

Fig. 1.—By connecting the L.F. amplifier lead directly to the detector anode as shown, the H.F. filter is virtually put out of action.

the resistance-fed transformer directly from the detector anode, the effectiveness of this filter is seriously impaired.

We expect, therefore, that your troubles are very largely due to the action of H.F. energy in the L.F. amplifier. A part of your circuit diagram is reproduced in Fig. 1: referring to this diagram, you should change over the connection from condenser C to the point marked X.

Trackless Trams.

Will you please tell me how to avoid interference from the trackless trams which pass my house? My receiver is a straightforward H.F.-det.-L.F. combination. Do you think that an input filter or a two-circuit tuner would improve matters?

Interference from trackless trams is so serious that we have almost given up attempting to offer advice in cases such as yours. The addition you suggest will not help to any great extent, although it may slightly mitigate the interference. It might be worth while to try altering the position of your aerial, and in some cases a different earth connection will improve matters. Of course, frame aerial reception is certain to be an improvement, but a set such as yours is hardly sufficiently sensitive to enable you to dispense with an outside aerial.

Keep Grid Resistance Low.

Will you please examine the circuit diagram of my proposed two-stage resistance-coupled amplifier, and, if possible, suggest any improvement that could be made?

We see that you intend to use a P.P.5/400 output valve, and would therefore recommend you to use a lower value of leak than 0.5 megohm in the output grid circuit. The external grid-filament resistance of a high-efficiency valve of this type should certainly not exceed some 200,000 ohms, and, to be on the safe side, you might use a leak of 100,000 ohms, with a coupling condenser of about 0.1 mfd. This combination will not introduce any serious loss of bass.

Shunt Resistance Calculations.

I am converting my battery-fed receiver for operation on D.C. mains. Will you please tell me how to calculate the necessary value of resistance shunt for each series-connected valve which takes less than the maximum filament current?

Would it be possible to obtain this information from the "resistances in parallel" abac in the new "Wireless World" Diary?

To make this calculation in the simplest possible manner it is convenient to regard the function of the shunt as that of absorbing the surplus current at the voltage rating of the valve filament across which it is connected.

All that need be done is to apply the formula $R = \frac{E}{I}$, where R is the value of the shunt to be used, E the filament voltage rating of the valve, and I the difference between the current to be passed through the series-connected chain and that taken by the valve concerned.

The diagram given in Fig. 2 should make the matter clear. Here it is assumed that the maximum current is 0.4 amp. (that consumed by the output valve), while the other valves each take a lower current. The H.F. valve consumes 0.2 amp. at 2 volts, so, applying the formula, we get $\frac{2}{0.2}$, giving 10 ohms as the value of the shunt resistance.

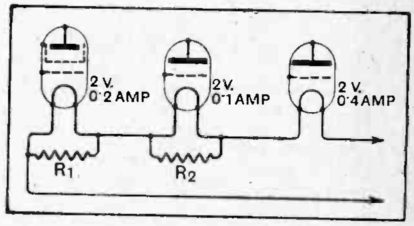

Fig. 2.—Valves in series with shunts across those filaments taking less than maximum current.

The necessary information could be obtained from the abac mentioned, but only in a rather roundabout way; in this case calculation is simpler.

Pick-up in Two Senses.

My receiver is entirely free from hum when radio signals are received, but there is an annoying background when the set is used for the reproduction of gramophone records—this in spite of the fact that all the usual precautions have been taken, and the pick-up arm has been earthed carefully.

It may help you to form an opinion as to the cause of the trouble if I say that the intensity of hum is greatly affected by the position of the volume control potentiometer slider. Can you suggest a simple cure?

It is fairly clear that A.C. voltages are being induced into the pick-up leads, and, if these connections are remade with screened wire, an improvement should result.

Further, there is the possibility that you are using a volume-control potentiometer of unnecessarily high resistance. True, the substitution of a much lower value may slightly impair high-note reproduction, but it will certainly give you a less noisy background.

Shielded Valves.

Is there any objection to enclosing valves (other than those in the H.F. stages) in metallic screening covers of the usual commercial type?

No harm is likely to be done by screening the valves, and, indeed, some advantage may accrue as a result of treating some of them, particularly the detector, in this way. It should be pointed out, however, that free ventilation should be allowed for a high-power output valve, as otherwise it may get unduly hot.

Staging a Come-back?

It seems to me that it should be possible to devise a scheme for making a crystal rectifier act as an automatic volume control device by feeding back rectified current through a bias resistance included in the H.F. valve grid circuit. Of course, matters would be so arranged that the H.F. valve is over-biased when an excessively strong signal is produced across the detector grid circuit.

If you think that this plan would work, will you please say if the enclosed circuit diagram represents a technically correct way of putting it into operation?

We are afraid that this scheme cannot be considered as being of much more than experimental interest. Even assuming a perfectly stable crystal rectifier, it seems very doubtful if sufficient excess bias voltage could be developed across the grid circuit resistance to give a really useful measure of sensitivity control.

In any case, your circuit diagram is wrong, as the extra bias resistance is in parallel with that already included in the cathode lead of your A.C. high-frequency valve. We have redrawn the diagram (see Fig. 3), showing a method of connection that, so far as it goes, should be satisfactory. It is suggested that the normal automatic bias for the H.F. valve should be abandoned, a dry cell being substituted. Of course, bias voltage due to the crystal output will be developed across the resistance R. This resistance will be of some thousands of ohms, but its actual value is best determined by trial and error. A smoothing circuit in series with the crystal will be essential, and is shown in the diagram.

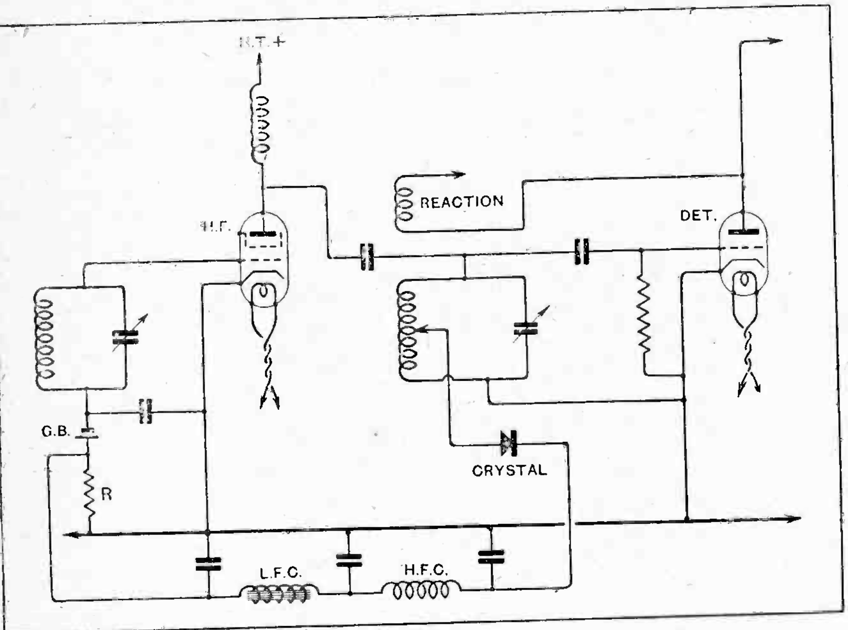

Fig. 3.—A crystal detector in a new rôle: automatic volume control for an A.C. receiver.

Where Long Leads are Dangerous.

In building a band-pass "H.F." receiver on modern lines, with a totally screened ganged condenser and separately screened coils, is there any risk in mounting the coils and condenser at a greater distance apart than is customary, provided care is taken to run the "live" H.F. leads by the most direct path?

Matters should always be so arranged that unscreened grid and plate wires may be as short as possible; consequently, some care should be taken to devise a layout that enables this condition to be satisfied. Apart from the risk of introducing instability by unwanted couplings, there is always a chance that the characteristics of a band-pass filter may be upset if there are appreciable couplings between the component circuits other than those provided in the design.

Resistance-capacity Output Filter.

Apart from the fact that a fairly large H.T. voltage would obviously be needed, is there any reason why a resistance-capacity output filter circuit should not give as good results as the conventional choke-capacity arrangement?

As a loud speaker feed resistance of between 10,000 and 20,000 ohms would be needed in most cases, it will be realised that the disadvantage of lost voltage is rather more serious than you seem to realise; for instance, assuming an anode consumption of 15 milliamps, as much as 30 volts would be absorbed in a resistance of 20,000 ohms. Thus it will be seen that, in almost every case, this type of output device is practically ruled out.

Apart from this very practical consideration, there is no other disadvantage, and, indeed, a slight improvement in the quality is generally to be expected as a result of using a resistance in place of a choke.

Grid-wiring Complications.

Will you please examine the circuit diagram of my three-valve receiver, and, if possible suggest a reason why it should be unstable at wavelengths below about 400 metres? Admittedly, stability can be obtained by reducing screening-grid voltage for the H.F. valve, but then sensitivity is poor.

Of course, a circuit diagram cannot show such details as screening, which are of great importance in preventing undesirable interstage couplings. But if you can be sure that your set is in order in this respect, we think it probable that the trouble is due, at least in part, to the elaborate wiring of the radio-gramophone change-over switch. Although the change-over system you are using is technically sound, it must be a very difficult matter to put it into practical execution in such a way as to avoid long high-potential leads, and we advise you to try a simpler plan. At any rate, it would be an easy matter to try the effect of cutting out the switch temporarily.

FOREIGN BROADCAST GUIDE.

RADIO SCHAERBEEK

(Brussels, Belgium).

Geographical position: 50° 50′ N., 4° 22′ E.

Approximate air line from London: 198 miles.

Wavelength: 246 m. Frequency: 1,220 kc. Power: 0.3 kW.

Time: Greenwich Mean Time.

Standard Daily Transmissions.

10.30, 12.30, G.M.T., gramophone records (Sun.); 20.15, concert, news; 22.00, dance music (Tues., Thurs., Fri., Sat.).

Male announcer. Call: *Allo! Ici Radio Schaerbeek à Bruxelles.*

Interval Signal: Bell.

Closes down with good-night greetings in both Flemish and French, followed by Belgian National Anthem (*La Brabanconne*).

Under the heading "Foreign Broadcast Guide" we publish from week to week a series of panels in this form giving essential details of broadcast transmissions.