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AND RADIO REVIEW

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B.B.C. POLICY.

THE suggestion has been made in our Correspondence columns that the actions of the B.B.C. are rather too often the subject of criticism in our Editorial columns; but we cannot accept this as an accusation which can be justified.

Why We Criticise.

It is true that we very frequently have occasion to criticise or make suggestions with regard to the policy and general activities of the B.B.C., but if we do so it is because of our concern for the welfare of the great movement which is headed by the British Broadcasting Corporation and whose destinies depend so much on how the activities of that Corporation are directed. Everyone must agree that the future of broadcasting in this country as an adjunct to entertainment, education, or for the general welfare of the public in whatever other direction, is bound up essentially with the way in which the broadcasting service is conducted and developed during these the all-important early years of its existence.

We have always contended that the primary reason for the existence of the B.B.C. is to provide programmes and generally to reach the homes of this country through the medium of the microphone. Whenever other activities are indulged in it is, in our opinion, tending to detract the attention, and the time, of the officials of the Corporation from what is their proper and legitimate sphere of activities into other channels, thereby resulting in neglect in some direction or another of the programme side.

The volume of correspondence which we have had from readers as the result of our suggestion that the programmes are too scrappy in their present make-up is sufficient indication to us that this is a matter which, put forward as it is in the spirit of a helpful suggestion, deserves the very careful consideration of those responsible for programme compilation.

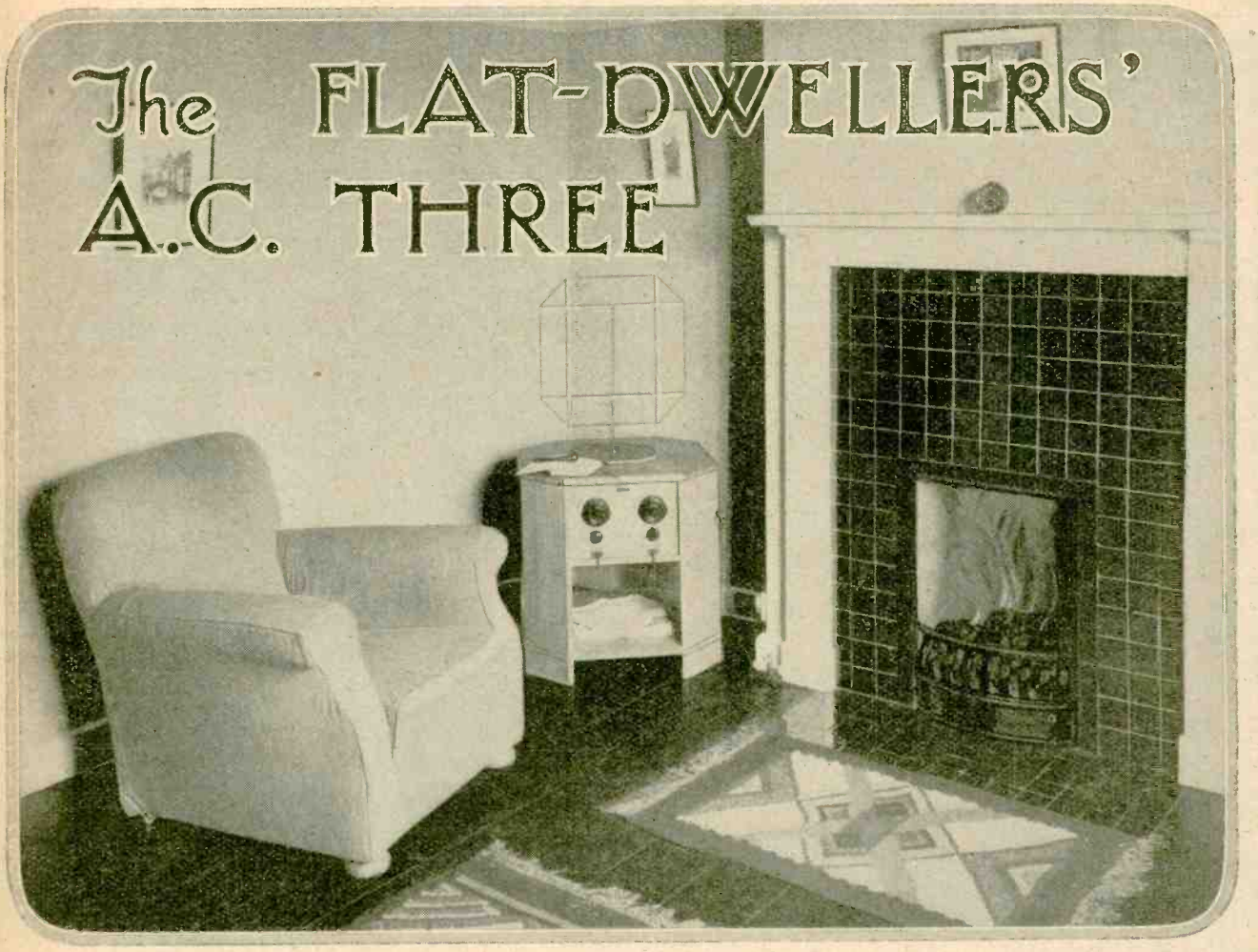
Dissipation of Energy.

We cannot get away from our conviction that the variety of interests of the B.B.C. is largely responsible for the present dissatisfaction with the programmes, and we would urge the Corporation to keep a tighter rein on the often well-intentioned activities of various departments which may lead to incursions beyond their proper sphere of operation. We take as one example of this kind of dissipation of energy which should be directed into other channels, a circular announcement which we received, in common, no doubt, with all other sections of the Press, sent with the compliments of the British Broadcasting Corporation, and announcing that Mr. Percy Pitt would conduct a popular operatic programme at the People's Palace. In the course of the announcement it was stated that the concert "will only be available to those who can attend the hall, as it will not be broadcast."

Who Pays?

We believe that it is pertinent to ask the B.B.C. whether this advertising of a concert, which on their own statement was not being broadcast and was, therefore, presumably in no way connected with the B.B.C., was done with proper authority, and whether the B.B.C. is prepared to justify the expenditure of listeners' money in such directions. We will admit, of course, that an isolated case of circularising the Press in this way is a matter which need not have involved much time or expenditure, but if this creates a precedent and is allowed to pass unchallenged, then the extent to which this kind of thing may develop at once becomes a matter of real consequence.

The FLAT-DWELLERS' A.C. THREE



A Self-contained Frame Aerial Set Employing the New AC/S Screen-grid Valve.

By F. L. DEVEREUX, B.Sc.

ALTHOUGH at first sight this receiver may appear to be somewhat specialised, inasmuch as it is designed to fit a particular piece of furniture,[1] it will be found on closer examination that the specification fulfils the requirements of most flat-dwellers, and is therefore of sufficiently general interest to warrant description. If it is felt that some further justification is called for, it may be stated at the outset that, whereas the set was designed only for alternative programme reception from the local and high-powered stations, it was found that at least eight Continental stations could be enjoyed at good loud speaker strength on any evening after sunset.

The receiver and eliminator form a self-contained unit, and, as the space occupied is rectangular, a cabinet can easily be made to fit it. The material for the panel can also be selected to the reader's individual taste, and need not be of weathered oak as in the original model.

[1] Weathered-oak book table; Messrs. Heal & Son, Ltd., Tottenham Court Road, London, W.1.

Of the restrictions imposed on flat dwellers in connection with the installation of receiving apparatus, the two most important are as follows:—

(1) The erection of an outdoor aerial, if not specifically forbidden, is generally impracticable.

(2) The volume of sound must be kept at a reasonable level in the interests of other tenants.

To these the writer has added a third self-imposed condition, viz.:—

(3) To avoid the cost, trouble, and uncertainty of battery maintenance, the power for both H.T. and L.T. shall be drawn from the A.C. supply mains.

Most people seem to think that if an outdoor aerial is forbidden, the thing to do is to rig up an indoor imitation round the picture rail. They saddle themselves with troubles due to the high self-capacity and poor selectivity of an indoor aerial when they could enjoy the neatness, knife-edge selectivity and directional properties of a frame aerial.

The implication contained in condition (2) concerns the type of valve to be used in the last stage and the

The Flat-Dwellers' A.C. Three.—degree of L.F. amplification preceding it. Experience shows that 1 watt of undistorted power is the maximum energy from the last valve which can be tolerated in the average self-contained flat. Half a watt is more than sufficient for most people, and this is comfortably within the capacity of the AC/R valve chosen for the last stage.

It was decided to use the Met-Vick series of valves in order that advantage might be taken of their new AC/S valve in the H.F. stage. The amplification obtainable from this valve, even with the simplest couplings, is so high that there is no necessity to incorporate reaction, a simplification which will be at once appreciated by those who have had experience with reaction in frame aerial receivers. The omission of reaction also simplifies tuning, and conduces to the better reproduction of high frequencies.

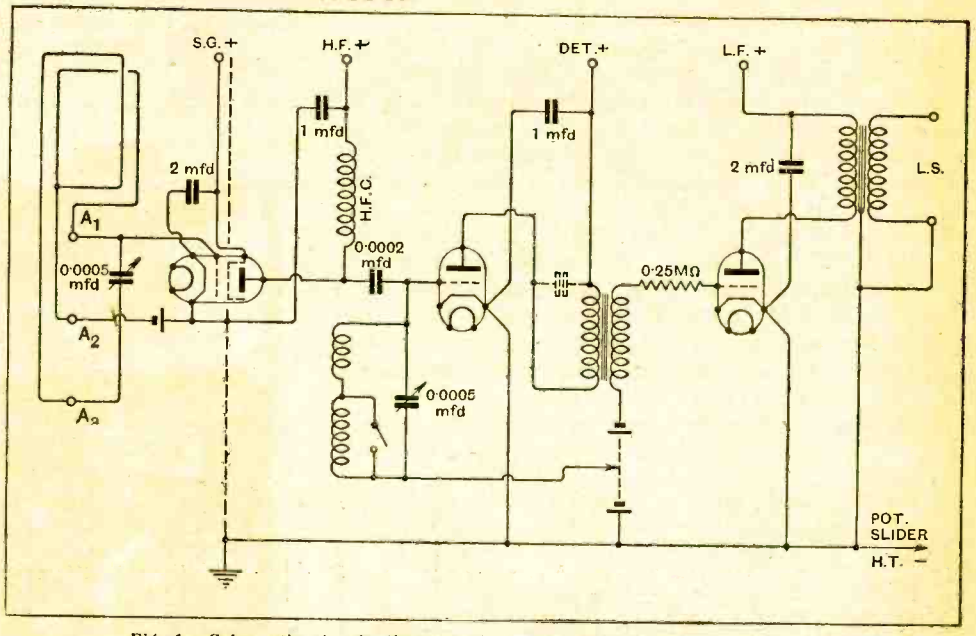


Fig. 1.—Schematic circuit diagram of receiver with filament circuits omitted.

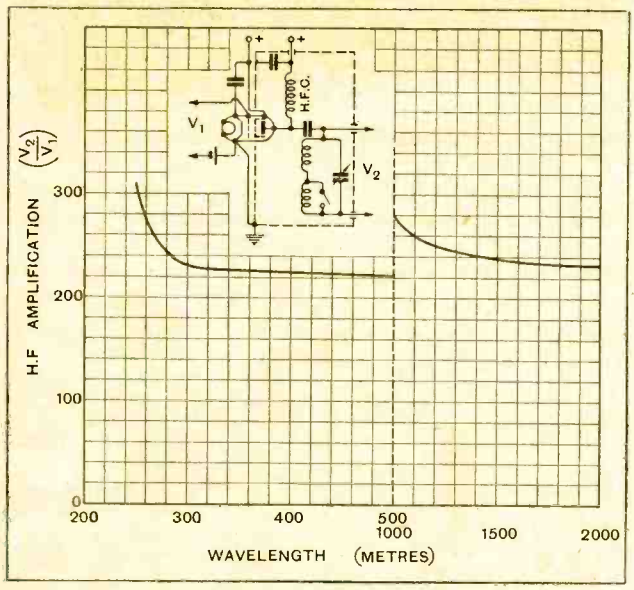


Fig. 2.—Amplification curves of the AC/S valve with parallel feed, tuned grid coupling; H.T. = 120 volts, screen-grid = 48 volts, G.B. = — 1½ volt. The measurements were made with a Lewcos H.F. choke, a 0·0002 mfd. coupling condenser and the coils shown in Fig. 6.

For full details of the Met-Vick type AC/S screen grid valve, the reader is referred to an excellent article in the February 13th issue of this journal. Of the various systems of coupling advocated in this article it was decided to adopt the parallel feed grid circuit on the score of simplicity. (The circuit is incorporated in Fig. 1). If one may say so, this scheme appears at first sight to be suspiciously simple. In view of the wide range of impedance values presented by the H.F. choke at different frequencies one would expect to find a wide discrepancy between the overall amplification obtained on the long and short waves and also an appreciable variation over the tuning range of each waveband. It was therefore decided to measure the amplification at a few representative wavelengths before finally deciding to make use of the parallel feed coupling.

Measuring the H.F. Amplification.

The H.F. circuit was assembled in a closed screening box, and a small measured E.M.F. applied between grid and filament of the valve, the output being

The complete receiver. Most of the parts are enclosed in the metal-lined screening box.

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measured by a valve voltmeter across the tuned circuit. The results are represented in the curve of Fig. 2, the amplification being taken as the ratio of V_2 to V_1. There is very little difference in the general level of amplification on the long- and short-wave bands, and within each band the amplification is remarkably uniform. At the lower end of each wave-band the curve tilts upwards, due to the fact that the L/C ratio of the tuned grid circuit is high. This results in an increase in the volts developed across the tuned circuit for a given input from the H.F. valve, and it is for this reason that 0.0005 mfd. tuning condensers have been employed. By reducing the number of turns in the

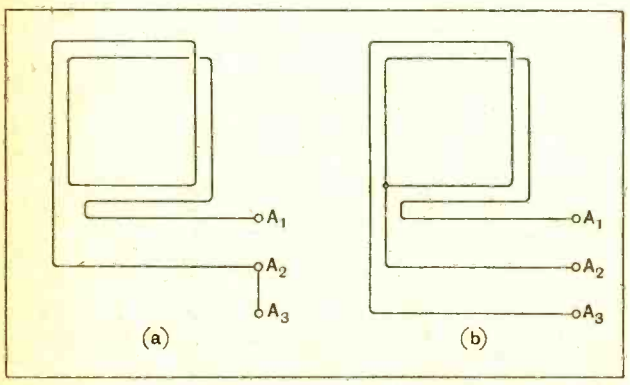
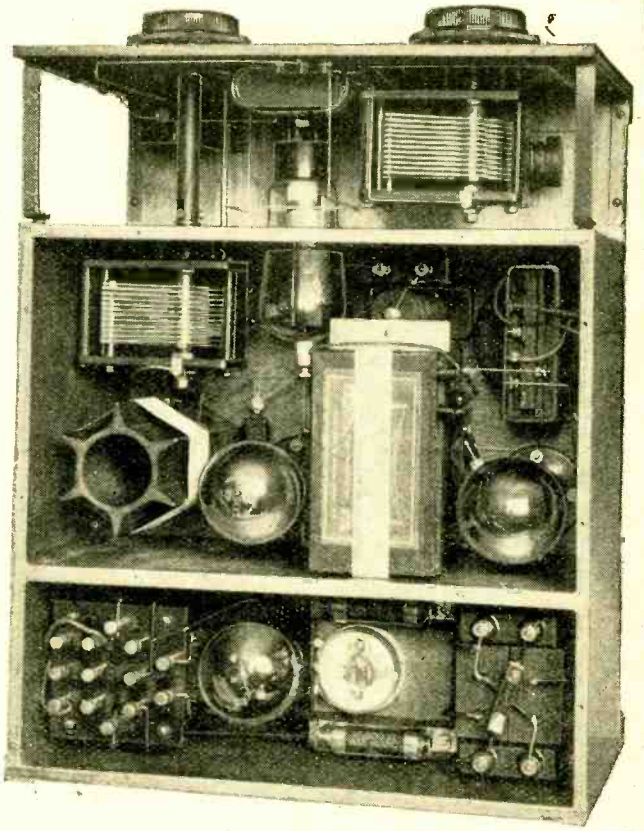


Fig. 3.—Frame aerial connections (a) for short waves (b) for long waves.

coils, the amplification over the 300-500 and 1,000-2,000 metre bands, in which most of the important stations are situated, can be made practically constant.

Experiments were made with various values of coupling condenser up to 0.001 mfd., but the amplification was found to be practically independent of this capacity. Accordingly a low value was chosen to assist in preventing the passing on of low-frequency currents.

The detector valve is an AC/G working as an anode bend detector. The unusually low A.C. resistance of this valve, even when adjusted for rectification, permits the use of transformer coupling, provided the primary inductance is of the order of 100 henrys or more. The Ferranti AF5 fulfils this requirement.



Plan view with lid of screening box removed.

The condenser built into this transformer has been relied on to by-pass the greater part of the H.F. component of the rectified anode current. Any residue which may find its way into the secondary is dealt with by the 0.25 megohm stopping resistance in series with the grid of the last valve. A H.F. choke in series with the primary was tried, but introduced trouble through interaction with the grid coils and H.F. coupling choke. Its omission in no way interfered with the function of the circuit, as it was found that the by-pass condenser in the transformer, in conjunction with the series grid resistance, were quite adequate in dealing with stray H.F. currents.

The output stage calls for little comment. An output transformer is

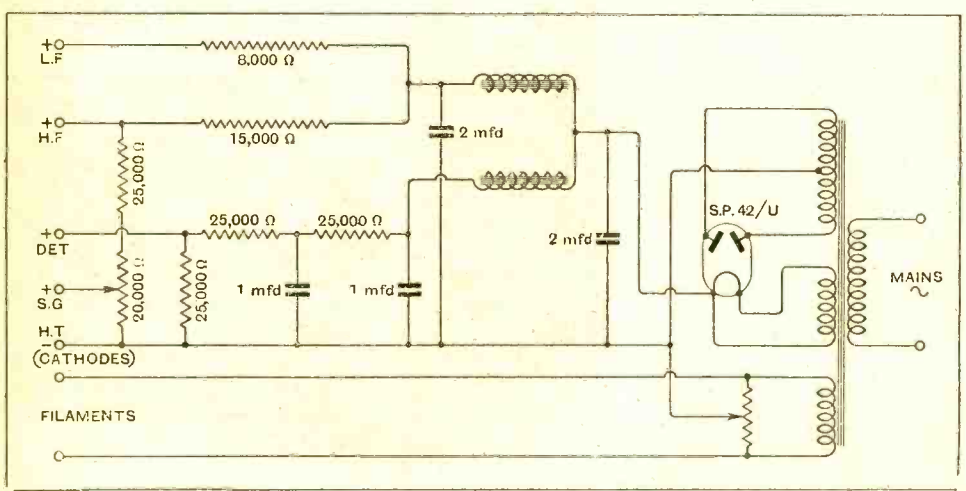


Fig. 4.—Schematic circuit diagram of rectifier unit.

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strongly recommended, as, by earthing the shroud and core and also one side of the secondary, coupling between the loud speaker leads and the frame aerial can be effectively prevented. This precaution is essential

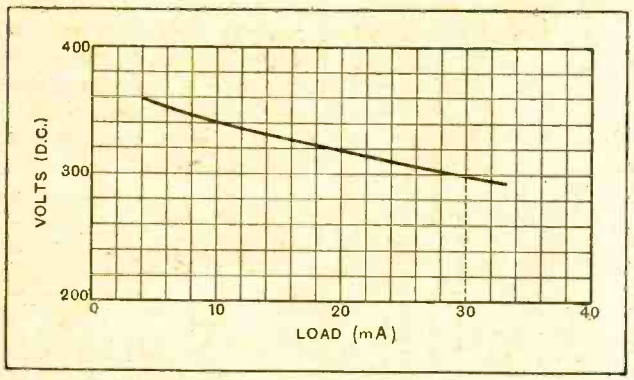


Fig. 5.—Regulation curve of Met-Vick combined "A" and "B" transformer and S.P. 42/U valve.

in a sensitive receiver of this character, otherwise instability will be experienced. The type chosen was a Pye tapped-primary output transformer. This transformer is made in four ratios to suit loud speakers of all types and impedances, and the reader is recommended to study the list before purchasing in order that the model chosen may match the loud speaker with which it is to be used. The model actually used is suitable for 750-ohm balanced armature loud speakers, such as the B.S.A. Kone. Terminals are fitted on the primary for 6,000-8,000 ohm or 2,500-3,000 ohm valves, the latter being employed with the Cosmos AC/R.

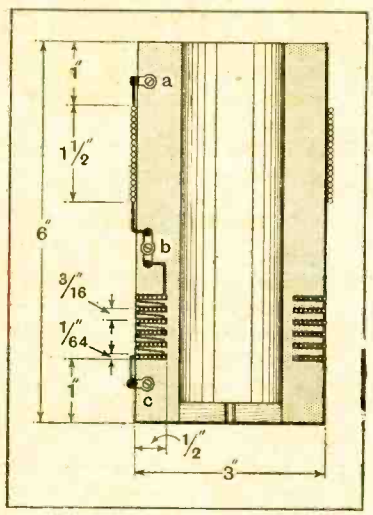
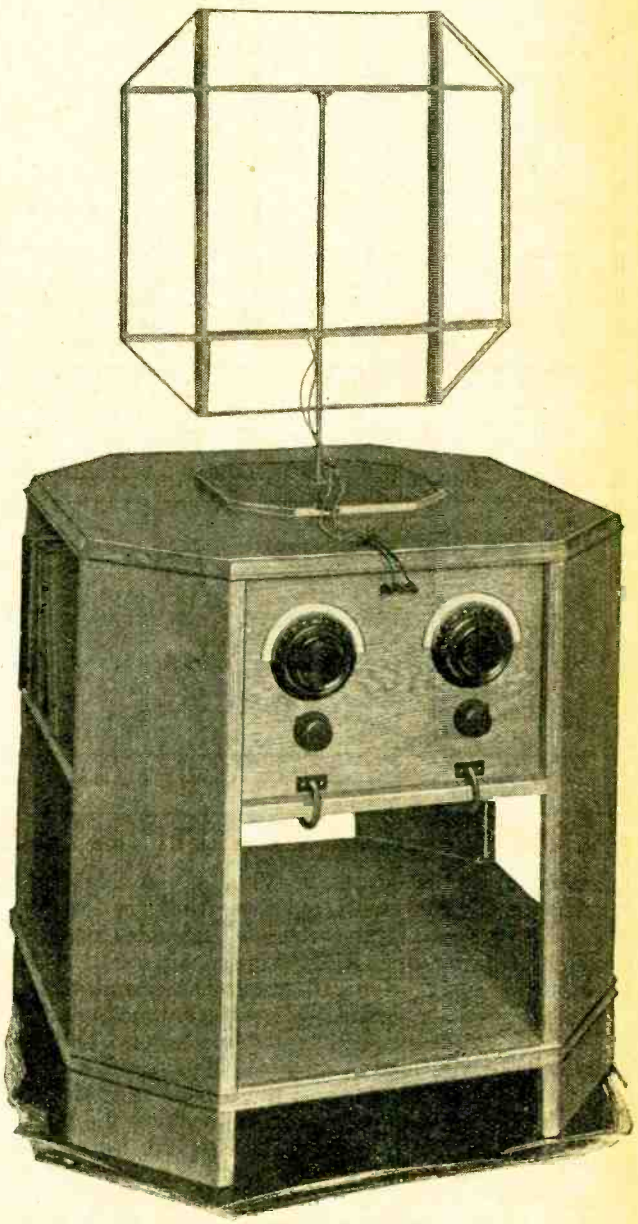


Fig. 6.—Sectional drawing of grid circuit coils. The short-wave winding consists of a single layer of 60 turns of 9/40 Litz and each slot of the long-wave coil contains 35 turns of No. 32 D.S.C.

To complete our survey of the receiver circuit we will revert to the beginning again and consider the frame aerial arrangements. On long waves a centre-tapped frame was found to be a distinct advantage, not only from the point of view of stability but also in reducing "mush" and local interference from electrical machinery. On short waves, on the other hand, no advantage was gained by centre tapping the frame; indeed, to do so would be disadvantageous, since it would result merely in a reduction of signal strength. The mush which proved troublesome on long waves was not picked up by the short-wave frame. At first the possibility of using a single frame with series-parallel windings was considered, but this was finally abandoned in favour of two separate frames for long and short waves. To change over from one system of connection to the other, as well as changing from series to parallel, would enormously complicate the switching, and result in loss of efficiency.

Fig. 3 shows the connections of the three terminal plugs for long and short waves; on short waves terminals A_2 and A_3 are bridged by a link which connects up the free side of the variable condenser to the low potential end of the frame.

With regard to the number of turns suitable for use with the grid coils, to be specified later in the article,



General view of the receiver in the book table for which it was originally designed.

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twelve turns on a frame 18in. square will be right for the short waves, and forty-four turns, centre-tapped, for the long waves on a frame of similar dimensions. The dimensions of the frame can be varied, provided the total length of wire remains unchanged (short waves, 72ft.; long waves, 264ft.)

The eliminator follows well-tried practice, and its schematic circuit is given in Fig. 4. A Met-Vick (Cosmos) transformer with separate windings for the rectifier filament and receiving valve filaments, in addition to the centre-tapped H.F. winding, is used. This transformer is silent in operation, runs cool, and shows remarkably good regulation. Used in conjunction with a S.P.42/U. full-wave rectifier valve, the variation of output voltage with load is shown in Fig. 5. The voltages are on the high side, and the utmost care should be exercised when making any adjustments to the rectifier; always switch off before removing the lid of the box. Also make sure that all condensers are of the quality specified in the list of parts; in particular, the 2 mfd. condenser across the output from the rectifier should not be of less than 500 volts A.C. test.

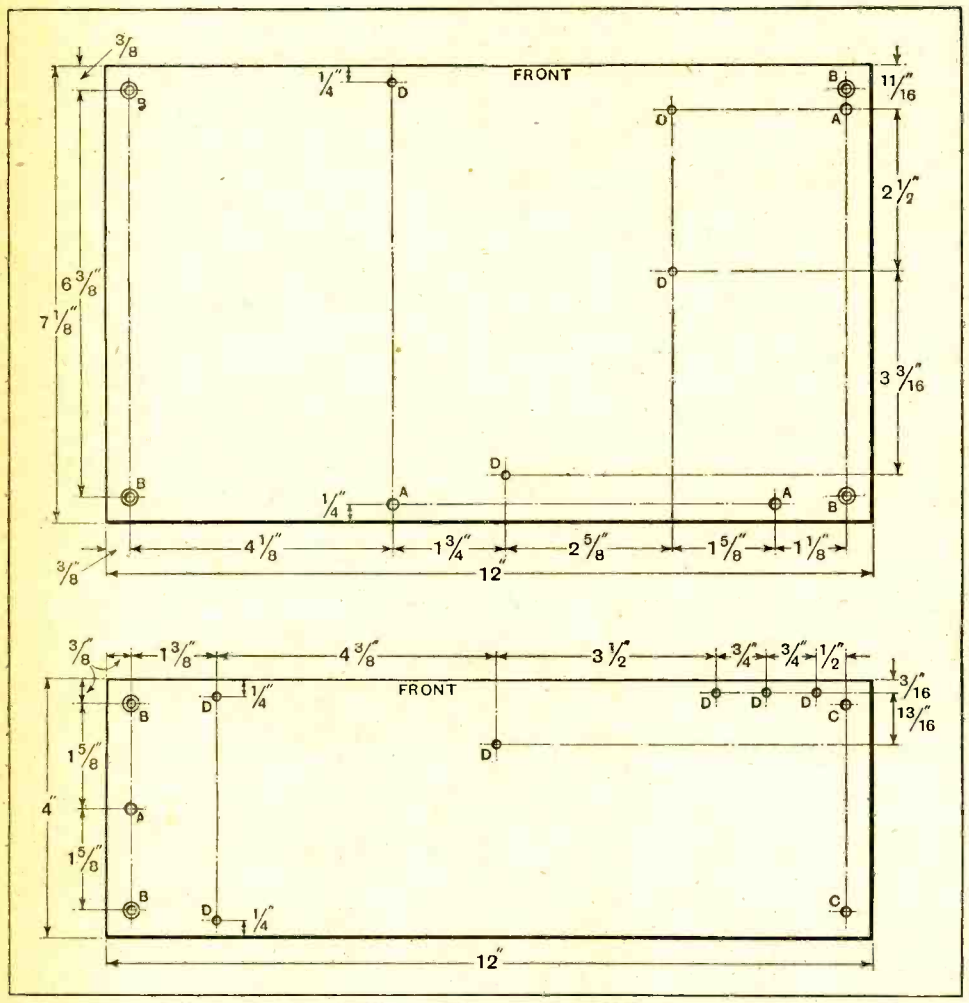


Fig. 7.—Drilling details of sub-panels for receiver and eliminator compartments of screening box. A, 3/16in. dia.; B, 5/32in. dia. countersunk for No. 4 B.A. screws; C, 5/32in. dia.; D, 1/8in. dia.

A preliminary test of the receiving portion of the circuit with H.T. batteries showed that the total load (including potentiometer currents) would be 30 mA. Hence the terminal voltage of the rectifier would be 300 volts under working conditions (see Fig. 5). During the D.C. test the anode currents of all valves were taken, and from these figures the resistance and potentiometer values required to break down the 300 volts to the voltage required by each valve were calculated. The results are included in Fig. 4. As a matter of interest the valve currents and voltages of the set are given in the table below:—

	H.T.	G.B.	mA.
H.F. Valve (AC/S) (S.G.=58.5 volts)	150	− 1½	7.5
Detector (AC/G)	100	− 3	1.0
L.F. Valve (AC/R)	180	−10½	15.0

The screen grid of the AC/S valve is supplied from a tapped, wire-wound potentiometer in conjunction with a rotary switch. This gives a range of about 45 to 60 volts, and enables the best screen potential to be found for each wave range. To a certain extent also it can be used as a volume control. It is most important that the screen grid should be by-passed to the cathode terminal of the valve by a large condenser of good power factor.

The H.T. Supply.

The eliminator unit is contained in a separate compartment, and is completely screened. This compartment also contains the smoothing equipment, so that the H.T. supply is entirely freed from hum before emerging. In this way coupling with the frame aerial circuit which might produce hum is avoided. The H.T. leads travel underneath the base, and are brought up into the receiver compartment, where they are immediately by-passed by the condensers shown in the receiver circuit (Fig. 1). By dividing the by-pass condensers in this way between the receiver and eliminator compartments, the external H.T. leads are kept free of both H.F. and L.F. currents. In the case of the detector valve, the H.T. voltage is further reduced in passing from one compartment to the other by means of resistance elements suspended in the wiring under the base.

The screening box is of ply-wood, lined inside and out with leaded iron, and the lid, which is provided with

LIST OF PARTS.

1 Plymax box, 12 × 12½ × 7½in. (Peto-Scott).
2 Variable condensers, Log. law 0.0005 mfd. (Burndept).
2 Ethovernier dials and Ethologs (Burndept).
1 Fixed condenser, 2 mfds., 500 volts D.C. test (Ferranti C.2).
4 Fixed condensers, 1 mfd., 400 volts D.C. test (T.C.C.).
3 Fixed condensers, 2 mfds., tested 500 volts A.C. (750 volts D.C.) working 250 volts A.C. (T.C.C.).
1 Fixed condenser, 0.0002 mfd. (Polymet).
3 A.C. valve holders (Met.-Vick).
1 Anti-capacity valve holder (Pye).
1 Cell, 1½ volt, Type G.T. (Siemens).
2 9-volt grid bias batteries (Ripaults).
5 Miniature wander plugs (Eelex).
1 Potential divider, 20,000 ohms (Climax).
1 5 pt. rotary switch (Zampa).
1 S/P cam switch (Wearite).
1 Pre-set 400-ohm potentiometer (Igranic).
1 Anode resistance, 8,000 ohms and holder (Ferranti).
1 Anode resistance, 15,000 ohms and holder (Ferranti).
4 Moulded resistances, 25,000 ohms (Met.-Vick).
1 Grid leak, 0.25 megohm (Pye).
1 H.F. choke (Lewcos).
1 L.F. transformer, AF5 (Ferranti).
1 Tapped primary output transformer, 1.8 : 1 and 1.5 : 1, No. 657 (Pye).
1 L.F. choke, B.1 (Ferranti).
1 L.F. choke, B.3 (Ferranti).
1 Combined "A" and "B" transformer, Type 63108 (Met.-Vick).
1 Rectifier valve, SP12/U (Met.-Vick).
1 AC/S valve (Met.-Vick).
1 AC/G valve (Met.-Vick).
1 AC/R valve (Met.-Vick).
1 Baseboard, 5-ply, 15½ × 12⅝ × ⅝in.
1 Oak panel, 12⅝ × 8¼ × ¼in.
1 Deep ribbed former, 3in. dia., 6in. long (Redferns).
3 Parallel plugs and sockets (Clix).
Quantity 32 D.S.C. 9/42 Litz. Systoflex, screws, brass strip, wood for sub-bases, flex, etc.

Approximate cost, including valves, £19.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer, and illustrated in the photographs of the instruments. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

a lip, must be screwed down to ensure perfect screening between the receiver and the eliminator. The whole of the apparatus outside the screen is associated with the frame aerial, and does not, therefore, require screening.

In spite of the compact layout, the construction presents no real difficulties, provided the various stages of the work are tackled in the right sequence. Complete constructional details will be given in next week's issue, but in the meantime there are one or two preparatory items which may be undertaken while the parts are being ordered.

The first step is to cut the five-ply baseboard to the dimensions given in Fig. 8, and to fit the ⅝in. battens at each end. If the thickness of the plywood is under or over ⅜in., the depth of the battens must be altered accordingly in order that the total depth may be kept at 1in. exactly.

Now cut and drill the sub-panels for the bottom of each screening compartment, and, using the panels as templates, transfer the holes to the bottom of the screening box. The edges on the undersides of the sub-panels should be slightly chamfered to fit the radius in the corners of the box. When placing the panels in position for marking the holes on the bottom of the box, see that the edges marked "Front" are facing the front panel, and take care that the panels are not reversed in transferring from the inside to the outside of the box. After drilling the box and cleaning the burr off the holes, place it in position on the baseboard and mark and drill holes to correspond in the baseboard. These may be of slightly larger diameter than those in the box to allow slight movement for alignment when the box is finally bolted to the baseboard. The operation of drilling the holes in the sub-panels, box, and baseboard, is probably the most important part of the construction, and should not be rushed.

The front panel is supported by two brass brackets turned up from brass strip. The top of each bracket is turned over to brace the top of the panel, and, as a refinement, is attached to the screening box by locknuts on short lengths of 4B.A. rod screwed and soldered into the edge of the box. This method permits slight adjustment in order that the panel may be set at right angles to the baseboard. Alternatively, wood screws may be used and the brackets packed away from the box with washers, the number of washers being adjusted until the panel is at right angles to the baseboard at each side.

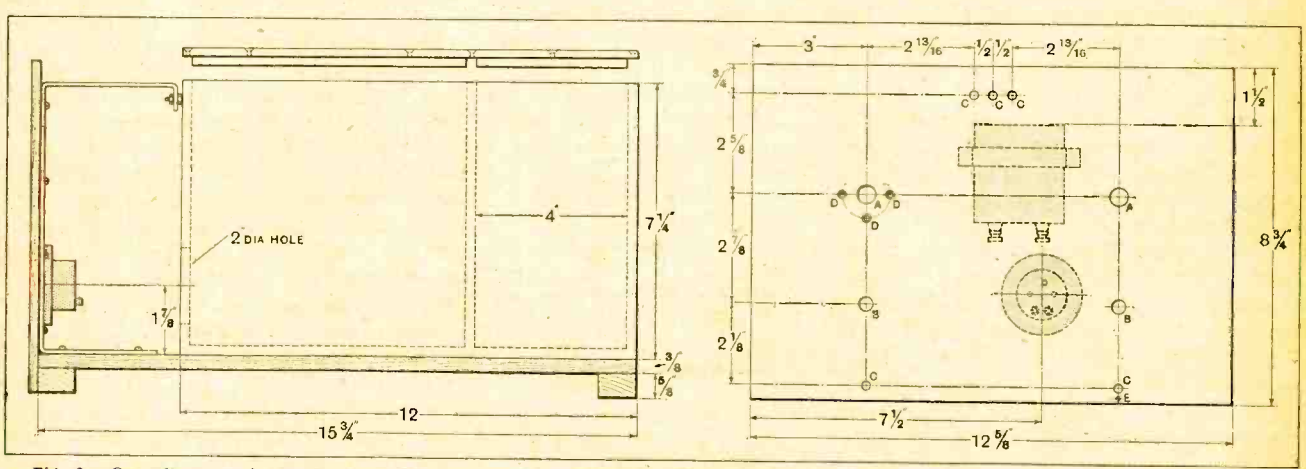
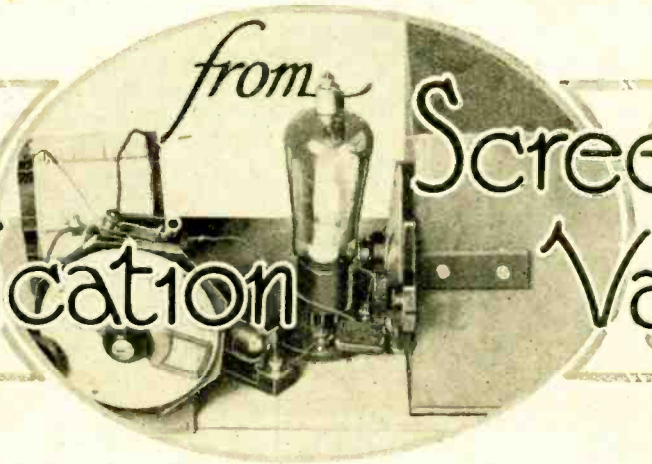


Fig. 8.—Overall dimensions of baseboard, screening box and front panel with drilling details for the latter. A, 1/2in. dia.; B, 3/8in. dia.; C, 1/4in. dia.; D, 5/32in. dia. countersunk for No. 4 B.A. screws; E, 3/32in. dia.

(To be concluded.)

More Amplification from Screen-Grid Valves



The Design of the Tuned Circuits.

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

(Concluded from page 426 of previous issue.)

THE practical design of tuned circuits to make the most of the screen-grid valve is a rather difficult one. From the point of view of amplification, it is quite clear that the best results will be attained, now that the achievement of stability holds no terrors for us, by the use of tuned circuits of the lowest practicable high-frequency resistance. On the other hand, such circuits enhance selectivity to such a degree that, even on the broadcast band of wavelengths, it becomes difficult to ensure that the sidebands which carry the higher notes of the received telephony are not cut off to any very appreciable extent. It is evident that the two conflicting tendencies can only be reconciled by means of a compromise, and that if care is not taken in designing the circuits some very unpleasant results may arise. There is, however, one alteration from standard design which enhances amplification without introducing additional loss of high notes.

The amplification attained by a stage, while increased by decreasing the high-frequency resistance of the tuned circuits employed, does not depend directly upon this resistance. Instead, it depends on the *dynamic resistance* of the tuned circuit, which may be described as the resistance offered by the tuned circuit to currents of the frequency or wavelength to which it is tuned. The dynamic resistance depends on the inductance of the coil, the wavelength to which it is tuned, and the high-frequency resistance offered to circulating currents of that wavelength. The algebraic expression for the dynamic resistance obtainable in terms of these three quantities, is:

$$R = \frac{3{\cdot}55L^2}{\lambda^2 r} \text{ megohms,}$$

where L = Inductance of coil in microhenrys.
λ = Wavelength in metres.
r = Equivalent series resistance in ohms.

For the highest amplification, R must be made as high as possible.

The writer has already drawn attention ("High Frequency Resistance," *The Wireless World*, December 26th, 1928) to the considerable increase in the high-frequency resistance of a tuned circuit that is brought about when a valve-holder and valve are connected across it, and figures have been given showing that of the losses introduced by the valve itself it is the insulating compound of the base that provides the greater part.

Decapping the Valve.

It is only a step from these data to the decision to employ valves from which the bases have been removed, and to dispense with a valve-holder by making soldered connections directly to the wires that come through the glass pinch. These leads are exposed when the valve is decapped. The use of valves in this somewhat undressed condition has a very appreciable effect upon the high-frequency resistance of the tuned circuits, and makes a good start towards raising the dynamic resistance to the highest convenient value.

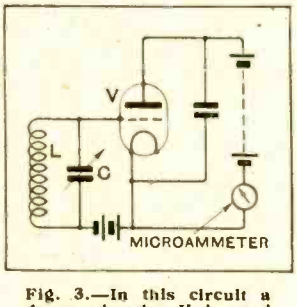


Fig. 3.—In this circuit a decapped valve V is used as an anode-bend detector. It had been calibrated as a voltmeter; the deflection of the instrument in the plate circuit for any H.F. voltage on the grid of the valve being known. The dynamic resistances given in the text apply to the above circuit as a whole.

A standard *Wireless World* Litz coil (70 turns of 27/42 Litz on a 3in. paxolin former) with tuning condenser, leads, and a Moullin voltmeter built from a decapped valve, were subjected to a series of measurements of high-frequency resistance. The Moullin voltmeter, it may be said, is nothing more than an anode rectifier with a meter in its plate circuit, so that the collection of components just described, and of which the circuit is given in Fig. 3, amounts to the tuned circuit, complete with detector valve, into which the screen-grid valve will deliver its output in the final set. In Table I are given the results of the measurements made, column 3 giving the dynamic resistance, in megohms, of the complete circuit for the

More Amplification from Screen-grid Valves.—

various wavelengths mentioned in column 1. Column 2 gives the dynamic resistance calculated from the copper losses of the coil alone according to Butterworth's formulæ.

TABLE I.

Wavelength (Metres).	Dynamic Resistance due to copper only (Megohms).	Dynamic Resistance of Circuit (Megohms).
200	1.01	0.263
225	0.941	0.281
250	0.886	0.285
300	0.758	0.299
400	0.597	0.275
550	0.394	0.227

The figures of Table I are plotted as curves A and B in Fig. 4.

It is amply clear, both from the curves and the table, that the dynamic resistance of the tuned circuit as a whole is much lower than can be accounted for by the

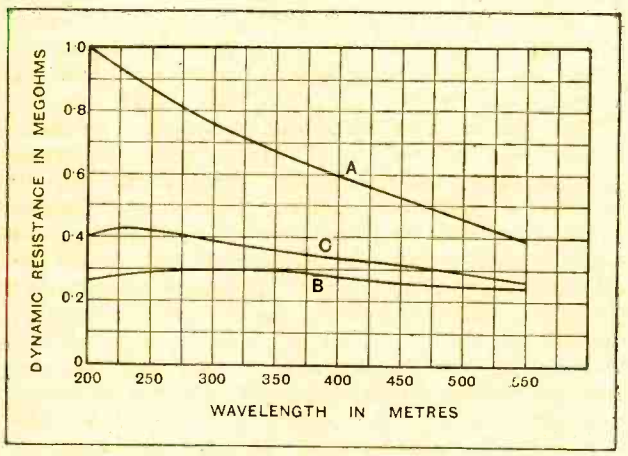


Fig. 4.—Curves showing frequency plotted against dynamic resistance.

copper losses in the coil alone; there are evidently very considerable dielectric losses still playing their shady part, in spite of the decapping of the valve.

Reducing Coil Former Losses

Any further reduction of such losses as might still be introduced by the valve was clearly out of the question —the valve was already decapped, and there were no further liberties that could be taken in that direction. It was remembered, however, that synthetic insulating materials had been found to introduce much higher dielectric losses than ebonite, so the jaundiced eye of suspicion fell on the bakelised paper former on which the coil was wound. It was decided to replace this by ebonite, and, since even ebonite introduces some small losses, to use a ribbed former in order to keep down the amount of insulating material in the immediate neighbourhood of the wire. A duplicate coil, wound on such a former, was next examined in the same way as before. Table II gives the results obtained, the third column, showing what we should expect if dielectric losses were entirely absent, being repeated from Table I, since this represents the ideal case that we are striving to reproduce as nearly as may be. The dynamic resistance of this tuned circuit is given in curve C.

Comparison of these figures with those of curve B shows at once that a very considerable improvement indeed has resulted through replacing the bakelised former by one of ebonite, as might indeed be expected from the meagre published data giving the dielectric properties of these two substances. The improvement found is most noticeable at the lower wavelengths, where the effect of dielectric losses is always most marked.

Coils of High Inductance.

The improvement was welcomed, but was not thought sufficient, and, in particular, exception was taken to the manner in which the dynamic resistance of the circuit tailed off at about 350 metres, so that amplification at wavelengths greater than this would be poorer by comparison than is desirable. A careful examination of coil, condenser, and anode rectifier (Moullin voltmeter) did not suggest any remaining source of dielectric losses that could easily be removed, though two fresh makes of tuning condenser were tried in turn to see whether any great share of the losses remaining could be attributed to that component. No appreciable change in the dynamic resistance of the circuit was found as a result of these variations, so that it is evident that the three condensers tried had about the same losses, and no one was to be preferred to the others.

Attention was then turned to the possibility of using a coil of higher inductance, for it will be seen from the expression already given for the dynamic resistance that an increase in inductance will carry with it a considerable rise in R. Admittedly, this will be partially counterbalanced by a rise in r, which will tend to bring R down again, but as the square of L appears in the numerator, and only the first power of r in the denominator of the fraction, it was hoped that there might be a gain on balance.

TABLE II.

Wavelength. (Metres).	Dynamic Resistance of Circuit. (Megohms).	Dynamic Resistance due to Copper only. (Megohms).
200	0.406	1.01
225	0.431	0.941
250	0.417	0.886
300	0.390	0.758
400	0.336	0.597
550	0.261	0.394

A new coil was therefore wound, this time on a 4in. ribbed ebonite former; as before, 70 turns of 27/42 Litzendraht were used. The inductance of this coil turned out to be 410 microhenrys in the open, but it was realised that with the high amplification that it was hoped to attain in the finished receiver pretty thorough screening would be necessary, so that the inductance of the coil was measured again inside a copper box of dimensions 8½in. × 7½in. × 7in. high. Centrally disposed within this box, the inductance was found to be reduced to 370 microhenrys, while its self-capacity had risen from 10 to 13 micromicrofarads. Its dynamic resistance was calculated, as before, from measurements of high-frequency resistance made both inside the

More Amplification from Screen-grid Valves.

box and outside; the following values were found:—

TABLE III.

Wavelength. (Metres).	Dynamic Resistance of Circuit in open. (Megohms).	Dynamic Resistance of Circuit in box. (Megohms).
200	0.409	0.455
225	0.425	0.466
250	0.454	0.476
300	0.450	0.487
400	0.422	0.440
550	0.391	0.360

Curves D and E of Fig. 5 show these results graphically. The unexpected effect of the screening in *raising* the dynamic resistance of the tuned circuit over most of the tuning range, instead of lowering it as might have been anticipated, shows that the losses in the circuit are now almost entirely due to the presence of faulty dielectrics, and suggests that the profitable limit of increase in inductance has probably been passed.

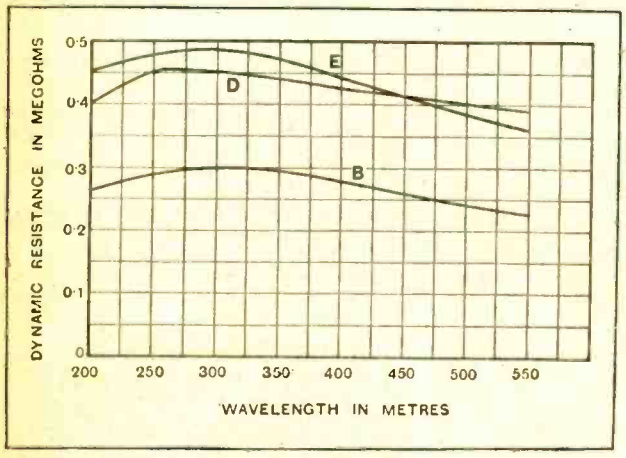


Fig. 5.—Curve B for the standard coil is repeated here for comparison.

Although by reducing the inductance slightly it might be possible to touch the half-megohm (at which the writer was aiming) at some part at least of the tuning range, yet it would result also in a still further tailing off of the values at the upper end of the tuning range.

This increase in the inductance of the coil was only made possible by the fact that the detector valve had been decapped; this led to a very appreciable drop in the minimum capacity of the circuit as a whole, and permitted even this large coil to be tuned down to wavelengths as low as 220 metres when used in a set.

It is a well-known fact that an increase in the parallel capacity across a tuned circuit increases the selectivity of that circuit, and hence its tendency to suppress the high notes carried by the sidebands of a telephony transmission. A second and extremely important advantage of the high inductance is therefore to be found in the fact that it permits the use of tuned circuits of unusually high dynamic resistance without any greater loss of sidebands than is incurred with tuned circuits of more normal design, so that by this means considerable additional amplification can be attained without the usual accompaniment of impaired quality.

A comparison of two receivers, one employing two standard *Wireless World* coils of 27/42 Litz on bakelised paper, and one employing two of the writer's high-inductance coils on ebonite formers, both with decapped valves, shows the following results:—

Tuned Circuits.	High-note loss at 5,000 cycles at 300 metres.	Overall amplification at 300 metres.
Standard	59%	46,000
High-inductance	56½%	73,000

It will at once be seen that the overall amplification with the high-inductance coils is quite considerably greater than with the standard coils, and that, in addition, the loss of high notes due to sharp tuning is a little less. The rather startling figures for the amplification of one stage include the step-up due to the coil in the grid-circuit of the high-frequency amplifier, and are based on the use of the Cosmos indirectly heated screen-grid valve, properly neutralised, of course, in both cases.

The amplification per stage which may be expected with this valve and which is seen under certain conditions to exceed 350 is shown in the table below, the figures there given being strictly comparable with the usual 40 times of the ordinary "good" H.F. stage.

These figures are calculated from the measured characteristics of the tuned circuit and screen-grid valve concerned, but the negative reaction effect due to the detector, which may tend to reduce amplification, has not been taken into account (see "The Valve as an Anode Bend Detector," *The Wireless World*, March 13th and 27th, 1929). Further, the calculated amplification is based on the complete absence of any reaction, intentional or otherwise, from the second tuned circuit to the first. In a practical receiver, even though extensive screening and neutralising are employed, it is difficult to avoid such reaction effects completely, though they can very readily be reduced sufficiently to ensure stability.

As a result of this stray reaction the effective amplification of the stage will rise to some value which cannot be predicted with any certainty. There can be little doubt that by deliberate partial deneutralisation an effective amplification of the order of 1,000 times could be attained without difficulty, though it is not very easy to say whether this figure is above or below the maximum that is consistent with stability over the whole tuning range, with a single setting of the neutralising condenser. Attractive though it may appear, such extra amplification is not altogether desirable, for it results in sharper tuning and accentuates not inconsiderably the loss of side-bands.

Wavelength. (Metres).	Amplification per Stage. Standard Coil.	Calculated Amp. per Stage. Special Coil.
225	249	351
250	252	354
300	261	364
400	243	337
550	212	296

The trial of a receiver embodying the specially developed stage made it very clear indeed that the amplification afforded was of an order unprecedented for a single stage.

A Review of Manufacturers' Recent Products.

PYE PENTODE OUTPUT TRANSFORMER.

In our issue of December 19th last we mentioned in these columns that Messrs. W. G. Pye and Co., Granta Works, Montagne Road, Cambridge, were about to put into production an output transformer for use with pentode valves. We are now able to supply further information regarding this component.

The step-down ratio is 3.5 to 1, and the secondary has been designed to suit

Pye output transformer for use with pentode valves.

loud speakers of the 750 ohm class. The D.C. resistance of the primary of the sample tested was 1,220 ohms, so there should not be any appreciable voltage loss in spite of the rather heavy anode current required by valves of the type that will precede this component.

The impedance of the primary was found to be 199,000 ohms at 920 cycles. A complete metal shroud is used and a small terminal provided for earthing the case, should this precaution be desired.

The price of this component is 20s.

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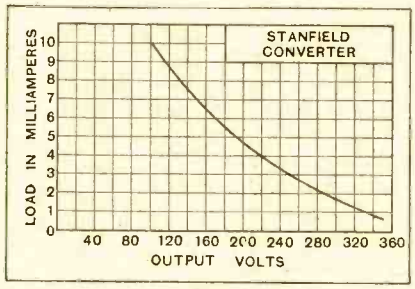
STANFIELD CONVERTER.

This is a device for obtaining high-tension current from a 4-volt accumulator, and should help to solve many of the difficulties besetting those not having mains available, but desiring to dispense with the more popular dry-cell H.T. batteries. Briefly, the unit consists of a step-up transformer with a vibratory "make and break" contact in the primary circuit. The high voltage output is rectified by an ordinary receiving valve—the plate and grid being strapped together so that half-wave rectification results. A filter circuits provides smoothing.

Provision is made for obtaining two separate output voltages, one being fixed, but the other—H.T.+1—is variable and obtained by tapping into a potential divider shunted across the output from the filter. The output from the transformer can be controlled by adjusting the vibrator, a small lever being fitted for this purpose.

The unit was tested on a few of the more popular types of three-valve sets, and although a slight fluctuation was noticed on a milliammeter in the output leads, this had a negligible effect on the performance of the sets, and we consider the unit satisfactory for use with simple receivers. The maximum load appears to be

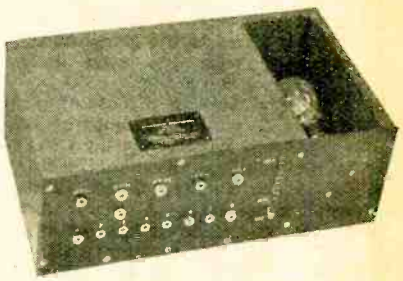


Voltage regulation curve from H.T. + 2 socket with vibrator adjusting lever at "maximum" setting.

about 10 mA., as under these conditions the output voltage drops to 100. On full load the drain on the accumulator was found to be 0.7 amp. at 4 volts, so that the efficiency can be given as 35 per cent.

It is essential that a separate accumulator be used for the converter—the filament cells must not be employed.

It will be seen from the curve that on "no load" the output voltage will be well over 350, and it would be desirable to adopt a definite order of switching on and off, so as to prevent damage, either to the unit or the components in the set, owing to this high "no load" voltage. The set



Stanfield converter for obtaining H.T. from a 4-volt accumulator.

should be switched on before the converter, and always turned off last.

The makers are the Stanfield Radio Co., Ltd., 27, Lots Road, Chelsea, London, S.W.10, and the price of the model 4/100 is £3 10s., including valve.

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FERRANTI VALVE TESTER.

This instrument has been designed to facilitate taking measurements of the various voltages and currents associated with a valve under actual working conditions when it is in position in the receiver. It is not always possible for the amateur to reproduce the conditions external to the set under which the valve normally operates, so that the advantages conferred by this multi-range meter will be readily appreciated. Actually, the valve tester is eight separate instruments in one, and it requires only the movement of a switch to bring into use any one of

the eight ranges provided. As only one range can be used at a time, simultaneous readings cannot be made, but as this is necessary only when preparing characteristic curves it is of no great importance.

This Ferranti valve tester is actually eight instruments in one.

The test set is provided with a plug, which should be inserted in the valve holder, and the valve normally occupying this position placed in the socket on the top of the plug. This enables the filament voltage, up to 10 volts, to be measured at the pins of the valve—an important measurement, as it indicates the actual voltage across the filament. The next position of the switch, marked "grid circuit," indicates continuity in this circuit, but does not give actual grid bias voltage. For this the switch should be moved to the grid volts ranges—either 10 or 100, as the case may be—and the black wander lead attached to the grid bias terminal associated with the valve under test.

The following two positions of the switch give H.T. voltage readings of 100 and 300 maximum respectively, and show the actual plate voltage, provided the D.C. resistance of the coupling device in the anode circuit is not high. A false reading would be obtained if an anode resistance was fitted so that the measurements on these ranges will hold good only provided transformer coupling is adopted.

Following these come two milliampere ranges, respectively 0-100 and 0-10, and these enable the anode current to be measured under operating conditions.

A few measurements were taken and checked with standard laboratory instruments. On the 100-volt range the error at full scale was found to be +1%; an error of the same order being recorded on a 50-volt reading. This is negligible. On the 100 mA. range the valve tester was found to have an error of +2%, the same percentage error showing also on the 10 mA. scale. The accuracy is extraordinarily good for an inexpensive instrument of such wide scope, and at the price of £5 5s. can be regarded as good value for money.

The makers are Messrs. Ferranti, Ltd., Hollinwood, Lancashire.

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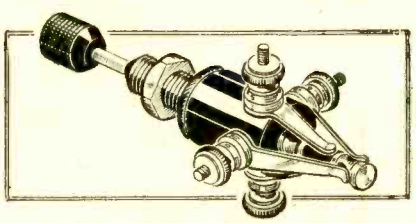
RED DIAMOND WAVE-CHANGE SWITCH.

This switch functions on the push-pull principle, and consists of a short length of insulating material carrying four contact springs and terminals, and fitted with a single-hole fixing bush. Opposite pairs of springs are connected or open circuited according to the position of the spindle, which is electrically connected to both contact rings, so that the switch is virtually a single-pole change-over arrangement.



Red Diamond 4-point wave-change switch.

The contact springs are strong, and both positions are positively defined, the springs seating into grooves turned in the rings fixed to the spindle.

Made by The Jewel Pen Co., Ltd., 21 and 22, Great Sutton Street, London, E.C.1, price 2s.

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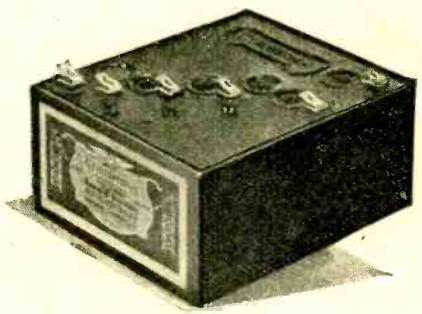
COLUMBIA H.T. BATTERY. Type No. 4721.

Columbia batteries are made by the National Carbon Co., Incorporated, New York, U.S.A. Although the particular sample tested is small dimensionally, it is stated to come within the category of the large-capacity types. Assuming that the economical discharge would be in the order of 10 mA., a loading resistance was adjusted to give an initial current of slightly under 12 mA.



Columbia large capacity H.T. battery, Type No. 4721, nominal voltage 60.

For the first 100 hours the voltage fell rather rapidly, but remained reasonably constant for a further 150 hours, when a natural cut-off was noticed. The discharge curve indicates that a better performance would have been recorded if the initial current had been slightly less, and probably the most economical discharge will be found to be nearer 8 mA. than the figure taken in this particular case.

The useful life of the battery, assuming an initial discharge of 10 mA., will be about 200 hours, but we anticipate an extension to 350 hours if 8 mA. is taken as the economical rate for this particular size.

Provision is made for obtaining intermediate voltages of 16½, 22½, 30, and 45, spring clips being fitted for each of these values.

The dimensions of the battery are 5⅜in. × 5⅛in. × 3¼in. over the clips, and the price is 10s. 6d.

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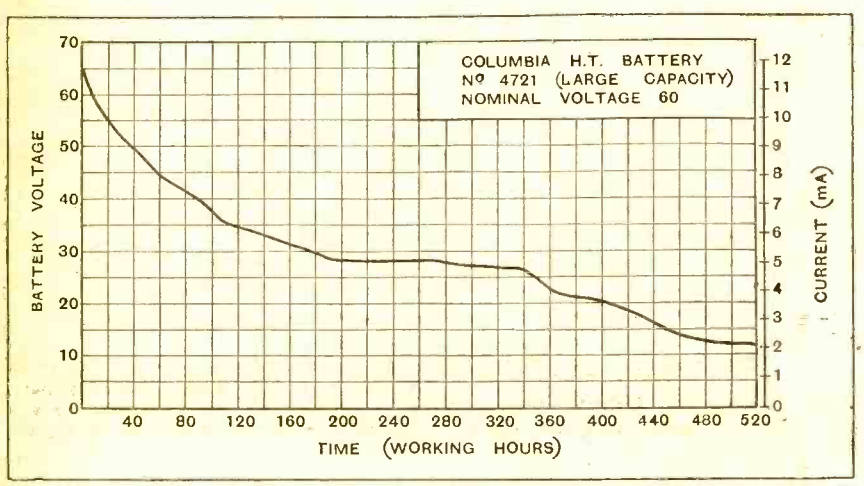
SPINDLES FOR PICTURE RECEIVERS.

The growth of picture transmission from British and Continental stations is giving rise to an increase in the supply of parts for constructing picture receiving apparatus. Even when a lathe is available, the amateur will probably find it preferable to purchase the spindle rather than attempt to make it owing to the difficulty of accurately cutting the traversing thread.

J. J. Eastick and Sons, Eelex House, 118, Bunhill Row, London, E.C.1, now supply suitable spindles. A specimen examined had been accurately turned between centres and was arranged to suit the "Fultograph" machine having a thread of 64 to the inch.



Discharge curve of the Columbia Type No. 4721 dry-cell H.T. battery.

CURRENT TOPICS

Events of the Week in Brief Review.

WHAT IS RADIO?

"Wedding by Radio" was the newspaper headline to last week's story of the titled lady who heard her daughter's marriage ceremony by means of land line from the church to her home.

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MEASURING SIGNAL INTENSITY.

"A Portable Radio Intensity-Measuring Apparatus for High Frequencies" is the title of a paper by Dr. J. Hollingworth, M.A., and Mr. R. Naismith, to be read at this evening's meeting of the Wireless Section of the Institution of Electrical Engineers. Further particulars under "Forthcoming Events."

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THE TELEPHONE EARTH.

G.P.O. inspectors are renewing a campaign to trace wireless listeners who "earth" their sets to telephone wires or cables.

While not actually dangerous, the telephone earth is not to be recommended, and the Post Office has every right to govern the use of its property.

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PARIS SHOW DISAPPOINTMENT.

The Sixth Paris Wireless Salon, the official exhibition of the French Manufacturers' Union, is to be held from October 25rd to November 3rd next in the Grand Palais, Avenue des Champs Elysées. Disappointment is expressed over the decision of the authorities to exclude international exhibits, many French amateurs regarding the Salon as an excellent opportunity for studying the latest British designs. It is possible, writes our Paris correspondent, that an international show may be staged by an independent organisation.

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ABYSSINIAN WIRELESS AMBITIONS.

Tenders for a 20-25 kW. short-wave station, capable of maintaining permanent communication with Europe, were recently called for by the Abyssinian Government. In addition to this central wireless station, says *The Times*, tenders were asked for for the supply and erection of five stations for use in the interior of Abyssinia capable of transmitting and receiving up to a distance of about 500 miles. It is understood that the tenders are now closed, but the adjudication has not yet been announced.

At present Abyssinia has no public wireless station, but use is made of the station belonging to the Italian Legation at Addis Ababa, which broadcasts news messages.

WORDS OF WISDOM.

"What is static? It is the lower portion of the atmosphere which we call 'air,' and in which our broadcasting is done—a gas."—Daily Paper.

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FORD WIRELESS.

A Wireless Communication Company is the latest project of the Ford Motor Company, according to a message from Detroit. Its object will be to link up the Ford organisation at home and abroad.

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A SUPERHETERODYNE CLAIMANT.

A notable event in the French radio world is the recent development of Radio L-L into a company with a capital of 12,500,000 francs. M. Lucien Levy, the founder, constructed the first wireless transmitter on the Eiffel Tower. He also claims to have "launched" the superheterodyne in 1916.

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MAN-MADE STATIC.

"Beehive humming is power-line induction," says a new publication issued by the U.S. Bureau of Standards, telling the harassed listener how to overcome local interference. Other instructions are equally laconic. "Make sure noise is not in set," advises the writer, "and look for bell-ringer noises in rural telephone exchanges."

"First catch your hare" is good advice, but it doesn't cover the whole problem.

I.E.E. ANNUAL GENERAL MEETING.

The annual general meeting of the Institution of Electrical Engineers will be held at headquarters on Thursday, May 9th, at 6 p.m.

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A SET FOR THE DEAF?

M. Gabriel, who interests himself in the War deaf, is inviting French wireless manufacturers to construct a two-fold receiver, wires our Paris correspondent. By means of a switch the receiver could be instantly converted into a sonnd amplifier, and being portable, would be a boon to anyone afflicted with deafness.

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AWARD FOR PROFESSOR APPLETON.

Professor E. V. Appleton, Professor of Physics at King's College, has been awarded the Morris Liebmann Memorial Prize for 1929 by the American Institute of Radio Engineers for the most important contribution to wireless progress during the last 12 months. Prof. Appleton's experiments have furnished fresh data on the influence of the Heaviside Layer on wireless transmission.

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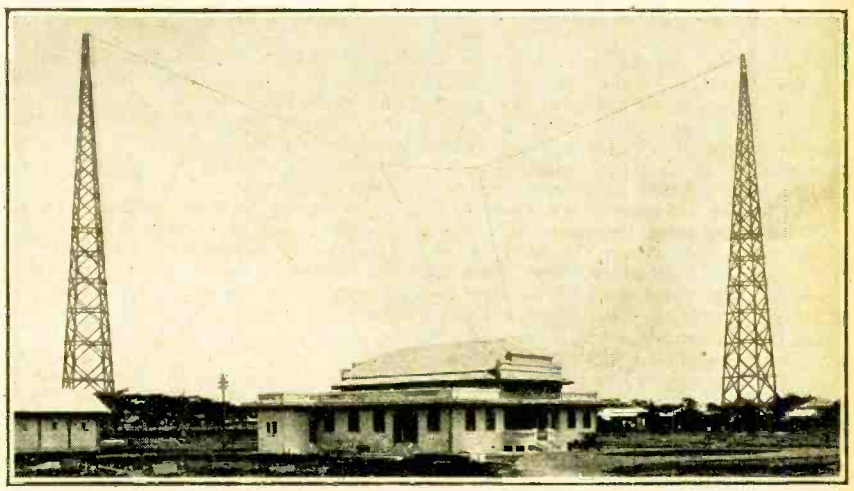
GERMAN OFFICIAL SHORT-WAVE TESTS.

The German official short-wave experimental transmitter, known to most amateurs under the call letters AFK (Doeberitz), also uses the call sign DOA. On most evenings the full announcement made reads as follows: *Achtung! Ach-*



SHORT WAVES FROM SIAM. The Telefunken station at Bangkok. A double aerial is employed to permit of transmission on 14 and 17 metres without alteration to the tuning.

tung! Hier ist der Kurzwellensender des Reichspostzentralamtes Telegraphen-technisches Reichsamt, Funkversuchsanlage Doeberitz. This is followed by the call letters. Various wavelengths are used, and the exact measurement is given at the end of the transmission. Broadcasts are mostly carried out on 40 and 87.45 metres, but on some days transmissions are made on 67.65, 71.45, 75.3, 77.2 and 82.9 metres. Times vary, but experiments are frequently effected from 6 to 8 p.m. B.S.T., and from 4 to 6 p.m. B.S.T.; on odd dates tests are also made from 8 a.m. to midday, mostly on Mondays and Fridays.

For the purposes of tests, news bulletins supplied by Wolffs Telegraph Agency are slowly read out, and during intervals—but not regularly—gramophone records are played.

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ALL ABOUT VALVES.

The first of a course of six lectures on "Thermionic Valves" will be given by Mr. W. H. Date, B.Sc., A.M.I.E.E., at the Polytechnic, Regent Street, London, W.1, on Wednesday next, May 8th, from 6.30 to 8.30 p.m.

The lectures, which will be given weekly (no lecture on May 22nd), will deal comprehensively with the subject, beginning with electronic emission and the two-electrode valve and concluding with a demonstration of transmission from the Polytechnic station, 6RA. The fee for the course is 7s. 6d. to students residing in London.

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WIRELESS ON TRANS-AMERICA AIR ROUTE.

Continuous wireless communication between aeroplanes and the ground has been achieved on the new Bœing Trans-America air route by the erection of a chain of 12 stations stretching from the Great Lakes to San Francisco. The transmitting and receiving equipment on each of the 35 aeroplanes has a range of 200 miles.

Plans are prepared for the initiation of a passenger telephone service which would link up each plane with any town in America. At present, however, the Department of Commerce forbids the transmission of any other than service messages.

Pilots on the route have made the interesting discovery that reception is better at 12,000ft. than at 100ft., owing to ground absorption.

FORTHCOMING EVENTS.

WEDNESDAY, MAY 1st.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "A Portable Radio Intensity-Measuring Apparatus for High Frequencies," by Dr. J. Hollingworth, M.A. and Mr. R. Naismith.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. General meeting and election of officer-bearers.

MONDAY, MAY 6th.

Croydon Wireless and Physical Society.—At 8 p.m. At 5, Altyre Road, East Croydon. Talk on "Piezo-electric Oscillators," by Mr. A. Gay (G6NF).

Bec Radio Society.—At 7.30 p.m. At Bec School, Beechcroft Road, S.W.17. Siemens Film: "Batteries and their Manufacture." (Non-members invited.)

MADRAS GOES AHEAD.

The City Fathers of Madras have opened a miniature broadcasting station, the equipment having been provided by the Madras Presidency Radio Club. To ensure the popularity of the programmes, the organisers are also installing loud speakers in all the parks and in about twenty municipal schools. This is a wise plan, and the enterprise of the Madras Fathers is being held up as an example to the other towns of India, where the citizens' apathy to broadcasting is simply due to the absence of the opportunity to hear it.

WIRELESS AT WESTMINSTER.

From Our Parliamentary Correspondent.

B.B.C. and Television.

In the House of Commons last week Mr. Day asked the Postmaster-General whether any agreement had now been arrived at between his Department and the B.B.C. by which facilities would be granted for the purpose of broadcasting by television.

Sir William Mitchell-Thomson said he had already announced his willingness to agree to a station of the British Broadcasting Corporation being utilised for television experiments outside broadcasting hours. The Corporation, however, could not provide the desired facilities for simultaneous transmission of speech and television until the completion of their new station at Brookman's Park, which was expected to be ready in July next.

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West Indies: No U.S. Broadcasting Monopoly.

In reply to a question put by Viscount Sandon, Mr. Ormsby-Gore said he was not aware that there was any reason to apprehend the establishment of an American broadcasting monopoly in the British West Indies and adjoining Colonies, but he would promise that any proposals which might be submitted for the establishment of a British service would be carefully considered. No such proposals had yet reached the Dominions Secretary.

Replying to further questions, Mr. Ormsby-Gore said it was a fact that in certain areas the reception of British news was impossible.

The question of broadcasting in the British Empire would come up both at the Imperial Conference and at the next Colonial Office Conference. The difficulties were technical much more than political.

WIRELESS IN EASTERN EUROPE.

"Novelties" at Vienna and Prague Fairs.

(From a Special Correspondent.)

THAT the crystal set still has a considerable vogue in the Near East was amply shown at the recent Vienna Fair, at which many of the humblest type of wireless receivers were on view. Some of these embodied novel designs which would have been interesting to British listeners a few years ago.

There were signs, however, of a distinct awakening to the possibilities of mains-operated receivers, and several types were demonstrated. The German Telefunken Company exhibited a three-valve instrument adaptable for use either with batteries or mains, a suitable transformer being supplied for mains connection. Provision was also made for a gramophone pick-up. Another interesting mains receiver—the Sigmaphone—was arranged for the addition, if desired, of a separate high-frequency amplifier. The makers are a Viennese firm — Radio Zentrale.

A big selection of portables was on view, ranging from a six-valve set by Telephonfabrik Berliner, weighing 25lb., and costing £22 in English currency, to the "Reize Baby," a little instrument costing £4 4s. without valves, and guaranteed to pick up anything within twenty-five miles.

Nothing of startling originality was in evidence, but the well-known A.E.G. Company, of Berlin, were up to date with the exhibition of several interesting gramophone-wireless combinations and electric pick-ups.

A Frank Admission.

Progress made by the Czechoslovakian radio industry was demonstrated at the Prague Spring Fair, many sets of surprisingly good quality and low price being seen.

One local firm made the frank admission that the three-valve set they were featuring had been designed for use with A.C. valves, but had not given satisfaction, so that ordinary valves were incorporated instead!

The Philips Company created a good deal of interest with their constructional kits, a prize being presented to the visitor who assembled a set on the spot in the shortest time.

Crystal-Gramophone Set.

Very few mains sets were in evidence, but a number of moving coil loud speakers were demonstrated.

Apparently a market for portable sets in Prague has yet to be created. Only three portables were shown in the whole Fair. Gramophone-wireless combinations were absent, the nearest approach being a novelty in the form of a gramophone incorporating a crystal receiver!

The Czechoslovakian broadcasting authorities have not yet arranged for the transmission of wireless pictures, but many visitors showed interest in a demonstration of Fultograph reception.

KIT CONSTRUCTORS' NOTES

The Formo Screened Grid Three.

THE set forming the subject of this article will not be new to many readers: it was introduced shortly before the Manchester Radio Exhibition, and was described at some length in our review of that show.

A preliminary examination of the descriptive broadsheet shows that special precautions have been taken to simplify the task of the beginner; probably the most important feature in this respect is the provision of a "Junit" wooden baseboard, on which is printed a practical wiring plan, with representations of the various components in their correct positions. It is sometimes suggested that these aids to construction are wrong, as they engender a false sense of security in the minds of those who have little or no theoretical knowledge, but mature consideration shows that this attitude is not altogether tenable. Anything that tends to remove sources of possible failure is surely to be commended, and the fact that these aids are available should not in any way prevent the constructor from studying the basic principles of his set and learning something of its technical details. That he all too often fails to do so is another matter, which will probably react to his own ultimate disadvantage; upkeep costs may be unduly high and results inferior to those attainable with more skilful handling.

A Popular Circuit Combination.

The circuit diagram of the Formo set is given in Fig. 1. In broad outline, it is the conventional combination of a screen-grid H.F. amplifying valve, coupled by means of a tuned anode device to a grid detector with capacity-controlled reaction. This is followed by a single transformer-coupled L.F. amplifier.

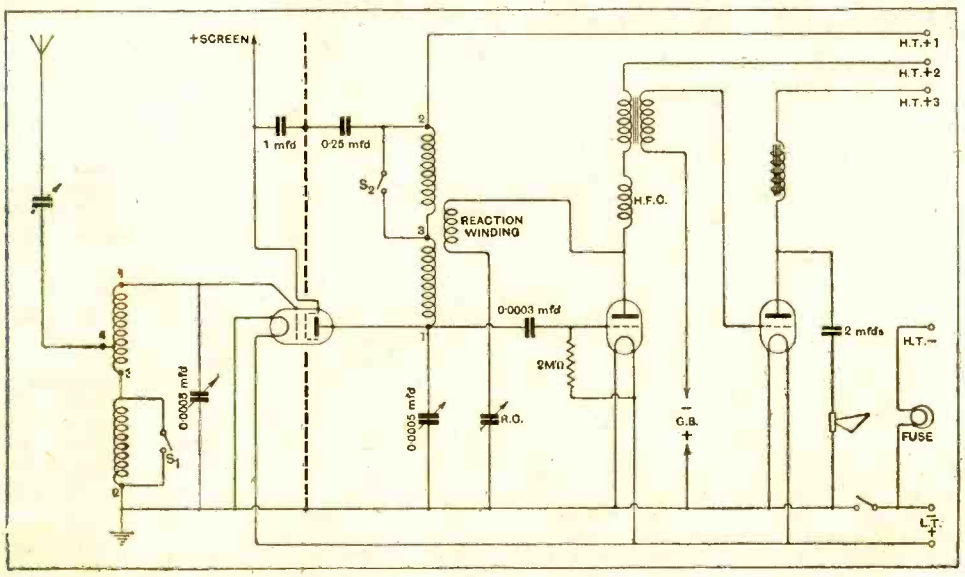


Fig. 1.—Complete circuit diagram. Numbering of the coil terminal points corresponds with the markings on the bases.

Coming to details, we see that, for medium wave reception, the aerial is coupled through an "aperiodic" auto-transformer arrangement, a semi-variable condenser being connected in series for adjustment of selectivity. Long and medium-wave coils are connected in series, the former being shunted by a short-circuiting switch which is closed for working on the normal band. On the long waves, aerial coupling is practically direct through the series condenser already mentioned.

Inductance in the anode circuit is changed in a similar manner, the long-wave section being short-

Kit Constructors' Notes.—

circuited when not required. It should be noted that the waveband switches S_1, S_2, though shown separately to avoid complicating the diagram, are actually combined in a single component.

The anode tuning condenser is not connected in the conventional manner: its stator is in metallic contact with the screen and common battery negative, the oscillatory circuit being completed through the 0.25 mfd. by-pass condenser—and partly through the H.T. battery, if it happens to have a low H.F. resistance. It should be remembered that a high-tension voltage exists across the tuning condenser, and care should be taken to avoid a short-circuit between its vanes, even though a protective fuse is fitted. This latter, by the way, is an addition to the original set.

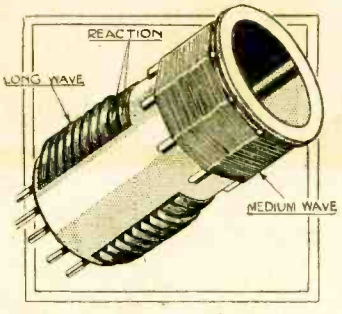


Fig. 2.—Construction of the anode coil assembly. The long-wave section is cut away to show pile windings.

Preventing Interstage Coupling.

Unusually complete screening is a feature of the set. Practically speaking, the grid circuit components are completely enclosed in a metallic box, as the vertical transverse screen fits fairly closely to the front panel and back of the container; indeed, in the case of the model tested, it made electrical contact at several points. This probably accounts for the fact that the H.F. amplification obtained is rather above the average; it was observed with interest that the complete stability which is normally attained is destroyed by removal of the back panel.

A consideration of the accompanying photograph might convey the impression that wiring is a matter of some difficulty, particularly as the "grid" section of the S.G. valve is enclosed in a metal box forming part of the screen. Actually, this is not so, as matters are so arranged that this screen may be fitted after the leads have been placed in position. Almost without exception, terminals are readily accessible and soldering is unnecessary at any point.

An output choke filter is a refinement not usually included in "kit" sets; the component parts of this device are built up as a single unit together with the L.F. intervalve transformer.

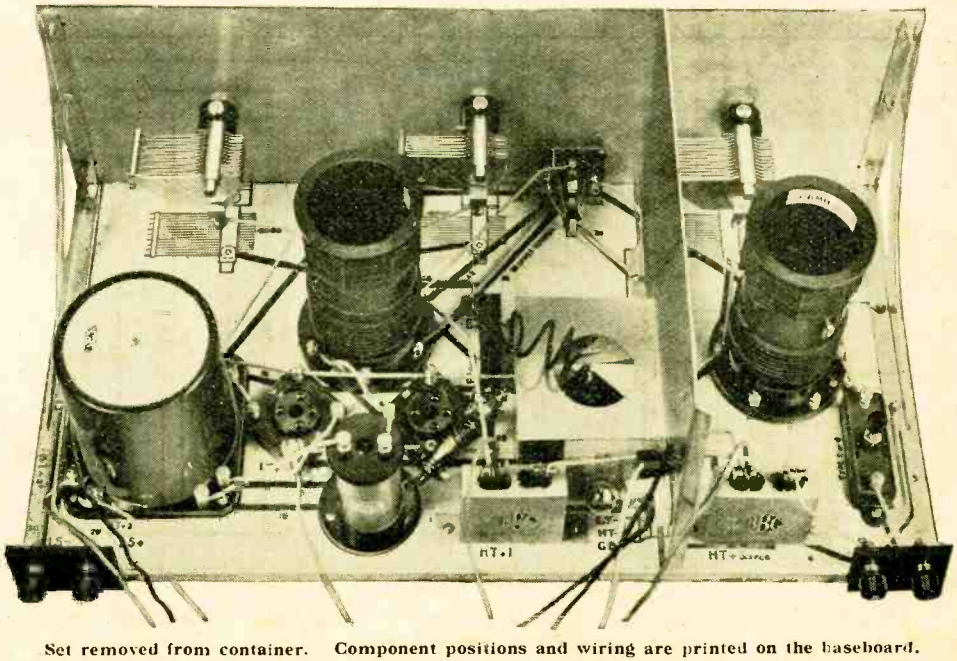
Sensitivity has already been mentioned in connection with the H.F. stage; in the matter of selectivity, performance is up to the average standard of this class of set, and is sufficient for all but the most exacting requirements, but in the immediate vicinity of a powerful transmitter there is a good deal of "spreading"; this is inevitable with no more than two tuned circuits of average resistance. Matters in this respect can be regulated to a certain extent by adjustment of the series aerial condenser; its setting, for best performances, is fairly critical when receiving long-wave stations.

It is rather a difficult matter to arrange for a single reaction winding to be uniformly effective on both wavebands; on test, a certain amount of "backlash" was observed, and it was found necessary to increase detector anode voltage rather beyond the usual maximum in order to get full regeneration at the upper end of the tuning scale. However, it is not a difficult matter to hit upon a satisfactory compromise, and in any case functioning of this control will be influenced by the actual characteristics of the detector valve.

Safe Filament Wiring.

In the makers' published instructions, specific reference is made to the fact that a pentode may replace the normal output valve, and the method of using it is detailed at length. This modification is to be recommended when maximum possible range is desired.

Finally, we must revert to Fig. 1 and point out that this diagram is drawn in the conventional manner for the sake of simplicity: actually, L.T. negative is joined directly, and H.T. negative *via* a flashlamp fuse, to the screen, the on-off switch being inserted in the lead between common negative filament bus-bar and panel, which is electrically part of the screen.



Set removed from container. Component positions and wiring are printed on the baseboard.

SOME INTERESTING FRENCH VALVES

Unorthodox Circuits for Multi-Grid Valves.

BESIDES most of the types available in Great Britain (other than valves for A.C., which are very badly represented) there are a considerable number of special valves on sale in France, which are of interest as departing more or less radically from the standard triode.

The most important of these is undoubtedly the "bigrille," with its two grids, the inner being usable as an "anti-space-charge" grid, but being in point of fact very rarely so used. Such valves are manufactured by practically all the leading firms (Radio-Technique, Philips, Fotos, Metal, etc.), and their use as the frequency changer in superheterodynes, strobodynes, and the like is absolutely standard practice; it is difficult to find a French super *not* using a double-grid valve—unless it uses a triple-grid!

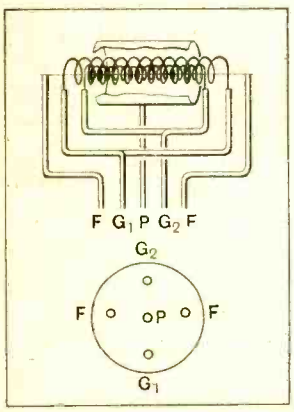


Fig. 1.—A double-grid valve and base. A straight filament is used around which there are two spiral grids and a cylindrical plate.

The arrangement of these valves (Fig. 1 and photograph) is very simple; a straight filament being surrounded by two spiral grids, with a cylindrical plate enclosing these. As a rule, the special five-pin base is used, although most of these valves are also available to fit the four-pin (triode) socket, the inner grid being connected to an extra terminal on the base of the valve. Little difference exists in general between the products of the different makers: all are, of course, four-volt valves. The price varies from 7s. to 8s. each.

The standard circuit is that of Fig. 2, where the outer grid is connected to the tuning circuit and the inner grid to the heterodyne; variations from this circuit, other than the simple inversion of the functions of the two grids, are comparatively rare and present little interest.

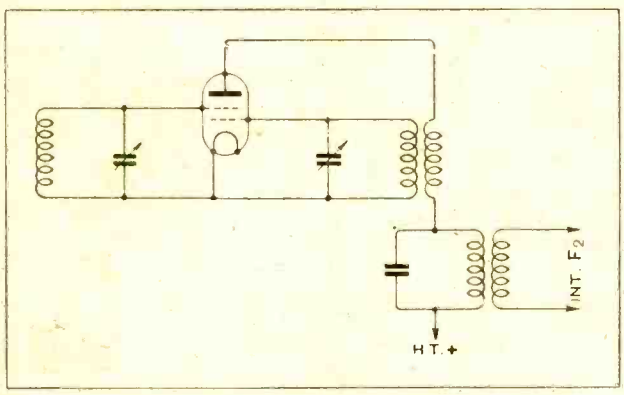


Fig. 2.—Standard frequency-changing circuit for double-grid valve.

As already mentioned, this valve is suitable for use in "space-charge" circuits, allowing of low plate voltages, but such circuits are rarely seen in France, and in any case are well known.

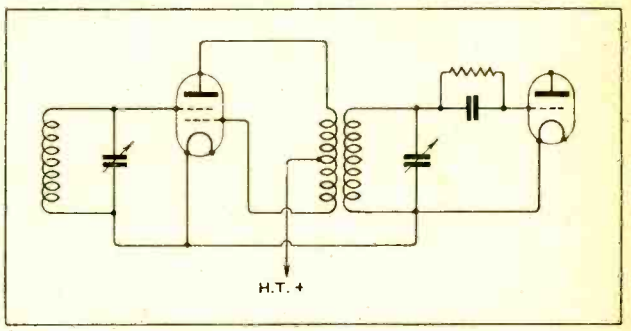


Fig. 3.—"Isodyne" circuit for high-frequency amplification.

There is, however, one circuit (other than that of Fig. 2) which is not infrequently used with these valves, the so-called "Isodyne" (Fig. 3), which is virtually a push-pull arrangement in high-frequency amplification, the plate and inner grid being connected to opposite ends of the primary. It may be noted that here the positive potential applied to this grid causes it to neutralise the space-charge to a certain extent, so that lower plate voltages than the normal can be applied. Similar arrangements have been used for low-frequency amplification, without great success; but the "Isodyne" for high-frequency has proved sufficiently practical to be embodied in at least one commercially produced set. It is obvious that a great number of reflex circuits are possible with these valves, but none have proved popular.

The electrode arrangement in the double-grid valve.

A valve of considerable interest is the "mixed grid" (Fig. 4),

Some Interesting French Valves.—

where the parts are of the same general form as in Fig. 2, but the two grids are of the same diameter and interwound to form, as it were, a double spiral, so that

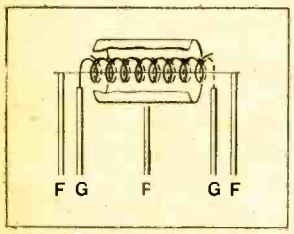


Fig. 4.—Showing the electrode disposition in a "mixed-grid" valve.

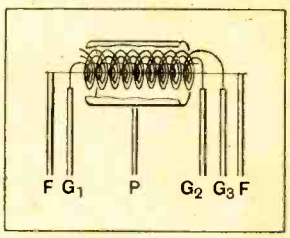


Fig. 5. — The electrode arrangement in a triple-grid valve.

there is no "inner" or "outer" grid. This valve is unsuitable for "space-charge" circuits, but works excellently where the grids are independent, as in the case of Fig. 2. It is also suited to various reflex and super-reaction circuits, but none of these have enjoyed more than a very brief popularity. This valve is also produced to fit the five-pin socket, or the triode socket with an extra terminal on the base; it sells at about 7s. 6d.

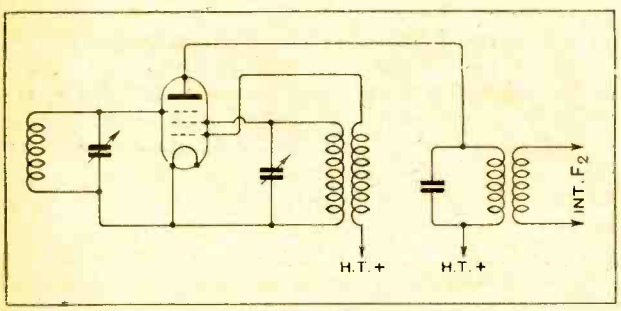


Fig. 6.—Triple-grid valve as frequency-changer.

An obvious extension of the double-grid valve is the "trigrille" (Fig. 5). This type of valve, which is produced by several makers, lends itself for use in some very interesting circuits, chiefly again as the frequency-changer of superheterodynes and the like. For example, the standard circuit of Fig. 2 can be used, but with the heterodyne connected to the *central* grid, and with the inner grid polarised positively ("space-charge grid"); but perhaps the most satisfactory use of this grid is that

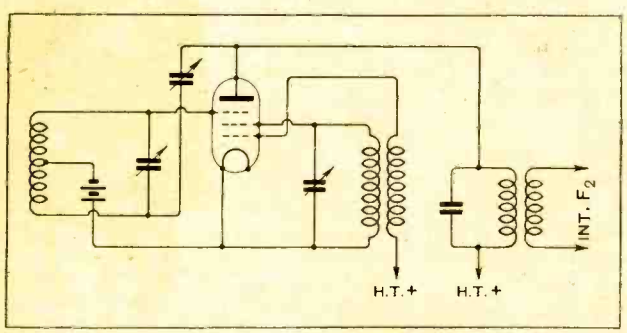


Fig. 7.—A frequency-changing circuit with reaction using triple-grid valve.

shown in Fig. 6, where it takes over the reaction effect from the plate, thus definitely separating this action from the feed to the intermediate frequency amplifier. (It should be noted that this inner grid is still polarised positively in this arrangement, so that the "space-charge" action still exists.) An extension of this circuit is given in Fig. 7, one of the few arrangements in which reaction can be used with a superheterodyne.

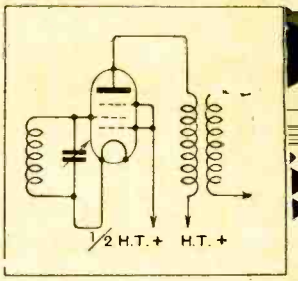


Fig. 8.—A triple-grid valve with five contacts.

These valves are supplied to fit the standard triode (four-pin) socket, the two inner grids being connected to the two extra terminals on the base of the valve; they are also made to fit the five-pin socket, with one extra terminal on the base, and for a special six-pin socket. These also sell at about 7s. 6d.

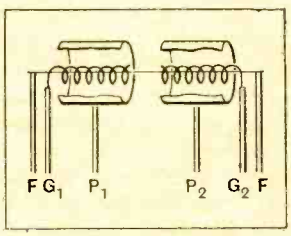


Fig. 9.—A two-plate, two-grid valve type one.

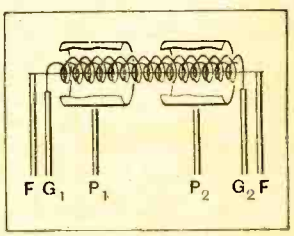


Fig. 10.—A two-plate, two-grid valve, type two.

Another type of three-grid valve is also produced, where the inner and outer grids both act as "space-charge" grids, the latter at the same time acting to a certain extent as a screen (Fig. 8). In this valve the central grid is the normal "control" grid; it will be noted that the two others are connected together (and to about half the plate voltage). As a result, only five external contacts are employed, and either the standard "bi-grille" socket can be used, or a triode socket with an extra terminal on the base of the valve, this being connected to the two "extra" grids. These valves are produced both for high- and for low-frequency amplification, at about 8s. and 10s. respectively.

No mention has been made of the screen-grid valves for high and low frequency, as these are not special to France. Their use here is extending, but very slowly indeed.

For circuits of the "back-to-back" type (symmetrical high-frequency amplification, "Eccles-Vallauri-Mesny" circuit) there is a very suitable valve made, embodying one filament, two grids,

A typical two-grid, two-plate valve.

Some Interesting French Valves.—

and two plates (Fig. 9). This practically corresponds to two triodes with a common filament, and its uses will be obvious.

There is, however, another "two-grid, two-plate" valve, which is in some respects more interesting (see Fig. 10 and photograph). Here not only the filament but also the two grids are common to the two systems. In one type of this valve the two plates are of the same diameter; in another type one is larger than the other

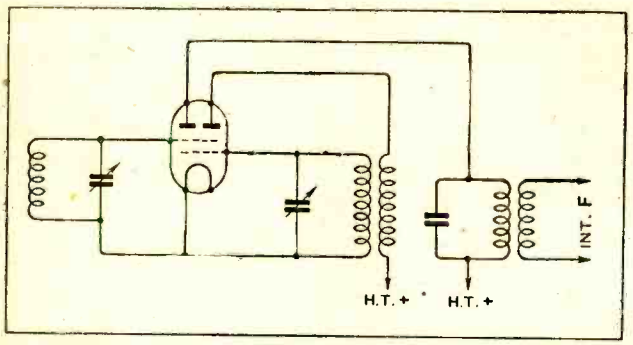


Fig. 11.—Using the two-plate, two-grid valve as a frequency-changer.

—this type was chosen for the photograph, merely because it shows the construction more clearly, the former type being the more usual. In the case of this valve the five-pin base is standard, the extra terminal on the base corresponding to the inner grid.

Here, yet again, the standard application is as a frequency-changer, allowing the reaction to the heterodyne circuit to be separated from the intermediate-frequency feed (Fig. 11). It has also been used in a super-reaction circuit (Fig. 12) with such success as to have become a commercial proposition; "X" is here a trap circuit tuned to the "howl" frequency.

Finally, a miniature valve may be mentioned, the so-called "plateless" valve, of dimensions similar to those of the Western Electric "peanut," but fitting the

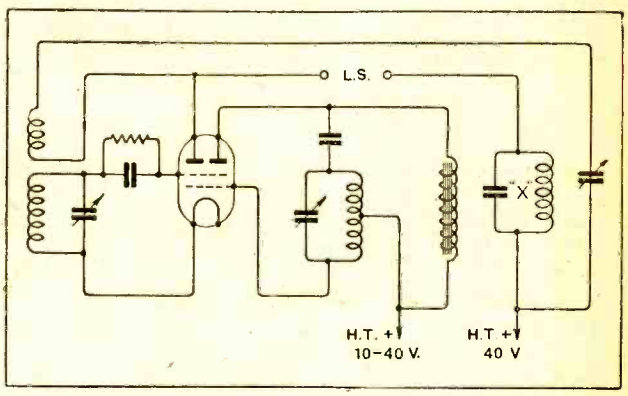


Fig. 12.—A super-reaction circuit with two-plate, two-grid valve. The tuned circuit X is a trap circuit tuned to the "howl" frequency.

standard socket. In this valve the anode is formed by the metallic deposit on the walls of the valve. Its chief characteristic is an almost complete absence of microphonic effect.

It may be of interest to English readers to add that one firm has adopted an elaborate but very explicit system of valve designation, consisting of the letter A or B and a number. The letter indicates the filament consumption (A less than one-tenth amps. and B from one- to two-tenths); and the number gives the factor of amplification and the mutual conductance—thus A 1404 indicates a μ of 14 and a conductance of 0.4 mA/V.

R. R.-H.

CLUB NEWS.

They Simply Fade Away.

"Reminiscences of Sets of the Past" was the title of an informal talk given by Mr. Remington at the last meeting of the South Croydon and District Radio Society. Many sets, famous in their day, were recalled, special interest being aroused by the one-valve reflex set, which, it was contended, could still hold its own. The lecturer's description of past methods of L.F. amplification aroused amusement tempered with sadness.

Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

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Simplicity in Modern Sets.

An example of what might be termed the modern "straight" set, viz., a three-valver embodying screened-grid H.F., detector, and transformer-coupled L.F., was demonstrated by Mr. W. Gartland at the last meeting of the North Middlesex Radio Society. The lecturer remarked that the introduction of the screened-grid valve had brought distant reception to the doorstep of the comparatively non-technical listener. The receiver under review was of the simplest construction, yet numerous foreign stations were tuned in at good strength.

At the annual general meeting of the society it was shown that the past year had been a highly successful one, the excellent field work carried out being a notable feature. Mr. F. T. Chapple was elected President.

Hon. Secretary, Mr. E. H. Laister, "Endcliffe," Station Road, N.21.

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Battery Construction Filmed.

The industrial film, "Batteries and Their Manufacture," recently referred to in *The Wireless World*, will be exhibited by Messrs. Siemens Brothers before the Bec Radio Society on Tuesday, May 7th. During the display a representative of the company will give a running commentary, and discussion will be invited.

Hon. Secretary, Mr. A. L. Odell, 171, Tranmere Road, S.W.18.

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A Musical Evening.

The headquarters of the Queen's Park Radio Society echoed with the peal of the organ, the beat of the drums and the strains of flute and violin on April 3rd, when a representative of Messrs. Celestion, Ltd., demonstrated Celestion loud speakers in conjunction with a Woodruffe pick-up. The depth and purity of tone made an impression on all who were fortunate enough to be present.

Hon. Secretary, Mr. H. F. C. Murfett, 12, St. John's Road, Wembley.

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Vacancies at Croydon.

Before the Croydon Wireless and Physical Society on April 22nd Mr. A. Baker lectured on "Latest Developments in Moving Coil Loud Speakers."

Visitors are heartily welcomed to any of the society's meetings, and full particulars may be obtained from the Hon. Secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

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A Vigorous Programme.

The arrival of summer time has not diminished the enthusiasm of Slade Radio, Birmingham. Regular meetings are scheduled until the end of May, the topics for discussion including Radio Drama, short waves (demonstration), and constructional problems. Visitors are always welcomed at the society's meetings, which are held at the Parochial Hall, Broomfield Road, Erdington.

Hon. Secretary, Mr. H. Clews, 52, St. Thomas Road, Erdington, Birmingham.

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High Frequency Work in Therapeutics.

Mr. G. G. Blake, M.I.E.E., recently repeated before the Golders Green and Hendon Radio Society his excellent lecture on the "Application of Electricity to Medical Practice," delivered before the Royal Society of Arts. Mr. Blake dealt with the gradual development of modern electro-therapeutics, discussing his investigations on high frequency spark discharge. These were illustrated by various experiments and photographs. One of the most interesting experiments shown was the simultaneous emission of Hertzian waves, radiant heat, infra red rays, visible light and ultra-violet rays from the one source, proving that all these phenomena are in reality waves differing only in frequency.

Hon. Secretary, Lt.-Col. H. A. Scarlett, CO, Pattison Road, N.W.2.

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Practical Television.

The Television Society will hold a "practical evening" on Tuesday, May 7th, at 7 p.m., at the Engineers' Club, Coventry Street, London, W.1. An informal discussion will be followed at 8 p.m. by a lecture (with demonstration) by Captain R. Wilson and Mr. A. A. Waters, entitled "Some Practical Considerations in the Building of Television Apparatus." Non-members wishing to attend are invited to apply for tickets to the Lectures Secretary, Mr. W. G. W. Mitchell, B.Sc., 95, Belgrave Road, Westminster, London, S.W.1.

BROADCAST · BREVITIES ·

By Our Special Correspondent.

London Regional's Debut.—Signal Strength: Fancy and Fact.—Sir Henry Wood and Savoy Hill.—International Messages.

The Canny Corporation.

Six years' experience of listener psychology has led the B.B.C. to a wise decision regarding the opening of the first regional station at Brookman's Park. I understand that the station will gradually insinuate itself into the regular programmes, beginning, perhaps, with the transmission of the late dance music during the first week, adding a talk or two in the second week, and so on, until the Oxford Street transmitter is entirely relieved of its responsibilities.

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Imaginative Reception.

At Savoy Hill they know only too well that if the exact time of a technical change is announced beforehand, the public imagination gets to work from the moment that the change takes effect. Differences in signal strength are usually magnified out of all proportion to variations which would be revealed by a field strength recording instrument, and this is especially observable when signals are weaker than before.

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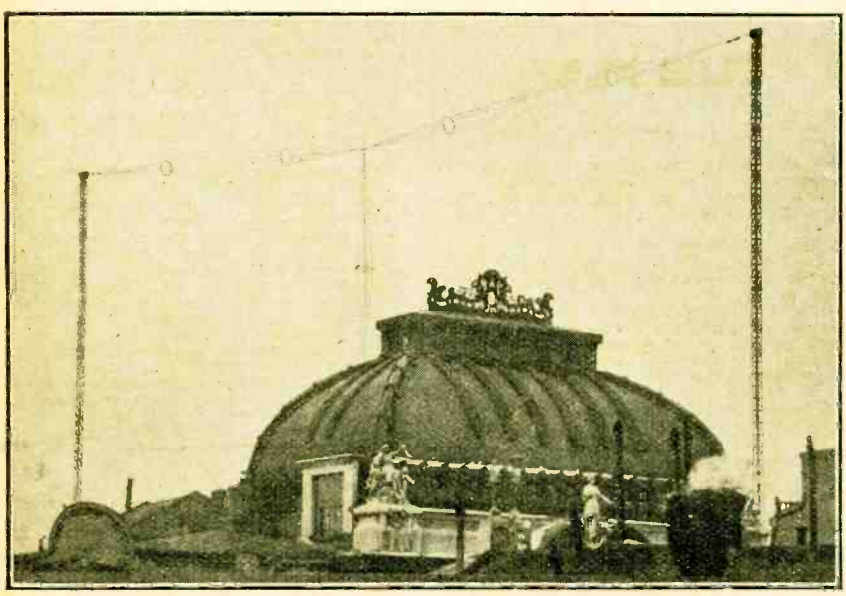
More Pamphlets.

Even with the change unannounced, the technical correspondence department at Savoy Hill expects a fairly bulky letter bag, as reception is bound to vary considerably in areas near the present 2LO, particularly in the case of crystal users. To prepare for the onslaught the B.B.C. is compiling two pamphlets, one giving hints to crystal users residing within a four-mile radius of Oxford Street, and the other for the benefit of the world at large, dealing with the ever-growing problem of selectivity.



EUROPE'S YOUNGEST BROADCASTING STATION. The aerial system of the new station at Belgrade, Yugo Slavia, erected on the roof of the Royal Academy. The inaugural programme was broadcast on March 7th last. Belgrade is temporarily using a wavelength of 225.6 metres.

A Spurt at Brookman's Park.

Meanwhile the work at Brookman's Park has gone forward with a spurt during the last few weeks, the contractors having to make up time lost during the frost of February. The four 300 h.p. Diesel engines with their D.C. dynamos are now installed, and the finishing touches are being given to the big storage battery. The H.T. machines, which can each give 160 kW. at 10,000 volts D.C., are now under test; they will probably be delivered in the next week or two at the same time as the two transmitters.

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Those Twin Transmitters.

And what of the transmitters? Are they both destined to entertain us with telephony? According to Captain Eckersley's original plans, the answer is in the affirmative, but at the time those plans were made no crystal gazer came forward with a description of that round table conference at Savoy Hill a few days ago when the future of television was discussed.

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Is the "Prom" Season Too Long?

The B.B.C. announcement that this year's Promenade Concerts will run for eight weeks—from August 10th to October 5th—will remind stalwarts of the old brigade of the happy days when the "Proms" flourished for no fewer than ten weeks each year.

Eight weeks is a more reasonable period, and there will be many listeners, not lacking in appreciation, who would rather that Sir Henry Wood and his orchestra compressed their heroic efforts into a still shorter space of time. To preserve freshness and *gaiété de cœur* in an orchestra making nightly appearances for eight solid weeks in succession is asking a good deal of human endurance.

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Sir Henry Wood and the B.B.C.

Apropos the "Proms," some interesting questions are being asked as to whether the 1929 series is likely to be the last under the baton of Sir Henry Wood, or, alternatively, under the régime of the B.B.C.

When Sir Henry signed his agreement with the B.B.C. in 1927 it was understood to be for a term of three years.

An important question arising out of the above is this: Would they be "Proms" without Sir Henry Wood?

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Gratitude from France.

French listeners are vocal in their gratitude to the 5XX announcer who, during the recent relay of the British and French Army Rugby match at Twickenham, interpolated a sufficient number of French phrases to give enthusiasts in France an idea of the game's progress.

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An Idea for Development.

The policy of including announcements in foreign tongues might be developed by all the stations of Europe without involving any sacrifice on the part of their respective nationals.

The warm-hearted listener probably thrills with benevolence when his local station addresses multitudes overseas, especially when he recalls the strange sense of gratification which he has himself felt on hearing a foreign announcer speak English.

oooo

International Messages.

Most, if not all, of the British stations are audible on the Continent, so, in view of the B.B.C.'s avowed admiration for the idea that nation should speak peace unto nation, would it not be an act of grace to inaugurate a series of brief messages to foreign listeners? What more appropriate time for such a gesture than Whitsun, which commemorates a day on which men from different lands heard the same message each in his own tongue?

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The Obstacle.

Our neighbours would quickly reply. Before long we should find ourselves switching on for the weekly "Paris Greeting," or the "Berlin Handshake," or the "Buda Pesth Fraternisation." The compilation of international greetings would call for some discretion ("no politics, no pack drill," would be a useful motto). But if the job were carried out with common sense, ambassadors and diplomats would be unnecessary. Herein, unfortunately, lies a possible obstacle to the scheme.

oooo

Organ Recitals from Coventry Cathedral.

On Thursday, May 16th, 5GB starts a series of weekly organ recitals relayed from St. Michael's Church, Coventry, now known as Coventry Cathedral, given by Dr. Harold Rhodes, the organist. Dr. Rhodes was at one time assistant to Sir Walter Parratt at St. George's Chapel, Windsor.

oooo

Prince George at the Microphone.

Prince George's speech, replying to the toast of the Royal Family at the Royal Academy dinner on May 4th, will be relayed to 5GB. Listeners to Daventry Experimental are also to hear the President of the Royal Academy, Sir William Llewellyn, Lord Plumer, Lord Salisbury, and Right Hon. J. H. Whitley.

oooo

The Politician in the Studio.

The speaker who does not know when to sit down is familiar to all who attend public gatherings. The political broadcasts are revealing another form of the malady in which the speaker refuses to sit down before the microphone. I hear that a prominent politician had recently to be entreated to adopt a sitting posture after he had protested vehemently that such an attitude would cramp his style. Some of these Parliamentarians have yet to discover that the "platform manner" in the studio is merely comic.

oooo

The Ideal Announcer.

What is the status of the announcer? In this country, at all events, there is still some doubt as to whether he should rank as an artist or merely as a sort of talking shopwalker. In America opinion is undivided, the announcer being regarded as the potential saviour of the nation's good diction. To find the best men for this onerous task, the American Academy of Arts and Letters recently inaugurated a competition, and for the last few weeks more than two hundred announcers throughout the United States have been "saying their mouthfuls" with all the clarity at their command.

The test having concluded in the last week of March, one committee and two sub-committees are now sorting out the good and bad marks. The winner will receive a medal.

oooo

Sunday Morning Broadcast.

On Sunday morning next, May 5th, when a military service from York Minster will be relayed by 2LO, 5XX, and other stations, music will be provided by the bands of the 5th Inniskilling Dragoons, the 1st Northumberland Fusiliers, and the 1st Green Howards. The Archbishop of York will give the address.

In the evening 2LO and other stations will relay a Catholic service from the Church of Our Lady of Victories, Kensington.

oooo

Ireland's "Big Ben."

To give the programmes of Belfast "a local habitation and a name," it has been decided to supplement Big Ben with the chimes of the clock on the Assembly Buildings, Belfast. The clock has a carillon of eleven bells, which play a well-known tune, secular or religious, after the hours of twelve, three, and six.

oooo

Nearly 2¾ Million.

On March 31st the total number of receiving licences in force amounted to 2,728,968, showing an increase of nearly 30,000 during the month.

oooo

Smellivision.

Something that makes small beer of television is reported from Angoulême, France. For in Angoulême you will find a listener who picks up the smell of wax candles from Nôtre Dame. Ha, you doubt it? Then be it added that there are nasal witnesses.

The event is chronicled by the listener himself in the Paris journal, *Radio Magazine*. While he was enjoying the music resounding through "the long drawn aisle and fretted vault," an unmistakable odour assailed his nostrils. He was on the point of doubting the evidence of his own nose, when his little girl came down the stairs exclaiming: "Where is that odour of candles coming from?"

"Plusieurs personnes que je suis allée chercher ont constaté cette odeur speciale," he writes. "Je serais désireuse de savoir si pareil fait peut être possible?"

This is undoubtedly a question for Dr. McLachlan. Has a smell transients?

oooo

Programmes First, Please.

It is being said of the engineers who are leaving the B.B.C. staff that they can read the signs of the future. Interpreted, this means that they can see no future for independent research work under the wing of a concern whose legitimate function is the dissemination of broadcast programmes.

FUTURE FEATURES.

London and Daventry.

MAY 6TH.—"The Prisoner of Zenda," by Anthony Hope.
MAY 7TH.—De Courville's Hour—6, "Gay Sparks."
MAY 8TH.—Covent Garden Opera.
MAY 11TH.—"The Island Princess," a musical comedy; book and lyrics by Guy K. Austin; music by Hubert W. David.

Daventry Experimental (5GB).

MAY 7TH.—A Programme of Music of the Sea.
MAY 9TH.—B.B.C. Popular Orchestral Concert from the People's Palace.
MAY 10TH.—"Moonshine," a new radio show by Charles Brewer; sketches by Edwin Lewis.

Cardiff.

MAY 7TH.—A Celtic Programme.
MAY 8TH.—"The Knights of St. John," a programme in honour of the Priory of Wales, by Froom Tyler.

Manchester.

MAY 9TH.—A Concert by the Band and Pipers of the Queen's Own Cameron Highlanders.
MAY 11TH.—"I Tell'd Yer So," a comedy by Claudia L. Wood.

Newcastle.

MAY 8TH.—North of England Musical Tournament.
MAY 11TH.—North of England Musical Tournament.

Glasgow.

MAY 8TH.—A Scottish Concert.
MAY 9TH.—"Sea Ways," a programme arranged by Gordon Gildard.

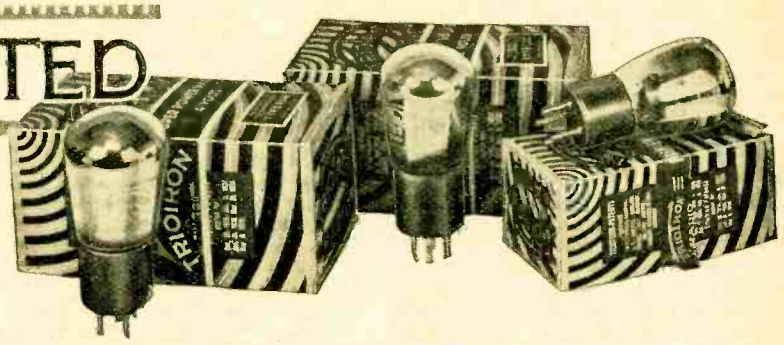
Aberdeen.

MAY 6TH.—A Scottish Concert.

Belfast.

MAY 6TH.—"Round the Samovar," a little Russian programme.
MAY 10TH.—A Programme of Scottish Music.
MAY 11TH.—An Irish Programme.

VALVES TESTED

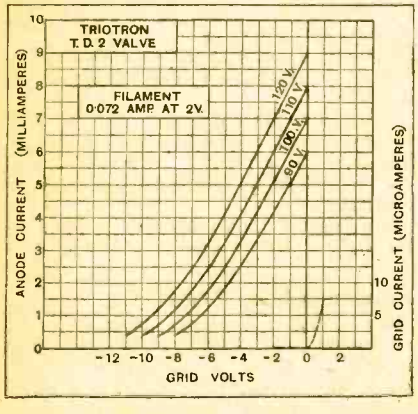


The Triotron Series.

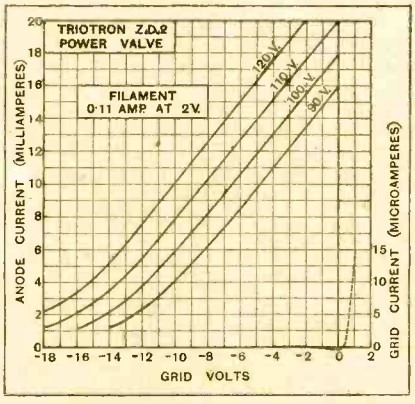
TRIOTRON valves are made in Austria and are supplied by the Electric Lamp Service Co., Ltd., 39-41, Parker Street, Kingsway, London, W.C.2. They are made in 2- and 4-volt types only, the prices having been fixed at 6/- for the H.F. detector and R.C.C. types, and at 7/6 for the low frequency amplifiers and super-power valves. The valves submitted for test were a T.D.2, a 2-volt H.F. and detector type valve; a Z.D.2, the low-frequency amplifier and small power valve in the 2-volt class; and an X.D.4, which is the super-power valve in the 4-volt series.

T.D.2.

The rated characteristics of this valve are as follows:—A.C. resistance 11,400 ohms, amplification factor 8.5, and mutual conductance 0.75 mA. per volt. It is essentially a general purpose valve and will function satisfactorily as either an H.F. amplifier, detector or first stage L.F. amplifier. The maximum anode potential is 120 volts, and for amplification purposes a grid bias of −6 volts will be required under these conditions. The specimen tested exhibited slightly better characteristics than the maker's rating. Measured at 100 volts H.T. and zero grid bias, the A.C. resistance was found to be 10,000 ohms, the amplification factor 10, and the mutual conductance 1.0 mA. per volt.



Average values under working conditions:—A.C. resistance, 11,700 ohms; amplification factor, 11; mutual conductance, 0.94 mA/volt.



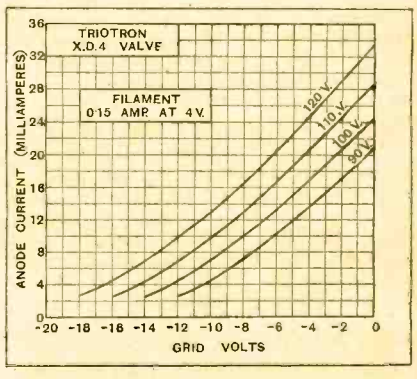
Average values under working conditions:—A.C. resistance, 4,760 ohms; amplification factor, 5.5; mutual conductance, 1.15 mA/volt.

The average constants under amplifying conditions showed only a very slight change, these being:—A.C. resistance 11,700 ohms, amplification factor 11, and mutual conductance 0.94 mA. per volt. There was not the slightest trace of reversed grid current showing that the sample tested was dead hard. Grid current starts at zero grid volts.

Z.D.2.

The maker's classify this valve as a low-frequency power valve and give its characteristics as being:—A.C. resistance 6,250 ohms, amplification factor 5, and mutual conductance 0.8 mA. per volt. Its operating conditions are:—120 volts anode potential, and $-10\frac{1}{2}$ volts grid bias. The average characteristics measured under these conditions were:—A.C. resistance 4,760 ohms, amplification factor 5.5, and mutual conductance 1.15 mA. per volt. The better mutual conductance shown by the specimen tested may be due to slight changes made since the literature accompanying the valves was printed, since a covering note explained that a slight improvement in the mutual conductance may be expected in the latest products of the factory.

The average anode current under operating conditions with 120 volts H.T. will be of the order of $9\frac{1}{2}$ mA. Grid current started in the specimen tested at +0.3 grid volts. There was a very slight trace of reversed grid current which at zero grid volts attained a value of 0.2 microampere. This cleared at −2 volts grid bias, and the valve under operating conditions with optimum grid bias was perfectly satisfactory. Apparently the specimen tested was not pumped sufficiently before the magnesium was flashed, as the surface of the "getter"



Average values under working conditions:—A.C. resistance, 2,900 ohms; amplification factor, 4.7; mutual conductance, 1.65 mA/volt.

alves Tested.

owed very slight traces of tarnish.

X.D.4.

This is the super-power valve of ie 4-volt class; the filament cur-ent, however, is 0.15 ampere only. he maximum H.T. is stated to be 40 volts. The specimen tested was ot given more than 120 volts—a value generally used and most popular—and with an anode potential of this order the average constants were found to be:—A.C. resistance 2,900 ohms, amplification factor 4.75, and mutual conductance 1.65 mA. per volt. The makers' rating for this valve is:—A.C. resistance 2,200 ohms, amplification factor 6, and mutual conductance 2.75 mA. per volt. A negative bias of $-10\frac{1}{2}$ volts will be required with 120 H.T. and the average anode current will be approximately 12 mA. A choke-capacity output circuit would be advisable in spite of the comparatively low value of the anode current. There was no trace of reversed grid current in this specimen, the valve being dead hard.

LETTERS TO THE EDITOR.

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.

'ILLEGAL" LISTENING.

Sir,—I should like to add a few remarks to your editorial of April 17th, reviewing the matter from another angle. I, like many others, I have no doubt, get a lot of pleasure in listening to Morse transmissions (I started wireless when there was nothing else to listen to), and often listen on 600 metres to shipping.

While listening at 1555 GMF on April 17th, I picked up an SOS broadcast by SYDS: "Position eight miles east of *Royal Sovereign Lightship;* in collision with other vessel; send tugboat."

The first SOS call consisting of "SOS de SYD" was not answered, and was apparently only heard by me.

Following this until 1605, I then 'phoned the Rye Harbour Coast Guard Station and gave them the message at 1610.

They thanked me very much for the information, which they passed on to the stations concerned.

The above, although in this particular case was of no great importance, but under other circumstances might prove the means of saving life, as when the Rye Harbour Lifeboat recently went out to the rescue of a shipwrecked crew, who had already been picked up by another vessel, owing to the late arrival of telephone message. The crew were all drowned.

Had someone been listening on 600m. at the time, they would have been in possession of the message to the effect that the crew were safe, approximately half an hour before the lifeboat put out.

In a similar case, are we then to keep silent on such matters, or should we pass on the message to the proper quarters and risk incurring the wrath of the Postmaster-General?

Rye, Sussex. W. E. P.

THE "SCRAPPY PROGRAMME" POLICY.

Sir,—I have read with interest your Editorial in *The Wireless World* for April 3rd, and also the letters of correspondents (particularly that of L. Phillips) contained in the same and other issues. I should like to take this opportunity of supporting the "down with snippet items" cry, and joining in the advocacy of one real programme per night.

The B.B.C. should cater for all tastes by setting aside a whole night for each class of listener, and not by trying to please all sections of the community in the space of ten hours. Criticism is useless unless concrete suggestions are put forward, and, therefore, I enclose herewith a plan for the better timing of programmes from main and alternative transmitters. The scheme is based on the following:—

"Once-nightly" programmes of practically three hours' duration are desirable now that listeners definitely devote evenings to "listening-in." Concert and theatre experience proves that 7.30 to 10.30 p.m. is the best time for the whole country for this period. The requirements of others can be met by different timing of the alternative programme.

The maintained circulation of the evening papers throughout the country proves that the early evening news is still learnt by this way by the majority (usually read on the way home by bus, tube, or tram) and so the B.B.C. cannot yet have proved any demand for *two* news bulletins from *all* stations. The necessity of supplying news to those outside the radius of evening newspapers can be met by retaining the news bulletin from 5XX only, but it might also be transmitted from 5GB under the alternative scheme.

In place of the news bulletin a "tea-time" type of light music is suggested as suitable for meal-hour listening, this to be of reasonable length instead of being of the snippet nature. This period could contain the gramophone record broadcasts when desirable. The talks would then follow, running concurrently so that those not interested could switch off definitely until the beginning of the main programme without feeling that a musical interlude was being missed.

The main programme should be definite in character (i.e., one night for one class of listener), and would be followed by the Weather and *Main* News Bulletin, late news being the chief items, and earlier news not too detailed; dance music would then follow, except, say, once a week, when about a three-quarter-hour variety would be given. The needs of those who like a late programme could be met by the alternative station giving a special programme after its earlier news bulletin.

5XX, Glasgow, Aberdeen Newcastle (P) Plymouth.	"Local" Stations.	5GB (Alternative Programme).
6.15 News and Weather. 6.30 "Local" Programme S.B. 7.0 to 7.45 Evening Talks. 7.45 to 10.30 Main Evening Programme. Not necessarily the same from all stations, and probably split up about once a fortnight as an "educational" night. 10.30 Main News Bulletin and Weather. 10.45—12.0 Dance Music. One night per week, 10.45 to 11.30, Special Variety. 11.30 to 12.0 Dance Music.	6.15 to 7.0 "Cafe-type" light music.	6.15 5XX, S.B. 6.30 to 7.15 Talks. 7.15—10.0 Alternative Evening Programme. 10—10.30 News and Talk. 10.30—11.0 Late night, special broadcast. 11.0 Close down or Pictures.

When the regional scheme comes into operation the timing under "5GB" would apply to one transmitter, and that under "Local Station" would apply to the other.

All "Girl Guides," "Boys' Brigades," and "Recipe" talks to be given before 6.15, and horticulture, sport and motoring talks to be included between 7.0 and 7.45.

The views and criticisms of fellow readers of *The Wireless World* are eagerly awaited. J. M. TOULMIN.

Preston.

Sir,—With reference to the correspondence in your columns and also your leaders on the lack of quality in the programmes of the B.B.C., I can heartily endorse the sentiments expressed. The Corporation appears to be pursuing a policy entirely dictated by a clique of "highbrow" enthusiasts who are quite out of touch with the requirements of the average listener.

Further, they appear to have become smitten with a religious complex. When one accidentally buys *The Radio Times* instead of *World Radio* one imagines that it is a copy of some Church periodical. Possibly the aforementioned highbrows think they are educating the public in religious matters. However, we do not pay our licence fee for this purpose. Every week, and particularly at times like Christmas and Easter, *The Radio Times* and the programmes are packed full of religious matter, and there is nothing more irritating to "the man in the street" than to have religion served out to him under another guise. By all means include

the church services, but we have had more than enough of these Cantatas, etc.

Wishing you every success in your effort to bring the programmes back to palatable matter.

T. A. CARLILE.

Wylam-on-Tyne.

Sir,—With reference to the letter from Mr. H. C. Hony, I should like to voice a protest in regard to the final paragraph.

I believe the criticisms advanced by Mr. Hony and others in regard to the patchy make-up of our present programmes are justified, but I also firmly believe that if a census were taken of the number of receivers capable of reproducing the soprano voice with anything approaching fidelity, it would abundantly provide the reason for Mr. Hony's and others' dislike of that type of artiste.

If Mr. Hony and others were capable of following and applying the lessons on receiver design published in *The Wireless World* during the past few years, I am certain that there are countless items in the B.B.C. programmes which they would appreciate, and which are now received with nothing but annoyance.

CYRIL T. HASTINGS.

Surrey.

Sir,—The purport of this letter in no way constitutes an apologia for the B.B.C., first, because that is not my perogative, and, secondly, because I agree with some of the adverse criticisms of the B.B.C. programmes and policy.

Your leading article in your issue dated April 3rd merits the attention of every licensee of the B.B.C. Expressed in moderate and sympathetic terms, it summarises the position of programme and policy disagreement in a manner that is calculated to induce consideration in the right quarters. It is a striking contrast to that of your correspondent, Mr. Phillips.

I trust sincerely that Mr. Phillips will credit me with goodwill if I criticise his letter, particularly since I concur with some of his conclusions therein defined. We shall agree, certainly, that our joint object is better broadcasting, but I do not think that his introductory remarks, including his criticism on "policy" are expressed in terms conducive to a spirit of camaraderie between himself and a correspondent acting on behalf of the B.B.C.

"Patronising superiority," "God-like infallibility," "Haughty being," "Self-glorification" and "Smaller hats" are terms which could not be expected to produce an atmosphere of peace or progress. I do not suggest that Mr. Phillips has written in the same strain as this to the B.B.C., but if he has done so, perhaps he will project himself into the place of the person replying per pro the B.B.C. and see for himself the state of mind he has produced. Exaggeration (whether humorous or merely alleged) has its uses, but, like "reaction," has its limits also.

Somewhere between intolerance and indifference there is a state of reasoned enthusiasm that means satisfaction with progress.

Realising, as we all do, that broadcasting has no "box-office" to register the pleasure or displeasure of its adherents, a sufficiently broadminded outlook (that still has depth) should not be difficult to acquire that will allow us to believe in the sincerity of the B.B.C. directorate and the bonhomie of the B.B.C. staff. The former have accepted a national stewardship for which they can be penalised (and often are); the latter being people like ourselves (and very much concerned about their job), are not likely to trifle with it. So why accuse the one of "God-like infallibility" and the other of "Patronising superiority"? If we demand a "My Programme," what about "the other fellow's" programme? If ever a stewardship endeavoured to supply novelty, certainly it is the B.B.C.

Amid all this heat and bother about the programmes and policy of the B.B.C. one outstanding feature is that so little has been offered in practical alternative. On the question of policy I agree with Mr. Phillips that the later news bulletin mars the evening programme, and with the Editorial that the main evening programme would be better if given up to pleasing one type of listener at a time.

One could also say that scheduled talks should give way on Bank Holidays to a more Bank Holiday spirit.

But if we want to do some lasting good to the whole British listening public the first thing to be done is to find what that public wants. Obvious, of course, but how difficult to obtain a representative plebiscite, and we might (for a space at least) cease carping and address all our ingenuity to a scheme commensurate with this task.

And when we can ask the directorate of the B.B.C. in definite terms for what we want, we can start to criticise afresh. As a ready means to this end, may I suggest that the B.B.C. set aside one week for grumblers. Call it "adverse criticism week," and the B.B.C. to ask, via the microphone and *The Radio Times*, for the complaints of dissatisfied listeners only.

Combining these two schemes we should get the programmes and the policy, we so richly deserve.

H. SHEARMAN DYER.

London, S.E.5.

"OLD LAMPS FOR NEW."

Sir,—May I be permitted to offer a reply to your correspondent, Mr. Frederic Hawkins? It seems regrettable that he has not as yet found a dealer whose word he can take on the matter, although I can assure him that many are to be so trusted.

Let him, however, go to any dealer holding a direct account with the valve manufacturer concerned and give his order, with the proviso that the valve or valves be forwarded direct to his address from works. Any reputable dealer will arrange to do this.

I would remind him, however, that this still leaves him in the hands of the makers, and as the valves will be invoiced to the dealer in question, one party will have to be trusted as regards payment.

Being myself a provincial retailer, you will appreciate the reason I write this over my (private) monomark.

BM/MB6F.

London, W.C.1.

Sir,—Referring to Mr. Hawkins' letter anent "Old Lamps for New?"

It seems to me that any possibility of this undesirable practice happening could be definitely negatived by the manufacturers themselves enclosing their products in suitable containers.

For instance, the B.T.H. valves I purchased some eighteen months ago were definitely sealed in "stout" containers by means of a simple strip gummed across the sliding inner lid and the carton. This strip bears the inscription: "Please see that this seal is unbroken." Through suitable apertures cut in the cartons valves may be tested and the glasses examined for breakages. Whether Messrs. B.T.H. continue to safeguard their clients' interests in this manner with their "Mazda" valve I am unable to say, having had no occasion to renew those already mentioned. (Usual disclaimer.)

The flimsy nature of the carton used by the average valve manufacturer has always struck me as being totally inadequate (considering the cost of the article it contains), and its open nature is simply asking for dishonest usage by unscrupulous dealers.

THOMAS T. KERR.

Glasgow.

MORSE INTERFERENCE.

Sir,—I was interested in your publication of complaints of Morse interference by readers, and, having experienced the same thing night after night, I wrote a strong letter to the B.B.C.

The sequel is rather interesting. Eventually a wireless expert from the local G.P.O. arrived at the house to hear the interference.

He did; all kinds of noises from automatic transmitters to different tuned Morse stations.

I explained that many good foreign programmes were being ruined, but the only satisfaction he could give me was that so long as the two Daventrys were clear the B.B.C. were not concerned.

The answer, then, is that all who possess all-world receivers or five- or six-valve sets have got to be content with Daventry or put up with hearing the beautiful music of Government Morse.

The daily Press reported that the Royal wedding at Oslo was relayed by Daventry without interference, but I heard it, and wondered whether it was music or Morse they were relaying.

Surely it is time we, who have sets to get Continental programmes, should be given at least a sporting chance of good reception—but perhaps Morse stations are better to listen to than some of the British programmes.

W. B. HATCHER.

Hereford.

READERS' PROBLEMS

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

H.F. Chokes.

I understand that the impedance of a choke varies directly with frequency; why is it that the test curves published in The Wireless World *show a falling off in impedance beyond a certain frequency?* A. M.

The statement you make is true only when the effect of resonance does not come into question, and the usual formula giving the impedance of choke coils is seldom of much value from a practical point of view when dealing with high-frequency currents. A choke in conjunction with the incidental capacities that exist across it will behave as a resonant circuit, and at a certain frequency will offer a much higher effective impedance than that due solely to its inductance. We would refer you to an article on this subject which appeared in our issue of September 26th, 1928.

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"Corked" Aerials.

A neighbour of mine who keeps pigeons has asked me to fit a number of corks to my aerial wire, in order that injury to his birds may be avoided. Of course, I have promised to fall in with his wishes, but am wondering whether this addition will have any prejudicial effect on the working of my apparatus. What do you think? W. G.

You need have no fears on this score. From the electrical point of view, the fitting of corks on your aerial wire will have no effect whatsoever. You must not forget, however, that the "windage" of the aerial will be increased; and to avoid swaying, or even possible damage in a heavy wind, its supports should be slightly more robust than would otherwise be necessary.

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Pre-detection Volume Control.

My receiver is a modified version of the "Everyman Portable" circuit, arranged for working on an outside aerial and with two L.F. stages. Would it be possible to add the form of pre-detection volume control used in the "Megavox" receiver by connecting a 1-megohm Igranic potentiometer across the coil? R. P. G.

Potentiometer control of H.F. input to the detector is quite practicable with a receiver of this sort, but it is not correct to join the regulating device across the whole of the grid coil when dealing with a modified form of the Hartley circuit. Instead, the resistance must be connected between the grid end of the winding and its centre point, in the manner shown in Fig. 1.

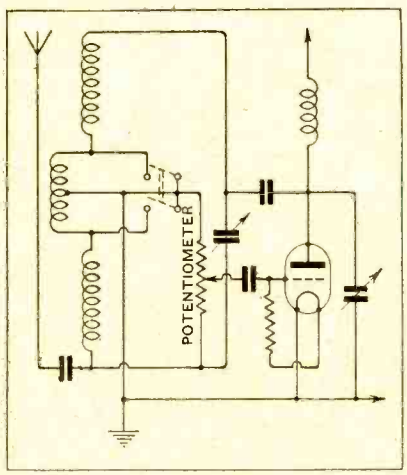

Fig. 1. H.F. potentiometer connected in a modified Hartley circuit.

"Parallel" Reaction.

How is it that I can hear fairly loud signals from my two nearest stations when the reaction coil is removed completely from my receiver? E. M. G.

We expect that your reaction control circuit is of the "parallel" type, in which there is, of course, direct continuity in the anode circuit, whether or not the coil is in position. If this assumption is incorrect, and if you happen to be using the "swinging coil" method of feed-back, in which the reaction coil is in series with the anode circuit, then the effect described goes to prove that there is a partial short-circuit across the reaction coil holder.

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Distortion of Piano Music.

The quality of reproduction afforded by my receiver is good on the majority of transmissions, but I notice that piano music seems to suffer from an unpleasant resonance, some notes being reproduced at very much more than their proper volume. Can you suggest where the trouble is likely to lie? R. B. M.

We expect that the disproportionate reproduction of which you complain takes place on other transmissions, but it is a fact that resonances are generally more readily noticeable when piano music is being transmitted. It is almost impossible to give a definite answer to your question, as the resonance may be either in the loud speaker or the L.F. amplifier. With regard to the first mentioned, your best plan is to eliminate uncertainty by borrowing another instrument for test. In the matter of the amplifier, it is rather more difficult to make helpful suggestions in the restricted scope of a letter. You should endeavour to assure yourself that its design is in keeping with modern practice; and, most important of all, to make certain that L.F. reaction is not taking place.

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Sets for Abroad.

Will you recommend a commercial set that can be depended upon to provide good signals here (in Egypt) *from the London and Daventry stations? I realise that a sensitive and consequently somewhat expensive outfit will be necessary.* R. I. M.

It is our considered opinion that no set, however sensitive, could be depended upon to provide really consistent reception of British stations in Egypt on normal wavelengths. It is well known that these transmissions are occasionally received there at night-time, but only when conditions are exceptionally favourable. We strongly advise you to concentrate on reception of the short-wave station (Chelmsford 5SW).

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

By-pass Condensers.

I am actually using condensers of 1 mfd. in place of those of 0.1 mfd. specified for the Megavox receiver. Is it likely that results would be improved by substituting the recommended values? A. G. C.

It is almost invariably safe to assume that there is no danger whatsoever in using larger by-pass condensers than specified for decoupling an anode or screen-grid circuit. The point is that the values recommended are sufficiently large to perform their function, and unless one already has other condensers, it is extravagant to use a larger capacity.

o o o o

Modified "S.G. Portable."

I am thinking of making the "Wireless World S.G. Portable," described in your issue of April 17th, but should like to use two compact resistance-capacity coupling units that I already have, in conjunction with ordinary valves. Will you please give me a diagram (from the detector onwards) showing how these modifications may be made? J. v. R.

The circuit you require is given in Fig. 2, on which suggested values for the coupling components are marked. These are similar to those included in a number of commercial units, but are not critical, and as a rule wide divergencies are permissible. You will note that the H.F. choke, connected in series with the loud speaker, which was included in the original diagram, has been omitted; it will seldom be necessary when using ordinary valves with an H.F. stopper in the grid circuit of the first L.F. amplifier.

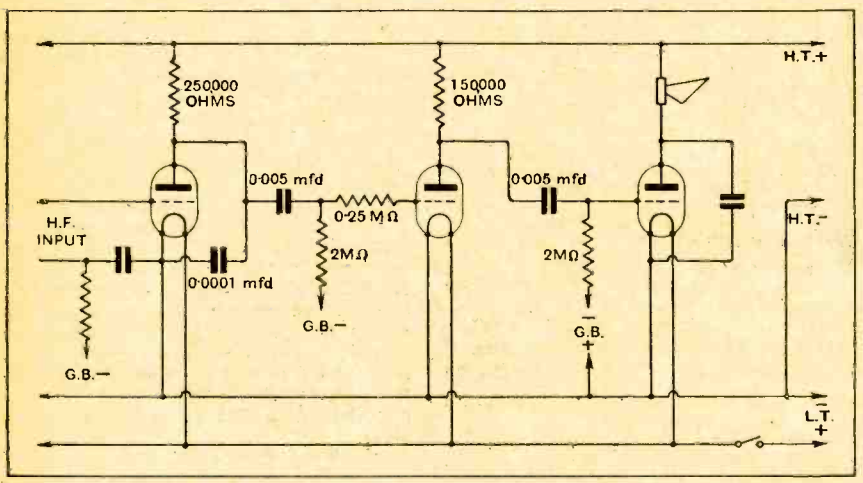

Fig. 2. Resistance-coupled L.F. amplifier for a portable receiver.

o o o o

Unnecessary Complications.

I am thinking of building the "Kilo-Mag Four," modified by using leaky grid condenser detection. Does this mean that reaction should be applied? Any hints and comments would be appreciated. E. C. P.

We do not care for your proposed scheme. The use of grid detection certainly presupposes the addition of reaction, which in turn would necessitate a complete redesign of part of the receiver. Anode bend detection seems to be much more suitable for a "two H.F." set, and if you must have still greater sensitivity than that at present provided, we think you would do better to use coils of lower H.F. resistance than at present (putting up with the side-band cutting that will take place), and adjusting primary turns so that the set is on the verge of oscillation—with normal filament current—at the lower end of the tuning scale.

o o o o

"The Valve as an Anode Bend Detector."

With reference to your recent article on the above subject, will you tell me if distortion is indicated by "kicking" of the needle of the milliammeter connected in series with the detector anode? A. L. A.

We think that you are confusing this matter with the use of a meter in the output stage. When dealing with a rectifier, variations in anode current and consequent movements of the needle may take place, even though no distortion is being produced; this is due to the effect of heavy modulation. The point is that, by connecting a meter in this way, we know that grid current will flow, and consequently distortion will take place, when the meter registers a current of above a certain value—generally between 1 and 1.2 milliamp.—with valves and anode pressures customarily used in the arrangement under discussion.

o o o o

Reaction Condenser Capacity.

In circuits of the Reinartz type, reaction control condensers with maximum capacities from as little as 60 micro-microfarads up to as much as 0.0003 mfd. are used. By what factors is the capacity of these condensers influenced? G. J. B.

This is rather a difficult question to treat adequately in a letter, but briefly, the capacity of the feed-back condenser is determined by the number of turns in the reaction coil, by its coupling with respect to the grid coil, and on incidental damping in the circuits. The tendency nowadays is to use as large a condenser as possible, consistent with retention of the high notes, and a comparatively small reaction coil.

o o o o

Coil Connections.

I have just been reading an article in which the expression "the top of the coil" is used; I take it that this refers to its electrical "top," as in the particular case in question there is an alternative method of mounting, and in neither position is one terminal higher than the other. Will you give me a simple definition? T. F. F.

We expect that your assumption is correct. This expression is almost invariably applied to the end of the coil which is at high signal frequency potential—in other words, the end which is connected either to grid or plate of the associated valve, as the case may be.

o o o o

The Broadcast Waveband.

Coils are sold and circuits are described as being suitable for "the medium broadcast waveband." Exactly what band of frequencies does this embrace? H. D'A. R.

According to the Washington Convention, wavelengths between 200 metres and 545 metres (550 to 1,500 kilocycles) are included in this band. The wavelength of 220 metres is shared with the "maritime mobile service."

By the decision of the recent Prague Conference, a few stations, generally situated in the more remote parts of Europe and at a distance from the sea coast, are distributed among the wavelengths between the upper limit of the medium band and the lower limit of the long wave band, so you will see that the Washington Convention allocation is not strictly adhered to.

o o o o

Protecting Inductive Windings.

I have read that current surges are produced when a valve circuit is interrupted suddenly. Does this mean that, to avoid all danger of damage to such components as L.F. transformers and loud speakers, it would be wise to fit a rheostat in place of a filament switch, in order that the valve current could be turned off gradually? B. B. R.

This precaution is quite unnecessary. When the filaments are broken by means of a switch, the current flowing through them is, of course, interrupted suddenly, but emission persists for an appreciable time as they cool gradually.

o o o o

WHO'S WHO IN THE ETHER.

Answers to Correspondents.

F. H. D. (Bath).—Aerodrome transmission on 900 metres (probably Croydon). Calls in English and French. **L. C. W. (Boreham Wood).**—Radio Feriby, the new Bratislava station, testing. **B. S. B. (Oxon).**—Radio Toulouse. Orchestral concert (first item, *Madame Butterfly*, by Puccini). The Italian station was Turin (Italy); Radio Torino.

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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.

CONTENTS OF THIS ISSUE.

BROADCAST TROUBLES IN AMERICA.

THE British public criticises the policy of the broadcasting organisation in this country, and often with very good reason, but, taken all round, we have really a good deal to be thankful for. The fact that advertising is not banned from the stations in the United States is being exploited at the present time in such a way as to imply that the improper use of broadcasting stations for advertising purposes is becoming a first-class national scandal. Whole pages of American national newspapers are being utilised for the publication in the advertisement section of an open letter to the Advisory Council of the National Broadcasting Company, criticising its policy in permitting the microphone to be used for commercial propaganda.

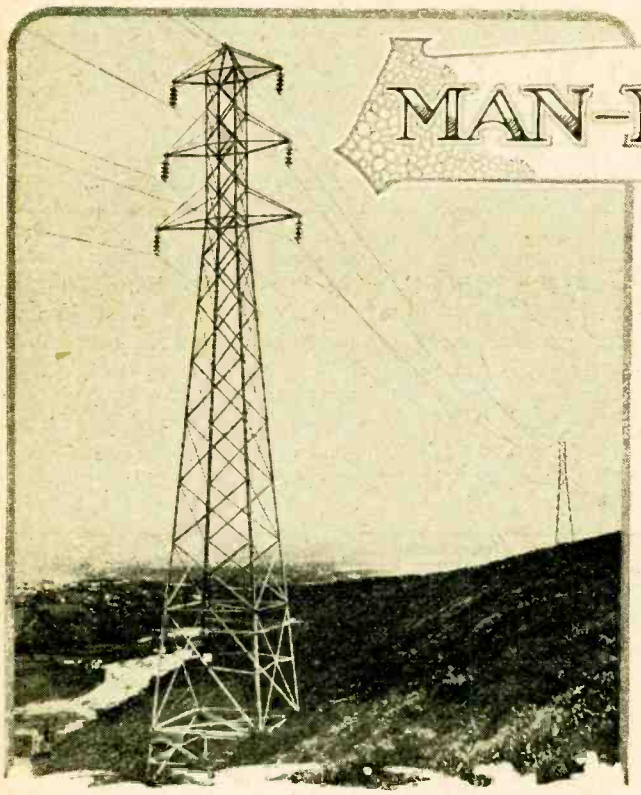
The letter begins:—

"As members of the Advisory Council of the National Broadcasting Company, organised to reflect the public interest in this great means of communication to the home, you will concede us the right to ask you publicly whether you approve or repudiate the action of the National Broadcasting Company in lending its facilities to the most harmful attack upon public health ever launched in the air. A single great tobacco organisation, backed by a fund of $12,000,000, has undertaken to transform 20,000,000 young men and young women in the United States into cigarette addicts, by a campaign of tainted testimonials secured from professional athletes, motion picture 'stars,' and other celebrities. Testimonials of such a nature that the War Department has rebuked a General for thus misusing his rank and uniform, and a well-known steamship company has disciplined two officers for a similar offence."

The Contrast Here.

Except for their own purposes and to benefit their particular interests, the Broadcasting Corporation in this country has, we believe, adhered very closely to the stipulation laid down by the Postmaster-General that the broadcasting stations should not be used for advertising purposes. This decision with regard to policy has only been rendered possible by virtue of the fact that the revenue for conducting broadcasting is supplied through the intermediary of the State. If once our broadcasting had been established on the basis that stations had to provide their own revenue, then advertising, as in America, would probably have proved the only possible means of maintaining the stations and providing adequate programmes. It has often been suggested that our broadcasting policy is too conservative in the matter of advertising, and that cautiously and judiciously introduced, it could do no harm and would be the means of providing substantial additional revenue wherewith to improve the general quality of the programmes. Let the present position which has developed in America be a lesson to us, if anything of the kind were needed, to be content with our present policy of a total ban on advertising, and not risk experiments which the experience of others has proved to be so disturbing.

Our present system gives us further advantages over others which are dependent for revenue on advertising, for the compilers of our programmes are left with complete freedom of choice of subject matter for broadcasting, whereas any other system would undoubtedly leave the programme organisers at times in a position of some embarrassment in making the choice between programme matter which they consider would be most attractive or beneficial from the listener's point of view, and alternative matter which had not these merits, but which, nevertheless, could not lightly be disregarded since it would result in more revenue for the station.



MAN-MADE STATIC

High-voltage Overhead Electrical Transmission Lines and Radio Interference.

By R. L. SMITH ROSE, D.Sc., Ph.D., A.M.I.E.E.
(*National Physical Laboratory.*)

THE Electricity (Supply) Act, 1926, authorised the creation of the Central Electricity Board, to which was entrusted the construction of transmission lines and transforming stations required for interconnecting the power stations selected for supplying the national requirements of electrical energy and for providing supplies to undertakings which have no power stations. The function of the overhead distribution line system is to enable large bulks of power to be transmitted from sources of energy to remote consuming points, so permitting the generation and supply of electrical power to take place on the most efficient scale. The scheme laid down for the complete system in Great Britain comprises about 2,600 miles of overhead transmission line carrying three-phase alternating current at 132,000 volts between phases. This line has become popularly known as the " grid " in electrical engineering circles, and will be formed of a number of stranded steel-cored aluminium conductors supported on steel towers about 80 feet high.

The possible effect of such a transmission line system upon the scenic properties of the countryside has already been the subject of comment in certain districts; and upon further consideration of the matter it is natural to enquire what possible effects this " grid " may have upon wireless reception, either at commercial receiving stations or on the much more numerous domestic broadcast receivers. Among the possible interfering effects which the overhead line system might cause in wireless reception are the absorption of energy from electromagnetic waves by long spans of the line, and the change of apparent direction of arrival of wireless waves as experienced at direction-finding stations. Also possible interfering noises might be produced on a wireless receiver due to surges in the line, leakage over wet or dirty insulators, and arc or spark discharges either between the " live " lines or from the line to earth *via* the ground wire or steel towers. The present article gives the results of a brief investigation of this matter and is conveniently divisible into two parts. In the first part a summary is given of the relevant literature on the subject showing the present state of knowledge on the possibility of interference, while the second part contains a description of some experiments which have been made to ascertain the order of the interference which is experienced in the proximity of a high-voltage discharge.

I.—Summary of Knowledge and Experience on the Interfering Effects of Overhead Line Networks in Radio Communication.

It is convenient to divide this portion into two parts, dealing first with the possible interfering effects due to the mere existence of the line, and then with disturbance caused by the fact that the line is carrying electrical energy.

(*a*) *Line Erected but Dead.*—Considering the analogous case of long trunk telephone lines, it is the general experience that in investigations of the attenuation of wireless waves no definite absorption effect, which could be ascribed to the lines, has yet been observed. This is reasonable, since it is unlikely that any circuits formed by the line will have a very low radio-frequency resistance even though resonance conditions might occur. In his experiments on the measurement of signal intensities of distant stations, Dr. Hollingworth has observed field strengths of as much as three times their normal value in the immediate proximity of trunk telephone lines, these values decreasing to normal at a distance of less than 100 yards from the line.

Some experiments on the effect of overhead telephone wires in producing errors in bearing on a wireless direction-finder were carried out by the author and Mr. R. H. Barfield in 1922.[1] It was found that for wavelengths of 2,000 to 4,000 metres serious errors of the order of 45° were produced immediately underneath the line, but

[1] R. L. Smith Rose and R. H. Barfield: "The Effect of Local Conditions on Radio Direction-finding Installations." *Journal I.E.E.*, 1923, Vol. 61, p. 184.

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that these decreased to 4° or 5° at a distance of 120 feet from the line. As a result of later general experience it is considered that at a distance of half a mile from the line the effect would be negligible on the above wavelengths. No other experiments of this nature appear to have been carried out, and it would probably be desirable to obtain more definite evidence of the effects which may be encountered on the shorter wavelengths now in general use, and arising from the much higher overhead lines (80 feet) which will form the high-power distributing system of the future in this country.

(*b*) *Line in Operation Carrying Power.*—An overhead transmission line carrying power under normal conditions would not be expected to cause interference at a wireless receiving station to a much greater extent than is already experienced from underground cables. The currents are of the same order in the two cases, and at the low-frequency of 50 cycles per second the effect of an induction field operating on a receiving antenna would be negligible except at very short distances (probably less than 50 yards) from the line. For similar reasons low-frequency earth currents would not cause any appreciable interference on a wireless receiving system. It may, therefore, be considered that any interference from the line under power would be limited to the occurrence of surges and spark or arc discharges. A search through the literature shows that little work has been carried out on the effect of such disturbances on a wireless receiver, although considerable attention has been given to disturbances caused to land line telegraph and telephone systems. Since it is a frequent practice to use an overhead transmission line for radio-frequency carrier current telephonic communication, particularly at times when the land line system has failed, it would appear that the disturbances at radio-frequencies are not very serious.

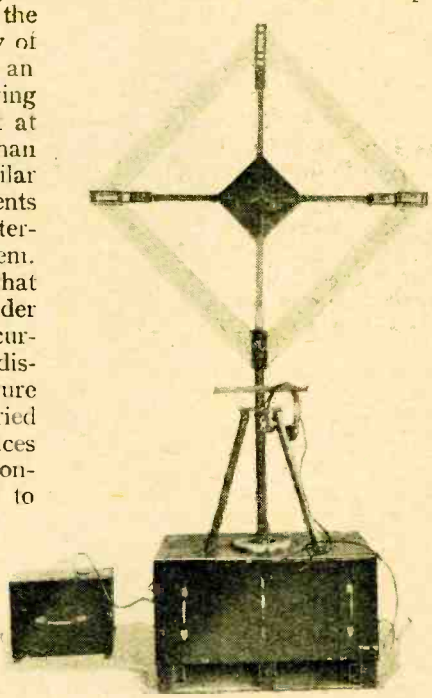

Fig. 1.—Single-frame coil direction-finder for wavelengths from 200 to 2,000 metres fully screened and ready for operation in making measurements of the strength of interference observed from high-voltage spark discharges.

The results of a brief investigation into the radio interference caused in the neighbourhood of a high-voltage distribution system were given by Ashbrook and Wight in 1926.[2] It is stated that several tests have been made directly beneath transmission lines up to 220,000 volts with a receiver properly shielded from low-frequency inductive effects. Provided that the voltage of the line did not greatly exceed the corona point, radio reception was quite free from interference over a range of wavelengths from 100 to 25,000 metres, even when the antenna was placed parallel to and 17 feet from one of the 220,000-volt lines. In this last case a choke-coil provided a low-resistance path to earth for the static potential and a high impedance to radio-frequencies.

A brief account of some experience of the interference caused by high-power overhead transmission lines on broadcasting receivers in Canada has also been recently published[3] by the Radio Department of the Ministry of Marine Fisheries, Ottawa. It was found that the interference was chiefly due to faulty contacts either in the lines themselves or in apparatus connected thereto. Out of some 5,000 cases of alleged interference investigated 80 per cent. were due to power lines and 90 per cent. were definitely cured after tracing the cause of disturbance.

In a paper dealing with various sources of interference with broadcast reception, R. H. Marriott[4] states that discharges over wet insulators on a 50,000 to 100,000-volt line may cause buzzes or crashing sounds in broadcast receivers. Within 200 feet from a 60,000-volt line, reception from a 50-watt station 10 miles away may be rendered unintelligible by such disturbances.

From a conversation with the engineer-in-charge of a high-power overhead line distributing system at 132,000 volts in South Africa, it was gathered that the maximum disturbances at wireless receivers in the neighbourhood was experienced when the line was flashing or brushing over wet or dirty insulators, particularly at times when the potential gradient of the earth's field reaches abnormal values. The production of surges in the line due to lightning flashes would not appear to add materially to the disturbance caused by the flash, although the presence of the line might bring nearer to a receiver the effects of a thunderstorm at a distant part of the line.

Before leaving this section it will be as well to recall the fact that the interference to wireless reception caused by electric tramway systems has been investigated in Germany and some interesting results have been published[5] recently.

In confirmation of previous experience it was found that the interference was worse with small than with large currents; in fact, some oscillograph records showed that with currents in excess of half an ampere the disturbance was negligible, whereas with currents of the order of 30 milliamperes the interference was serious and could be detected at distances of more than two miles from the line. The experiments supported the view that the trouble is due to damped oscillations set up by the interruption of the steady current passing from the overhead wire to the contact wheel of the car. Tests made with different contact

[2] R. B. Ashbrook and R. W. Wight: "Radio Interference," *Electrical World*, 1926, Vol. 88, pp. 851-853.

[3] *Electrical Review*, 1928, Vol. 103, p. 66.

[4] R. H. Marriott: "Interference." *Proc. Inst. Radio Eng.*, 1923, Vol. 11, p. 382.

[5] A. Clausing and P. Muller: "The Disturbance of Radio Communication by Tramways and its Remedies." *Elektrotech Zeitschrift*, 1928, Vol. 49, pp. 178-180.

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materials showed that carbon and zinc rubbing on copper were superior to other metals. The paper already referred to also contains a discussion of the use of condensers and chokes in the car lighting and power circuits to reduce the high-frequency disturbance for this particular case.

(*c*) *Conclusion.*—From the available information as summarised above, it may be fairly definitely concluded that at a wireless receiving station situated outside a minimum distance of the order of half a mile from a high-voltage overhead distribution line no interfering or disturbing effects will be experienced due to the existence of the line or the current which it is carrying. The only point upon which no definite information has been traced is the effect of spark discharges from the line on a receiving station not less than half a mile away, and it was therefore considered desirable to investigate this matter. When, as may sometimes be the case, the wireless station is itself drawing power from the line through a sub-station, it is possible that the effective distance from the line may thereby be reduced. It is considered, however, that existing and well-known methods of using filter circuits in the supply mains would provide an adequate means of avoiding any effects of surges and discharges which might otherwise be introduced by this direct connection.

II.—Some Experiments on the Interference Effect of a High-voltage Spark Discharge on a Radio Receiver.

With a view to making the above conclusions on the subject of interference from high-voltage overhead lines more complete, some simple experiments have been carried out at the National Physical Laboratory to ascertain the effect of a high-voltage spark discharge upon a sensitive wireless receiver operating on various wavelengths.

(*a*) *Apparatus Employed.*—For these experiments the high-voltage equipment of the National Physical Laboratory was arranged to produce discharges over a string of insulators about 6 feet long, the potential difference between the terminals prior to breakdown being about 850,000 volts. At the frequency of 50 cycles per second employed, the current through a maintained arc discharge was about 0.5 ampere. The observations of interference were carried out with two portable direction-finders, one operating on wavelengths between 5 and 10 metres, and the other having a working wavelength range of from 200 to 2,000 metres. No definite figure can as yet be assigned to the sensitivity of the short-wave receiver, but it may be stated that it has been used for signal strength observations at distances up to two or three miles from a low-power transmitter. The larger receiving set, when operating in the range of wavelengths of from 300 to 400 metres is known to give an audible response to signal field intensities of the order of 2 microvolts per metre with the coil in the maximum receiving position. On the longer wavelengths of 1,000 to 2,000 metres, the sensitivity is probably only about one-tenth of this.

(*b*) *Preliminary Experiments.*—The method of experiment was to raise the voltage across the gap formed by the insulator string while listening on the receiving set. During this period various parts of the high-voltage equipment gave off a brush discharge which was both visible and audible. Up to the time of breakdown of the spark gap, however, nothing was heard

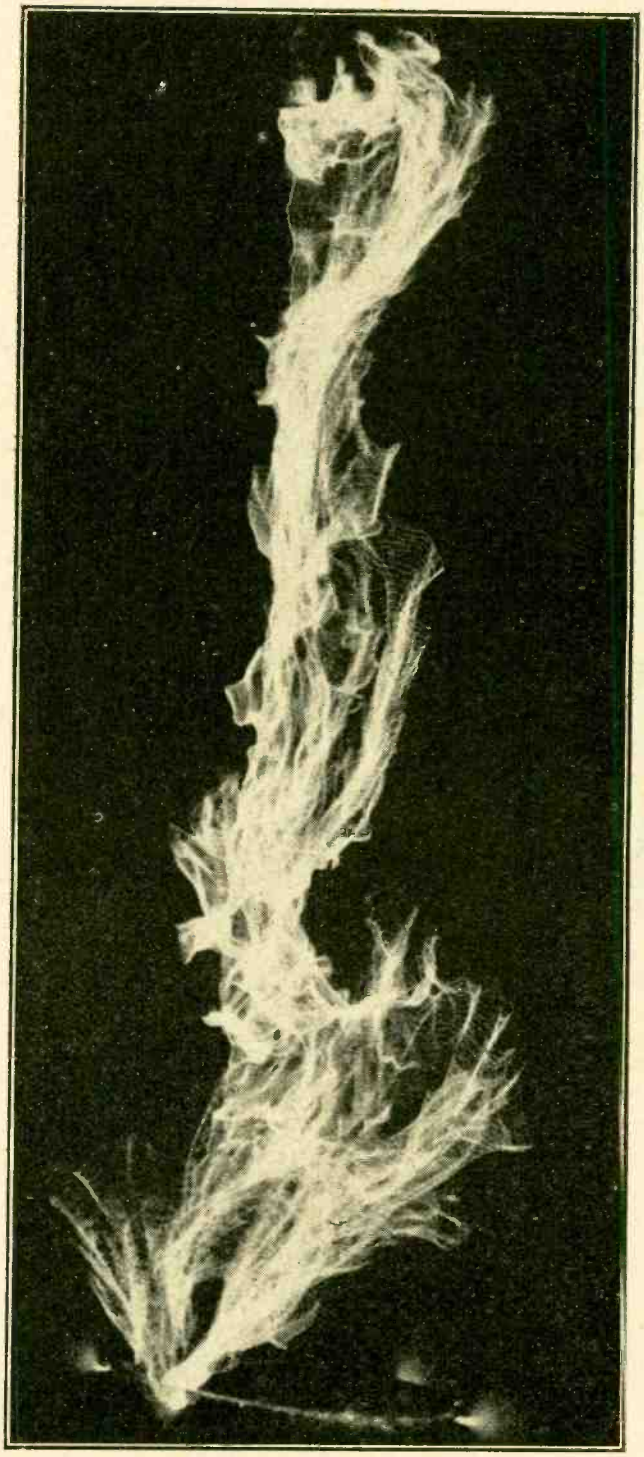

Fig. 2.—Photograph of an electrical discharge over a string of insulators about 7 feet long, with an applied pressure of about one million volts. (The insulators employed are seen more clearly in Fig. 3.)

Man-Made Static.—

on the wireless receivers even when these were only ten or twenty yards from the installation. When the voltage was sufficient to cause a spark to jump over the string of insulators a click was produced in the telephones of the receivers, while, when the discharge took the form of a maintained spark or arc, a low buzzing note was heard in the telephones. It was soon found that except at the shortest distances the sudden clicks due to the sparks produced a very small interfering effect, while the buzzes due to the arc discharges were much more serious. A noticeable feature of the response in the receiver in the latter case was a distinct lull or silent interval between the click due to the spark and the buzz due to the arc. The acoustic effects of the discharge in the high-voltage building were subject to an analogous distinction, suggesting that the current through the ionised path followed by the arc takes an appreciable time to increase after the first spark occurs.

(*c*) *Observations on a Wavelength of 7.5 Metres.*—Using the short-wave loop receiver operating on a wavelength of 7.5 metres, it was found that the interference was serious at a distance of 15 yards from the flash, but decreased rapidly as this distance was increased. At a distance of 220 yards, any effects of the high-voltage discharge became quite inaudible and did not in any way interfere with the normal operation of the receiver.

(*d*) *Measurements on a Wavelength of 360 Metres.*—It has already been mentioned that the larger direction-finder has its optimum sensitivity in the wavelength range of 300 to 500 metres, and it was, therefore, natural to find that the interference was greatest on this range. At distances of from 16 to 100 yards from the spark gap the disturbance produced by the arc discharges was very serious, and when repeated at intervals of two or three seconds gave considerable interference with the reception of broadcasting from 2LO (London), which produces a carrier wave field intensity in the neighbourhood of about 10 millivolts per metre. By locating the receiver so that the directions of the spark gap and of the 2LO transmitter are approximately at right angles, and then rotating the receiving coil so that the received modulation from 2LO was of the same order as the interfering noise from the high-voltage discharge, a measure was obtained of the quasi-field-intensity of the interference. The method is admittedly rather crude, but it is considered to have served its purpose in enabling the values in the table to be obtained showing the order of the interference at various distances from the discharge. It is to be remembered that the values refer only to the buzzes produced by maintained arc discharges of from one to

λ=360 M. SENSITIVITY OF D.F. SET=2 MICROVOLTS PER METRE.

Position of set.	Distance from spark gap in H.V.B.	Interference (microvolts per metre).	Remarks.
Inside H.V.B.*	16 yards	>1,000†	—
Outside big doors of H.V.B.	60 yards	300	20 yds. from general power mains.
Outside North Lodge	220 yards	140	12 yds. from general power mains.
In wireless hut	500 yards	300	5 yds. from general power mains.
In sports field	500 yards	10	100 yds. from general power mains.
" " "	600 yards	3	200 yds. from general power mains.
On drive	600 yards	3	200 yds. from general power mains.

* H.V.B.=High-voltage Building.
† The modulation field intensity of 2LO in the neighbourhood of Teddington is taken as 1,000 microvolts per metre.

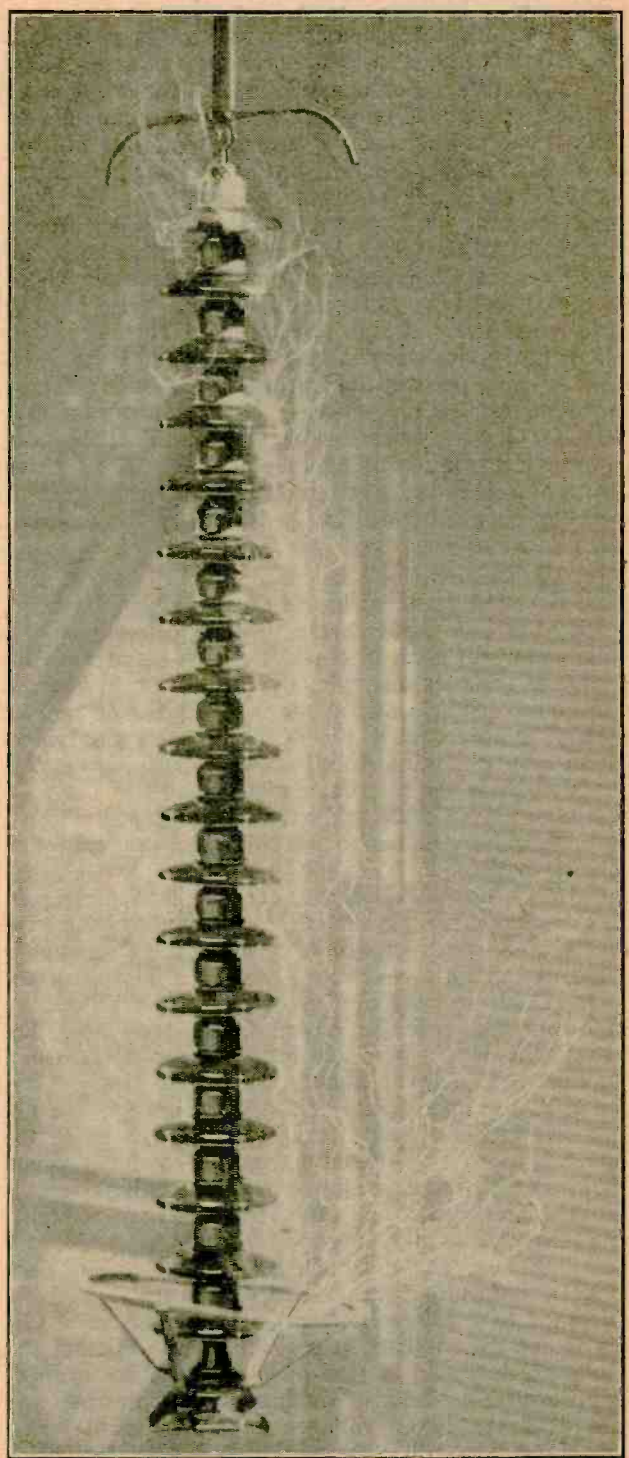

Fig. 3.—Photograph of an electrical discharge over a string of insulators about 7 feet long, with an applied pressure of about one million volts.

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five seconds duration, which, for the purpose of these observations, were repeated at the rate of about ten per minute.

It will be noticed from these results that while in the open the effective field strength of the interference falls to a practically negligible value at 600 yards, this is subject to a great modification when the receiver is placed near any electric light or power mains within the Laboratory. For example, inside the wireless hut the field strength is of the order of 300 microvolts per metre; but as soon as the proximity of this hut and the mains feeding it is left, the field strength decreases rapidly. Now, the alternating current for the high-voltage equipment is generated in the building from a direct-current supply. There is, furthermore, no metallic connection between the various main cables supplying the high-voltage building and those entering the wireless hut. It is to be concluded, therefore, that, where the various mains run in proximity to each other in other parts of the Laboratory, there is sufficient inductive connection between them to form an easy path for the transmission of the effects of the discharges from one building to the other. A telephone connection between the buildings did not appear to alter the connection already provided by the mains in the above manner.

(*e*) *Observations on a Wavelength of* 1,600 *Metres.*—With the receiver tuned to the wavelength of Daventry (5XX) the interference from the long discharges was quite serious at short distances. At 46 yards from the discharge gap, for example, the effective field strength was about 200 microvolts per metre. This decreased rapidly, however, and the disturbance on this wavelength was quite inaudible at distances above 140 yards, even in the proximity of the mains in the wireless hut. Part of this result is undoubtedly due to the lower sensitivity of the receiver on this wavelength, as already explained.

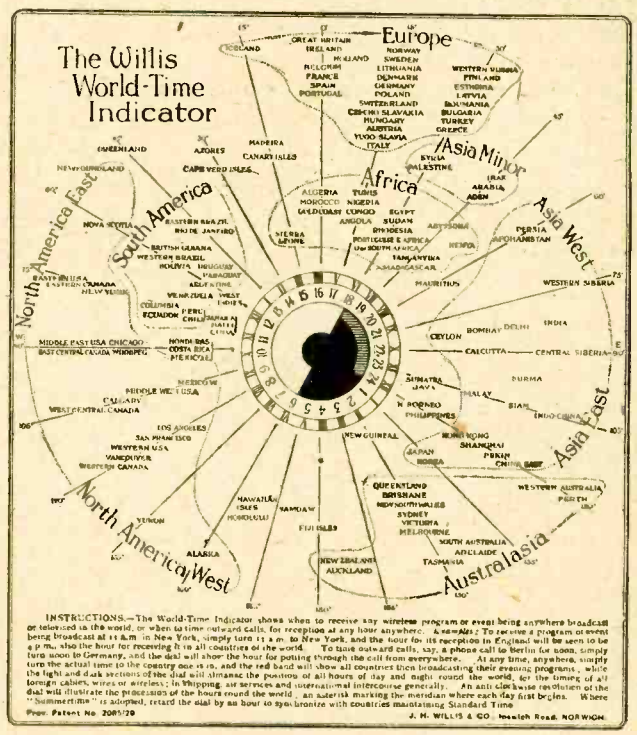
(*f*) *Conclusions.*—It seems evident from the results of the above experiments that, while the interfering effects of a spark or arc discharge initiated by a voltage of about 850,000 and passing a current of the order of half an ampere may cause serious disturbance on a wireless receiver situated within 200 yards, the disturbance rapidly decreases with distance and becomes negligible at about 600 yards. The serious nature of the interference at short distances is due not so much to the effects of an isolated spark as to the repeated action of long-drawn arcs, a condition which would rarely occur in the operation of high-voltage transmission lines. The above results were obtained with the discharge taking place inside a steel-frame brick building, but the opening of a metallic door 30 feet square near the spark gap made no appreciable difference to the interference. As against this limitation to the experiments, it may be mentioned that the results are intended to give information as to the possible disturbing effects of discharges from transmission lines at much lower voltages and with small spark gaps. It appears that the minimum distance of half a mile of a wireless receiver from the line, chosen on other grounds, will also ensure freedom from the disturbing effects of spark or arc discharges, except when the receiving station is in electrical connection with the line. In such a case, as previously mentioned, the use of special filter circuits in the connection might be necessary and would probably be effective.

The work described above was carried out on behalf of the Radio Research Board, and acknowledgement is due to the Department of Scientific and Industrial Research for permission to publish this description thereof.

A NEW WORLD-TIME INDICATOR.

WE have received from Messrs. J. H. Willis & Co., Ipswich Road, Norwich, an ingenious little device for readily comparing the times of all countries of the world, consisting of a card about 8in.×7in., in the centre of which is a rotatable dial about 2in. in diameter marked with the 24 hours of day and night.

The card around the dial is divided by radial red lines into degrees of longitude east and west of Greenwich, each radial line indicating 15°, to correspond with the international time



zones. The principal cities of the world are printed in their respective longitudinal positions around the centre, so that by placing the correct hour on the dial opposite the name of any town or country the corresponding times in other countries of the world can be read off at a glance. The normal hours of darkness, 6 p.m. to 6 a.m., are shaded black in the centre of the dial, but a part of this darkened semi-circle, between the hours of 6 p.m. and midnight, is marked with a red band to indicate the time during which evening broadcasting programmes are usually transmitted. Thus, by setting the actual local time on the dial opposite Great Britain on the card one can see at a glance what countries of the world are broadcasting their evening programmes, and conversely by setting the red band opposite any desired country one can see the time during which its programme should be listened for in any other country.

The device is, of course, equally serviceable in all international intercourse, in the timing of cables, telephone calls, etc., and the general design of the indicator is clear and simple.

The FLAT-DWELLERS' A.C. THREE

Constructional Details and Notes on Operation.

(*Concluded from page 455 of the previous issue.*)

By F. L. DEVEREUX, B.Sc.

CONTINUING the work of preparing the panels and baseboard for final assembly and wiring, the next step is to drill the holes *d*, *e* and *f* (Fig. 13) in the baseboard near the front panel. The mounting of the components on the front panel may now be undertaken with the exception of the variable condenser, which is fitted after the potentiometer has been wired. The Ethovernier dials are screwed in position in accordance with the makers' instructions, and then the bushes for the switch extension rod and the ¼in. brass rod for the right-hand condenser dial. The latter is simply a plate with a ¼in. hole in the centre, and the holes for the fixing screws should be oversize in order that it may be properly centred when fitting the dial movement. An ebonite extension tube with set screws set at an angle of 120 degrees is used to connect the dial with the condenser inside the screening box. By using the paxolin spindle at the condenser end the projection outside the screen of metal parts associated with the H.F. circuit is avoided.

If a wooden panel is used, as originally specified, and there is any doubt concerning the insulating properties of the wood, the frame aerial sockets may be bushed or mounted on a small ebonite tablet.

The radial switch for the potentiometer requires slight modification before fitting. The copper strip joining the centre bush to one of the studs must be removed and means provided for taking a connection direct from the moving arm. To this end the copper strip may be cut through and used as a soldering tag for the bush, thus leaving all the studs free. The switch may now be fitted to the panel together with the valve holder and Ferranti condenser, and as much as possible of the wiring completed.

Wiring the Screen-grid Potentiometer.

The Climax potentiometer is mounted on the baseboard in front of the radial switch on an ebonite pillar ¾in. high. The tapping wires should be uncoiled by inserting a match and pulling; this will avoid kinks and twists in the wire. Starting from the right as viewed from the front, connect a wire to each stud on the switch, as shown in the wiring diagram, using systoflex to protect the wires. This will use up about half the potentiometer; the remaining wires may be cut off.

With the work on the potentiometer completed the left-hand tuning condenser and dial may be assembled together with the screening plate provided and the

The Flat-Dwellers' A.C. Three.—

wiring of the front panel finished, not forgetting the baseboard-mounting bias battery. Before leaving the front panel holes should be drilled through the battens

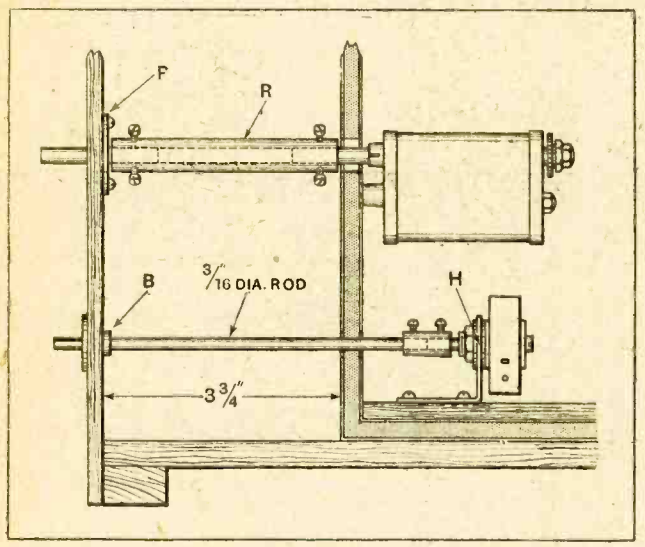


Fig. 9.—Details of extension rods for variable condenser and wave range switch. The diameter of the hole H in the switch bracket should be oversize to allow movement for centring.

from the front for the mains and loud speaker leads and the earth wire.

We may now turn our attention to the receiver sub-base. Before commencing assembly, the construction of the grid circuit tuning coils should be undertaken in accordance with the details given in Fig. 10. The long- and short-wave coils are wound side by side on a ribbed ebonite former, and are similar in design to the grid coils successfully used in *The Wireless World* S.G. Regional Receiver.[1] The slots for the long-wave winding may be cut with a model-maker's hacksaw which makes a slot of just the required width for the No. 32 D.S.C. wire. It will be noticed that the number of turns recommended for both long- and short-wave coils is less than in the S.G. Regional coils. In conjunction with the 0.0005 mfd. tuning condenser, this ensures that the H.F. amplification for the more important stations shall be uniform. An added advantage is that the long- and short-wave bands overlap, thus giving continuous tuning from 150 to 1,800 metres. A wooden disc is driven into the base of the former for the purpose of fixing the coils to the sub-panel. The remainder of the components should now be assembled in accordance with the dimensions in Fig. 11, and wired to Fig. 13, leaving wires projecting through the base for the valve filaments (twisted flex), the cathode and the three +H.T. connections for the H.F. detector and output valves. As a precaution, the case of the A.F.5 transformer should be earthed by cleaning the enamel off one of the feet and fitting a soldering tag under the holding-down screw. One side of the secondary winding of the output transformer should also be joined to the earthing terminal on the case and provided with a short lead and tag for earthing to the screening box. The grid bias batteries are mounted on a thin wood platform 5½in. × 2¾in., which is fixed to the top of the A.F.5 transformer by small brass angle brackets inserted under the screws at the corners of the case. Finally, leads of adequate length should be provided for making connection to the right-hand variable condenser when this has been fitted at a later stage.

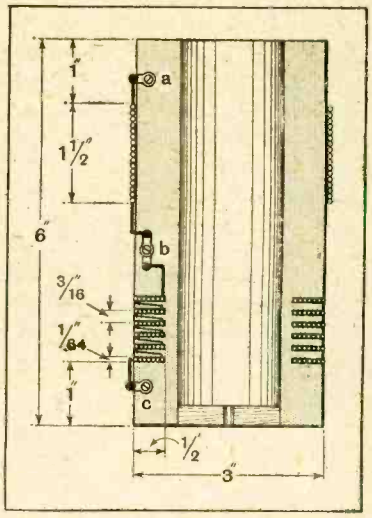
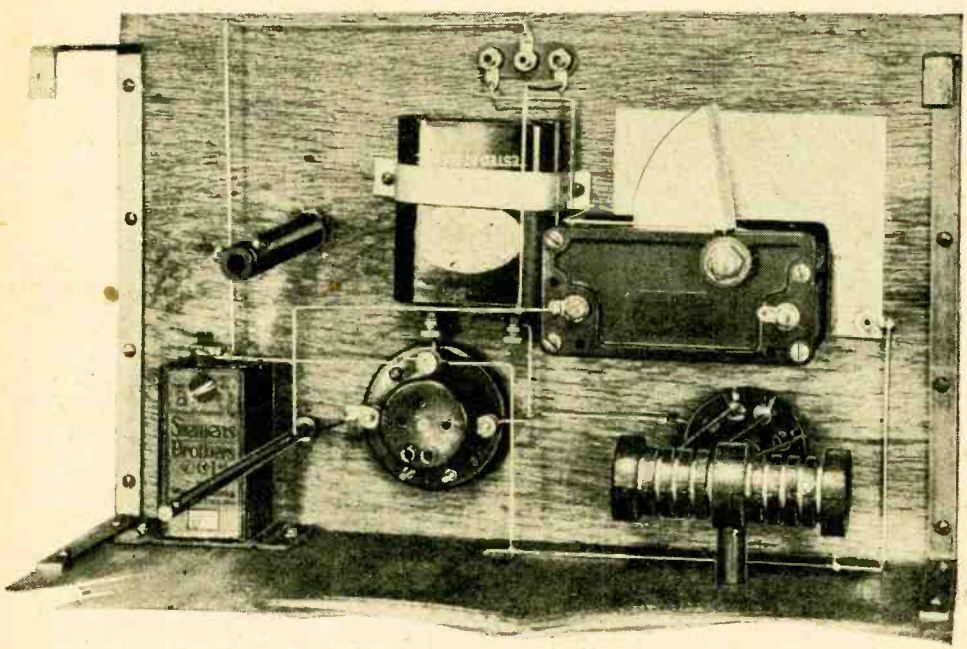


Fig. 10.—Sectional drawing of grid circuit coils. The short-wave winding consists of a single layer of 60 turns of 9/40 Litz and each slot of the long-wave coil contains 35 turns of No. 32 D.S.C.

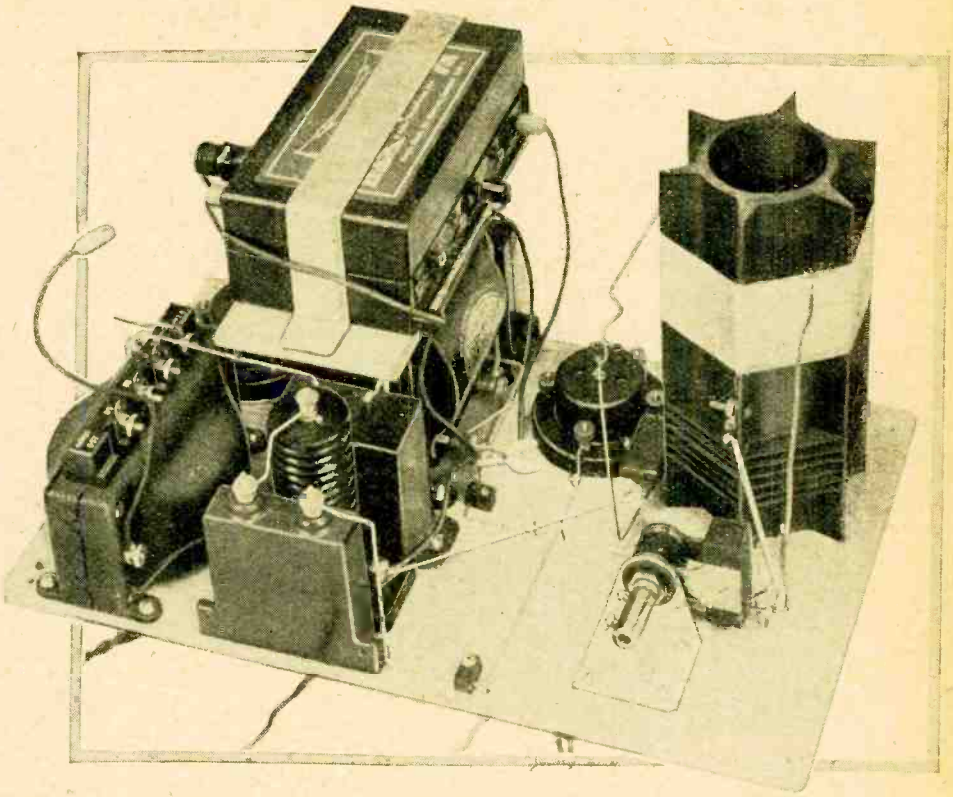
The eliminator unit is



Components on the back of the front panel must be assembled and wired before fitting the screening box to the baseboard.

[1] March 27th and April 3rd, 1929.

The Flat-Dwellers' A.C. Three.—built up on a panel carrying a sub-stage mounted on ebonite pillars. The three pillars marked A in Fig. 12 are secured top and bottom with countersunk screws and serve to hold the sub-stage rigid during assembly. The remaining pillars B are fitted at the bottom with lengths of 4B.A. screwed rod which pass through clearance holes for holding down the corners of the eliminator base to the screening box and the main baseboard of the set. The sub-stage carries the filament potentiometer, the smoothing condensers and three of the eliminator resistances. Two of these are wire-wound and the third—a moulded resistance—is suspended on the wiring across the smoothing condensers. The method of fixing the smoothing condensers is interesting; the two 1 mfd. condensers are used to clamp down the projecting feet of the metal-cased 2 mfd. condensers, as it was found that the spacing of the screw holes in the moulded condensers was of just the required width. The two smoothing chokes are mounted horizontally underneath the sub-stage.



The receiver unit wired ready for assembly in the screening box.

The wiring of the eliminator unit is quite simple. In all there are eight leads passing through the base, two each for the mains and filament heating circuits, three + H.T. leads, and one for the cathodes and common H.T. negative.

With the receiver and eliminator sub-panels completed, the work of assembly may be commenced. Instructions have already been given for drilling the bottom of the screening box, but before fixing the box to the baseboard, holes must be drilled for mounting the 0.0005 mfd. variable condenser and also a clearance hole for the switch extension rod.

The receiver and eliminator units may now be inserted in their respective compartments in the screening box. To facilitate the passage of the wiring through the bottom of the box, lengths of flex were soldered to the rigid projecting wires to serve as "pull-throughs." Unless this device is adopted, some difficulty may be experienced in fitting the wiring to the holes, particularly in the case of the eliminator unit. The box may now be fitted to the baseboard and secured with countersunk screws and nuts at the corners of sub-bases inside each compartment. Threaded rod is provided for the holes at the left of the eliminator unit.

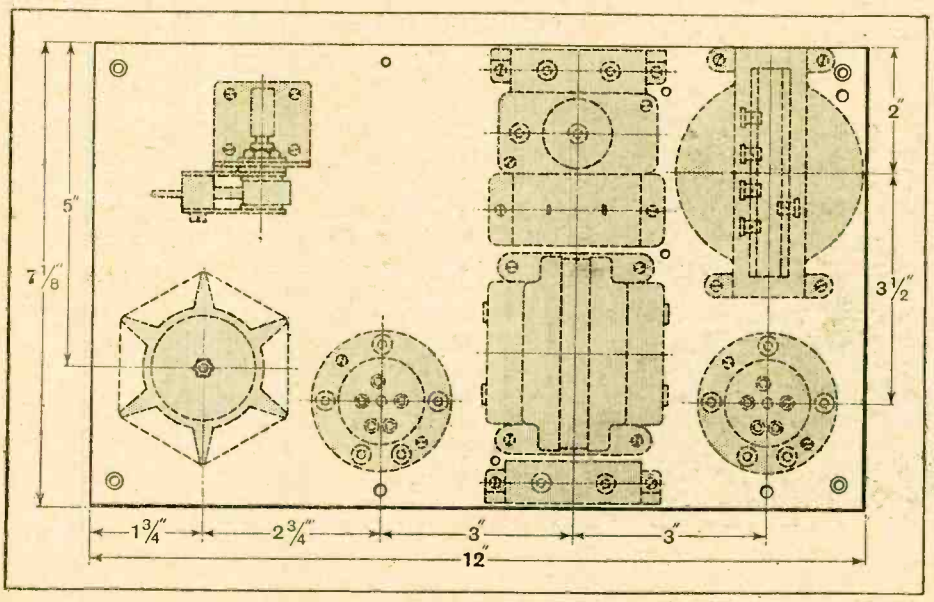


Fig. 11.—Layout of parts on the receiver sub-base.

The Flat-Dwellers' A.C. Three.—The next step is to centre the wave range switch in the oversize hole H in the brass bracket and to fit the extension rod for the wave range switch through the bush B, tightening up the set screws in the connecting sleeve, after which the variable condenser can be assembled inside the receiver compartment. The paxolin extension rod should first be locked in position in the hollow condenser spindle. Now, holding the ebonite extension tube (R in Fig. 9) in one hand, take the condenser in the other and insert the paxolin spindle through the clearance hole in the screening box into the end of the ebonite tube and draw the condenser up to the side of the box with the three countersunk screws provided. The brass rod for the dial movement is next inserted from the front through the bearing plate P, and after fitting the dial, the set screws in the tube R may be tightened up, taking care that the dial reading corresponds with the position of the vanes inside the condenser. The wiring of the condenser (C2) can now be completed, making sure that the grid lead from one side of the condenser, C_{11}, and connection "a" on the grid coil goes to the fixed vanes. To complete the wiring it is now necessary to make the interconnections between the leads projecting through the base, in accordance with the lettered wiring plan, not forgetting the earthing lead E.

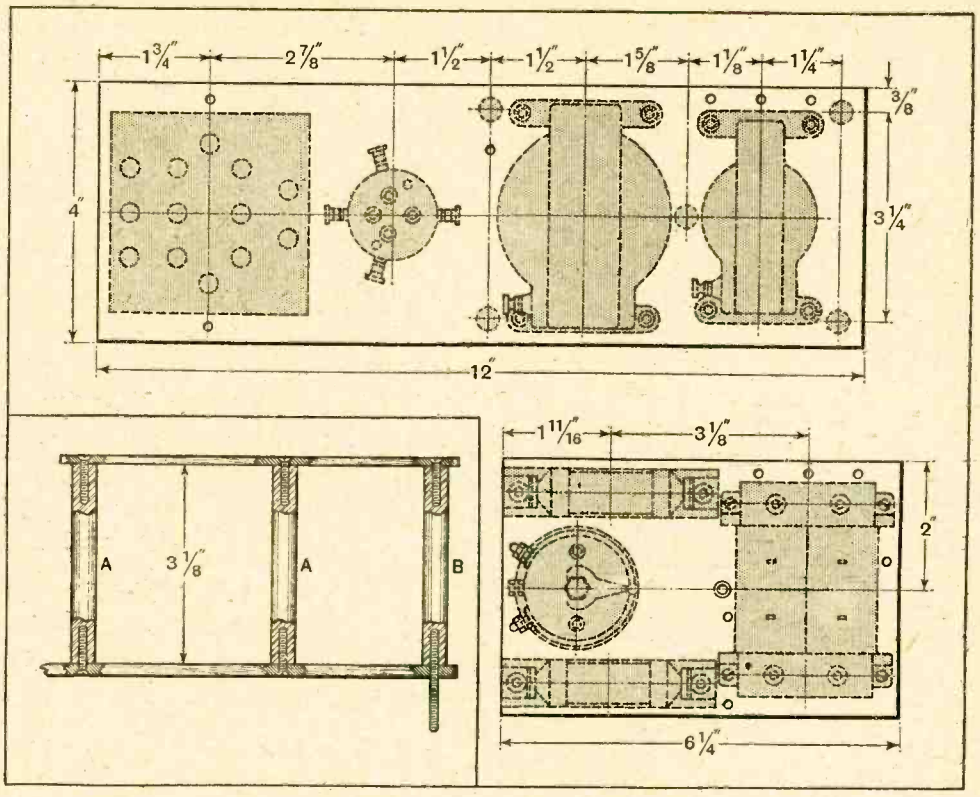
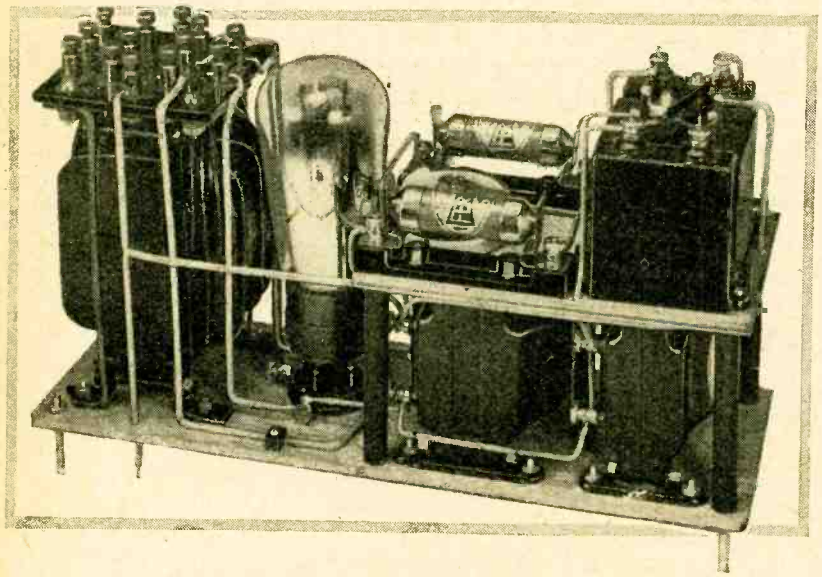


Fig. 12.—Layout of parts on the eliminator base and sub-stage showing method of mounting ebonite supports. The metal-cased 2 mfd. condensers on the sub-stage are held down by the moulded 1 mfd. condensers.

The set is now ready for testing. First inspect the fuses associated with the power point from which the set is to be worked. These should be replaced with 5 amp. lighting fuses, or, better still, No. 47 S.W.G. copper wire which fuses at 1 amp. If such a course is impracticable, due to the fact that more than one plug is supplied from that particular fuse, it will be necessary to fit a pair of fuses externally in the leads from the power plug to the set. "Sifam fuses rated at 1 amp. (fusing current 1.5 amp.) are quite suitable for this purpose. The holders may be screwed to a small ebonite or paxolin panel and mounted in a protected position.

Having connected up the loud speaker and frame aerial—preferably the short-wave—join the earth lead to the water pipe or the earthed casing of the house wiring, set the potentiometer in the rectifier compartment to the mid-position, screw down the lid of the screening box, and switch on. After about ten seconds, during which time the filaments are heating up, a faint hum should be heard



Rectifier and smoothing unit before assembling in screening box.

The Flat-Dwellers' A.C. Three.—

indicating that the circuit is alive. This hum should not be sufficiently loud to interfere with the reception of any of the stations marked on the left of the calibration chart. If it is, switch off the set, remove the lid, and try various settings of the filament potentiometer, replacing the lid for each test. Experiments have proved that there is a slight residual hum due to pick-up in the core of the A.F.5 transformer. It is cured by substituting resistance coupling, but at the cost of a considerable reduction in all-round efficiency. The writer, therefore, prefers to retain the transformer coupling, as the hum is not sufficiently serious to interfere with the dozen or so stations which can be enjoyed from a programme point of view.

The reader will soon find the settings of the screen-grid potentiometer on the left of the panel which give best results. In the original receiver it was found that a lower setting was necessary for the long waves. On this band 5XX, Radio Paris, and the Eiffel Tower are prominent. The tuning goes down to about 500 metres, and the transmissions of the civil aviation services are well received on the 900-metre band.

As is only to be expected with frame aerial reception

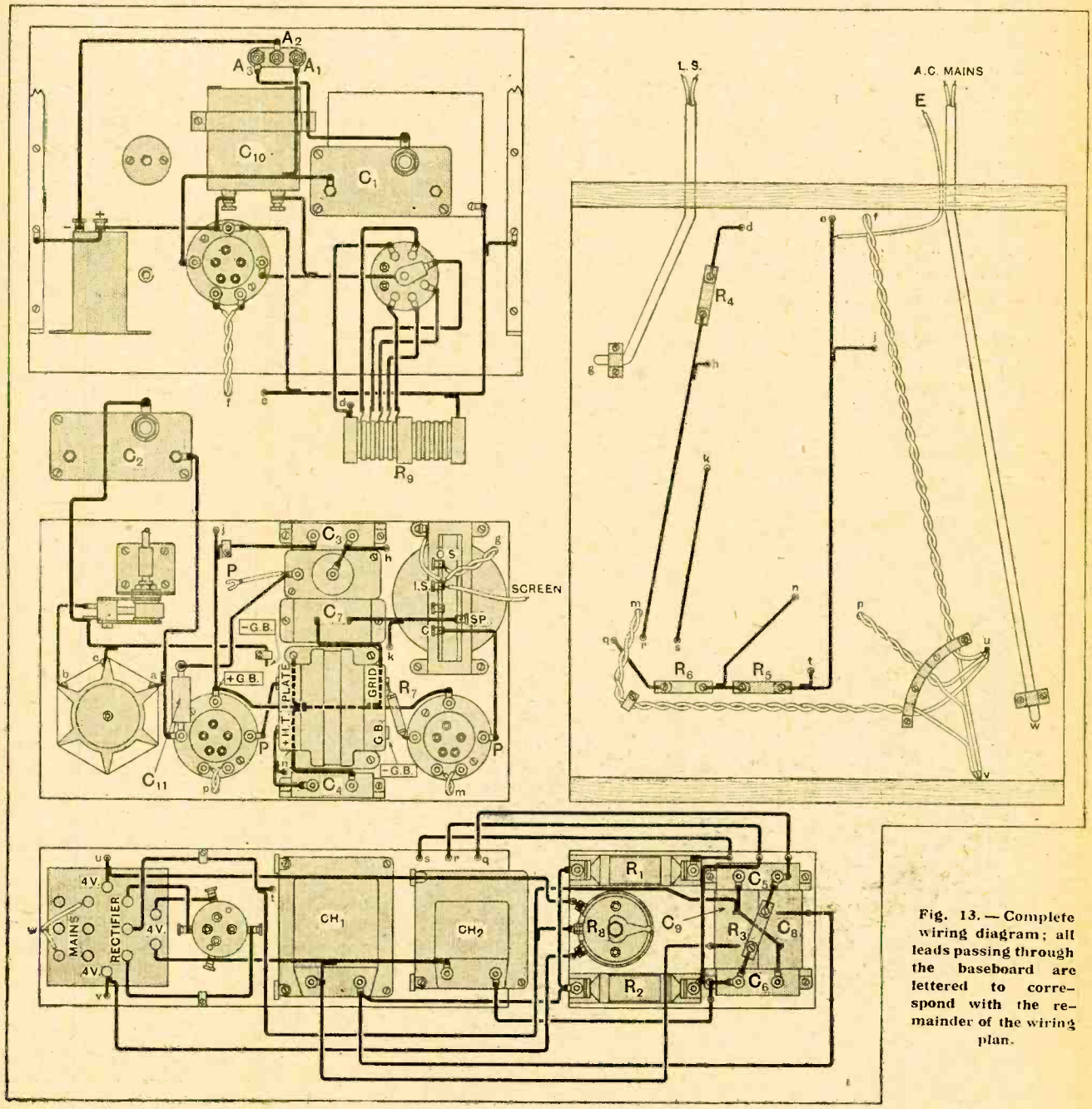


Fig. 13.—Complete wiring diagram; all leads passing through the baseboard are lettered to correspond with the remainder of the wiring plan.

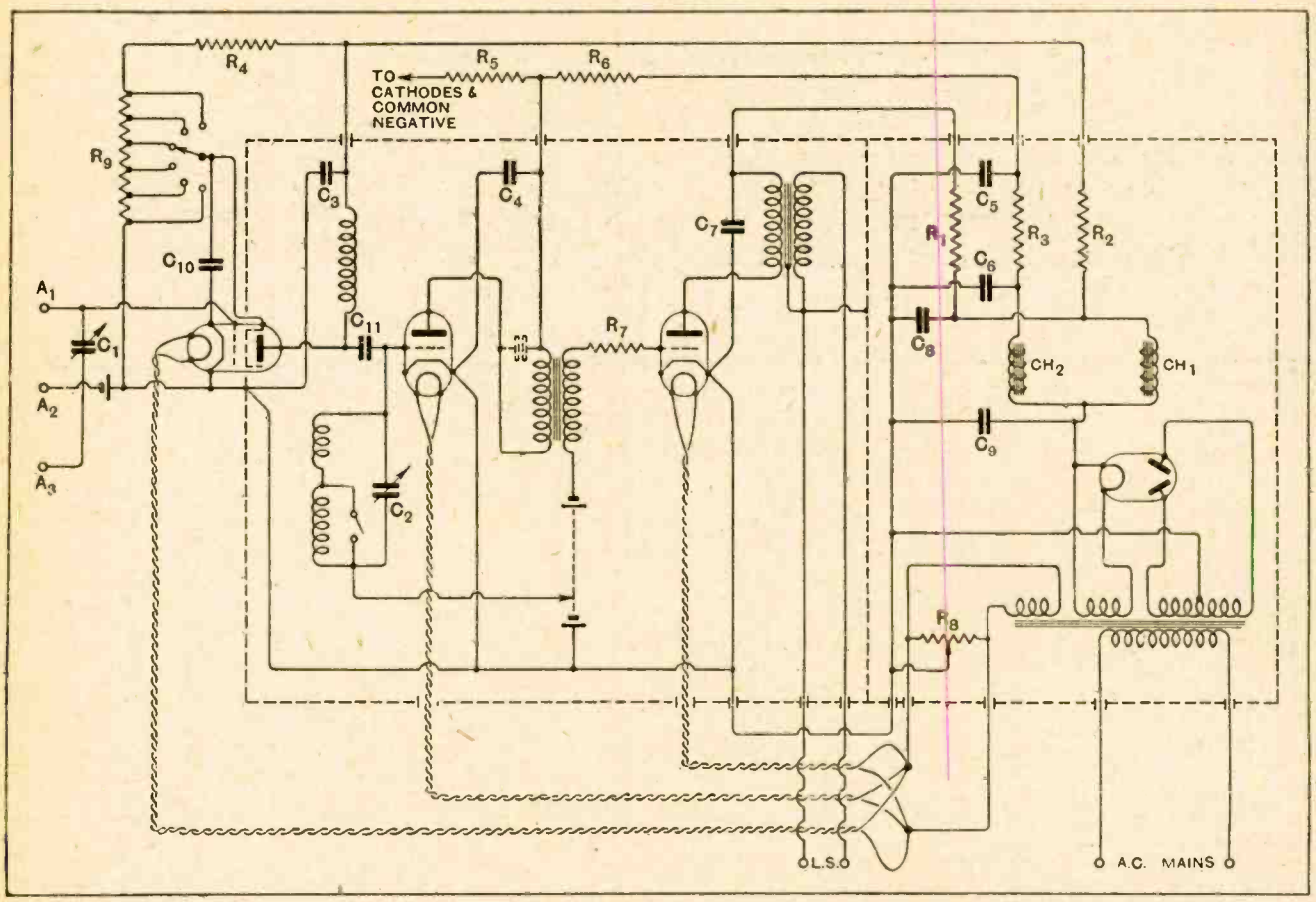


Fig. 14.—Complete circuit diagram. C_1, C_2 = 0·0005 mfd. variable; C_3, C_4, C_7, C_8 = 1 mfd. (400v. D.C); C_5, C_6, C_9 = 2 mfd. (250 A.C); C_{10} = 2 mfd. (Ferranti Type C2, 500v. D.C); C_{11} = 0·0002 mfd.; R_1 = 8,000 ohms, wire wound; R_2 = 15,000 ohms, wire wound; R_3, R_4, R_5, R_6 = 25,000 ohms, moulded; R_7 = 0·25 megohms; R_8 = 400 ohms; R_9 = 20,000 ohms; CH_1 = 22/50 henrys (50 mA.); CH_2 = 20/48 henrys (7 mA.).

selectivity is beyond reproach. For instance, Barcelona (350.1 metres) was received clear of 2LO (358.9 metres). In a set of this type the aerial circuit tuning is sharper than the H.F. coupling, and it is advisable to use the left-hand dial for calibration rather than the right.

In conclusion, the writer ventures to think that the present receiver is indicative of the future trend of domestic receiver design. National schemes for the standardisation of 240 volt, 50 cycles A.C. supply will, in the near future, enable the majority of listeners to avail themselves of the advantages, both as regards efficiency and maintenance, of indirectly heated valves. The phenomenal increase in efficiency will encourage a more general use of frame aerials, and it is not too much to hope that we may soon see a falling-off in the crop of masts and poles which sprang up under the influence of broadcasting to disfigure our houses and gardens.

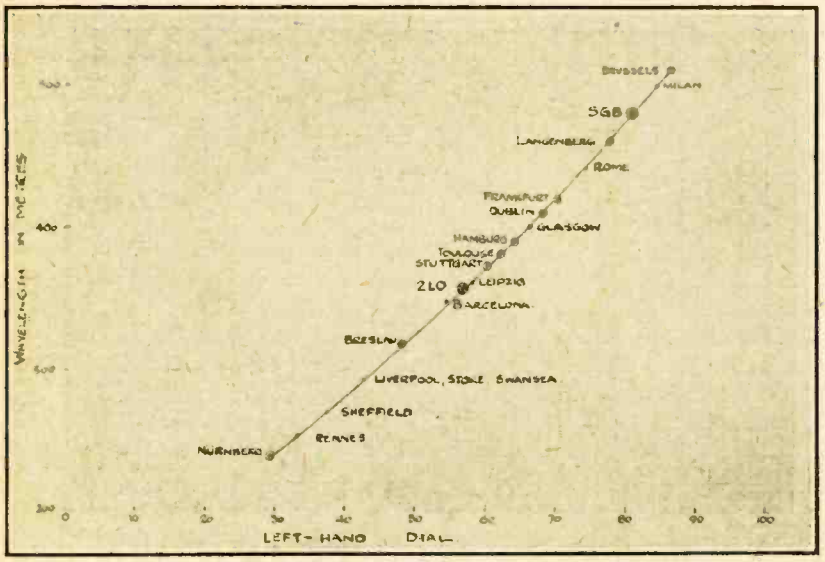
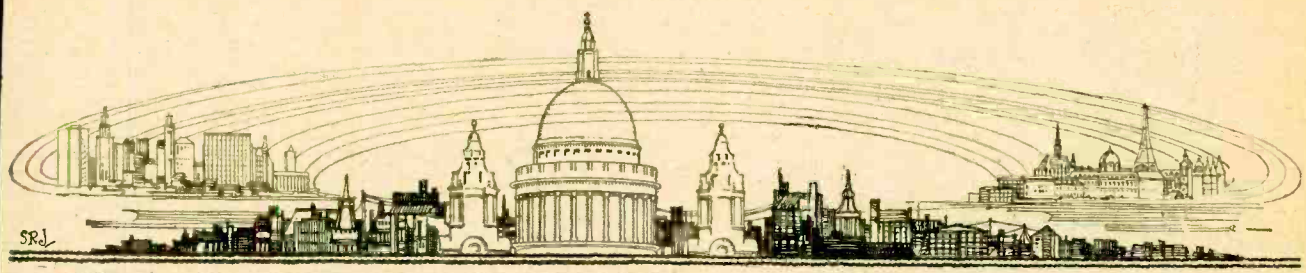


Fig. 15.—Calibration chart for the lower wave band made during a test at a place 20 miles north of London. Stations marked with one or more circles were enjoyed at full loud speaker strength without interference.

This receiver will be available for inspection at the Editorial Offices, 116/117, Fleet Street, London, E.C.4.



CURRENT TOPICS

Events of the Week in Brief Review.

KOENIGSWUSTERHAUSEN ON SHORT WAVES.

So advanced is the work on the Koenigswusterhausen short-wave station that its preliminary tests may be expected at any moment.

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NO MORE CONCERTS FROM FL?

Rumour has it that the Eiffel Tower, Paris, will soon devote its transmissions entirely to telegraphy, the broadcast concerts being abandoned. The French Radio Industry has now planned the erection of a 100-kilowatt transmitter some few miles outside Paris.

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"A MUSICAL INSTRUMENT."

The Southend magistrates have decided that a loud speaker is "a musical instrument worked by mechanical means." The decision was the outcome of a case in which the owner of a wireless shop was fined £2 for operating a loud speaker from an upper window to the annoyance of other tradesmen in the neighbourhood. The defendant gave an undertaking to abate the nuisance.

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RADIO AT PARIS FAIR.

A wireless section will form part of the 1929 Foire de Paris, which opens on Saturday next, May 11th, in the Parc des Expositions. Whilst a number of interesting exhibits may be expected, writes our Paris correspondent, it is unlikely that novelties will be numerous as most of the important wireless products of the French market are reserved for the official Salon in October. The Fair closes on May 26th.

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EARLY MORNING BROADCASTS FROM GERMANY.

The main German broadcasting stations, each in turn, give one night concert every month, the transmission starting at midnight and continuing until 1.30 a.m. This month the arrangements are as follows:—Langenberg, May 9th; Breslau, May 11th; Munich, May 14th; Koenigsberg, May 17th; Stuttgart, May 22nd; Leipzig, May 25th; and Frankfurt, May 30th. The broadcasts will also be taken by the individual relays. Calls are frequently given during the intervals, as it is realised that these late transmissions are of interest to foreign listeners.

SHORT-WAVE SET AT THE VATICAN.

According to Press reports, a powerful wireless transmitter will shortly be installed in the Vatican, enabling the Pope to address the Faithful in all parts of the world. It is understood that short waves will be employed.

WHITSUN.

Owing to the Whitsun Holiday the latest date upon which small advertisements can be accepted for *The Wireless World* of May 22nd is Wednesday, May 15th.

PICTURES FROM HOLLAND.

Owners of and prospective owners of still-picture receiving apparatus will be interested to learn that a Fultograph photo-electric transmitter has now been installed at Hilversum. Experimental broadcasts of still pictures are beginning early this month, and it will not be long before a regular service is in operation. With 5XX, Hilversum and Radio-Paris as "daylight" stations and 5GB, 2LO and Vienna after dark, an excellent picture service is ensured for the present summer.

HIGH POWER BROADCASTING FROM ITALY.

According to a report we have received from Rome, the proposed high power broadcasting station will be erected at Frascati, a popular summer resort, only 15 miles south-east of the Italian capital. The aerial masts will be situated on the Alban Hills, 980 feet above sea level.

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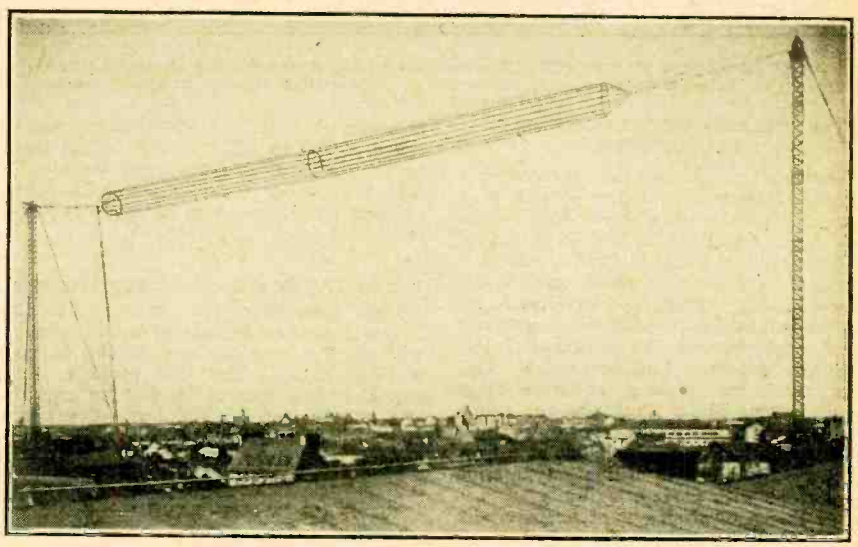
DOG DEVOURS AERIAL.

A dog's appetite for wireless held up the operations of the Byrd Antarctic Expedition a few days ago, according to a radiogram received by the Kolster Radio Corporation. One of the Eskimo dogs, evidently dissatisfied with the regular *table d'hôte*, found his way to the roof of the wireless cabin on the "City of New York," the flagship of the Expedition, and fastened his teeth in the loop aerial of the radio compass. The heavy insulation of varnished braid and cambric at once appealed to his palate, and he continued chewing after he had reached the high-frequency cable.

It was several days, says the report, before the radio operators were able to renew contact with the Expedition's wireless-equipped aeroplanes.



BROADCASTING IN SWEDEN.—This view of the aerial of the Stockholm broadcasting station explains why signals are strong.

WIRELESS AND SAFETY AT SEA.

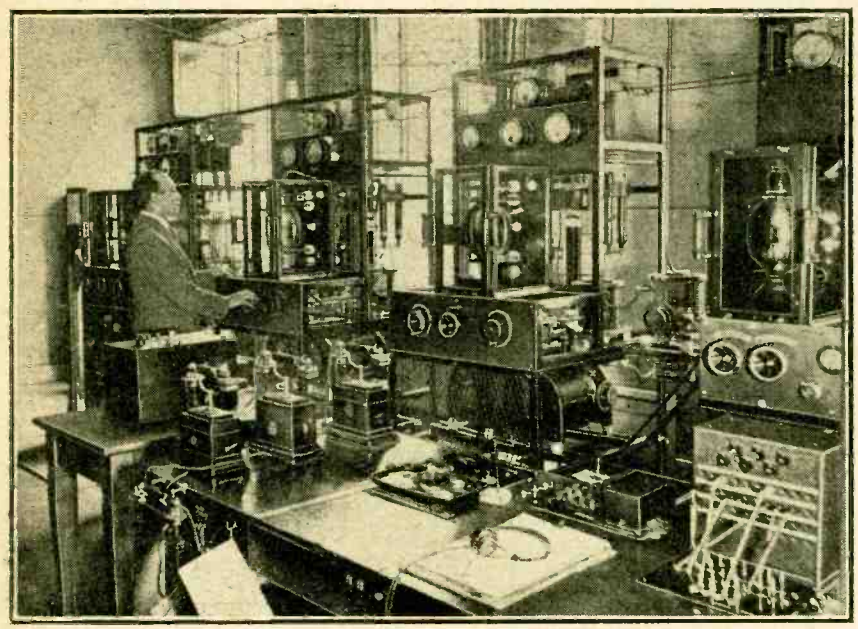
Among the several committees set up by the International Conference on Safety of Life at Sea now meeting in London, is one dealing with wireless telegraphy. This committee is under the chairmanship of Herr H. Giess, Ministerial Councillor in the German Ministry of Posts. Two sub-committees have been formed. One of these, dealing with technical questions, is presided over by Mr. Bland van den Berg, Inspector of Coast and Ship Radiotelegraphy in the Netherlands Government service; the other sub-committee is under the chairmanship of Lieut.-Commander C. P. Edwards, Director of Radio under the Canadian Government, and is discussing the question of compulsory wireless on ships and hours of watching for distress signals on various types of vessel.

FISHING WITH WIRELESS.

Reports received by the Marconi International Marine Communication Company from a number of steam trawlers on which Marconi apparatus is installed indicate clearly that its value is very considerable. Units of fishing fleets have been enabled to communicate throughout their operations and by exchanging reports of fishing conditions to concentrate on the grounds where working was found to be most profitable at the time.

In addition, by keeping in touch with the owners the trawler skippers have been enabled to obtain last-minute market reports, and to land their catches at the ports where prices were most favourable.

Practically all the Marconi-equipped trawlers carry ¼-kilowatt transmitters of the quenched-gap type with two-valve receivers—type M.R.4 C.—having a wave range of 200 to 3,000 metres. With this apparatus trawlers are able to communicate with other trawlers and with land stations over distances of 200 to 300 miles and more.



THE STOCKHOLM TRANSMITTER, which has an aerial power of 1.5 kilowatts. The station works on a wavelength of 438 metres. It supplies regular programmes to ten relay stations.

EXCHANGE QUOTATIONS BY FULTOGRAPH.

The use of Morse for transmitting lengthy messages to ships at sea may become obsolete in view of the system now being exploited on the three liners, "Orvieto," "Avilla" and "Minnewaska." On each of these vessels picture-receiving apparatus has been installed in association with wireless equipment designed by the Marconi International Marine Communication Co., Ltd., and the nightly bulletins from Rugby giving Stock Exchange quotations are now transmitted by the Fultograph system. Experiments show that at ranges of thousands of miles ordinary typescript is received with perfect legibility.

For this enterprising experiment credit is due to the Wireless Press, Ltd., who supply the news, and Wireless Pictures, Ltd., who are responsible for the transmitting and receiving apparatus.

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VALVE TAX FOR FRENCH LISTENERS ?

New proposals for taxing French listeners are embodied in a Bill which will shortly be considered in the House of Deputies. The Bill provides for annual licence fees of 3s. 6d. for crystal sets and 7s. for the simplest valve sets, and a rising scale in accordance with the number of valves in use.

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VIENNA'S SHORT-WAVE STATION.

"Hier Kurzwellensender Ravag, Wien," is the call put out by the new Vienna short-wave transmitter which is eventually destined to relay the programmes from the capital. During the present nightly tests its power is limited to some 40 watts in the aerial, but the signals have already been clearly picked up in various parts of the Continent.

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RADIO IN U.S. NATIONAL DEFENCE.

A Bill to establish a commission for regulating "all common carriers engaged in the transmission of intelligence by wire or wireless" is to be laid before the United States Senate by Mr. James Couzens, of Michigan, who contends that the State should exert as much control over radio as it does over the railroad and other transportation facilities, with the object of organising a system of national defence.

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PICTURES FROM RELAY STATIONS.

Readers who are able to receive the Fultograph transmissions from Vienna on 520 metres occasionally find that the pictures are spoilt by interference. It is interesting to note that the difficulty can sometimes be overcome by tuning in Linz on 350 metres, as this station acts as a relay to Vienna.

In addition to the transmissions of still pictures from Koenigswusterhausen, pictures are also sent from Berlin (Witzleben) at 8 p.m. on several days of the week, and are sometimes relayed by other German stations.

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ELECTION SPEECHES ON THE GRAMOPHONE.

A set of historic gramophone records which should play a prominent part in the coming Election campaign has been forwarded to us by the Columbia Graphophone Company, Ltd. They consist of political speeches delivered under the auspices of the Conservative, Labour and Liberal Parties, and the speakers include Mr. Stanley Baldwin, Mr. Ramsay MacDonald, and Mr. Lloyd George, besides other prominent members of each party.

Apart from their political appeal, the records are technically interesting on account of the remarkable purity of reproduction. We understand that they are now available for sale to the general public.

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INTERNATIONAL WIRELESS SHOW.

Fribourg, Switzerland, will be the seat of an International Wireless Show from September 7th to 15th next. The Swiss broadcasting authorities will take an active part in organising the exhibition, which will be representative of all the leading European countries.

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WIRELESS AND OIL DEPOSITS.

The report that wireless was to be used for locating oil deposits in America is discounted by an official decision of the Federal Radio Commission, which has granted 12 licences to the Interstate Geophysical Explorations Company for radio intercommunication between oil surveyors. It is definitely stated that radio waves will not be used for "sounding" purposes.

The World at your Finger Tips

A WANDERER RETURNS TO THE "OLD GAME"

By B. H. DAVIES.

ONCE upon a time I used to delight in constructing high-powered wireless receivers. My den was lumbered up with enormous sets, rising once to the height of a ten-valve superhet., hooked up along an enormous plank, or an extremely inefficient tangle commencing with three V24 valves tuned by a triple-ganged condenser on the H.F. side.

In those days I had a first-class aerial, 50 feet high, and delightfully situated far enough from the coast to dodge the shipping Morse and the noisier French coastguard stations. But my valve bill dwindled when I moved to a house on the coast, abominably situated in a direct line between 5XX and Paris, and hemmed in by nursing homes stiff with violet-ray apparatus. Simultaneously the advent of super-power output valves and better loud speakers taught us all something about quality reproduction; so it came about that a fairly simple set was left permanently tuned in to 5XX. The 300-500-metre band stations were smothered with Morse, and quite impossible. Barring Hilversum, the long-wave foreign stations were always inferior to Daventry. So we got into the way of depending on a single transmitter.

We lazily informed ardent dial-twiddlers that it was technically impossible to bring in distant foreign stations without using lots and lots of reaction; and if you pump a moving-coil speaker full of stations dragged in by hanging on to the brink of oscillation with your eyebrows, why, the resultant noise is worse than an organ-grinder with a tenth-hand organ. Then one day an ingratiating person unloaded a *Wireless World* "Kilo-Mag IV" from his motor car and insisted on my hooking up batteries to it, and returning to the old game of searching the ether. We consented, solely in order to show him what an idiot he was.

> THE tale of one who, having pitched his dwelling in the Sunny South, found that Morse from the sea and ultra-violet rays from home (nursing) threatened to warp his wireless, but . . . .

A job lot of batteries was hitched up to the "Kilo-Mag IV" with the aid of some odd bits of flex. The three dials were spun experimentally, but a deathly silence brooded over the room. "Got any shock absorbers on your car, old man?" Three pairs of practised eyes scanned the wiring suspiciously for a "dis.". Ten deft fingers plucked at the joints of the circuits in search of a fractured connection. But the owner turned the dials purposefully and the moving coil suddenly began to throb violently. The deathly silence was merely the silent background of the "Kilo-Mag" when untuned to a transmitter. We acknowledged this one indisputable merit with knowing looks, and immediately heaped scorn on the rotund melodies which shook the ornaments on the mantelpiece. "Well, what d'you think of *that*?" enquired the triumphant owner. I snapped contemptuously, "I can do Daventry every bit as well as that on a detector and two note mags with swinging coil reaction." (I couldn't, but conceit in others must be discouraged at all costs.)

Not What it Seemed.

"*Daventry?*" hissed the scandalised owner; "you just wait!"

We waited.

The band clashed triumphantly up to its finale.

Came the silence of the interval.

Seconds passed.

These long intervals simply scream "Foreigner" to a practised listener. Foreign announcers don't spring for the microphone, B.B.C. fashion, the instant that the conductor's baton shakes the last instrument to rest.

More seconds passed.

At last we distinctly heard some infinitely distant person take a deep breath before an

Paris "at home."

The World at Your Finger Tips.—

invisible microphone, and a garlicky kind of voice masticated some phrase in which the words "Radio Torino" were definitely intelligible. *Turin?* With real quality and terrific volume silhouetted against utter silence? It couldn't be; yet it *was*!

When all doubt was removed we seized a writing-pad, ruled out three vertical columns and began a station log. I won't pretend that the log even now poses as a scientific document. It certainly contains records of over seventy dial settings. But we haven't definitely identified more than about forty of the stations which we have heard. By "definitely" I mean that we have not heard the announcers of some thirty of them say their little piece. We have drawn out shapely graphs on squared paper, with wavelengths up the left-hand margin and condenser

"Suburbia," Reykjavik.

degrees along the floor line; and we fancy we know that such and such a black blob on the graph line is Reykjavik, and so on; but we can't speak Icelandish, and quite a lot of the other languages concerned; and the worst of foreigners is that they will talk so fast; and we don't subscribe to a programme paper, because we thought we had given up station-hunting for good. But the men of the house are admitting with enthusiasm that station-hunting with a superhet. or three V24 valves is one thing, and station-hunting with razor-sharp tuning and real quality against utter silence (i.e., with a "Kilo-Mag IV") is an entirely different proposition.

A Talks Eliminator.

Moreover, in wireless matters—after dinner, at any rate—the last word rests with Joan. Joan is one of the newly enfranchised flappers. She is going to vote either Liberal or Socialist. (She doesn't much care which.) This sudden switch from 18 years of fierce Conservatism on her part is simply and solely due to the B.B.C. She understands that the B.B.C. is now a Government department, and that its directors would go out into opposition with Baldwin and Hicks and Churchill. This determines her vote. Fairness, she avers, reconciles her to an occasional talk on how newts breathe, or why Ruritania has ordered six new *minenwerfer*. But *three* dull talks, one after the other, and that on a Saturday night, completely undermine her political principles. She is going to ask the local Socialist candidate at his next meeting if he will pledge his party to broadcast jazz from 8 p.m. till midnight daily, and a maximum of one talk per day. Meanwhile, father, since you *can* make a wireless set which will bring in some topping music when 5XX is having a prolonged spasm of mouldy talks, why *don't* you? And this copper-box affair, she continues, doesn't compel you to change coils and sting your fingers because you forgot to switch the mains off first! You just pull down those three dinky little levers; I can even do it myself. And somehow or other it doesn't pull in that awful Morse, even on the short waves! And altogether, what about it?

So I fell to wondering whether it was a frightful job to turn Edison Bell coils into transformers, and to solder up the joints deep inside those copper cells. And so Saturday came, and 5XX sank into silence at 2 p.m. and the B.B.C. promised nothing more till 3.30 p.m., and it was raining cats and dogs. Hugh reminded father that we hadn't listened to the aeroplanes for donkeys' years. Father looked grave. Would the long-wave transformers tune as low as 900? And could he bring in the variations of the plane aerials with three dials? Anyhow, he made the gallant attempt. "C-R-RR-OY-DON," rasped out instanter, followed a few seconds later by the *je vous écoute* of a Goliath pilot. Then Croydon got in an awful paddy because some pilot had given the registration number of a bus which wasn't supposed to be in the air at all. The pilot sulked when he was called up again, and finally Croydon called up an R.A.F. aerodrome, which thought the number was wrong, and all the ground officers got very hot and bothered indeed.

Building Up a Log.

When we tired of this fracas, a brief twiddle brought in a most mellifluous concert from Hilversum so violently that the volume control had to be operated hastily for fear of buckling the paper cone on the

Spanish joys.

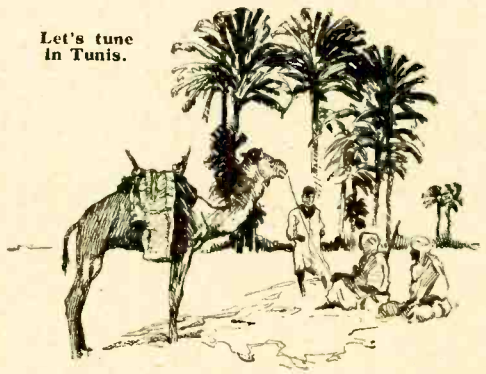
speaker. By mid-afternoon we had listened to ten or a dozen long-wave stations, and after dinner that night we gradually built up a record log on 300-500-metre stations.

By this time the "Kilo-Mag IV" had completely reconverted a little coterie of *blasé* ether-hunters, who thought that they would never return to the lost thrills of listening through far-flung space to foreign stations. Its great virtue is that at every few degrees round the dials there is certain to be a foreign station with the

The World at Your Finger Tips.—

volume and quality of 5XX, which is sure to provide an interesting item when 5XX is busy with fare appealing only to a few selected connoisseurs. Such a set takes the boredom out of broadcasting.

By now the set has been tried on (*a*) a frame aerial; (*b*) an indoor aerial, consisting of flex looped round a picture aerial; (*c*) an ordinary G.P.O. aerial run from a low garden tree to a chimney; and (*d*) an expert's aerial stretched from a 50ft. steel mast to another mast on a tall house. It works most excellently on all of them. In emergencies it can give first-class results off a few stations with any old aerial hook-up that the user cares to improvise. On a thoroughly poor G.P.O. aerial it will make Turin and Cologne and Vienna and all the better European stations sound like 5XX at 50 miles on a first-class set; and on a fine 40ft. or 50ft. aerial it will bring in the whole world, from America downwards. The most extraordinary feature about it, to my thinking, is its background. It does not, as one would expect, drag in a constant squittering of unwanted mush. Heterodynes necessarily exist in the present crowded state of the ether; but if a heterodyne can be resolved by any set, the "Kilo-Mag" will do it. For example, London, Leipzig, and Paris (Radio LL) constitute a heterodyne on many powerful sets, for their respective wavelengths are 361, 366, and 370 metres. But with a little simple manipulation of the three dials each can be heard at full L.S. strength without a trace of the other two. Or, again,



Let's tune in Tunis.

Cologne roared in with such terrific force that it was audible over the first 40 degrees of the short-wave range on rough tuning, with two dials more or less right, and the other dial a few degrees out. But a little labour gradually tuned Cologne right out, and brought in *six* other stations on slightly shorter wavelengths.

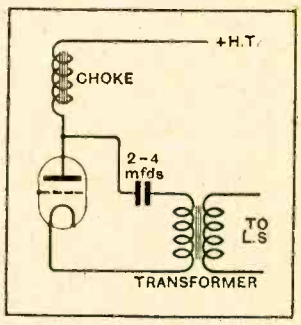
The three dials can be operated with extreme ease after a few well-spaced logs have been made. The setting of the first dial naturally depends on the aerial in use, but the second and third dials keep tolerably well in step. For instance, on Cologne they both read 40; on 2LO, 100 and 102 respectively, and on Budapest, 173 and 175. They are less in step on the long waves, reading 32 and 49 on Hilversum, and 110 and 130 on Radio-Paris. But these small discrepancies are readily grappled with, for the stations worth hearing are always audible with two of the three dials in tune.

In short, the "Kilo-Mag IV" has quite revised the doctrines firmly held a week ago by one household of inveterate listeners. We used to argue that the solution of all broadcasting problems was to aim at quality reproduction of the nearest British station, or of 5XX, if one lived near the coast. We now hold with equal ferocity the doctrine that one should use a "Kilo-Mag IV"; and when the 5XX programme happens to be boring to our particular circle, switch over to any of twenty powerful foreign stations, and you will soon hit an alternative programme which will cause you to view regional schemes with a cold, codfish eye.

COMBINING OUTPUT CHOKE AND OUTPUT TRANSFORMER.

How to Prevent Overloading and L.F. Oscillation.

THERE are in use a certain number of output transformers of comparatively small size, some of which carry on an independent existence as isolated components, and some of which are permanently built in to moving-coil loud speakers of the low-resistance type. If the owner of such a transformer tries to increase the power of his output stage, either by raising the anode voltage or by putting in a second output valve in parallel with the first, it may happen that the quality of reproduction becomes decidedly poorer than before, owing to partial or complete saturation of the core of the transformer under the influence of the much greater steady plate current that it now has to pass, resulting also in reduced inductance.



A choke-filter fed output transformer.

The most obvious cure for this trouble is to replace the transformer with a new one of more generous dimensions, built to work with the augmented plate current, but this is not always convenient, either because the transformer already to hand is a permanent part of the loud speaker, or because there is difficulty in obtaining a larger model to suit the speaker. In such a case the difficulty may be completely surmounted by providing a choke to carry the steady plate current, and connecting the primary of the output transformer in the position occupied by the loud speaker in a simple choke-feed output scheme, as indicated in the attached diagram.

This procedure has the additional advantage that it simultaneously diverts the bulk of the speech currents from the anode current supply circuits, and so checks any tendency to "motor-boating" that might otherwise occur; this advantage would not be obtained by replacing the old transformer by a new one of greater dimensions.

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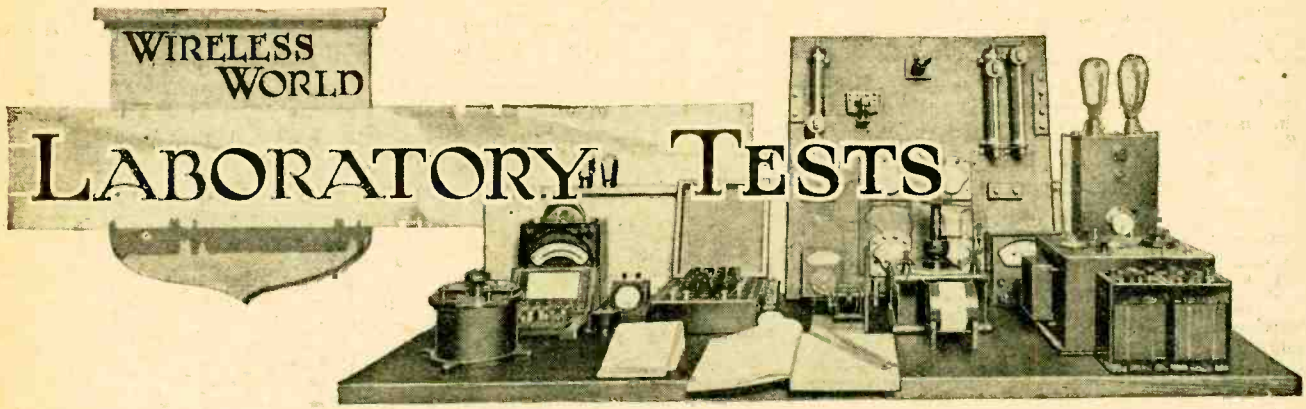
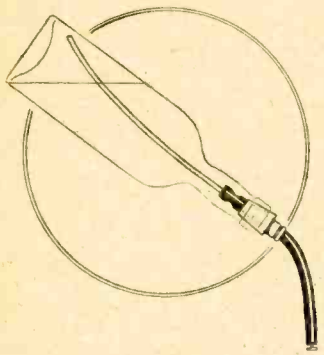


A Review of Manufacturers' Recent Products.

DISTO FILLERS.

Topping a high- or low-tension accumulator battery is a tricky business, and unless care is exercised much of the distilled water will be spilled and wasted. Many ingenious devices have appeared during recent years, all of which have many points in common, but the special fillers offered by Messrs. H. Jenks, Ltd., 54, Ebury Street, Eaton Square, London, S.W.1, seem to occupy a class apart.

The device consists of a long tube, sealed into a rubber stopper, and is intended to be used in conjunction with a discarded wine or vinegar bottle. The external end of the filler has a small valve which normally arrests the flow of water, but on pressing the tip of the spout against the top of the plates in the cell the valve opens and allows the liquid to flow. When the level rises to about ¼in. above the plates the supply is automatically cut off, thus preventing an overflow. The water enters the spout through a hole just below the bottom of



Disto filler for "topping-up" accumulator cells.

the stopper, and it is, of course, necessary to see that the end of the tube dipping into the bottle is above the level of the liquid when held in the position for filling, otherwise air will be unable to enter and the device will fail to function.

This device will be found particularly useful for "topping up" all types of accumulator cells used in wireless, although these fillers were developed originally for motor car batteries. Two types are made, but the one with the long spout will be the most useful to wireless users. These are being offered at 5s. each, plus 3d. for postage.

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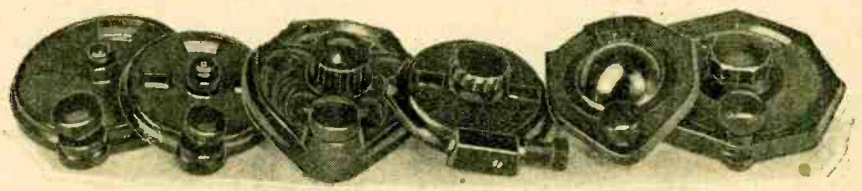
ISO DIALS.

These dials, which are of foreign make, are available in a variety of sizes ranging from the 3in. diameter "Baby 85" at 2s. 6d. to the handsome 4in. "Shield 125" at 5s. 3d. With the exception of two of the cheaper models, all dials are



Assortment of Iso Dials.

arranged for direct or slow motion drive. The "Baby 85" and the "I-K" dials are slow motion only, the drive being of the friction type operating against spring tension. There was no trace of slip in the samples sent in for review. The two-speed dials are fitted with gear drive and in certain cases, namely, the "Shield 125," the "Super-Nostra 114," and the "I-K" dials, are each provided with a bakelite indicating disc, thereby rendering these particularly suitable for use where both banks of vanes are at high oscillating potential, since hand capacity effects will be reduced to a minimum.

The indicating discs are engraved 0-100, both clockwise and anti-clockwise; the dials can be used, therefore, on any type of condenser fitted with a ¼in. spindle. All dials are enclosed in cleanly moulded black bakelite shells with wide open windows. The workmanship throughout is of a high order, and the mechanism compares favourable with that fitted to many of the more expensive dials on the market.

The sole agency for Iso dials in the British Isles has been acquired by Messrs. Haw and Co., Ltd., 20, Cheapside, London, E.C.2. Prices are as follows: "Super Nostra 114," 4s. 3d.; "Standard 100," 2s. 9d.; "Baby Precision 70," 4s.; and "I-K Iso Dial," 3in., 3s. 9d. (4in. 4s. 6d.).

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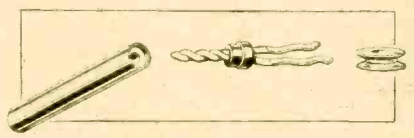
P. AND F. IDEAL TERMINAL.

This terminal consists of two parts, one, a hairpin-shaped clip attached to the wander lead, and the other a small grooved ring fixed to the point at which contact is desired. The bared end of the wire is threaded through the centre of a short length of rubber tube, which is provided with a metal sheath, and contact between the spring clip and the lead made by screwing the shank of the clip into the centre of the rubber inset. The outer metal tube restricts the expansion of the inner tube so that the wire is gripped firmly by the shank of the clip.



P. & F. Ideal spring connector.

To attach the wandering lead to the point of contact it is then only necessary to push the hairpin clip into the groove on the ring referred to previously. In the samples sent in for review small bushes are fitted to prevent the spring clip contacting with the metal tube. These are supplied in red and black for distinguishing positive and negative conductors. We think that an improvement could be made by employing outer tubes of insulating material, as this would confer a greater factor of safety. These could have distinguishing colours, and so answer a dual purpose.

These clips would appear to be particularly useful in portable sets, as they will not shake loose even though subjected to very severe vibration. The price, complete with grooved ring, is 6d. each, and the makers are Messrs. Priestley and Ford, 3, Carr's Lane, Birmingham.

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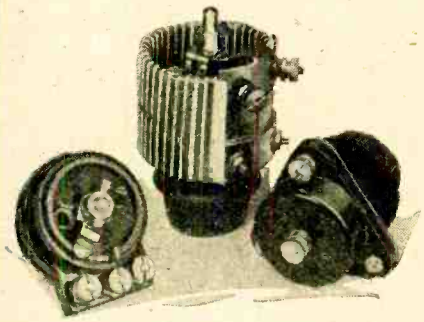
ROTOR-OHMS.

These are variable high resistances of foreign make, and are being marketed in this country by Rotor Electric, Ltd., 2-3, Upper Rathbone Place, W.1.

Particular interest will centre on those most suitable for volume control uses, and we accordingly submitted a sample potentiometer to a test. The model chosen had a nominal resistance of 500,000 ohms, and on measurement the actual resistance was found to be 490,000 ohms. The resistance element is protected by a wire-wound fibre strip, over which rides the moving contact. There is, therefore, no wear on the resistance element. Tests reveal that the resistance is fairly evenly distributed over the track, and it is quite unnecessary to connect the component in any special manner. These high resistance potentiometers are being offered at 6s. 6d. each, and can be obtained in five different values, ranging from 70,000 ohms maximum to 7 megohms.



Range of Rotor-Ohms.

The Heavy Duty Rotor-Ohm is a compression type resistance and rated to be variable from 5,000 ohms up to 10 megohms, and to dissipate 10 watts. Measurements showed that the minimum value was not too well defined, as this could be made very much smaller than the makers' figures by applying a little extra pressure to the knob. A minimum of 2,000 ohms was obtained and the maximum value attained was found to be well over 10 megohms. This sells at 7s. 6d.

A heavy duty filament rheostat was included in the samples sent in for review. The resistance takes the form of a strip wound on asbestos, and since the maximum value is 1.86 ohms only its usefulness will be restricted to employment in power amplifiers where the filament current may be of the order of amperes.

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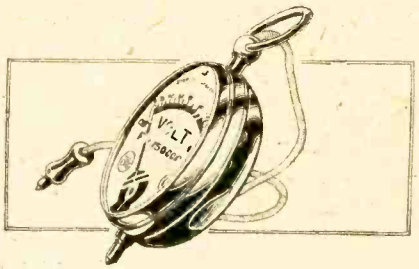
HOLZMAN POCKET VOLTMETER.

A voltmeter reading to 150 volts is indispensable in the correct operation of a receiving set by way of assuring the correctness of anode potentials. Quite inexpensive instruments with only a moderate degree of accuracy are suitable for this purpose, and of this class is the new moving iron instrument, type No. 25, obtainable from Messrs. Louis Holzman, 37, Newman Street, London, W.1. By incorporating a permanent magnet the movement is both polarised and dead



Holzman Watch-Type voltmeter reading 0–150 volts.

beat, while its resistance is of the order of 15,000 ohms, or about 100 ohms to the volt. A current of 9 mA. gives a full scale deflection.

Appreciating that great accuracy is not a feature of this class of voltmeter, tests revealed that its readings give a fair indication of the condition of an H.T. battery. At 45 volts an error of minus 19 per cent. was found, but at 120 volts the reading agreed with that of a standard instrument. Over the more generally used part of its scale taken as between 100 and 150 volts, the average error was as small at 2.5 per cent. The price of the instrument is 7s. 3d.

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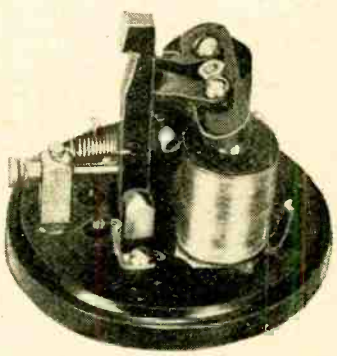
PICTURE RECEIVER PARTS.

Wilkins & Wright, Ltd., Utility Works, Holyhead Road, Birmingham, are specialising in the production of parts for the picture receiver. In addition to the relay, spindle and various contacts which have already been referred to in these pages, they now have available the other necessary components, including the trigger release and cylinder. A moulded bakelite base supports the release trigger movement which consists of a vertical two-spoon electromagnet with an armature attached to an extension piece on the trigger. Oblique pole faces convert the downward pull of the magnet so as to provide a sideways movement to the trigger. Contacts are fitted for energising the clutch circuit while the tensioning spring and controlling screw give critical adjustment. The winding has a resistance of 20 ohms and, therefore, passes a current of 0.3 amp. when connected in a six-volt circuit. A small current such as this is readily handled by the relay contacts. The trigger itself is of hardened steel so that it will not readily wear while the catch faces are suitably shaped to render adjustment easy.



Trigger release for Picture Receiver. A Utility Product.

Little comment need be made concerning the cylinder. It is of nickel-plated brass and well finished, is both light and strong

The Utility Cylinder.

and carries the necessary cams for actuating the switching contacts.

Readers experiencing difficulty in obtaining parts for making up picture receiving machines will obtain much helpful information by addressing an enquiry to Messrs. Wilkins & Wright, Ltd.

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AMATEUR BAND WAVEMETER.

This absorption wavemeter which we reviewed in our issue of October 17th last was subsequently found not to satisfy the requirements of the P.M.G. It has now been redesigned by the General Radio Laboratory, and the new model submitted to the Post Office Engineering Research Station.

In view of the recent stipulation that amateurs must possess a piezo-electric standard, it is interesting to learn in an official statement that this new wavemeter, which is of the absorption type, conforms to Post Office requirements.

This new model is known as Type 558-P Amateur Band Wavemeter, and is obtainable from Messrs. Claude Lyons, Ltd., 76, Oldhall Street, Liverpool.

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TRADE NOTES.

The "K.N." Electrical Products, Ltd., announce that they have moved to larger premises at 5, 6 and 7, Singer Street, Tabernacle Street, London, E.C.2. The telephone number is Clerkenwell 6643, and the telegraphic address "Kayenelec, Finsquare."

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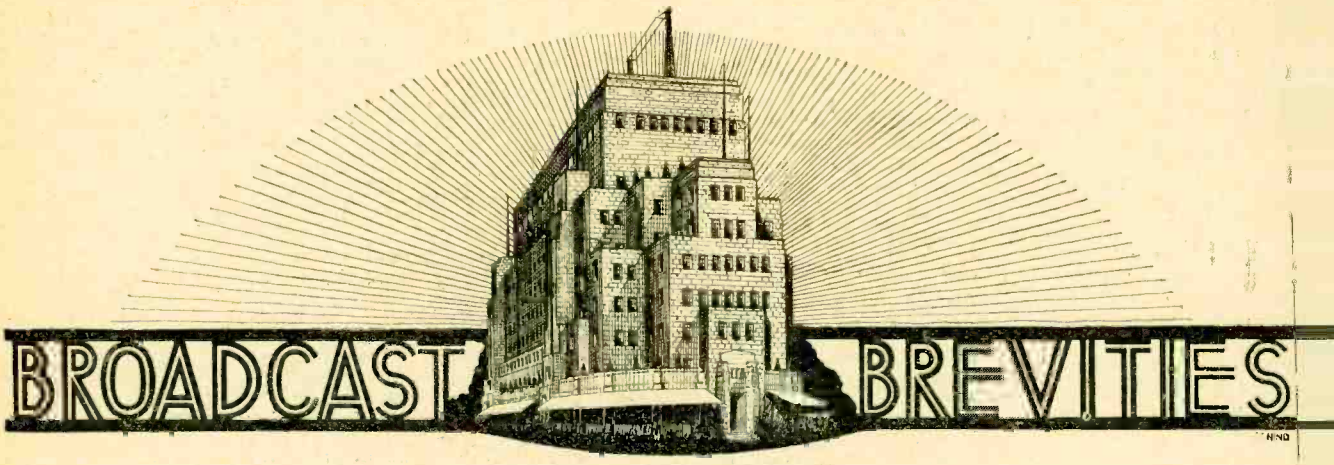
The entire business of A.F.A. Accumulators, Ltd., 120, Tottenham Court Road, London, W.1, has been acquired by Messrs. Pertrix, Ltd., who will carry on the business from the same address until further notice. The new company are equipping a factory at Redditch for the manufacture of Pertrix dry-cell batteries and all types of accumulators previously supplied by the vendor company.



By Our Special Correspondent.

Farewell to Keston.

After four years of service, the Keston receiving station of the B.B.C. is now to be scrapped. The good work is to be carried on by a more efficient station, to be erected two or three miles away near Tatsfield village. The actual site of this new B.B.C. outpost is Botley Hill, which adjoins the main road from Croydon to Westerham and Limpsfield.

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A Lofty Site.

The hill is 860 feet above sea level (Keston is not quite 600 feet high) and is the highest point in Surrey with the exception of Leith Hill. (I hear it suggested that the Tatsfield eminence be renamed Reith Hill!) The spot is an isolated one, so the only local interference to be feared will be that caused by the portables of picnicking parties, and the B.B.C. will know how to deal with these.

Officially the station will be known as the Tatsfield Receiving Station, and it is expected to be ready before the end of July.

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Self-contained.

The engineers at Tatsfield will continue the work now being done at Keston. This consists of checking the performance of each of the B.B.C. stations, tracing sources of interference, keeping a watch on British and Continental wavelengths, and occasionally relaying programmes from abroad.

A healthy independence will be ensured by the installation of a charging plant supplying storage batteries for lighting and power, and by the provision of camp beds.

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Wanted: "Doubles."

A fact which is coming to light with the departure of so many engineers from the B.B.C. staff is that there are not enough understudies. It seems that when a Big Man goes, he leaves behind him a number of mysterious gadgets—in various stages of experimentation—which no one else understands nor dares to touch for fear of upsetting some new cosmic theory.

I hear that a mishap nearly occurred in the Manchester studio a few days ago in consequence of the refusal of a new invention to function in the absence of its creator, who is now wrapt up in the "talkies."

In future the B.B.C. sleuths would do well to hunt in couples.

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Too Old at Sixty?

Rumours continue to float around concerning a successor to Mr. Percy Pitt, the able Director of Music at Savoy Hill. In this connection it is pertinent to ask whether the B.B.C., as a Government Department, intends to adhere rigidly to the convention which superannuates a man at the age of sixty.

In the realms of art and letters a man is often in his prime at that age. The juvenile Schuberts and Mendelssohns of to-day are not so numerous that British music can afford to throw over those musicians who are unfortunate enough to have been born before 1870.

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A Successor?

From an unofficial source I learn that Mr. Adrian Boult, the well-known conductor and composer, has definitely accepted the post of director of B.B.C. music.

FUTURE FEATURES.

London and Daventry.

MAY 13TH.—Covent Garden Opera.
MAY 16TH.—"There are Crimes and Crimes," a comedy by August Strindberg, translated by Edwin Bjorkman, arranged by Dulcima Glasby.
MAY 17TH.—Political Talk.

Daventry Experimental (5GB).

MAY 13TH.—An Hour of Requests.
MAY 16TH.—B.B.C. Popular Concert, from the People's Palace.
MAY 17TH.—"How it Strikes Me," by Professor Gilbert Murray.

Cardiff.

MAY 15TH.—A Somerset Programme.

Manchester.

MAY 12TH.—Mussenet Programme.

Newcastle.

MAY 15TH.—Concert from the North-East Coast Exhibition.

Glasgow.

MAY 12TH.—Annual Church Parade of the Territorial Army in Glasgow.

Aberdeen.

MAY 15TH.—"The Pie in the Oven," a comedy by J. J. Bell.

Belfast.

MAY 13TH.—Novelty Programme.

National Orchestra Enrolments.

Recruits for the B.B.C. National Symphony Orchestra began to line up on Monday of last week, when the preliminary auditions commenced. A special committee is engaged on the weeding-out process. The chosen few will be required to exhibit their talents before Sir Thomas Beecham and other eminent musicians

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"Everywoman."

Feminist circles, I believe, have often complained against the generic use of the term "Everyman" to include persons of both sexes. The B.B.C., who are always attempting to remove anomalies, will tackle this one on May 31st, when they will broadcast a play on the lines of "Kaleidoscope" (which was produced last autumn, and dealt with the life of a man), telling the life story of "Everywoman."

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The Prince at Newcastle.

The Prince of Wales will make another of his frequent appearances before the microphone on Tuesday next, May 14th, when H.R.H. will open the North-East Coast Exhibition. The inaugural speech will be broadcast from Newcastle, and will be followed by a running commentary on the ceremonial scenes.

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Morning Talks.

Since Wednesday last, May 1st, the morning talks from Daventry, 5XX, have also been broadcast from 2LO.

When the B.B.C. introduced the innovation of morning talks from 5XX last January, it was stated that the service would be experimental for four months and that listeners would be invited to express opinions on the talks in that period.

According to an official statement from Savoy Hill, the response has amply justified the experiment. Housewives have taken immediate advantage of the recipes and menus broadcast, and their enquiries alone have amounted to 14,000 in the course of four months.

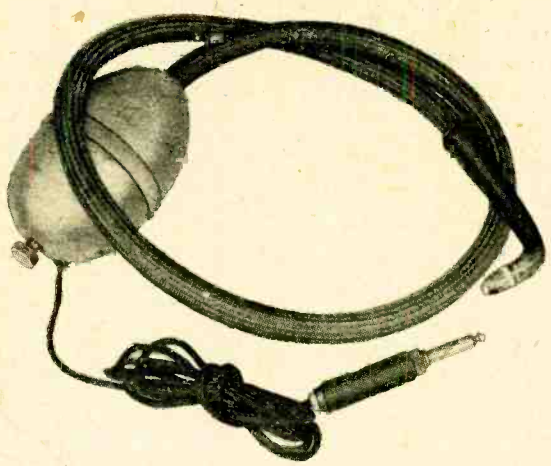
BROADCAST RECEIVER FOR THE DEAF.

A Description of a Special Loud Speaker Unit with Sound Conduit.

By C. M. R. BALBI, A.M.I.E.E.
(Hon. Consultant to the National Institute for the Deaf).

UP to the present time no provision has been made in regard to a special broadcast telephone apparatus for the deaf. As is well known, the choice of a unit for any form of reception lies between a loud speaker and headphones, and although headphones have proved of good service in the case of the deaf, loud speakers have been of little use, where the degree of deafness has been appreciable.

Now certain interesting experiments have recently taken place which show that, provided the volume of sound is very much amplified without distortion, even the extremely deaf can hear well. The problem of obtaining an electrical output of sufficient intensity is not a difficult one, as distortionless amplifiers can now be made to handle several watts if necessary, but the conversion of the electrical energy into sound has always been a problem which has confronted the deaf.



Loud speaker unit with flexible metal sound conduit and earpiece. The speaker is connected to a broadcast receiver by means of the plug.

Headphones are designed to handle only a normal intensity, and they begin to distort very badly as soon as much power is put through them. In this connection the curves shown in Figs. 1 and 2 are of interest, because they show the relation between frequency and intensity of a normal ear.[1] While the "level" A B in Fig. 1 may be regarded as the average intensity of speech appreciated by the normal listener, the level C D (Fig. 2), which is a thousand times that of the level A B represents the intensity that would be appreciated by a deaf listener whose audition area is represented by X Y Z. From this it can be seen that the intensity of sound must be greatly increased to make X Y Z hear comfortably.

Now headphones are not designed to handle this power; they are too flimsily constructed to withstand the mechanical forces that would be put upon them. Greater forces require greater provision in regard to mechanical rigidity such as is to be found in the design of loud speakers.

To enable the deaf to hear broadcast reception the reproduction unit is designed on the lines of a loud speaker, and hence is capable of handling very large volumes of sound without distortion, but, of course, the construction is massive, and in consequence heavy. In order that the deaf may be able to listen in comfort, a sound conduit two or three feet long is provided with an orifice which can be applied to the ear. The design of this sound conduit calls for special consideration.

It seems just as important for this unit to taper inwards towards the outlet as it is for a loud speaker horn to taper outwards if good reproduction is to be obtained. Tubes of uniform bore but of diminishing section when connected together do not give as good

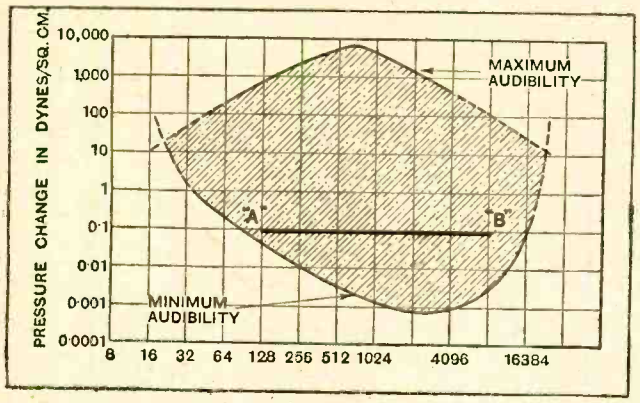


Fig. 1.—Audition area of a normal person. The average of sound intensity required by a normal person is represented by "A" "B".

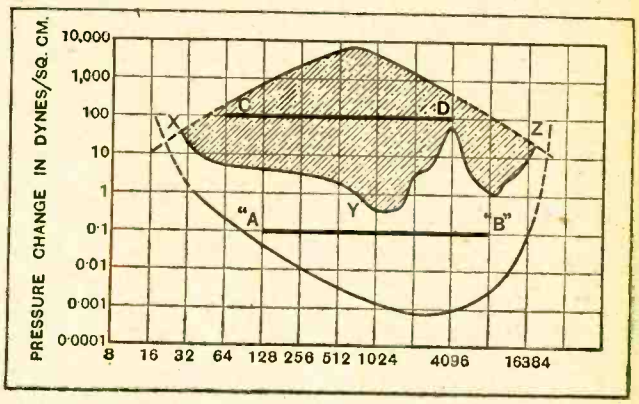


Fig. 2.—The standard of sound intensity required by a deaf person is represented by C D.

[1] *The Lancet*, May 2nd, 1925, and September 15th, 1928, p. 583.

Broadcast Receiver for the Deaf.—

results. Also, in tubes made of elastic material, the losses are very great, so a flexible metal tube is found to be the best.

A photograph of this instrument is shown in the text; when the plug at the end of the long cord is inserted into a loud speaker jack of a suitable broadcast receiver which is known to give good loud speaker reproduction, the deaf person may place the body of the instrument on a convenient support and listen-in.

The arrangement is capable of giving far better reproduction than a pocket electrical aid for the deaf, because the microphone used in the broadcast transmission is incomparably better than the microphones used in any such portable aids, and the receiver, as has just been stated, is capable of handling much louder signals than the ear-pieces used with any of these auxiliary equipments.

In this way the deaf should be able to get the full benefit of broadcast reception, which usually proves a great boon to those who have the misfortune to be so afflicted.

LETTERS TO THE EDITOR.

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.

TELEVISION.

Sir,—I welcome the courtesy of your columns to reply to your correspondent's letter in your issue of April 24th, in which Mr. Halsey asks, quite rightly I think, for fuller information and more constructive articles on the subject of television, and I may say at once that it would be an easy and pleasant matter to press for the immediate release to the technical journals of a number of constructive articles were it not for the two fundamental difficulties that have hitherto delayed this new development. I refer, of course, to broadcasting facilities and to the patent situation. I am happy, however, to observe that in both these problems matters are now approaching an equitable solution, and it is the earnest desire of all concerned that these services shall now be delayed no longer than is essential to effect the necessary arrangements. Meanwhile, your correspondent will readily recognise that it would be of little use constructing a receiving apparatus in the absence of the all-important transmitting service, and it is now confidently anticipated that as a result of co-operation and goodwill this essential service will soon be readily available to the public and to the amateur experimenter alike.

But I am sure Mr. Halsey will allow me to say that the study of television is by no means dissociated from obscure mathematical consideration as he appears to suggest, nor indeed are the problems unrelated to those of radio. On the contrary I need only mention one of the difficulties that preceded the recent official broadcast tests, viz., the problem of sideband interference, which, as a result of patient study and experiment, has now been almost completely eliminated.

I must, however, add a word of praise to the amateur activity to which your correspondent refers. The development and demonstration of true television, like radio telephony, was in its inception due entirely to the amateur, and it is for this reason that we have pleaded so long and so earnestly for a fairer recognition and less fettered facilities for the amateur experimenter to whom our modern civilisation owes so much and is so loath to acknowledge. CLARENCE TIERNEY.

The Television Society,
April 25th, 1929.

"SCRAPPY" PROGRAMMES.

Sir,—I was very interested in the correspondence concerning "scrappy" programmes, and particularly in Mr. Bertram Munn's letter. Mr. Munn's satire is worthy of G. B. Shaw, but if "the brains behind the B.B.C. programmes" are of the dimensions suggested, is it not probable that the letter will be used by the B.B.C. officials as further proof of the general popularity of their present programme policy?

Personally I have been satisfied with the programmes, but perhaps the reason is somewhat unusual. I am very much more interested in the technical side of broadcasting, and I know that there is little fear that I shall be requested by other members of the family to "leave the set alone" for very long any evening I happen to be at home. On the rare occasions that there is some sustained musical programme, like the "Proms," I am perfectly willing to sit down and *listen* with enjoyment. One frequently hears of people reading a book when they are listening (?), and this always seems to me to be uncomplimentary either to the book or to the B.B.C. One usually chooses a good book. A programme is either worth *listening* to or it is not. I have never yet seen anyone reading a book at a concert. By all means press on for "the greatest good for the greatest number" on the line you have taken up.

I once wrote a letter of appreciation to the B.B.C., I think it was in connection with one of the "Proms," and the reply I got was rather striking. They thanked me for my letter and hoped that in the future the programmes would be more to my liking! H. H. DYER.

Derby.

Sir,—May I be allowed once more to comment on the B.B.C. policy and programme question, and in doing so, thank you for giving the British public an excellent opportunity of satisfying themselves that the majority are not in favour of the present arrangement.

All letters published, except one, were in agreement with Mr. Phillips's letter. The one which was not in agreement is very interesting. I have a recollection of meeting a very charming gentleman in Manchester by the name of Munn (I believe his christian name was Bertram), and I know that he was a member of the B.B.C. staff. Is this a case of the home-made trombone being played with much gusto? If so, perhaps we may be right in concluding that readers of *The Wireless World* are unanimous.

Mr. Munn's one point is defending the scrappiness of the programmes, and whilst his letter is extremely interesting to read, he surely does not put forward the exponent of the gramophone on the river as any criterion, for, surely, if that person had been interested in the B.B.C. programmes the gramophone would have been transformed into a portable wireless set, so I am afraid Mr. Munn's example has a negative result.

The suggestion for all letters received by you on this subject to be forwarded to the B.B.C., as put forward by Mr. Hubbard, is quite a good one, but I am only afraid that the superior attitude characteristic of the organisation would consign the said letters, along with the other two letters of criticism received since broadcasting started, to the waste-paper basket, whilst the 1,613 letters would still occupy their place of honour in the gilt frame. J. E. KEMP.

Manchester.

SUPPRESSING PERSONALITY.

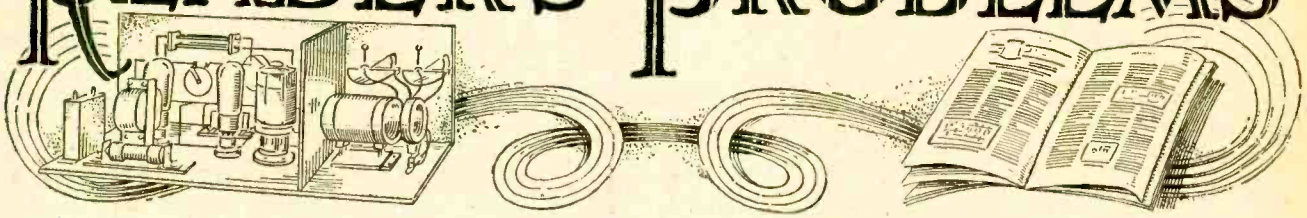
Sir,—I have just read your article, "Suppressing Personality" in your issue of March 20th.

It surely is obvious to all intelligent people that the Broadcasting Corporation is not interested in the wishes of the people, but in its own interests only. The said people allowed it to come into being, as they allow other forms of bumbledom, and, now being helpless, must take what they get.

The contrast to the good old "company" programmes makes strong men weep. HOWARD ROBERTS.
(Captain.)

S.S. *Murex.*

READERS' PROBLEMS



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Relative Sensitivity.

You have from time to time published articles dealing with the relative merits of the anode bend and leaky grid condenser methods of detection, but I do not remember having seen the subject treated in relation to my own particular problem. I have decided upon a three-valve H.F.-det.-L.F. receiver, and wish to obtain the loudest possible signals with this arrangement from London and Daventry stations, which are almost equidistant from me, and about forty miles away. My aerial and local reception conditions may fairly be described as good. Which method of rectification will best meet my needs?

M. C. M.

It is not always possible to be definite in these matters, but, assuming that you use an efficient H.F. stage, there can be hardly any doubt that anode-bend detection will give considerably louder signals with a circuit such as that you specify. At your comparatively short distance, the H.F. voltage input to the detector should be sufficiently great for adequate loading of an anode rectifier; it will almost certainly be possible to overload a grid circuit detector in these circumstances.

o o o o

Adding a Tuned Aerial Circuit.

It seems to me that it should be an easy matter to add a tuned aerial circuit to my "Megavox" receiver. I propose to use an auto-transformer arrangement, and should be glad if you would give me a diagram showing the method of connection, if you consider that the scheme is practicable.

W. G.

The "Megavox" receiver lends itself very readily to modification in this manner. Necessary additions include loading coils of the ordinary plug-in variety for the wavebands to be covered, and a tuning condenser, preferably with a capacity of not less than 0.0005 mfd. These should be connected as shown in Fig. 1; they may conveniently be mounted in a box placed on the left-hand side of the receiver, or, alternatively, they can be secured to the side of the cabinet.

It will be necessary to provide extra tapping points on the primary of the aerial grid transformers; as a rough guide, we expect you will find best results are obtained when the loaded aerial connection is made to a point about two or three turns above the earthed end of the winding.

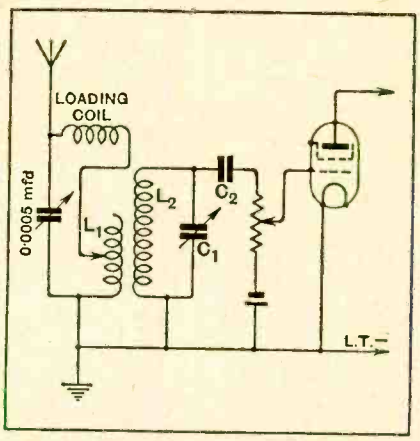


Fig. 1.—Tuned auto-coupled aerial circuit for the "Megavox" receiver.

Unless the loading coil is mounted at some distance from the set, and at right angles to the existing input windings, it will be desirable to interpose an earthed metal screen, which may conveniently be secured to the end of the cabinet.

RULES.

(1.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(2.) Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(3.) Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufactured receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Extending Wavelength Range.

It is assumed that the "S. G. Regional Receiver" does not cover the complete range of wavelengths between 200 and 2,000 metres; I suppose that, as usual, "non-broadcasting" waves of from about 550 to 1,000 metres cannot be received. If this is correct, will you tell me how the set can be modified to include this band?

K. W. T.

The set as described misses the wavelength between, roughly, 560 and 700 metres. The easiest and simplest way of ensuring an "overlap" is to fit secondary and H.F. tuning condensers of 0.0005 mfd. instead of 0.0003 mfd., as specified.

The tuned aerial circuit presents a difficulty: obviously, it can be overcome by changing the loading coil for reception of intermediate wavelengths; but, if you object to this plan, we suggest the use of a larger capacity—say, 0.00075 mfd.—for the tuning condenser, and a fairly small value for the aerial series capacity.

o o o o

Waveband Switching.

In receivers including switches for waveband changing there seems to be no general agreement as to whether unwanted coils should be merely thrown out of circuit or "shorted." Which plan do you advise? H. S. R.

It is not possible to dogmatise on this matter; a good deal depends on the exact arrangement of the circuit, and more on the disposition of the coils with relation to each other. To take an instance, you will realise that it is often convenient to wind both long and medium wave coils co-axially on a single former; in such cases it is highly advisable to short-circuit the idle winding. When the coils are mounted at some distance from each other and with their axes at right angles, this is often a quite unnecessary precaution.

In certain cases there is obviously no disadvantage in joining long and medium wave coils in series, the former being "shorted out" when it is not required. This is a very simple and effective plan, but it is not always convenient when dealing with H.F. transformers; perhaps the safest way is to arrange the switch to disconnect and to short-circuit the unwanted windings at the same time.

Resistance and Transformer Coupling.

In a "mixed" L.F. amplifier, with resistance and transformer coupling, it seems to be usual that the resistance stage should be immediately after the detector. Is there any special reason for this? In the case of the set I propose to build, it would be more convenient to reverse this order.

P. H. S.

The important point here is that the effects of overloading are much more serious and distressing to the ear when the overloaded valve immediately succeeds a resistance stage, and consequently has a condenser in its grid circuit. In a properly designed amplifier, overloading of the penultimate stage cannot take place before it is produced in the output valve, and consequently it is better, from this point of view, to use a transformer in the second position.

oooo

Scientific Wiring.

Some time ago you published an article showing how the stability of a receiver could be improved by wiring the circuits in a special manner, individual plate, grid and filament circuits being fed with current through separate leads. Will you give me a diagram showing how this method may be applied to the H.F. side of my own set, which has two high-frequency amplifying stages, with screen-grid valves? V. L. W.

The article to which you refer was published in our issue of April 25th, 1928, and we think that a consideration of it, in conjunction with Fig. 2 herewith, will make the matter clear to you. From our diagram you will see that separate pairs of feed leads are run to each individual filament, anode, and screening grid. In addition, grid circuit wires are run in pairs and parallel to each other. Ordinary twisted twin flex wire may be used, except in cases where a "working" high-frequency potential exists between the pair of leads.

This method of wiring does not provide immunity against inter-circuit coupling due to a high resistance in the source of anode supply, but, of course, there is no reason why it should not be used in conjunction with the anode feed resistance scheme.

The diagram may be taken as representing diagrammatically the run of the wiring, but it should be added that, in cases where the tuning condensers are mounted at some distance from their associated coils, the formation of inductive loops may be avoided by running the connecting wires in parallel pairs.

oooo

Eliminator Design.

There seem to be two main methods of regulating the voltage output of an eliminator—series resistances or a potential divider. Which of these two devices is considered to be preferable? B. D. H.

It is hardly possible to answer this question in general terms. The voltage regulation of an eliminator, including a potential divider, will be better and less affected by the load imposed by the external apparatus. On the other hand, it is more likely to give rise to troubles brought about by resistance common to the anode circuits of several valves. By adopting the other method, it is possible to arrange for the series resistances to form part of a de-coupling scheme.

Perhaps the best arrangement of all is a combination of the two methods, in which those valves requiring a comparatively high voltage of a not-too-critical value are fed through resistances, a potential divider being provided for screening grids and, in certain circuits, for an anode bend detector.

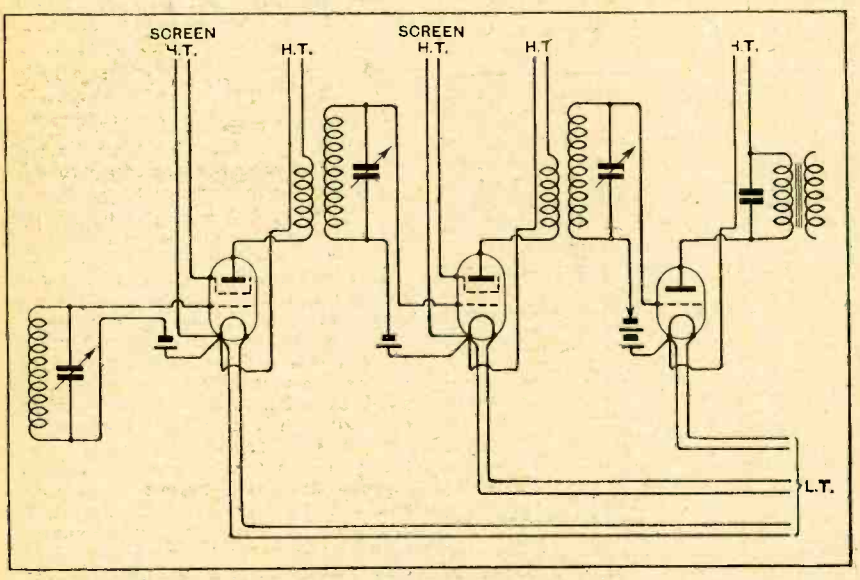


Fig. 2.—Individual feeds for each anode and screening-grid circuit, combined with non-inductive grid connections: scientific wiring as applied to a set with two screen-grid H.F. valves.

Changing Condensers.

My "Everyman Four" receiver, fitted with square law tuning condensers, has given satisfactory results for over two years. Do you think that its performance would be greatly improved by fitting more modern S.L.F. components? J. H. S.

The operation of tuning will be slightly easier if these condensers are used, as the dial settings corresponding to the different transmissions will be rather more evenly spaced, but you must not expect any real improvement in performance unless the losses in your existing condensers happen to be unduly high.

oooo

Forgotten Volts.

I am in difficulties in the matter of charging my 120-volt H.T. accumulator battery from 240-volt D.C. mains. The required charging rate is 0.1 amp., but the regulating resistance of 2,400 ohms, as worked out by Ohm's law, actually passes a much lower current. Does this indicate that the cells themselves have a considerable internal resistance, which should have been taken into account?

P. J. McE.

Provided that the cells are properly filled with acid, and their plates are intact, it is unlikely that their internal resistance is appreciable. It seems, in calculating the value of series resistance, that you have forgotten to subtract the back-voltage of the battery from that of mains. In your particular case, a pressure of 120 volts only (not 240 volts) is available for driving current through the cells and series resistance; consequently, the latter is of double its correct value.

oooo

Neutralising Unnecessary.

From recent articles I understand that the amplification obtainable from a screen-grid valve may be greatly increased by neutralising. Will you tell me how this addition may be made to the circuit of the "S.G. Multiple Valve Portable" without otherwise modifying its design? E. R.

The circuits of this receiver are so arranged that stability is obtained over the waveband covered; neutralising is of advantage only when uncontrollable oscillation would normally be produced without its aid; it does not confer any benefit in itself, and is unnecessary in this case.

oooo

Ultra-short Wavelengths.

I am thinking of making up a short-wave receiver, but am wondering whether it would work satisfactorily with my eliminator. Can you give me a word of advice? T. D. M.

Generally speaking, a mains unit is not a satisfactory source of anode supply for a short-wave receiver, which generally depends on critical adjustment of reaction for satisfactory performance. However, it is sometimes found possible to use an eliminator for the L.F. amplifier, in conjunction with a dry battery for feeding the detector anode circuit. This plan is quite economical.

The Wireless World

AND RADIO REVIEW

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CONTENTS OF THIS ISSUE

REGIONAL SCHEME AND THE FUTURE OF RECEPTION.

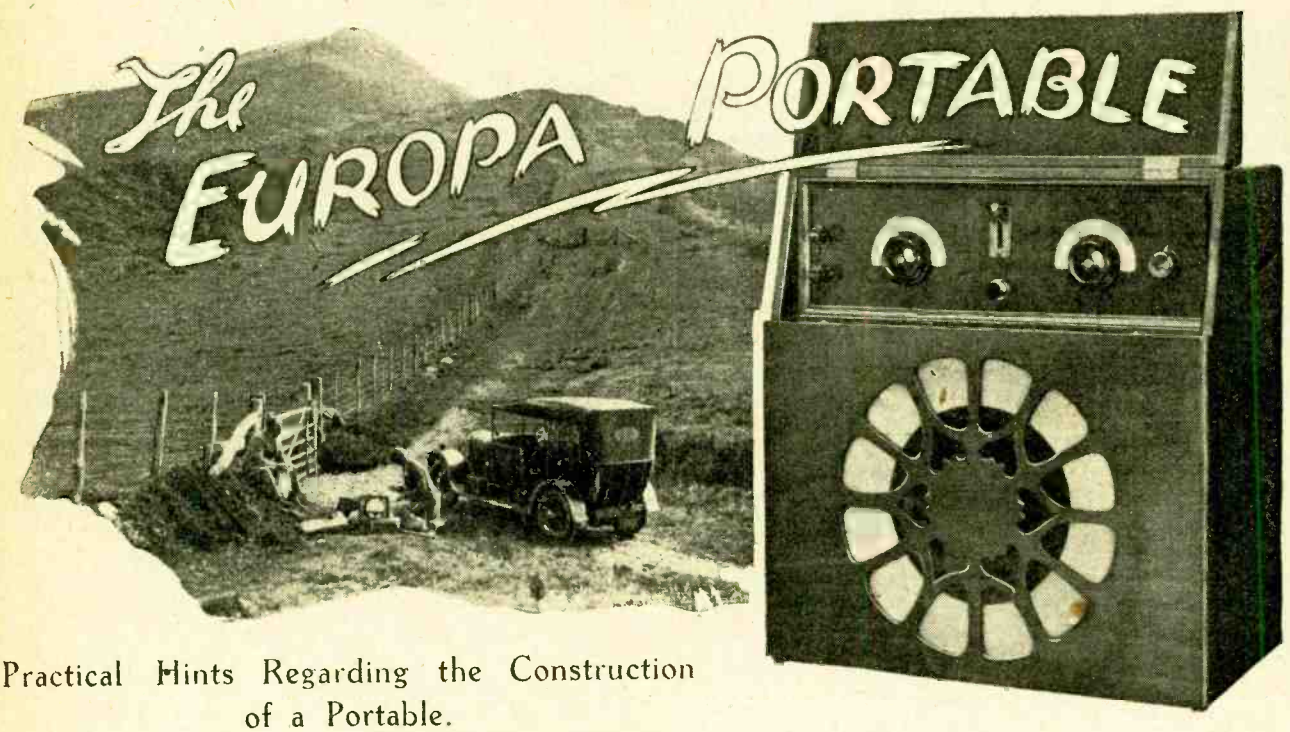
IN a month or so from now it is anticipated that listeners will get their first taste of the introduction into their midst of the first high-power station of the regional scheme, and it is interesting to look ahead and anticipate what the effect is likely to be.

First, we are told that Brookmans Park Station will radiate one programme, but later on it is intended that the same station shall be used for two programmes radiated simultaneously on different wavelengths. That the B.B.C. are themselves a little concerned as to what the effect is going to be upon the listeners is, we think, indicated by various statements which have been made officially from time to time. Capt. Eckersley, in a statement on the distribution of broadcasting stations made in February of last year, referred to the "wipe out" area in the neighbourhood of the regional stations where the field strength would be greater than 30 millivolts per metre, and he said, "A listener within this area can be absolutely guaranteed a service from the local station, but will require a receiver of special design for distant reception." This month, in another official statement, the B.B.C. has said: "Listeners in this area (*the neighbourhood of Brookmans Park*) will probably complain that they are unable to receive the alternative programme from 5GB to which they have been accustomed. We suggest that the alternative programme be forgone until Brookmans Park radiates a second programme.

"The foreign station listener in these areas, unless he has very selective apparatus, will be unable to tune out the London transmission."

Such statements as these cannot be regarded as very reassuring. If we are told that over a comparatively wide area neither 5GB, foreign stations, nor, in fact, any other alternative to the local station will be receivable, then we are virtually being compelled by the B.B.C. to listen to the local transmission and nothing else. We cannot believe that this is going to be satisfactory to listeners generally. As the regional stations are completed one by one the "wipe out" areas throughout the country will increase and will be doubled (from the point of view of wavelength band receivable) when each regional station transmits two programmes on different wavelengths.

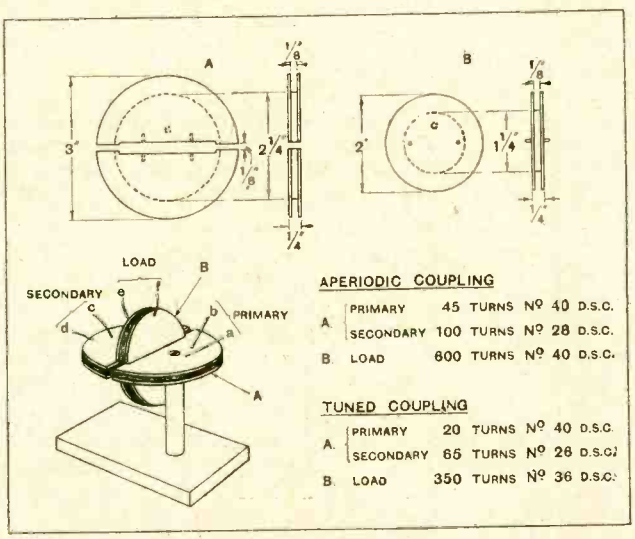
Listeners, we think, are entitled to ask whether all this is really necessary, whether, in fact, the B.B.C. is not vastly exaggerating the power that is required for reasonable reception. Is it still the policy of the B.B.C. to aim at providing satisfactory crystal reception throughout the country, and, if so, is not this being done at the expense of listeners who have invested in valve sets? Of what further use is a selective valve set, acquired in order to have a choice of programmes, if alternative reception is rendered practically impossible owing to the "wipe out" effect of a transmitter dumped in the vicinity? We are afraid that the establishment of the regional station at Brookmans Park, with its proposed power, is likely to prove a rude shock to many listeners. Whilst we still maintain that the principle of alternative programmes and regional stations is sound, we think that the power should be very carefully considered, and we fear that the radiation of two programmes from the same station on different wavelengths is going to prove a very serious problem, especially to crystal users, because of the difficulty of separating the two. We believe that the listener ought to be entitled to look upon Europe as the source of his entertainment to receive whatever station he likes at his choice, though, no doubt, he would still mainly devote his attention to his local station because of the better quality obtainable therefrom.



Practical Hints Regarding the Construction of a Portable.

HOME constructors do not, as a rule, build portables, while rarely does one find articles dealing with such receivers. This is because the skilled amateur dislikes the portable, while it is beyond the skill of the inexperienced listener to build one. Added to these observations is the significant fact that the cheaper portables cost less than do the components necessary to build a first-class instrument. That the enthusiast has little liking for the portable is due to his knowledge of the compromises that are called for in bringing together into small compass a complete frame aerial, loud speaker set. He usually associates, perhaps, poor performance with receivers of this class, for it is not always realised that the present-day portable with modern valves is capable of meeting those requirements of long-range reception with pleasing quality while fitted with batteries that will give many weeks of service without attention. It is not until one possesses a portable that its utility is appreciated, and with summer ahead the advantages of a well-built self-contained set will quickly reveal themselves.

The instrument here described is a four-valve set with two screen-grid H.F. stages and pentode output. It has a frame of generous dimensions, the containing cabinet measuring 16½in. × 17½in. × 8½in., the complete receiver weighing 32 lb. Three months' regular reception of programmes can be obtained from the H.T. battery, while the apparatus used in the output stage results in unquestionably good quality of reproduction. As to cost, it is assumed that the constructor can find many of the necessary components already to hand, and except for the tuning condensers, which are of a specially small design, the other necessary parts of the receiver are mainly bridging condensers, valve holders and, of course, the four two-volt valves (P.M.12, P.M.2Dx, and P.M.22). By the substitution of four-volt valves (P.M.14, P.M.4, P.M.24), performance will be improved, and less current will be taken from the filament battery. The smaller ampere-hour capacity of the four-volt accumulator, however, will necessitate more frequent charging. Screen grid amplifying stages normally embody generous screening equipment and demand numerous precautions to prevent interstage coupling when the two stages are fed from a common battery. Such a design might have

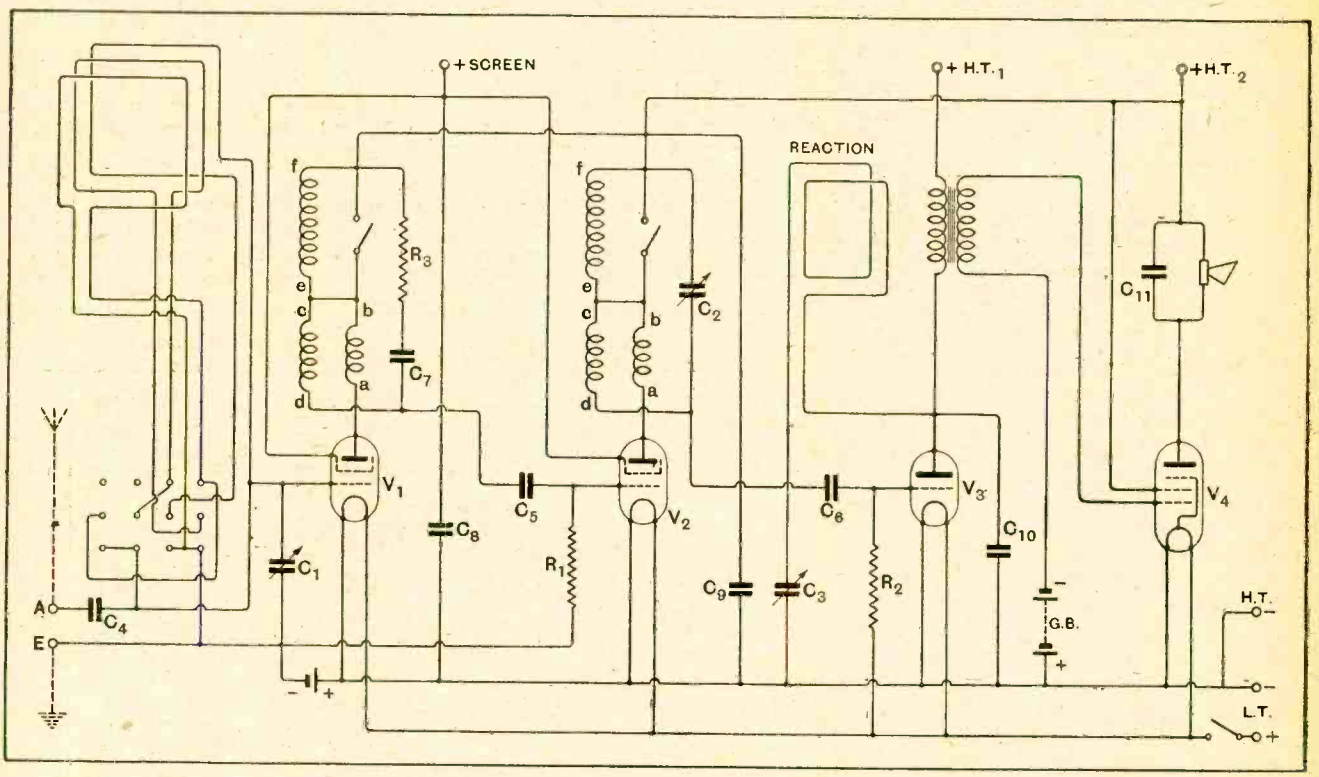


Dimensional details of the interlocking formers used for constructing the H.F. couplings. Although best made of turned ebonite, suitable formers can be made from cardboard.

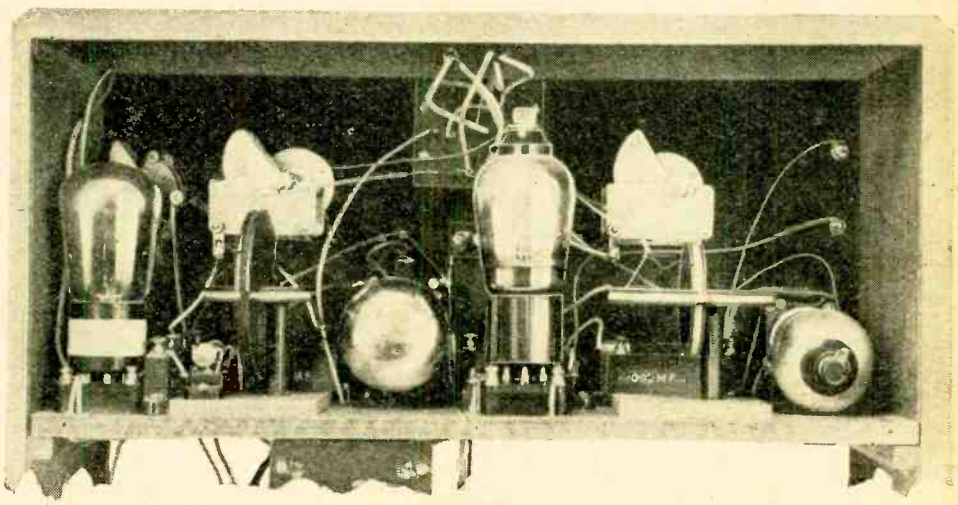
The Europa Portable.—

been slavishly adopted, but in a reasonably compact space construction would have proved exceedingly difficult. When two tuned screen grid amplifying stages are employed self-oscillation will invariably occur in spite of the adoption of every precaution to prevent it, assuming that the H.F. intervalve couplings are designed to give maximum amplification. A rough layout readily shows that so long as one reduces the primary windings of the H.F. transformers to the point where self-oscillation does not occur, then the adoption of screening boxes, although desirable in non-portable receivers, can be dispensed with in making up a simple portable.

It is unsafe to build any portable by merely bringing together an assembly of components and expecting when the last wire is soldered into position and the valve current switched on that everything will behave exactly as intended. Such a method of construction may reveal at the last moment either self-oscillation or, on the other hand, poor amplification, and the remedying of either of these evils in a finished receiver is a desperate undertaking. It is more satisfactory to proceed slowly, testing step by step. Commence, therefore, with the winding of the frame. To provide for both long- and short-wave reception, this consists of three sections which are connected in series or parallel. A space equal to the width of one turn of wire is left between each section. Although the commercial set constructor dare not omit provision for long-wave reception, the amateur may prefer to simplify matters by restricting his set to the broadcast band only. In this case the frame will consist of 13 turns of No. 22 D.C.C., the ends terminating on the tuning condenser.



Portable receiver circuit with two screen grid stages and pentode. C_1, C_2, 0.0005 mfd.; C_3, 0.0001 mfd.; C_4, 0.0002 mfd.; C_5, 0.0005 mfd.; C_6, 0.0003 mfd.; C_7, 0.0001 mfd.; C_8, 0.003 mfd. or larger; C_9, 2 mfds.; C_{10}, C_{11}, 0.002 mfd.



Short leads connect the switch with the frame sections. Wires are run by the shortest route between the components.

LIST OF PARTS.

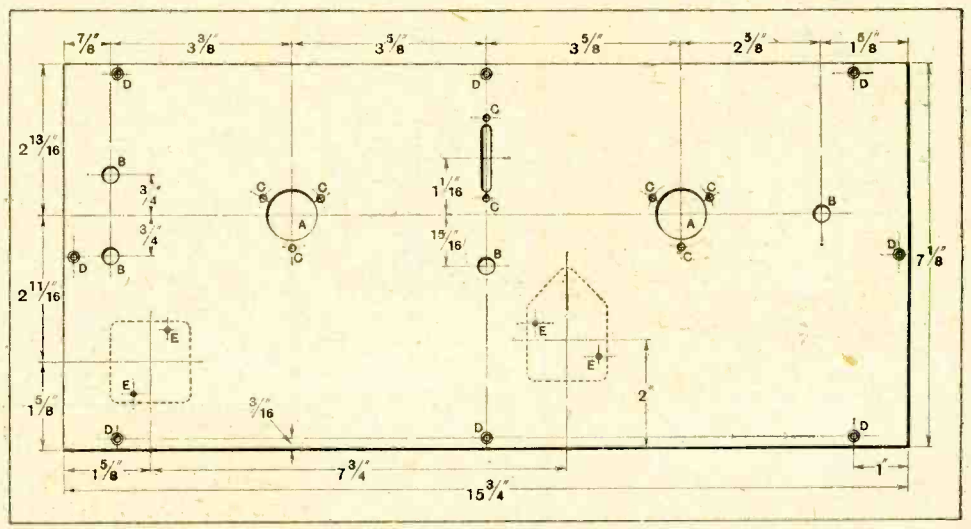
1 Panel, 15¾ × 7½ × 3/16in (Paxolin or Pertinax).
1 Portable cabinet with baseboard and loud speaker panel (Cameo "Ideal.")
1 Loud speaker unit (Blue Spot. 66k).
1 Loud speaker chassis (Gilman).
2 Variable condensers, 0.0005 mfd., with new type dials (Utility "Mite").
1 Reaction condenser, 0.0001 mfd. (Burton).
1 "On and Off" switch (Bulgin).
1 6-pole changeover switch (Utility W.147/6).
3 Valve holders (Whiteline).
1 Valve holder for pentode (Whiteline).
2 Grid leaks, 2 megohms, and holders (Dubilier).
1 Resistance, 600 ohms (Wearite).
1 L.F. transformer (Philips).
1 Dry cell (Ever Ready "O" type).

1 Fixed condenser, 2 mfds. (T.C.C.).
1 Fixed condenser, 0.0001 mfd. (Trix).
1 Fixed condenser, 0.0002 mfd. (Trix).
1 Fixed condenser, 0.0003 mfd. (Trix).
1 Fixed condenser, 0.0005 mfd. (Trix).
2 Fixed condensers, 0.002 mfd. (Trix).
1 Fixed condenser, 0.003 mfd. (Trix).
1 2-volt accumulator (Edward's Type E.L.2).
1 H.T. battery, 120 volts (Pertrix).
2 Valves, P.M.12.
1 Valve, P.M.2DX.
1 Valve, P.M.22.
5 Wander Plugs (Lissenin).
2 Spade ends (Lissenin).
Wire for coils as specified, Systoflex, screws, etc.

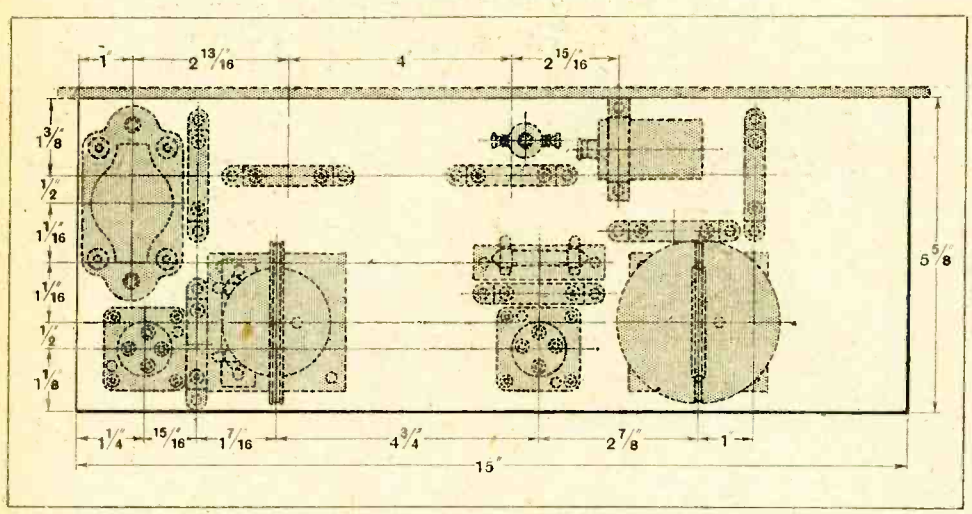
In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer, and illustrated in the photographs of the instruments. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

Next make up the front panel. Bakelised board is much stronger for this purpose than ebonite, although it is a little more difficult to work. No tapped holes are required, neither are any screw-heads exposed. The screw fixings of the two horizontal valve holders, although passing right through the panel, are too far down to be seen from the front.

Assemble also all the baseboard components excepting the H.F. transformers, and run all connecting leads associated with the detector and pentode, as well as the leads to the aerial and earth terminals. So far, very little work has been involved, and



Drilling details of the front panel. A, 15/16in.; B, 5/16in.; C, 1/8in.; D, 1/8in. and countersunk; E, 1/8in. for 6.B.A. screws.



Dimensional layout showing the assembly of the components on the baseboard.

a preliminary test can now be made, using the set as a reacting detector followed by the pentode L.F. stage. It is necessary to connect an aerial through the condenser C_4, the frame and the variable condenser C_1 being the tuned aerial circuit. One side of C_1 is taken straight to C_3 and the other to L.T.−. This arrangement should at least bring in a local station as well as 5GB almost anywhere in England with a reasonably good aerial. At this stage test for acoustic reaction by temporarily fitting the loud speaker and receiver in the cabinet and assuring oneself that the

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The Europa Portable.—

setting up of a note of constant pitch in the loud speaker does not result. This difficulty, although sometimes met with, was at no time encountered in the course of building this portable, and is probably prevented by completely enclosing the valves away from the loud

This view shows the arrangement of the batteries.

speaker compartment. In the course of this test apply the maximum battery potential to the pentode and determine by test the most suitable grid bias and detector valve potentials. These will probably be about 7 and 70 volts respectively.

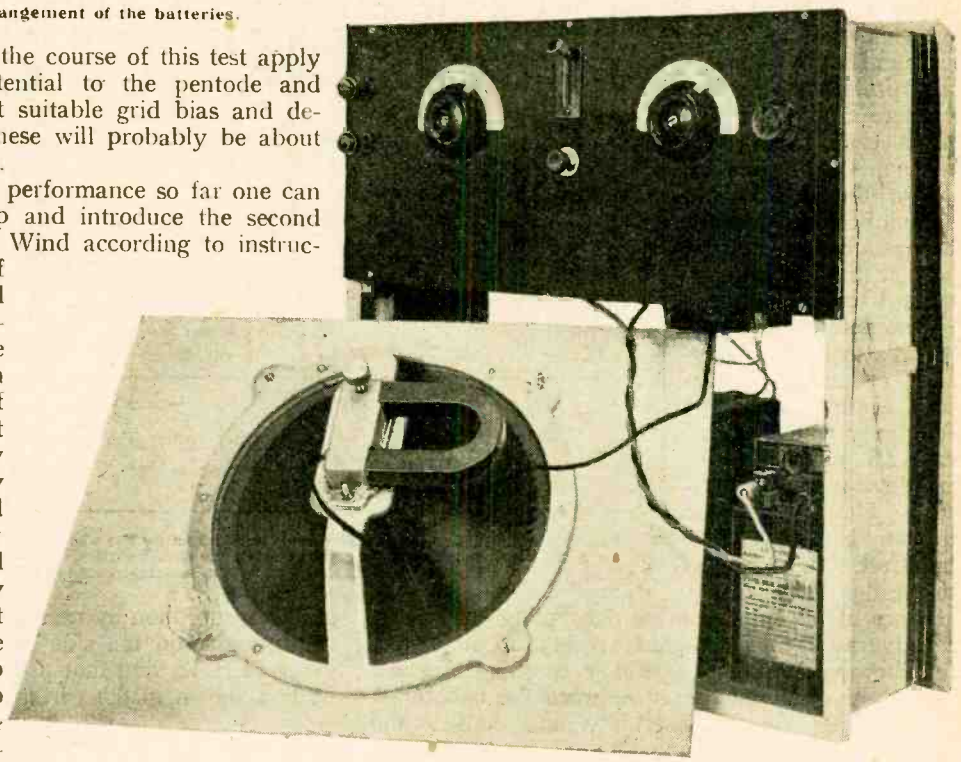
With the set giving good performance so far one can safely proceed to make up and introduce the second H.F. intervalve coupling. Wind according to instructions as regards gauge of wire, number of turns, and mean diameter. The direction of rotation of the former is the same for both primary and secondary of the broadcast band coil. It is the outer end of primary and secondary respectively that connect to anode and grid. Two layers of dry paper separate primary and secondary. It is quite easy to build suitable formers out of cardboard assuming the tuning range is restricted to the broadcast band. Two stiff cardboard sides are held apart by suitable circular cardboard spacers. Seccotine may be sparingly used for securing the pieces together, though winding should not be attempted until the former is thoroughly dry.

Now proceed to test the performance of the second H.F. stage. This time the frame connection from C_1 is taken to C_5, and the grid leak R_1 is taken to L.T. –, for the time being omitting the grid cell. Only the frame aerial should now be used, for the connection of an external aerial would tend to prevent self-oscillation. It should now be possible to tune in a local station up to 20 miles, while there should be no tendency to oscillate except by bringing into use the reaction condenser. Note that the tuning positions fall conveniently on the condenser scales, thus verifying the frame and transformer windings.

H.F. in the L.F. Amplifier.

One of the principal troubles met with in portable set construction is due to the oscillatory H.F. currents passing through the L.F. amplifier. Here they impair the performance of the L.F. valve or valves, and on reaching the loud speaker produce uncontrollable reaction effects with the frame, resulting in a serious cutting down in the range of reception and a tendency to the setting up of a shrill whistle when an endeavour is made to use reaction. A by-pass condenser of generous capacity is connected in the anode circuit of the detector to prevent the passing on of H.T. as well as providing for efficient detection. As a precaution, also, a lead is taken from the metal frame of the loud speaker to the negative terminal of the two-volt accumulator.

With everything satisfactory to this point the first



Receiver unit removed from the cabinet showing the frame windings and assembled loud speaker.

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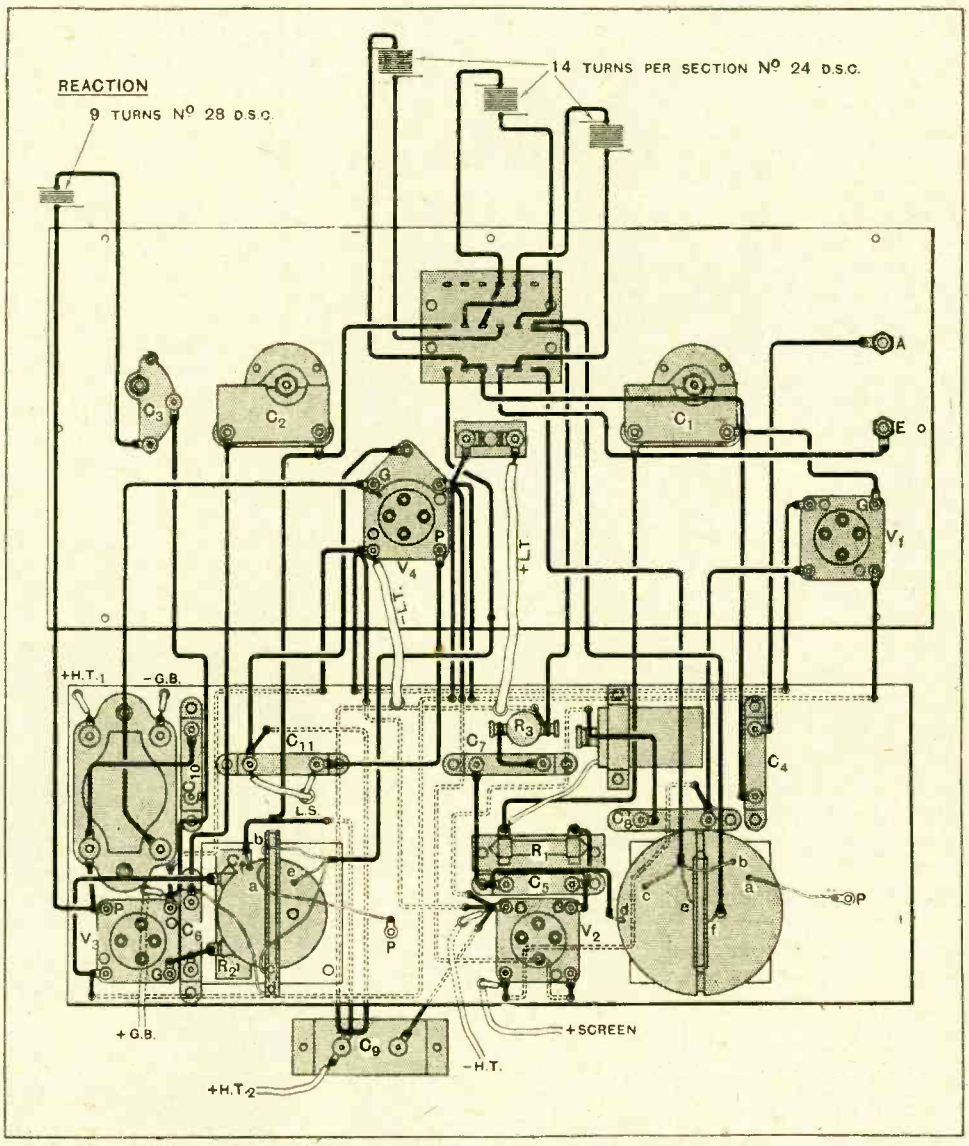
stage H.F. amplifier may be added. This is a semi-aperiodic stage sufficiently flatly tuned to operate over the required band. As built, it peaks on a wavelength of about 400 metres, yet gives satisfactory amplification over a very wide range. Fixed tuning is provided by a shunt condenser across the winding broadened by the series connection of a 600-ohm resistance. It is not advisable to connect up this resistance-condenser circuit without a preliminary test, using a variable condenser in place of the fixed one. Tuning the transformer winding will vary the amplification, though it should not be possible to obtain a result appreciably better than that provided by the fixed condenser.

It will be noted from the practical wiring diagram that many of the battery wires are run beneath the baseboard. These are taken by the shortest paths and pulled tight. Use No. 24 wire with a covering of 1 mm. sleeving for joining up. This sleeving is very much finer than that customarily procurable and makes a neat job. The wires above the baseboard are merely taken in sleeving by the shortest route, while the fine wires taken from the transformers are also protected by sleeving. There are three fine wires on each transformer connecting to common points on the switch, and these are, of course, bundled together as a common lead.

The fact that small resistances and condensers are not interposed in the common battery leads carrying H.F. currents as a precaution against interstage coupling may call for comment. All such precautionary devices were experimentally fitted, yet their elimination had no detrimental effect.

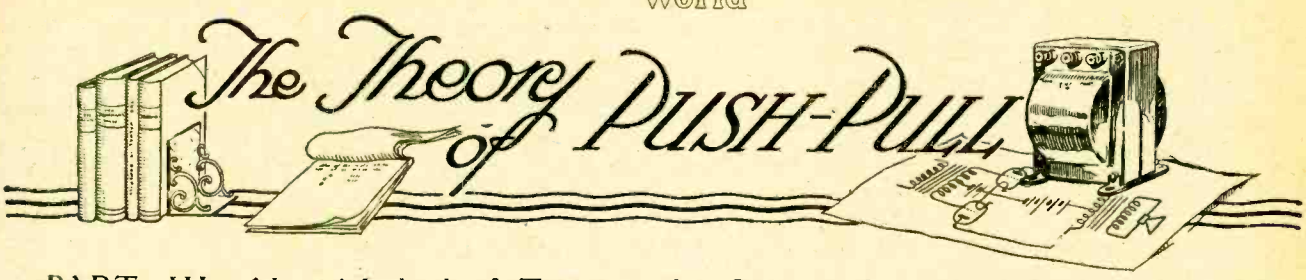
The reader may query the absence of a comprehensive decoupling scheme so much advocated for high-gain stages; he may rest assured, however, that the aperiodic coupling of small overall amplification interposed between the two tuned circuits militates against instability and confers the obvious advantage of easy operation.

When connecting up the H.T. battery so as to provide grid bias for the output stage, it should be noted that the H.T. – lead connects to a point some 7.5 volts from the minus terminal, the latter connecting to the grid biasing lead. The actual H.T. voltage markings are therefore reduced by the amount of this grid bias. Suitable screen potential for the H.F. valves is obtained by connecting to the sockets marked either 80 or 90. With the set finished and in working order it is worth experimenting by way of economising in H.T. consumption by running an independent lead from the terminal on the side of the pentode to a reduced value of H.T. than that provided by the common connection shown in the wiring diagram.



Practical wiring diagram. The leads are taken by the shortest path between the components on panel and baseboard. Leads beneath the baseboard are shown dotted and do not run by the paths indicated but by the shortest route from point to point.

[*This receiver will be available for inspection and demonstration at the Editorial Offices, 116, Fleet Street, London, E.C.4.*]



PART III.—New Method of Treating the Output Circuit. The Causes and Prevention of Parasitic Oscillations.

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

(Concluded from page 118 of the January 30th, 1929, issue.)

IN Part I of this series of articles on push-pull [1] we indicated two salient methods of applying grid bias, namely, (*a*) biasing to the middle of the straight portion of the valve characteristic, (*b*) to the middle of the curved portion. So far as the former condition is concerned, we conducted a fairly detailed discussion in Part II.[2] We have, therefore, now to treat the second method of biasing. In this case we can, as a first approximation, assume that the positive swing is dealt with by valve V_1 and the negative swing by V_2 of Fig. 10. The primary and secondary windings of the transformer are continuous and wound on the same core. The primary is tapped at the centre for the H.T. connection. The secondary is shown by the two sections, S_1 S_2, for the sake of illustration. This is the normal arrangement of the transformer windings.

It might be thought that instead of one special transformer, two separate transformers could be used. This, however, is not possible unless the loud speaker is specially arranged. Referring to Fig. 10 and regarding the two transformers P_1 S_1, P_2 S_2 as being separate, we see that during the positive swing V_1 is active, whilst V_2 is dormant. Thus the portion S_2 of the secondary circuit contributes nothing to the output. The difficulty which faces us is due to the idle secondary winding being in series with the loud speaker, or whatever impedance constitutes the output. Moreover, its relatively large inductance will curb the currents of higher frequency. In like manner S_1 will curb the higher frequency currents when V_2 is active. It is very obvious that two separate transformers will not answer our purpose, although they would be quite satisfactory if the valves were biased to the middle points of their linear characteristics.

A solution to our problem which applies to both methods of biasing when using two separate transformers

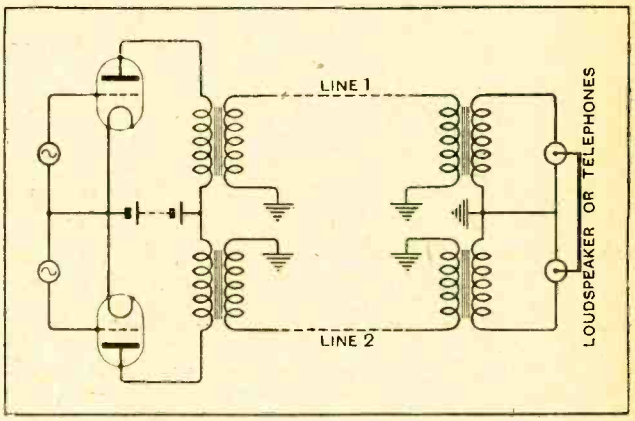


Fig. 12.—Diagram showing scheme of Fig. 11 applied to distant operation of reproducing apparatus.

is given in Fig. 11. Here P_1 S_1 and P_2 S_2 are the two transformers. The output circuits of S_1 S_2 are shown as two identical loud speaker moving coils. These coils are *electromagnetically separate,* but *mechanically coupled.* Electromagnetic separation is imperative only for bias to the mid-point of the linear characteristic. There is then no mutual electrical action between the currents in the coils, since this would result in reduced output. Mechanical coupling of the coils is requisite to secure

[1] *The Wireless World*, June 13th, 1928.
[2] *The Wireless World*, Jan. 30th, 1929.

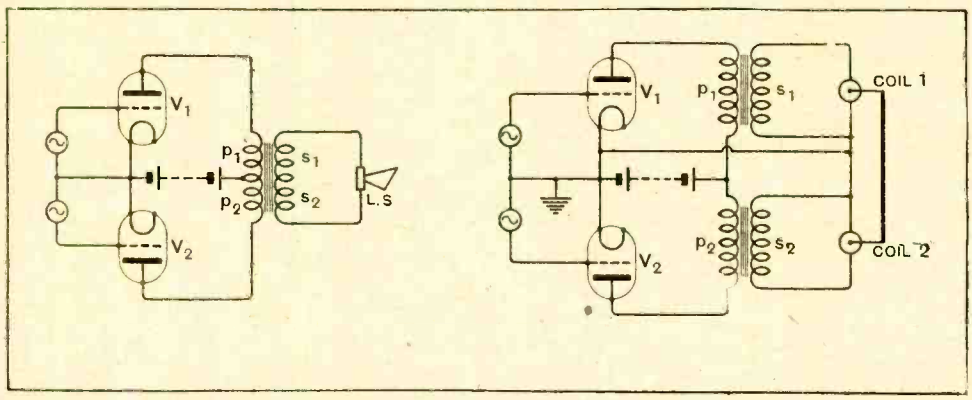


Fig. 10.—Diagram showing output transformer for push-pull arrangement, the primaries and secondary being wound on the same core.

Fig. 11.—Diagram illustrating the use of two separate output transformers for push-pull. There are two separate loud speaker coils coupled mechanically, but with a minimum of electromagnetic coupling.

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the output from the positive and negative half-waves, and to obtain the linearity effect described in Part I, when biasing to the middle of the curved portion of the valve characteristics. In Fig. 12 the above principle is shown applied to distant operation. There are two separate transformers at each end of the line or cable. There are two cables and an earth connection. This could be effected by a twin-flex lead-covered cable, the insulated cores representing lines 1 and 2, the sheathing being earthed. Here we assume that the electromagnetic coupling between the cores is negligible. With a non-twin line this would not be the case. The same condition arises in the practical construction of the telephone or loud speaker coils. We shall forthwith discuss this phase of the problem.

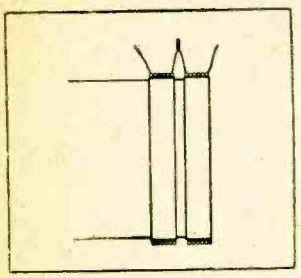

Fig. 13.—Diagram showing arrangement of mechanically coupled coils with small electromagnetic coupling.

The simplest case for treatment is an ordinary coil-drive arrangement. A normal high-resistance coil for use with a triode has about 1,000 turns of 46 S.W.G. By using 48 S.W.G. and dispensing with a former, it is possible to get 1,000 turns *side by side* (Fig. 13) in a length of $\frac{3}{8}$in. If either coil is used independently it will be found on short-circuiting the idle one that the output is not affected to any discernible extent. When the same experiment is performed with two coils closely coupled, one being wound over the other, there is an appreciable reduction in output when mid-point biasing of the linear characteristic is used.

Coupling Between Coils.

It would be inaccurate to deny the existence of mutual inductance between two side-by-side coils, but the voltage induced from one to the other is relatively small enough to be neglected. Where it is desired to uncouple the coils a *negative* mutual inductance can be inserted in the circuit. This is merely a mutual inductance of the same magnitude as that which exists between the coils, but its sense is reversed. The schematic diagram is sketched in Fig. 14. Since coils used in a loud speaker have an iron core, the mutual inductance between them will vary with the frequency. Moreover, the anti-mutual inductance should vary also with the frequency which can be effected by using an iron core. This refinement is hardly necessary. The anti-mutual inductance should have a minimum of leakage and resistance to avoid introducing added inductance and loss into the circuit.

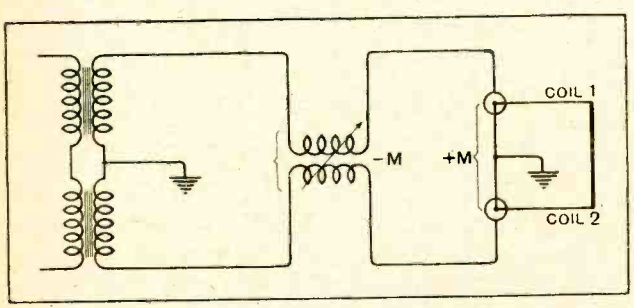

Fig. 14.—Circuital arrangement for annulling any electromagnetic coupling between coils of Fig. 13.

The next point we have to consider is the relative output powers using an uncoupled electrical system of push-pull, and the two methods of biasing the valves.

To avoid complications it will be wise to study the problem as applied to high resistance coils,[3] the circuit diagram for which is shown in Fig. 15. L_1 L_2 consists of two separate chokes without electromagnetic coupling. A form of circuit equivalent to Fig. 15 is illustrated in Fig. 16. When the valves V_1 and V_2 are both substantially similar and biased to the middle of the linear portions of their characteristics, each valve supplies one-half of the total electrical output to the loud speaker.

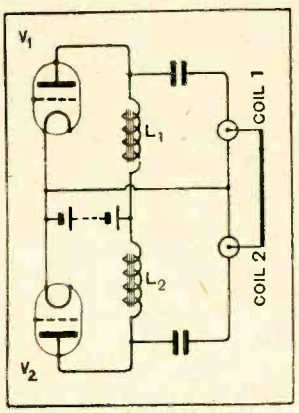

Fig. 15.—Diagram showing arrangement of output circuit when two magnetically separate but mechanically coupled high-resistance coils are used.

It is clear that the current i (root mean square value) is equal in both coils. Thus the force in each coil is proportional to i. But the forces are additive by virtue of the mechanical coupling between the coils. Hence the total force is proportional to $2i$, and the output to $4i^2$.

Biasing to the middle of the curved portion of the characteristic gives slightly more than twice the grid swing obtained by the other method. Thus the current in one of the coils will be slightly greater than twice its value with the other mode of biasing. Let us assume that the current is $(2+x)i$, this being the root mean square. Then this is the equivalent current reduced to one coil, the other being assumed out of action, since they function on alternate half-waves. The force is clearly proportional to $(2+x)i$, and is greater than that for the other method of biasing by a small amount. The output is proportional to $(4+4x+x^2)i^2$. In practice $(4x+x^2)i^2$ is not sufficiently marked to be of any real importance. The output with either method of biasing is not quite *four* times that from a loud speaker with 1,000 turns 46 S.W.G. and one power valve, since the inductance and resistance of the narrower coils of 48 S.W.G. are higher than those of the former. Nevertheless, we have arrived at an extremely interesting and important conclusion, namely, "In a back-to-back arrangement of valves where there is mechanical but

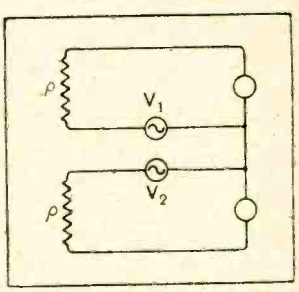

Fig. 16.—Here a form of circuit equivalent to that of Fig. 15 is illustrated.

[3] A tapped moving coil was used by the author in a push-pull cable recorder as described in patent 291,516, March 2nd, 1927.

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no electromagnetic coupling between the components of the output circuit the power delivered is substantially identical whether the valves are biased to the mid-points of the straight or to the curves in their characteristics."

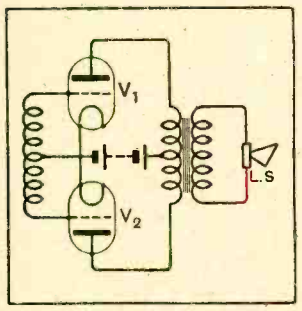

Fig. 17.—Simple push-pull circuit transformer-coupled to loud speaker.

Parasitic Oscillations.

In using the push-pull method of amplification at radio frequencies where tuned circuits are employed difficulties are invariably encountered. If the neutrodyne principle is adopted care must be exercised in certain cases that parasitic oscillations are not aggravated instead of being alleviated. The parasitic oscillations are in general of higher frequency than those which occur due to oscillation at the frequency of the main components (coils and condensers). Although we are not particularly concerned in this article with the application of the push-pull system to radio frequencies, the general principles associated with the production of parasitic oscillations apply equally, but in different degree, to audio frequencies. Moreover, the Editor has correspondence from readers of *The Wireless World* the trend of which indicates that some experimenters have met with difficulties which may be traced to some form of parasitic oscillation.

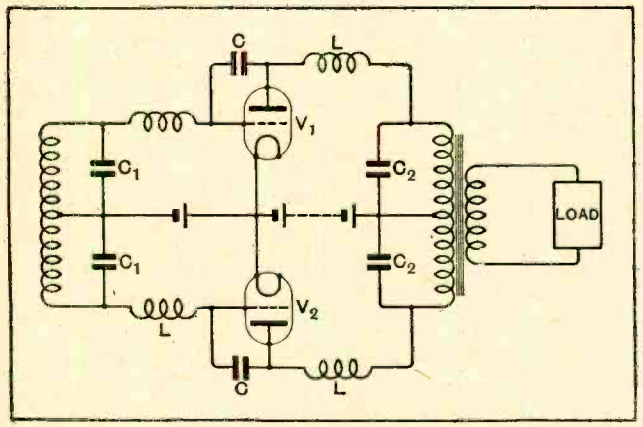

Fig. 18.—Showing arrangement of two valves in push-pull fashion, with coil (C_1 C_2) and electrode capacities (C) and inductance of leads (L).

A typical push-pull circuit associated with a power valve is depicted in Fig. 17. This simple diagram has been drawn in greater detail in Fig. 18. Here the self-capacities of the transformer windings and the inductances of the connecting leads have been indicated, since they play an important part in the phenomenon under discussion. At supersonic frequencies the inductances of the transformer windings are sufficiently high to be regarded as enormous impedances. Hence they can be left out of account. There remain (1) the interelectrode capacities; (2) the capacities of the transformer windings; (3) the inductances of the leads. These three components have been reassembled in their respective positions in Figs. 19 and 20. The oscillatory circuit A B E D of Fig. 20 resembles the form of circuit used for the generation of radio oscillations of short wavelength. Since L and C are relatively small, the frequency of the corresponding *parasitic* oscillation will be relatively high, and therefore supersonic.

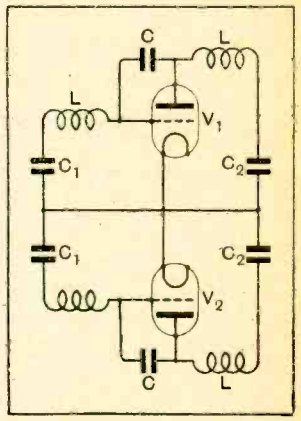

Fig. 19.—Circuit of Fig. 18 as it would appear so far as a parasitic oscillation of supersonic frequency is concerned. See Fig. 18 for meaning of symbols.

Another mode of oscillation can be traced out as follows: Suppose we take one of the pair of back-to-back valves of Fig. 18 and draw its circuit alone. This, minus the inductance of the leads, is shown in Fig. 22, and is nothing more nor less than our old friend the tuned anode. The grid has an oscillatory circuit, due to the inductance of the transformer secondary and its self-capacity. Likewise, the anode has a tuned circuit of similar nature. The grid to anode capacity has been indicated, and this supplies a certain degree of back coupling. With a *power* triode this arrangement is usually quite stable.

Tuned Anode Analogy.

Now we have an identical circuit for the other valve of the pair. Putting these two circuits together and remembering the mutual inductance between the two primary and the two secondary windings, we arrive at Fig. 23. Here we have two tuned anodes in parallel, either of which separately is quite harmless. But the mutual effect of the two primaries (and the two secondaries) on each other is not quite perfect, due to leakage.

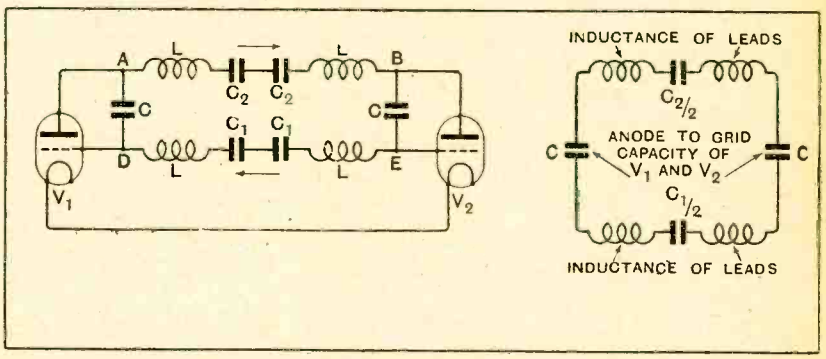

Fig. 20.—Circuit of Fig. 19 simplified by redrawing and omitting the connection from the junction of C_2C_2 and of C_1C_1 to the common filament lead. A B E D is an oscillatory circuit of supersonic frequency.

Fig. 21.—Diagram of Fig. 20 simplified to show that it is an ordinary oscillatory circuit. By "lumping" the inductances and condensers, it could be represented by a single inductance and a single condenser.

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This leakage can be considered as a small inductance or residue due to incomplete flux interlinkage. Redraw-

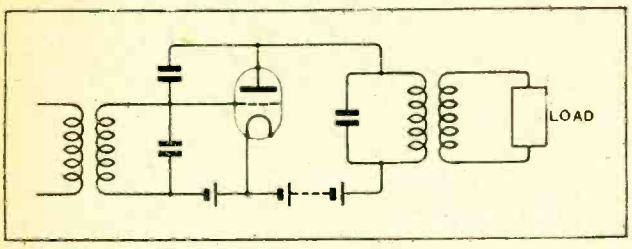


Fig. 22.—Showing that the circuit of one of a pair of back-to-back valves is akin to tuned anode.

ing the circuit to incorporate the leakages, we have the arrangement of Fig. 24. There are now two valves in parallel, each being associated with an oscillatory circuit. It may happen in certain cases that the conditions are consistent with self-oscillation. The parasitic currents are indicated by the arrows.

It is possible that this latter mode of oscillation is more likely to occur with radio than with audio circuits.

Although we have indicated two modes of parasitic oscillation, it does not immediately follow that these will occur in an audio-frequency amplifier. We know quite well that a tuned anode circuit will oscillate only when the conditions are favourable. That is to say, the

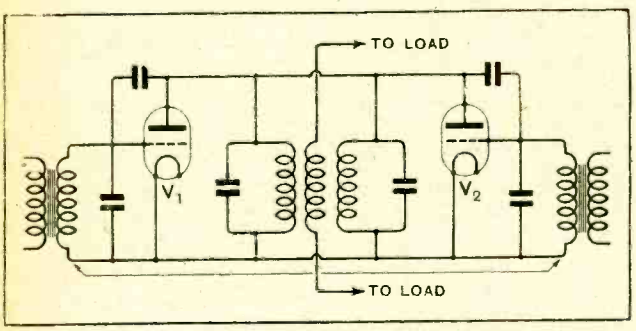


Fig. 23.—Showing that back-to-back valve circuits are equivalent to two paralleled tuned anodes.

coil inductances, coil capacities, coil resistances, valve capacities, valve parameters, have to be related in a certain manner before persistent oscillation is secured. Moreover, in our back-to-back audio amplifier conditions must be appropriate in order that parasitic currents shall be generated. One would expect, for example, that there would be a greater tendency to oscillation with valves of large magnification factor and large anode to grid capacity than with valves having more moderate attributes.

Push-Pull Neutrodyne Circuit.

Parasitic oscillations are a direct cause of distortion, as evinced aurally on the loud speaker—long before the power valve is worked to capacity by the audio-frequency voltage. The cure for this disease is to insert a resistance in the grid lead to each valve. The magnitude of the resistance in each lead should be such as to upset completely the condition for sustained oscillation. In other words, the system is unable to supply the energy required to overcome the i^2r loss in the damping resistances. The damping resistances are shown in Figs. 25 and 26, and they are clearly in series with the oscillatory circuits for both parasitic modes.

The value of the grid resistance depends upon the frequency. For radio work, where the main circuits are set for broadcast frequencies, resistances of about 500 to 1,000 ohms are adequate. For audio-frequency

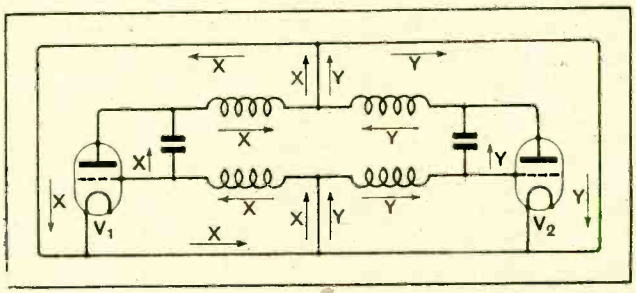


Fig. 24.—Showing "parallel" parasitic circuits in back-to-back amplifier.

amplifiers the resistances will be greater, say, 10,000 to 50,000 ohms. They ought not to be large enough to cause an amplification loss in the upper audio-frequency register, and, furthermore, they must, as far as practicable, be devoid of inductance and self-capacity. In this respect a reliable grid-leak is about the best commodity to use for damping purposes.

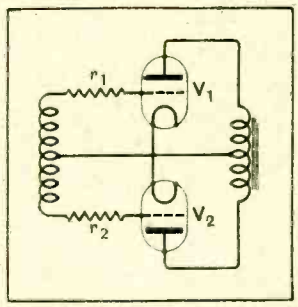


Fig. 25.—Diagram showing method of curbing parasitic oscillations in push-pull circuit. r_1 r_2 are resistances to damp out parasitic oscillations of the two types described in the text.

Lastly, we come to the question of neutrodyning push-pull circuits. I think it was Pope, the poet, who reduced rhyming to fit in with a formula. In the same vein we can reduce neutrodyning to a formula, as follows: There must be applied to the grid of the valve a potential equal to and in phase with that on the anode. Well, we have seen in Part II that in a symmetrical back-to-back system *with valves biased to the mid-points of the linear*

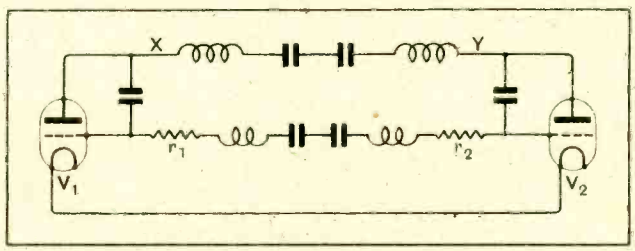


Fig. 26.—Showing circuital position of damping resistances r_1 r_2 of Fig. 25 for curbing parasitic mode of Fig. 20. Clearly resistances inserted at X and Y would also be effective. At high frequencies this is permissible since the resistance required is small, but at low frequencies it is large and would reduce the anode feed.

The Theory of Push-Pull.—

characteristics, at any instant a pair of valves are doing the same thing with a phase difference of 180°.

Taking V_1 V_2 of Fig. 27, their anodes are at equal but opposite potentials: so also are their grids. But we require the grid of, say, V_1 to have a voltage applied to it equal in magnitude and in phase with that of the anode. Now a condenser will alter the phase appropriately. Accordingly, a condenser is connected from the anode of V_2 to the grid of V_1. The capacity of this condenser is the effective anode-grid capacity of V_1. Valve V_2 is neutrodyned in like manner.[4] We have now to see whether any additional parasitic circuits have been added due to the presence of these cross-connected neutrodyne condensers. The resulting circuit is that of Fig. 21 with the condensers C C added, and is shown in Fig. 28.

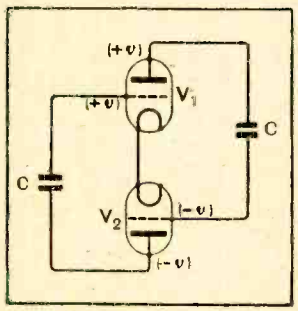


Fig. 27.—The anodes and grids of a symmetrical mid-point back-to-back arrangement are at equal and opposite potentials. The diagram shows how neutrodyning is effected.

Clearly we have now some additional parasitic circuits. The resulting oscillations can be damped out by inserting resistances in both *grid and anode circuits,* as shown in Fig. 29. For radio-frequency circuits the resistances required are relatively small and will not reduce the H.T. voltage. For audio frequencies the anode resistances would be larger and might be of such a magnitude as to reduce not only the H.T. appreciably, but to modify the frequency characteristics of the stage. Parasitic oscillations are more likely to occur with valves of high magnification factor value than with power triodes. However, on the average these oscillations are always a "possibility," and it was thought desirable to ventilate the subject, so that if difficulties arise they can be explained as shown above.

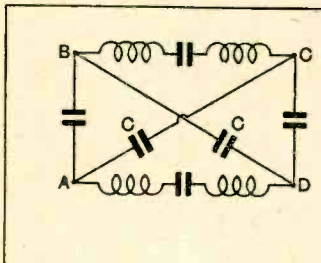


Fig. 28.—Showing additional circuits ABC, ACD, ABD, BCD introduced by neutrodyne condensers CC of Fig. 27.

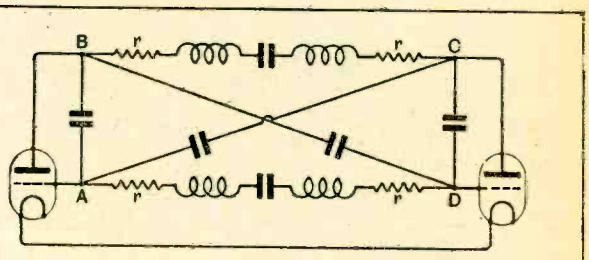


Fig. 29.—Showing damping resistances r in anode and grid circuits. It will be seen that each circuit has at least a damping resistance 2r.

[4] The present contribution together with parts 1 and 2 was written in April, 1928, but publication has been delayed by arrangement with the Editor to make room for other contributions of topical interest. In *Experimental Wireless* of October, 1928, p. 555, Mr. W. B. Medlam suggests the use of a neutrodyned push-pull amplifier to avoid feed-back. It appears, therefore, that both Mr. Medlam and myself have evolved the same idea independently. So far as I am concerned, the genesis of the idea is contained in my patent specification, 290,351, of February 10th, 1927. The complete idea matured on writing this article.—N. W. McL.

THE PRAGUE CONFERENCE.

The International Bureau of Radiotelephony Officially Recognised.

APART from its useful work in stabilising the wavelengths of European broadcasting stations, the Prague Conference has conferred an official status on the International Bureau of Radiotelephony, which previously could only recommend and suggest, without having any power to make authoritative decisions.

The International Consultative Committee for Radiotelephony, composed of delegates from all European countries, will meet whenever required by a majority of the administrations concerned, and will be summoned by a notice from the International Telegraph Bureau at Berne. This Committee will discuss questions of interest to all the countries concerned and especially the removal of any obstacles in the way of carrying out the "Prague Plan," or modifications necessary.

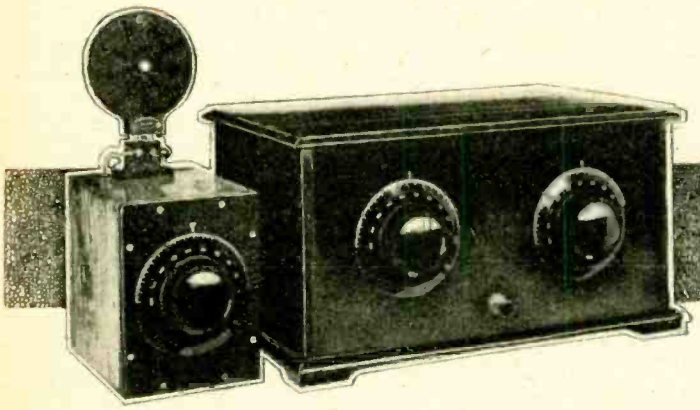
The International Union of Radiotelephony is to be officially recognised as the expert council whenever collective action is necessary and will maintain the balance of rights between the several administrations. It will also see that the various broadcasting stations maintain the correct wavelengths allotted to them, and will notify the International Telegraph Bureau of any decisions agreed on or other matters necessary to be communicated internationally.

The Prague Conference agreed that the 1,124-metre wavelength used by the German Police authorities shall be recognised as that for use in their international communication with other European countries, and that 3,350 metres (89.5 kC.) and 5,660 metres (45 kC.) shall be reserved for synoptic meteorological messages.

It also recommended that broadcasting stations working on the 200- to 545-metre waveband should be reduced, as far as compatible with the national needs, both in power and in number, and that as much use as possible should be made of common wavelengths; also that all reasonable steps should be taken to prevent harmonics which would interfere with stations on other wavebands, and *vice versa,* that other stations should be urged to prevent the creation of harmonics likely to interfere with broadcasting on this waveband.

With regard to amateur and experimental stations, the Conference considers it desirable that the authorised international call signs should be adopted by all radiotelegraphic stations capable of causing interference with others, except only in the case of military stations or radio beacons, and that any irregularities observed in transmissions from European amateur stations should be communicated to the administration concerned.

Matters deferred for future discussion include the suitable intervals to be reserved between each wavelength, the supervision of the stability of all wireless transmissions, and the formation of a permanent international service for the control of frequencies.



IMPROVING SELECTIVITY

By "RADIOPHARE."

Getting Ready for Brookmans Park.

THERE is, or should be, no mystery about selectivity: broadly speaking, the performance of a given receiver can only be improved in this respect by reducing the H.F. resistance of its tuned circuits, or, alternatively, by increasing their number, and thus adding to the filtering effect imposed on incoming signals. This is a general statement, and is subject to one or two important reservations; for instance, we all know

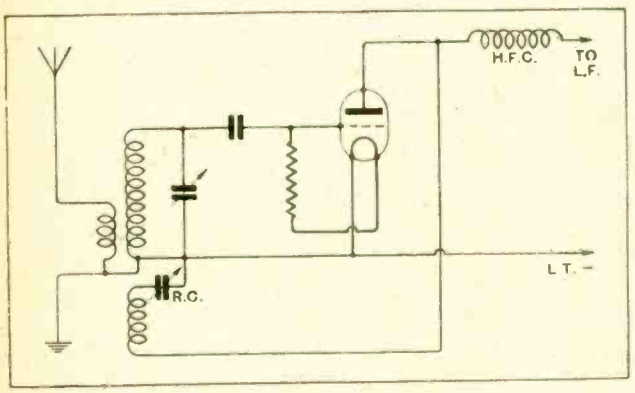


Fig. 1.—A conventional detector circuit with capacity-controlled reaction.

that a set with anode bend rectification is more selective than when the competing system is employed, but as this article is intended to deal only with simple sets without H.F. amplification—which are generally most in need of improvement—it will not be misleading to ignore the exceptions, which, after all, only tend to obscure the main issue.

We are accustomed to say that the selectivity of a receiver may be improved by reducing the number of turns in the aerial winding of an "aperiodic" coupling transformer, or by a reduction of aerial series capacity. This is true enough, up to a point, but when we come to examine matters critically, it is found that selectivity is mainly attained in this way by sacrificing signal strength. On applying the *reductio ad absurdum* test, it is seen that the statement is a loose one, for, if we go on cutting down aerial coupling progressively, we come to the point where the aerial is removed altogether, and reach the state of affairs cynically advocated by the old-time wireless man, who held that a disconnected aerial was the only perfect cure for interference troubles!

Filter, Wavetrap, or Two-circuit Tuner?

When we try to apply the two main methods of improving selectivity which are laid down in the opening paragraph of this article, we find that the limit to which circuit resistance may profitably be reduced is quickly reached, especially when dealing with detector-L.F. sets having grid rectification. There remains the possibility of increasing the number of tuned circuits, either in the form of pure filters, a wavetrap, or a tuned and variably-coupled aerial transformer. The first plan is hardly practicable, while the second has a limited field of usefulness, is rather difficult to add—

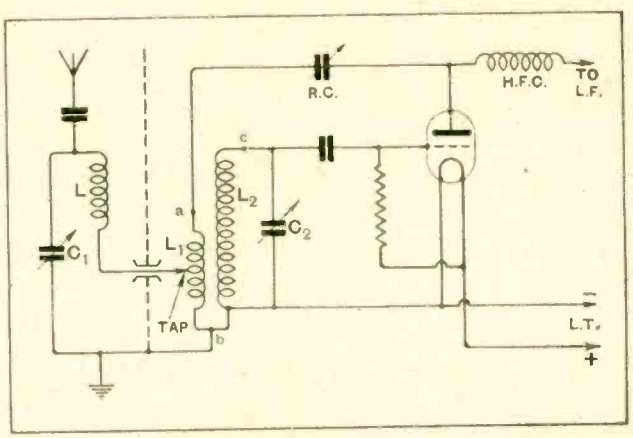


Fig. 2.—Tuned aerial circuit, specially adapted for adding to an existing receiver. C_1, aerial tuning condenser; C_2, secondary tuning condenser; L, loading coil; L_1, coupling-reaction coil; L_2, secondary coil; a, b, c, terminal points of coil, corresponding with Fig. 3.

in its best form—to a completed set, and is at least as difficult to operate as the two-circuit aerial coupler. In this arrangement an extra circuit can be made to serve a really useful purpose, and it is submitted that

Improving Selectivity.—

in no other practical way can the selectivity of a set be so radically improved.

It is admitted that regenerative detector-L.F. sets, which stand most in need of improvement in this respect, are the most difficult to modify, but, provided reaction control is smooth and fairly constant, it is by no means impossible to devise a satisfactory scheme; indeed, a receiver on these lines has recently been described in *The Wireless World*,[1] but as this arrangement was somewhat specialised, it is considered that a description of another method, readily adaptable to existing sets, may be of interest.

Altering the Aerial Circuit.

A typical detector circuit with "untuned" aerial coupling is given in Fig. 1: the same arrangement,

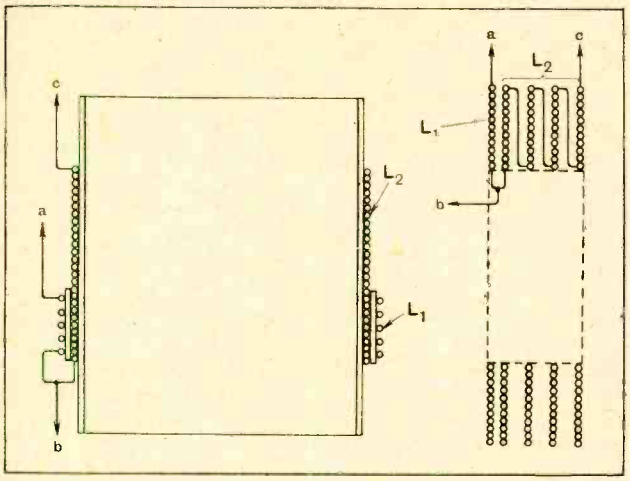


Fig. 3.—Sectional drawing showing construction of coils for medium and long wavebands.

modified by the addition in question, is shown in Fig. 2, from which it will be seen that the tuned aerial circuit is connected to a tapping on the reaction coil L_1; the portion of this winding between the tap and its earthed end acts as the primary of a transformer, of which L_2 (the grid coil) is the secondary. It is necessary that the reaction condenser (R.C.) should be transferred to the high-potential end of the circuit; this is admittedly a disadvantage, but hand capacity effects need give no trouble if an earthed shield is interposed between panel and condenser, particularly if the control dial is of such a size that the operator's hand is not in close proximity to the "live" shaft.

If existing coils are well designed and reaction control is really good, it is quite possible that they will not need serious modification; all that will be necessary is to join together the points at present connected to R.C., and to make a tapping for connection of the aerial circuit. This junction will generally be at the second turn from the earthed end of the winding, but its exact position is best determined by trial: coupling is tightened by moving the tap away from the earthed end, and *vice versa*.

[1] "The Two-Circuit Two," February 6th.

Unless promising results are at once attained it is well worth while to build special coils on the lines shown in Fig. 3; these may be fitted with plug-in bases in any manner convenient to the constructor. The secondary of L_2 (medium wave secondary) may consist of 68 turns of No. 26 D.C.C. wound on a 3in. cylindrical former. The combined aerial-reaction winding L_1 has 12 turns of fine wire (about No. 30) spaced 20 turns to the inch and about $\frac{1}{16}$in. from the secondary; it is supported on a series of insulating strips in the manner familiar to the majority of readers. In specifying this reaction winding, it is assumed that a reaction control condenser of about 0.0003 mfd. will be used; a maximum capacity of this order is recommended, and the substitution of a lower value will call for an increase in the number of reaction turns.

Some Practical Details.

A good deal of latitude is permissible in the construction of the long-wave coil: what is needed here is a reasonably efficient secondary winding having an inductance suitable for covering the waveband desired in conjunction with the tuning condenser available, and, tightly coupled to its earthed end, a combined reaction-aerial winding of about 40 turns of fine wire, tapped at approximately the fifth turn. As in the case of the short-wave transformer, the exact position of this tap should be determined by trial. A satisfactory form of winding is shown in the diagram: L_2 is in four sections, each with 50 turns of No. 32 D.S.C. wire and having an outside diameter of $3\frac{1}{4}$in. The reaction winding, as given above, is of the same wire, in the form of a single-layer helix, spaced $\frac{1}{32}$in. from the other coil.

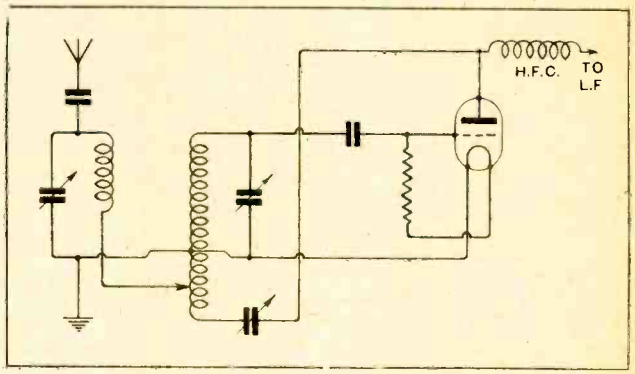


Fig. 4.—The same method of coupling applied to a "single-coil Reinartz" circuit.

As there is seldom enough room inside the cabinet to allow of the addition of an extra tuning condenser and coil, it will often be convenient to mount the former component in a small wooden box, to which the loading coil may be attached, either in the manner shown in the illustration at the head of this article or at the side of the box. Whatever method is adopted, the axes of the two coils should be at right angles, in order to minimise stray couplings between them, and the interposition of an earthed metal shield, as shown in dotted lines in Fig. 2, is to be recommended.

CURRENT TOPICS

Events of the Week in Brief Review.

TRAIN TELEGRAMS.

The Paris, Lyons and Mediterranean Railway has just installed wireless telegraph receivers on a number of express trains, writes our Paris correspondent. Telegrams to and from passengers are handled *en route*.

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THE REAL THING AT LAST?

From Invercargill, New Zealand, comes the news that a local inventor has perfected a device for eliminating atmospherics and other interference to wireless reception.

As nearly every country has now "perfected" a device of this sort it is only fair that New Zealand should have its chance.

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DEMONSTRATIONS AT OLYMPIA SHOW.

Twenty-five specially constructed demonstration rooms will be a novel feature at this year's National Radio Exhibition at Olympia. These rooms, situated in the gallery, will be available for demonstrations of loud speakers from a common output or from gramophone records.

The duration of the Show has been extended to ten days, the dates being Monday, September 23rd, to Thursday, October 3rd, both days inclusive, and the Exhibition will be open each day from 11 a.m. to 10 p.m.

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PICTURES FROM EUROPE.

Owners of Fultographs will very soon be able to receive pictures from nearly every country in Europe. Several of the German stations now provide regular transmissions during programme hours.

From Central Europe comes the news that Prague and Budapest are also installing photo-electric Fultograph transmitters, and their transmissions are to begin to-day (May 15th).

Southern Europe will soon be sending still pictures, for Rome, Madrid and Barcelona are inaugurating a service almost immediately. Nearer home, Brussels, whose new 10-kilowatt transmitter provides such good reception in this country, is acquiring a still-picture transmitting plant, whilst both Hilversum and Radio-Paris will have their regular services in the course of a few days.

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CHANGE OF ADDRESS.

Owing to an increase of business, the Climax Radio Electric Company have removed to new premises. Their address is Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.

SOVIET PROGRAMMES FOR CHINA.

The "cultural needs of the Chinese people" are being catered for by the Soviet authorities by the opening of the new broadcasting station at Khabarovsk, on the Manchurian frontier. The inaugural programme on Wednesday last was in Chinese, English and Korean.

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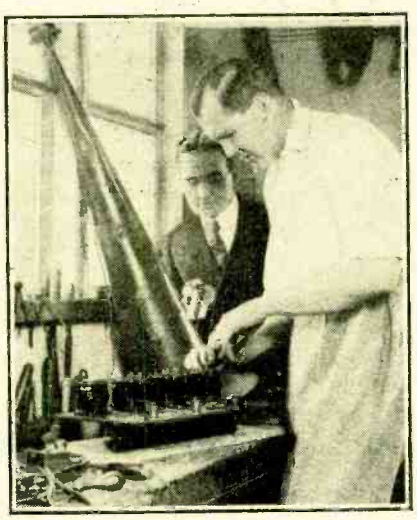
CAPTAIN IAN FRASER.

As a keen wireless experimenter Captain Ian Fraser, the blind M.P. for St. Pancras, is making active use of his



ARMING FOR WAR. Captain Ian Fraser, the Conservative candidate for St. Pancras, putting finishing touches to his home-made public address equipment.

technical knowledge during the Election campaign. To address large open-air meetings he employs a powerful speech amplifier of his own design. Incidentally, he was one of the few Parliamentary candidates who used valve amplifiers during the 1924 Election, in which he was returned as Conservative member for St. Pancras with a substantial majority.

Captain Fraser's work on behalf of the blinded ex-Service men of St. Dunstan's is widely known, and many of our readers are aware of his association with wireless and broadcasting. He is a Past-President of the Radio Society of Great Britain, and is Chairman of the B.B.C.'s Advisory Committee on Programmes. It is interesting to recall that Captain Fraser was a member of the Committee of Enquiry into Broadcasting which recommended the establishment of the present Corporation.

SHORT WAVES FROM EIFFEL TOWER?

The installation of a short-wave transmitter on the Eiffel Tower for communication with the French Colonies is a project of the Radio Manufacturers' Union of France. It is stated that French colonials are agitating for concerts and news from home, having been impressed by the enterprise of the British and the Dutch.

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WIRELESS TELEPHONY ON CANADIAN TRAINS.

As a result of a successful trial on a Canadian National Railway's train travelling between Montreal and Toronto on May 7th, a regular wireless telephone service is shortly to be established on Canadian express trains. During the test, passengers were able to converse with friends in Montreal and Toronto while travelling at 40 miles per hour.

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AUDIO-VISION.

The Audio-Vision Appliance Company is the arresting title chosen for the company resulting from the merger between the Victor Talking Machine Company and the Radio Corporation of America. The new concern will manufacture radio-gramophones.

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MAN-MADE STATIC.

Boonville Village, New York State, is more up to date in wireless matters than many other strongholds of civilisation. A bylaw has been passed forbidding the maintenance or operation of any electrical device causing interference to local wireless sets. No electric sign with a make-and-break contact may be used, says *Radio Broadcast*, unless equipped with condensers properly earthed, and electric pianos are prohibited. Violet-ray machines may not be used between 6 and 10 p.m. except in emergencies. Anyone disregarding the ordinance will be considered a disorderly person and subject to a penalty of $100.

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GOOD NEWS FOR GENEVA.

The broadcasting millennium, when "wavelength schemes" may be a mere memory, is foreseen by the French astronomer, M. Charles Nordmann, who points out that salvation from mutual interference will eventually be found on the short waves between 1 and 10 metres. Between these limits, he affirms, there is room for 25,000 transmitters, without overlapping. "The day on which this is realised," he remarks, "there will be an ethereal manger of hay for every wireless Pegasus."

A Review of the Latest Products of the Manufacturers.

MAINTEN H.T. ELIMINATOR. Model D.C.M.1.

This model, which is for use on D.C. mains, has been designed in accordance with the I.E.E. recommendations; a metal case is used and all "live" parts adequately protected. Two output voltages are provided; one nominally 60 volts and the other 120 volts or more, according to load. This is assuming the supply mains are of the order of 200 volts D.C.

The output voltages are interdependent on the load current taken from each tapping, and tests showed that the marked voltages were obtained when

Mainten H.T. Eliminator, Model D.C.M.1.

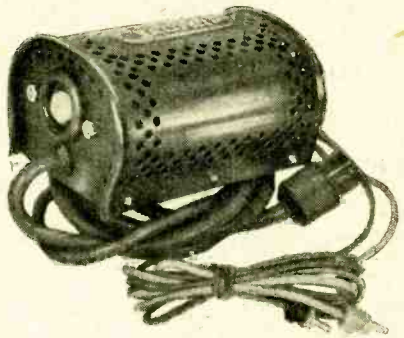
9.5 mA. were taken from the 120-volt tap and 5 mA. from the 60-volt socket. The supply was 210 volts.

A practical test was then made, using a 3-valve set (0-v-2) fitted with an average-sized power valve. The eliminator delivered 120 volts at 12.5 mA. and there was practically no mains ripple to be heard three feet from the loud speaker.

The makers are The Mainten Manufacturing Co., 126, Portland Road, Hove, and the price of the D.C.M.1 is 39s. 6d.

OLDHAM H.T. BATTERY CHARGER.

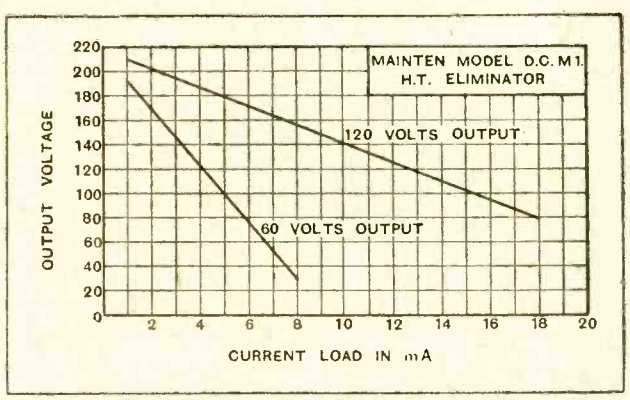
Oldham & Son, Ltd., Denton, Manchester, well known as makers of accumulator batteries, supply also suitable charging units for use with electric supply



Oldham H.T. battery charger Type A.C. H.T.1.

mains. A popular-priced Oldham H.T. battery charger was recently introduced. It is very simple to operate, and for a small expenditure provides an easy method of maintaining the H.T. accumulator battery in good condition. It will satisfactorily deal with batteries up to 150 volts, and is rated to provide a charging current of 30 to 60 mA. A small lamp is fitted which serves the double purpose of indicator and fuse, glowing brightly when the charging rate exceeds 40 mA.

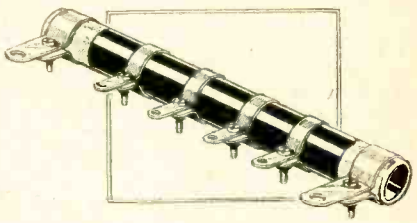
The 200-240-volt unit, tested on a 200-volt A.C. supply, gave a charging rate of 18 mA. to a 120-volt battery. On a 240-volt supply the charging rate became 29 mA. When charging a 60-volt battery with inputs of 200 and 240 volts the charging rates were 33 and 44 mA. respectively. It is advisable when using this battery charger to provide a double-pole change-over switch between battery and set in order that the connections to the receiver may be entirely removed when the battery is on charge. This precaution is necessary as the output leads are not separated from the mains by a transformer. The same precautions are, of course, necessary when a D.C. battery charging device is used with direct-current mains.



Voltage regulation curves of the D.C.M.1 model. Measurements were made of each output voltage under load separately.

"ALWAYS" POTENTIAL DIVIDER.

The Abingdon Wireless Supplies, 45, Stert Street, Abingdon, Berks, have recently put on the market a range of inexpensive potential dividers eminently suitable for use in battery eliminators. These are not wire-wound; the resistance element consists of a graphite composition deposited on a porcelain tube. Contact with



"Always" Potential Divider.

the extreme ends of the resistance element is made by first depositing a thin film of copper on the tube. Metal bands are then clamped at the ends, and at intervals along the graphite deposit to form contact points. These potential dividers are made in values ranging from 1,000 ohms to 500,000 ohms and are stated to carry a current of 20mA with safety. The sample tested had a nominal resistance of 10,000 ohms and a measured resistance of 11,000 ohms. A current of 20mA was passed through the resistance for a period of eight hours continuously and at the end of this test the resistance was again measured. It was then found to have dropped to 10,300 ohms. A slight rise in temperature occurred during the test which probably accounts for the lower value recorded as when the divider had cooled to normal temperature its resistance had risen to 10,500 ohms.

At 2s. each these potential dividers may be regarded as good value for money.

"METAPLAC" WIRELESS PANELS.

Messrs. Borst Bros., Ltd., 74, Rivington Street, London, E.C.2, who are plywood specialists, have recently put into production a special range of three-ply wood panels covered on one face with thin aluminium sheet. The unfaced side is intended to form the front of the panel, and accordingly has been finished in an appropriate manner. This can be obtained polished, or, if desired, in the natural state.

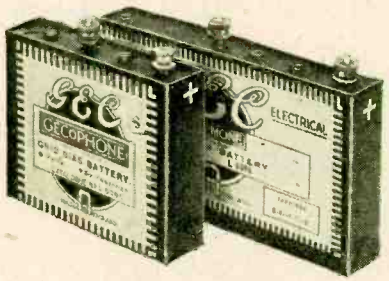
These special panels confer all the advantages of metal panels, but without that unsightliness so often accompanying a plain metal surface. It is not within the scope of all home constructors to apply a pleasing finish to aluminium or copper panels. To enable more complete screening to be obtained, this firm supply also baseboards treated in a similar manner, but in this case the thickness of the wood is increased to about $\frac{5}{8}$in., five-ply being used. Vertical screens can be fitted, utilising the same material, but it is doubtful if any real advantage, apart from appearance, will accrue. Nevertheless, metal-surfaced wood is available for this purpose.

These panels are manufactured in all standard sizes, and prices will be quoted on application. As an approximate idea of the cost, we might mention that a panel 14in. x 7in. x $\frac{1}{4}$in. thick comes out at about 5s., from which it will be seen that prices compare favourably with other types of panels. Tests show that the panels can be easily worked; the drilling of holes is a relatively simple matter, provided Morse drills are employed. Wood-bits should not be used, as these will not cut a clean hole in the metal surface.

o o o o

GECOPHONE GRID BATTERIES.

Recently the range of Gecophone dry-cell batteries has been augmented by the addition of three sizes of grid bias batteries. An unusual feature of these is the provision of terminals fitted with a split plug as an alternative to the more familiar wander-plug.



Gecophone 6- and 9-volt grid bias batteries.

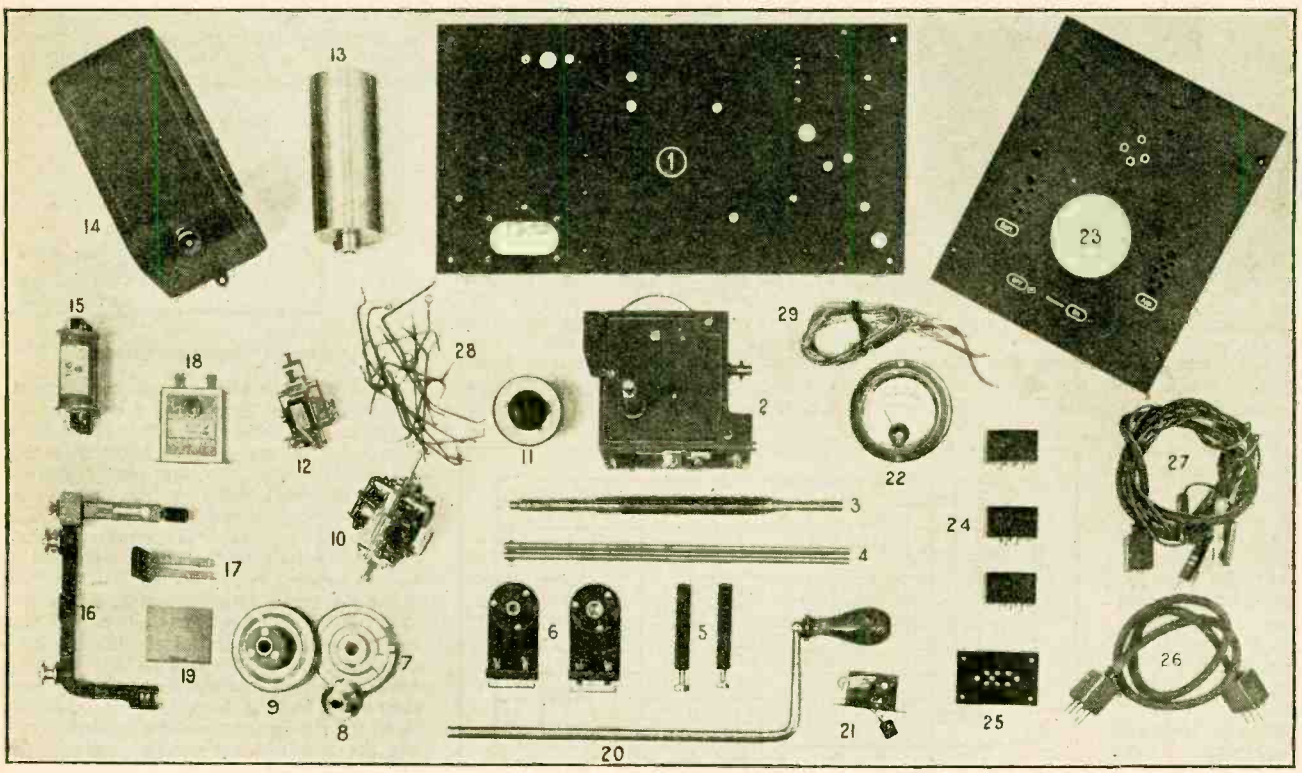
For biasing detector and first-stage L.F. amplifiers the 6-volt size will generally suffice, and as the dimensions of this are only 3$\frac{1}{4}$in. x $\frac{7}{8}$in. x 2$\frac{7}{8}$in. high, it can be accommodated conveniently inside the receiver. For small-power valves the 9-volt size will be found most useful; this measures 5in. x $\frac{7}{8}$in. x 2$\frac{7}{8}$in. high. Practically all other requirements will be met by using one or more of the 15-volt units which occupy a space of 9in. x $\frac{7}{8}$in. x 2$\frac{7}{8}$in. overall.

These batteries are products of the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, and are being offered at the following prices: 6-volt unit, 1s. 6d.; 9 volts, 1s. 9d.; and 15-volt units, 3s. 6d. each.

o o o o

PICTURE RECEIVER KIT.

The home constructor now interested in picture reception will find his needs catered for in the "Fultograph" (Wireless Pictures (1928), Limited, Dorland House, 14-16, Regent Street, London, S.W.1) set of parts. Complete in every way down to the smallest screw, no component constructional work is necessary. The outfit goes together quite easily, and problems of mechanical or electrical adjustment do not arise. Even the connecting leads are provided, already cut and bent to shape. A saving of nearly 40 per cent. on the price of a finished instrument is effected by assembling the components. The inclusion of the necessary containing cabinets for picture receiver and relay panel would, we think, be appreciated by the amateur.



THE FULTOGRAPH KIT. (1) Aluminium plate. (2) Double spring motor. (3) and (4) Spindle and guide rods. (5) Uprights. (6) Ball bearings and plates. (7) Cam plate. (8) Spiral pinion. (9) Magnetic clutch. (10) Trigger release and switch blades. (11) Speed control. (12) Relay. (13) Picture cylinder. (14) Trigger cover. (15) Input transformer. (16) Carriage with knife-edge wheel and stylus. (17) Magnetic clutch contacts. (18) and (19) Condenser and spacer. (20) Winding handle. (21) Key switch. (22) 5 mA. meter. (23) Relay panel. (24), (25), (26) and (27) Connecting leads and cover plate. (28) and (29) Internal connections.

Applying Vision and Imagination in the Grand Manner.

IN a former thesis[1] I developed the proposition that portions of the frequency spectrum which were full of excitement, of glamour, of romance, were being neglected by the millions who devote themselves only to that small part labelled "Radio." This time I propose to show how Wireless itself—even Broadcasting—can have its own glamour and romance restored to it, which it has lost by being so commercialised; by being set out in programmes in the daily papers; by having its receivers calibrated in the names of stations, so that they become more matter-of-fact than the dials of an automatic telephone; by allowing its devotees to niggle about with petty details such as a fourth (is it? Or fifth?) grid or the design of a loud speaker to look like an aspidistra.

All this is soul-destroying: if it is allowed to go on, wireless will soon have about as much romance as there is to be found in catching the 8.27 to Town every day. The only way to save it is to tackle its problems—for it still has problems—in what I may call the Grand Manner: to bring to bear on them Imagination and Vision. Let me give you an example: What is a great—perhaps the greatest—problem in broadcasting? Interference—interference by atmospherics and by other broadcasting stations. (There is also interference by oscillating; but that is the special care of the Chief Engineer of the B.B.C.—I would not dream of intruding on his preserves.)

Yesterday.

In the old days—long before broadcasting, or even the wireless amateur, was dreamed of—the Marconi engineer would leap from his bed in the middle of the night, toil through the sleet to the station or laboratory, and work till breakfast time on some bright idea which had come to him as he slept, or lay sleepless. The odds were that the bright idea belonged to one of two classes—either a new way of coaxing the interference to run harmlessly to earth by a path made as attractive to it as possible, or a new way of taking signals plus interference and balancing them against interference only: so simple—(S + I) − I = S, and there you are . . .

The first way had the advantage of seniority. It formed, indeed, almost an emblem of seniority—like the stripes on a naval officer's sleeve. The comparative junior, when he rigged up his receiving circuit, would have to content himself with perhaps one wavelength or so crammed into his coils, with one or two paths to earth proudly held out to lure the X (or the jamming station). Then a real receiving expert would come along—and the room would soon be crowded with coils and wavelengths and nodes and antinodes, and their bits of wire leading to earth and elsewhere. And if that expert went away to lunch and somebody tripped over a wire and pulled a homely tie-clip away from its special and precise point, communication was broken off completely till that exact spot could be found again: and if in searching for it another tie-clip became displaced, the matter was really desperate, because there were no signals to guide one until the two exact spots were found simultaneously. . . .

Ah! but the second way was the more alluring, the more glamorous—one really bright thought, and a world fit for signals to live in. . . . And the glorious sensation of imminent success when, by some perfect adjustment of balancing, the crackle of Xs was suddenly hushed into a kind of throbbing silence,[2] and one waited breathlessly for the minute-hand to creep round to the appointed moment when the programme should begin, and signals should stand out against that silence like crisp, black letters against a snowy sheet. And the minute-hand would creep past the appointed time, and no signals broke the silence. Late in starting, perhaps . . . wait . . . And still no signals came. Then a hurried disjointing of the complex circuit and the frantic rigging up of the simple one (change-over switches were rare in those days) . . . just to make sure . . . and there the signals were, just as usual, with the same old Xs half-drowning them: and there they had been all the time . . .

To-day.

It is all very well to smile pityingly at these prehistoric gropings in the dark. After all, the Big Brains of modern "Radio" occasionally do very much the same thing to-day. Not so very many months ago a prominent researcher—the inventor of a circuit known over all

[1] "What Do They Know of Radio . . . ," *The Wireless World*, October 3rd, 1928.

[2] A curious effect, that "balanced" silence; teeming with baffled forces; as unlike an ordinary silence as the silence of a lion, pacing up and down the bars of its cage, is unlike the silence of a flower.

Pretty Idea . . . .—

the world—announced a new method of combating atmospherics. It bore such a marvellous resemblance to the methods of ancient history that many of the "old school" must have smiled sympathetically but knowingly when they read a little later how some other researcher had proved mathematically that there was something wrong with the first man's ideas; that the brand-new 1928 "balancing" arrangement must suffer the fate of those of 1910. And that the X, like the poor, will be always with us.

I am not saying that this is so—I am just quoting. After all, I don't always believe mathematicians, do you? They announced their Conservation of Energy idea, and squashed all hope of the long-sought-for Perpetual Motion: and now we read of engineers getting a 60 h.p. plant to work on the difference in temperature of the water at the surface of the sea and at a point deep down. Yes, I am aware that it is really getting the energy from the sun's heat, thanks very much; but, after all, that doesn't make so very much difference so far as usefulness is concerned.

To-morrow.

So there is a chance, I suppose, that one fine day someone will bring out a new balancing method which will work perfectly and will solve the interference problem for every kind of Wireless; and the Old School will kick themselves hard for having tried every single possible thing except that; and the mathematicians will say, oh! well, of course he superimposes the cosmic rays on them before opposing—that isn't *real* "balancing"; we never said *that* was impossible; in fact, the whole method is implicit in our equation (29)—only we didn't trouble to point it out. . . .

But in the meantime I want to show you how, by treating the problem in the Grand Manner, with Vision and Imagination, I have managed to solve it in five minutes so far as Broadcast Reception is concerned. For although the title of this article is quite unobtrusive, that is only my personal choice. If I had been one of those strong, silent Company Promoters—one of those hard-bitten (and most justifiably so, in my opinion) men of Big Business, whose "Yea" is Yea and whose "Nea" is Nea—that title would have run:—

INTERFERENCE AND BROADCAST RECEPTION:
THE PROBLEM SOLVED:
BRILLIANT DISCOVERY BANISHES BROADCASTING'S BIGGEST BUGBEAR.
FEELING ON THE STOCK EXCHANGE.

Can you, after all, deny it to be a big achievement? The amount of cerebral grey matter exercised on the subject since 1896 amounts now to 9.73×10^{17} c.c. at N.T.P. Schlumpf puts it at 1.04×10^{18}, but his figures are discredited by the French school on the grounds that—being very near-sighted—he invariably included in his statistics any cauliflowers *au gratin* which he happened to meet. However, even at the lower figure. . . . And here have I gone and solved it in a few minutes. I have no time for petty details: here is the grand, broad scheme in its outline. It is utterly new and perfectly sound. At the B.B.C. station, the input amplification is so arranged that full control of the transmitter occurs when the orchestra (say) is playing pianissimo A thermionic relay so regulates this input that as the music gets louder the control remains always constan —so that the waves leave the aerial fully modulated as if, in fact, the orchestra were playing without any light or shade—always ff (fump fump, as the small child learning the piano explained it). The same thermionic relay also regulates the amplitude of the carrier wave, and this variation—by its effect on a small ingenious device at each receiver—keeps on adjusting the sensitivity of that receiver so as to produce the exact effect of light and shade. The ingenious device working off the carrier wave is sharply tuned so that it is unaffected by other carrier waves, and has enough electrical inertia not to respond to atmospherics.

Now do you see what happens? That absolute criterion of good reception—the ratio Signal/Interference at the receiving aerial—remains always at its maximum. The interference causes no more trouble—even in the softest parts of the music—than it does at present when the orchestra is playing its loudest; that is, it is negligible. The relay at the transmitter is simple: the ingenious device at each receiver is child's play to a Researcher—some pretty work on the grid. . . . After all, the work is half done already in the various "volume control" methods. Or isn't it?

Well, there I think I will leave it: and there I think it will be left. The more I think about it, the more I feel I was right—after all—to choose that smaller title for this article. That title, by the way, is derived from a phrase very current at one time among the Old School—a phrase due to the Great Man of Wireless, who would use it when some bright notion went, somehow, wrong; a phrase which has formed the epitaph of many a promising child of fertile brains:—

"Pretty idea. . . . No damned good."

o o c o

USEFUL AID FOR DIRECTIONAL STATIONS.

WE have received from the Royal Geographical Society an ingenious diagram for orienting a directional aerial on a distant station, which has been devised by Mr. E. A. Reeves, their map curator and instructor in survey.

The diagram represents a hemisphere in stereographic projection and, for convenience, the geographical positions of the principal wireless stations are indicated in red.

To obtain the true bearing and great circle distance between any two stations their difference of longitude is marked off on the line representing the latitude of the distant station, and this point is ticked on a straight-edge radiating from the centre of the diagram. This straight edge is now rotated through a calculated angle and the new position of the tick-mark gives the required data.

The book, with separate copy of diagram and radial pointer, can be obtained from the Royal Geographical Society, price 7s. 6d.

o c o o

CRYSTAL CONTROL OF TRANSMITTERS.

HOLDERS of transmitting licences may be interested to learn that the Quartz Crystal Co., 63A, Kingston Road, New Malden, Surrey, have prepared a 10-page cyclostyled pamphlet on "Practical Crystal Control." This deals with the construction of crystal controlled oscillators; crystal control using one or more stages of frequency doubling and many useful hints regarding the care and maintenance of crystals. It is well illustrated, and copies can be obtained at the price of 2d., plus postage.

BROADCAST BREVITIES

By Our Special Correspondent.

More About the Prague Scheme.—"Broadcasting House."—B.B.C. Staff Changes.

Attacking the Prague Scheme.

The Prague scheme is being severely trounced in advance by more than one critic, but the most insidious blow is struck by the B.B.C. engineers at Keston, who report that in the last fortnight there has been less disturbance in the European ether than ever before in the history of broadcasting! This is a "back-hander," indeed, even more devastating than the vituperations of Dr. Saint-Beat in *Le Radiogramme*, Toulouse.

Dr. Saint-Beat's attack is less subtle. He describes the scheme as outlandish and uncouth, believing it to be the outcome of official "cynicism and cretinism." (According to the Oxford Dictionary, "cretinism" is a combination of idiocy and deformity common in Alpine valleys.)

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A Mistaken Assumption.

This surprising assault turns on the assumption that the Prague Conference represented the forces of officialdom arrayed against the interests of private broadcasters. That the assumption is entirely wrong is shown by the fact, forecast in these columns a few weeks ago, that the Prague Conference has given an authoritative status to the Bureau Internationale de Radiophonie, a private agency existing solely to further the interests of all European broadcasting organisations.

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B.B.C. Optimistic.

The doctor's diatribe may have some justification in the particular case of France, for it appears that the French Post Office, as sole representative of France at the Conference, has appropriated for its own broadcasting stations all except one of the available wavelengths, leaving the remaining solitary wavelength to be torn to pieces by rival private interests. A distressing state of affairs, but not one that warrants a "bull-at-a-gate" attack on the Prague scheme as a whole.

As a matter of fact, the B.B.C. regards the scheme very optimistically, notwithstanding the tactlessness of Keston.

o o o o

"Broadcasting House."

Tenders for the construction of "Broadcasting House" are to go out in a few days' time. Except for very slight alterations, the building will appear exactly as shown in the published drawing. I understand that the contractors will be required to complete the building, ready for occupation, by the end of 1931.

Which will be completed first—"Broadcasting House" or the Regional Scheme? There are people who would answer without hesitation.

o o o o

Ichabod.

"Gone are the old familiar faces," sang Charles Lamb. The same song is being sung at Savoy Hill, for, with Cecil Lewis and Rex Palmer joining the procession to the "talkies," people are looking round to see how many of the pioneers are left. They can be numbered on the fingers of one hand. Lord Gainford, Sir John Reith, Captain Eckersley, Stanton Jeffries, and Miss Cecil Dixon—these are all remaining of the little band at broadcasting headquarters in December, 1922.

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Dehumanisation.

It is significant that no new "personalities" are replacing those who have left. This is in keeping with the prevailing policy at Savoy Hill, where the dehumanised atmosphere of a Government Department grows more and more oppressive.

For the milk of human kindness it seems that we must all go to the talking films and the gramophone.

o o o o

To Sir Walford Davies. . . .

Dear Sir Walford,—

What a pity it was that, in your delightful talk last week on "Handel at the Harpsichord," you said: "I will now play the harpsichord as softly as I can." Had you forgotten that watchful control engineer, who could make your softest notes sound like strokes on the anvil? And do you know that he did? PATERFAMILIAS.

o o o o

Empire Day at 2LO.

Sir Henry Newbolt is arranging 2LO's Empire Day programme for broadcasting on May 24th. The composer of "Drake's Drum" and other great epics promises to produce a feature-programme which should appeal to all.

o o o o

An Infallible Rule.

To decide whether you are listening to a gramophone broadcast or a genuine performance in the B.B.C. studio is quite easy, says *The Bristol Times*. Judge by the programme standard. If the singer is Clara Butt it is a gramophone record.

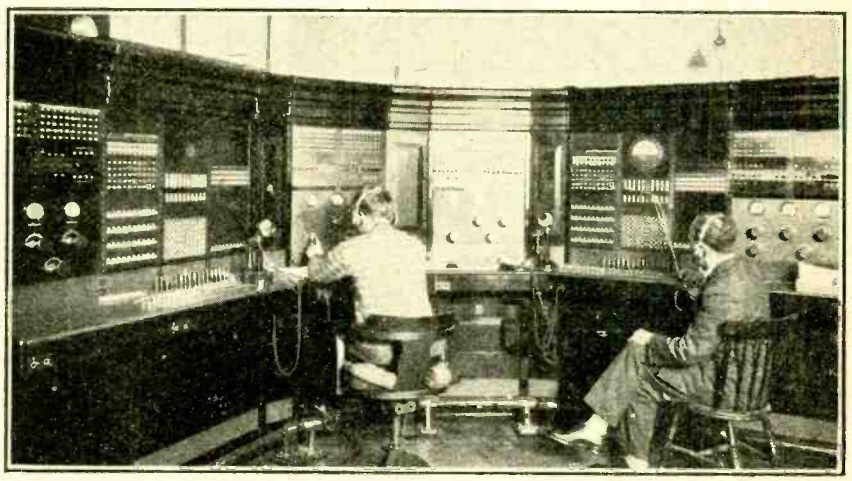


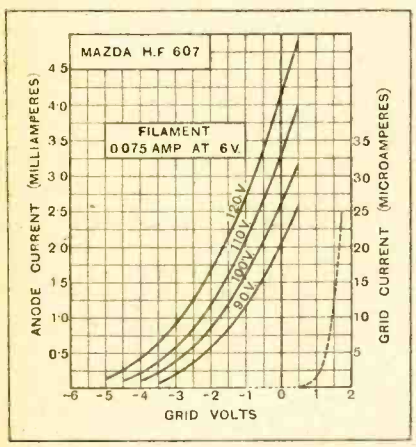
Photo: "Manchester Guardian."

B.B.C.'s NORTHERN NERVE CENTRE. The control room at the new Regional Headquarters at Manchester, from which programmes are distributed to all stations in the Northern Group.

VALVES WE HAVE TESTED

The Mazda 6-volt Series.

WITH the exception of the super-power output valve, P.X.650, the remaining five in this series are practically identical in construction with the two- and four-volt valves discussed recently in this journal. It will be recalled that the range in each case consisted of an H.F., R.C., G.P. (general purpose), L.F., and a power valve, and each of these types figure in the six-volt class. As is only to be expected, the valves in this class show a higher average in efficiency, this being evidenced by the better mutual conductances attained in every case.



Average values under amplifying conditions; A.C. resistance, 19,000 ohms; amplification factor, 18.2; mutual conductance, 0.96 mA. per volt.

H.F. 607.

This is a medium A.C. resistance valve designed primarily as an H.F. amplifier, and is, perhaps, most suitable for use in neutralised H.F. circuits, although with suitable intervalve couplings it will function satisfactorily as an L.F. amplifier. With 120 volts H.T. and 1.5 volts grid bias, the anode current will be in the order of 2 mA., and in spite of its 20,000 ohms A.C. resistance could be followed by a transformer, provided this component had a high inductive primary winding and an iron circuit sufficiently generous to permit this current to pass without undue drop in inductance.

H.F.607.

Characteristics at 100 volts H.T. and zero grid bias.

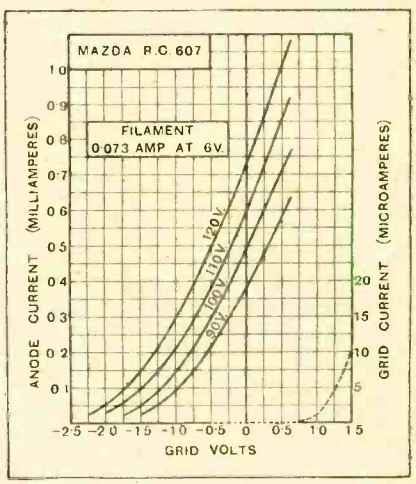
H.F. 607.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	20	20,000	1
Specimen 1 ..	20	20,000	1
Specimen 2 ..	21	25,000	0.85

The measured characteristics of one of the two specimens tested agreed with the maker's rating, but in the other case an increase in the A.C. resistance and amplification factor resulted in a slightly lower mutual conductance. The average values under operating conditions as an amplifier measured at 120 volts H.T. and −1.5 volt grid bias were: A.C. resistance 19,000 ohms, amplification factor 18.2, and mutual conductance 0.96 mA. per volt.

If employed as a grid current rectifier, it would be permissible to follow this either by a suitable transformer or a resistance-capacity coupling. In the case of the last mentioned, an anode resistance of about 60,000 ohms would be suitable, and in either case the H.T. should be restricted to about 60 or 80 volts.

R.C. 607.

Although the R.C. class of valves was developed originally for use as amplifiers, followed by resistance-coupling, present-day practice rather tends to favour them as anode detectors for small inputs.



Average values under amplifying conditions; A.C. resistance, 75,000 ohms; amplification factor, 40; mutual conductance, 0.53 mA. per volt.

The R.C.607, which comes within this class, will be discussed mainly from this point of view.

R.C.607.

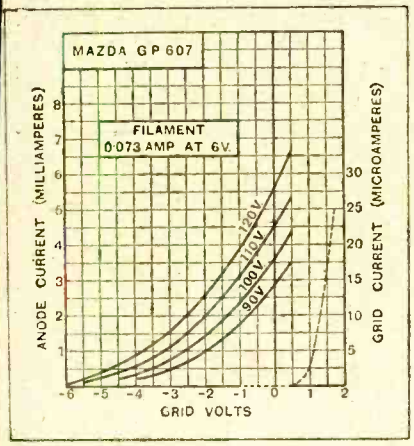
Characteristics at 100 volts H.T. and zero grid bias.

R.C.607.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	40	90,000	0.45
Specimen 1 ..	37	74,000	0.5
Specimen 2 ..	40	91,000	0.44

The characteristics of the two specimens tested did not differ materially from the maker's figures, the mutual conductances being of the same order at 100 volts H.T. and zero grid bias.

alves We Have Tested.—

Used as an anode bend detector, owever, there will be a considerble increase in A.C. resistance, and he impedance in the external anode ircuit will naturally require to be arge. The makers recommend a reistance of 2 megohms, and, although his value would appear desirable, ve venture to suggest that in cases vhere the available H.T. is limited



Average values under amplifying conditions; A.C. resistance, 19,000 ohms; amplification factor, 17; mutual conductance, 0·9. mA. per volt.

to 120 volts it would be admissible to reduce this to 0.5 of a megohm.

Possibly occasion will arise to use this valve as an amplifier, in which case an anode potential of 180 volts, or more, will be required to compensate for the volts absorbed in the anode resistance. The average values measured at 120 volts H.T.—on the anode of the valve, not battery voltage—and zero grid bias were found to be: amplification factor 40, A.C. resistance 75,000 ohms, and mutual conductance 0.53 mA. per volt.

G.P. 607.

It is difficult to allocate to the G.P.607 any particular function, as

G.P.607.
Characteristics at 100 volts H.T. and zero grid bias.

G.P.607.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	14	12,500	1.1
Specimen 1 ..	16	12,000	1.3
Specimen 2 ..	15.5	12,300	1.25

a valve with an A.C. resistance in the order of 12,500 ohms nominal will operate equally well as H.F. amplifier, or L.F. amplifier, or as a grid detector.

As an H.F. amplifier, however, some slight readjustment of the primary turns on the H.F. transformer may be necessary in the interests of selectivity.

Under operating conditions as an amplifier, with 120 volts H.T. and −3 volts grid bias, the anode current will be in the order of 1.6 mA., so there should be no difficulty in the choice of an L.F. transformer if the valve is to be used with this type of coupling.

The measured A.C. resistance and amplification factor at 120 volts H.T. and −3 volt grid bias were: 19,000 ohms and 17 respectively, and the mutual conductance 0.9 mA. per volt.

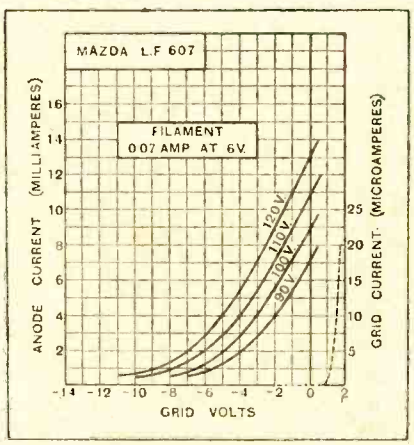
L.F. 607.

This valve is essentially a low-frequency amplifier, and as such is particularly suitable for use immediately following the detector when this stage is preceded by one or more H.F. amplifiers.

L.F.607.
Characteristics at 100 volts H.T. and zero grid bias.

L.F.607.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	9	5,300	1.7
Specimen 1 ..	10	5,400	1.8

Unfortunately only one valve of this type was available for test, but as the measured constants agreed reasonably well with the maker's



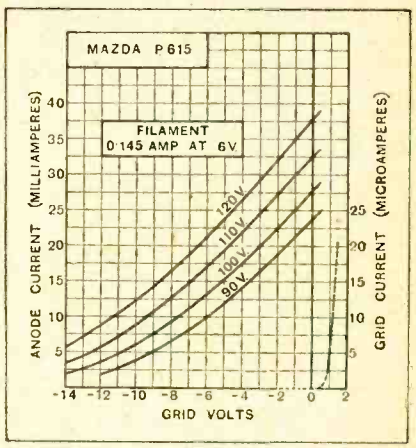
Average values under amplifying conditions; A.C. resistance, 6,700 ohms; amplification factor, 8; mutual conductance, 1.2 mA. per volt.

figures, it can be regarded as a representative specimen.

Under amplifying conditions the average A.C. resistance and amplification factor were found to be 6,700 ohms and 8 respectively, the mutual conductance being 1.2 mA. per volt. Suitable operating voltages are 120 H.T. and −4.5 grid bias, the anode current under these conditions being approximately 4.6 mA.

P. 615.

This is an output valve of average power - handling qualities and should meet the requirements of the terminal valve in most 3- or 4-valve sets, unless a very large power out-



Average values under amplifying conditions; A.C. resistance, 2,700 ohms; amplification factor, 5.7: mutual conductance, 2.1 mA. per volt.

put is demanded. In view of the comparatively large anode current—about 17 mA. with suitable grid bias and H.T.—a choke-capacity output circuit or output transformer is desirable, as this deflects the steady D.C. component of the anode current from the loud speaker windings.

P.615.
Characteristics at 100 volts H.T. and zero grid bias.

P.615.	Amplification Factor.	A.C. Resistance (Ohms).	MutualConductance (mA/Volt).
Maker's rating	6	2,600	2.3
Specimen 1 ..	5.7	2,300	2.5
Specimen 2 ..	6.5	2,700	2.4

The measured constants of the two specimens tested were sensibly in agreement with the maker's rating, the mutual conductances being slightly better.

Under amplifying conditions the average A.C. resistance was found to be 2,700, the amplification factor

Valves We Have Tested.—

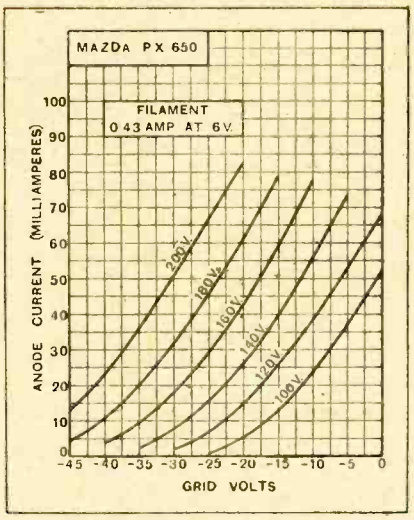
5.7, and the mutual conductance 2.1 mA. per volt. These measurements were taken with 120 volts H.T. and −9 volt grid bias. Careful tests were made with all the valves discussed so far for reversed grid current, but with the exception of one, P.615, all valves failed to reveal any trace of this, indicating that the vacuum is dead hard. Grid current normally commences at about +0.6 grid volts, and this fact can be taken into consideration when fixing the grid bias for amplifying purposes.

P.X. 650.

This is a rather special valve having a comparatively low A.C. resistance but a good mutual conductance, and has been designed for operating moving coil loud speakers. Its operating voltage is not excessive—

P.X.650.
Characteristics at 200 volts H.T. and − 40 volts grid bias.

P.X.650.	Amplification Factor.	A.C Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	3.5	1,750	2.0
Specimen 1 ..	3.1	1,430	2.16
Specimen 2 ..	3.4	1,600	2.1



Average values under amplifying conditions; A.C. resistance, 1,600 ohms; amplification factor, 3.4; mutual conductance, 2.1 mA. per volt.

200 volts being given as the maximum—but as the anode current is in the order of 23 mA., either a mains unit or H.T. accumulators would be preferable to dry-cell batteries for the anode supply.

The constants of the valve have been measured under rather unusual conditions, these being given at 200 volts H.T. and −40 volts grid bias, whereas it is general to show these at 100 volts H.T. and zero grid bias.

In one of the specimens tested, namely, that having the higher A.C. resistance, the anode current was sensibly in agreement with the maker's figures, but in the case of the other valve a slight excess under all conditions was noticed. Further tests revealed a slight trace of reversed grid current in this specimen, but no trace whatsoever could be found in the valve which we will take as the representative sample.

H.T.	Grid Bias.	Anode Current (mA).	
		Maker's Rating.	Measured.
200	−40	23	22.9
180	−37	18	16
120	−22	11	11
100	−17	9	10

It would appear from an examination of the characteristic curves that the grid bias recommended is slightly on the high side, and it might be advisable to experiment with various adjustments under working conditions.

LETTERS TO THE EDITOR.

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

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

BRITISH MANUFACTURERS.

Sir,—May I trespass upon your space to thank the gentleman signing as "Sigh-or-Two"—I wish he had been brave enough to subscribe his name—for elucidating the patent position for me which, quite candidly, I did not know existed as shown; but I do wish he could have been a trifle more convincing regarding his paragraph that "no doubt several British manufacturers would supply such an article practically from stock" when the two well-known ones that I referred to treated the matter of selling such an article with complete indifference, thus forcing my hand to buy abroad instead of writing to a few more with the great possibility of still not getting what I wanted.

Burgess Hill, Sussex. E. T. SOMERSET.

"ILLEGAL" LISTENING.

Sir,—I have read with interest the letter from "W. E. P." in your issue of May 1st, on the subject of the new licence regulations. Your correspondent instanced the reception of an SOS call from a ship in distress, which he was able to help indirectly by passing on the unanswered message to the coastguard authorities.

He asked whether any listener who happens to overhear an SOS to which no reply appears to be forthcoming should "keep silent on such matters" (in view of the new restrictions regarding secrecy) or pass on the message to the proper quarters and "risk incurring the wrath of the Postmaster-General."?

Evidently your correspondent is unaware that SOS messages are classed as "messages sent for general reception," and are therefore unaffected by the new restrictions.

Repetitions by land stations of distress messages from ships or other mobile transmitters are always addressed to "CQ," and it is clearly stated in Art. 10, paragraph 1 (3) of the International Radiotelegraph Regulations that the call "CQ" is used for "radiotelegrams of general information . . . and information of all kinds *intended to be read by anyone who can receive them.*" (The italics are mine.)

In view of this, I think listeners need have no qualms about intercepting distress traffic, and, if no reply appears to be forthcoming, passing details of SOS messages received to the proper authorities. In fact, as your correspondent pointed out, such action might easily be of the utmost value in saving life, and surely ought not to be discouraged.

Wandsworth Common. W. OLIVER.

MORSE INTERFERENCE.

Sir,—May I be permitted, through the columns of your journal, to reply to Mr. W. B. Hatcher's letter concerning "Morse Interference"?

While quite agreeing with Mr. Hatcher that it is very annoying to have programmes spoilt in this way, I would point out to him that wireless was first put into use for Goverment and commercial communication, and not as a means of entertainment for the public. Broadcast programmes have developed to such an extent that some people imagine that wireless should be used for nothing else!

Everything possible is done on all sides to prevent Morse stations interfering with broadcast stations, but we can hardly expect necessary messages to be stopped to enable us to hear something for our own personal amusement. Unselective receivers are often the cause of serious Morse interference, and the use of a wavetrap is sometimes a remedy.

I am not suggesting that this is the cause of interference in all cases; it certainly is not. However, I have heard a good many receivers whose owners complain of Morse interference, and when an efficient wavetrap has been fixed in circuit the trouble ceases.

I shall be glad to hear other readers' views on this subject.

Turnham, Surrey. JAMES N. ROE (G 2VV).

SCRAPPY PROGRAMMES.

Sir,—Mr. Hastings is perhaps right that criticism of B.B.C. programmes should only come from those who have perfect receivers. Still, I think the B.B.C. should take into consideration that the vast majority of listeners have neither the technical knowledge nor the necessary cash to enable them to possess such receivers.

You, Sir, will remember helping me with my first set before the days of broadcasting proper. My present set is a "Megavox Three" with correct voltages and grid bias and the best moving-coil loud speaker I know of. If Mr. Hastings knows of anything better for perfect reception I should be glad to hear of it, but I would beg him not to jump too hastily to conclusions about other people's technical abilities.

Marlborough, Wilts. H. C. HONY.

Sir,—I have read with interest the various letters on the subject of B.B.C. programmes as published in your paper.

In most cases I agree that it is sometimes difficult to find a programme to suit one *every day* of the week, but can one reasonably expect this at present?

In most localities the local station is practically a washout as an alternative programme, as it either relays 2LO, or is ruined by Morse, or its range is only a few miles. This brings us back to 5XX and 5GB for our choice of programmes, and, with only two programmes to choose from, it is too much to expect the B.B.C. to satisfy all tastes. When the new London high power station is a going concern they will have three stations from which to send different programmes (I conclude 5XX will have its own programme), and the job will be easier. Until then it seems rather useless agitating for anything except slightly more continuous programmes instead of Mr. Hubbard's "snippets" and for military band or symphony concerts not to be monopolised by indifferent singers. Another great improvement would be the playing of proper military band music by the Wireless Military Band instead of the travesties of some of the symphonies that one hears at present. The lighter type of military band music would be welcomed by many people: Sousa marches and such like. That there is a need for lighter music I have ample evidence, as I am continually being asked, as a maker and repairer of wireless sets, to make the set capable of receiving the Hilversum and Kalundborg stations, both of which transmit the best light music programmes in Europe.

Hermitage, Berks. GUY S. M. ASHLEY (MAJOR).

Sir,—All this yammer in your Correspondence columns about the programmes isn't worth a ha'p'orth of peas. The B.B.C. will read, mark, and then say with a grin: "Listen to these poor nuts—as if *we* don't know better than they do what is good for 'em!"

If you write to them they just sling it over to a Hard-shell, who says to himself: "Ah! I think stock reply No. AX/256/ff9 will meet the case," and he fires you back something reading like this:—

Dear Sir,—

We are sorry you don't like our programmes—such lots of people do; write again when you've got time.

Yours faithfully,

JOHN SPRIGG,
pp. A. S.,
(pro deputy sub-assistant joint controller,
divisional section, talks dept., programmes).

P.S.—If *The Wireless World* will find out what the new transmitter at Potters Bar is going to do as regards field strength in North London, and if we are going to be swamped at ten miles by 20-30 kW., we'll be glad.

Golders Green, N.W.11. JONATHAN HOWLE.

"OLD LAMPS FOR NEW."

Sir,—With reference to correspondence on the above subject, I submit that the complainants are being just a trifle fussy about the valves they buy. Nowadays the life of a radio valve (excluding high-emission, coated-filament, super-power types) is practically unlimited, so that even a month or two's use by a trader would not affect the valve appreciably. In practice no trader who valued his reputation would sell as new a valve so used as to show a falling off in efficiency on test. I do not uphold the practice complained of, but when all is said and done a valve sold after a slight amount of proper use is absolutely as good as new.

As to Mr. Kerr's suggestion that valves should be sealed up in their cartons, as in the old days, I may point out that such a practice would mean that the poor experimenter (and most of us *are* poor) would have to buy every valve he ever tried in a set. Often in a new set one has to try many different makes and types of valve in each socket before arriving at the best combination. In super-hets. and push-pull amplifiers it is essential to match up valves for best results. Many of us are indebted to the courtesy of retailers in allowing us to borrow different valves from stock for test purposes, and there is a sort of "gentleman's agreement" between trader and customer that the discarded valves will be returned in good condition. It would be a great pity if these present cordial relations between dealer and consumer were to be clouded by an atmosphere of suspicion and distrust.

Winchester. PATRICK J. R. KING.

TELEVISION.

Sir,—Mr. F. Halsey's letter in your issue of April 24th raises points of great interest to the experimenter who would like to turn his attention to television. So far we have received from the Baird Company (a) positive assurances that television is now sufficiently developed to make it suitable to become a popular hobby; (b) impassioned appeals to the amateur to devote his attention to it; (c) practically nothing in the way of facts and figures with reference to total installation and maintenance costs.

The Baird Company would, I am sure, be doing a great service to prospective experimenters in television if they would give direct answers to the following questions:—

(1) The *minimum* H.T. voltage required is stated in their literature to be 350; what is the *optimum* H.T. voltage for really good results?

(2) What is the total H.T. current drain with 350 volts?

(3) What is it with the optimum voltage?

(4) What other batteries are required?

(5) What are the E.M.F.'s of these batteries?

(6) What are their current loads?

(7) Is one wrong in assuming that something considerably greater than average loud speaker signal strength is required to operate the televisor?

(8) What width of sidebands must be allowed for by the set designer in order to avoid sideband cutting and the consequent introduction of distortion?

It is not unreasonable to assume that either an accumulator battery (representing an outlay of some £15) or a heavy-duty eliminator is necessary to supply the H.T. current at 350 volts or more.

Also, a second receiving set is required of a quality, one understands, much superior to that of the set in use in the average household; this set must incorporate a considerable number of valves, the output stage consisting apparently of two L.S.5A's in parallel. In view of this, is it not somewhat misleading to the general public to state (*vide* the *Evening News* interview) that the apparatus can be sold for about £12? Is not the real figure for a complete installation nearer £120?

I hope that neither Mr. Mosely nor any other of the battle-axe-wielding members of the Baird Company and the Television Society will read into my questions a desire to carp or to "crab." They arise purely and simply from a genuine desire for essential information that has hitherto been far from easy to obtain.

London, N.W. R. H. WATSON.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

A False Assumption.

(In a letter complaining of apparent lack of sensitivity.) . . . After all, I suppose that there cannot be very much wrong with my set, as I receive very loud signals from Toulouse almost every night; but would it be possible that my H.F. stage is effective only on the particular wavelength of that station? J. C. M.

You must not be lulled into a sense of false security by this example of "freak" reception. It has been noted for some time that the particular station you mention has been receivable at very great strength; in fact, its signals are often louder than those of a local station forty or fifty miles away. This means that the input to your aerial from the distant station is so great that good signals will be heard even though a serious fault exists. Similarly, we think it most unlikely that your H.F. stage performs especially well at one particular wavelength; although perfectly even amplification over a wide range of wavelengths is rare, it is unusual to find a really marked "peak."

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Gramophone Amplifier.

Is it possible to use the "S.G. Regional Receiver" with a gramophone pick-up? If so, will you please describe the necessary alterations, bearing in mind that I prefer a simple arrangement, and if possible one for which a simple single-pole on-off switch (already in my possession) may be used. P. C. N.

Provided that you use a fairly sensitive pick-up (an article which appeared in our issue of March 6th should prove helpful in making a choice), there is no reason why this set should not be used for gramophone reproduction. Overall magnification should be sufficient to load an ordinary super-power valve with maximum specified anode voltage.

A simple but effective method of connection is shown in Fig. 1, from which you will see that the pick-up is connected in the low-potential end of the detector grid circuit; for gramophone work it will be obvious that this valve must be converted to an L.F. amplifier, and consequently its negative grid bias must be reduced—to approximately half the value necessary for rectification.

The pick-up may be connected to terminals as shown, or, perhaps better, through a plug and socket arrangement.

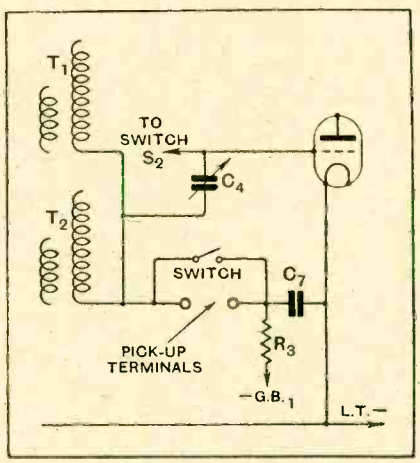

Fig. 1.—Modifying the "S.G. Regional Receiver" for gramophone amplification. Reference lettering corresponds to the original diagram.

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufactured receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Something for Nothing.

Will you please refer me to the published instructions for making the most efficient type of single-stage H.F. amplifier (using a screen-grid valve) for inclusion in my receiver, which it is proposed to rebuild? It is essential that the design should not include extensive screening. S. T.

We fear that your main requirements are mutually incompatible. Speaking from a practical point of view, it is essential that a high-efficiency H.F. amplifier should be thoroughly screened, and indeed, it is hardly an exaggeration to say that the extent of this screening is more or less a measure of the amplification that may be obtained—of course with stability.

It may be added that when a neutralising scheme forms part of a screen-grid amplifier, it is possible to dispense with a certain amount of screening that would otherwise be necessary, because any capacity coupling between grid and plate circuits can be balanced out, but the same broad principle holds good even in this case.

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A Charge Indicator.

I have recently wired up a circuit for charging an H.T. accumulator battery from my household D.C. mains through a lamp resistance. When the battery is first connected up the lamp glows quite brightly (though not at normal brilliancy); when the charge is nearly finished the lamp filament is barely at red heat. Does this indicate that anything is wrong, either with the battery or with my method of connection? A. C. G.

No; this is quite a normal effect. When you first connect your batteries for recharging, it is quite likely that the voltage of each cell has fallen to something in the neighbourhood of 1.8 volts, but when they are fully charged this may rise to, perhaps, 2.5 volts. Consequently, the back-pressure of the battery, which is in opposition to that of the mains, is greatly increased, and the flow of charging current will be correspondingly reduced. Indeed, your lamp is acting as a rough-and-ready indicator of the state of charge of the battery.

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EMPIRE DAY, 1929.

EMPIRE DAY will again be celebrated on May 24th, and each year this is made an occasion appropriate for tightening the bonds which knit our Empire together and renewing tokens of goodwill between all sections of the Empire. Wireless has its part to play in this task, and is capable of performing a very important *rôle* indeed, by means of broadcasting.

It was generally recognised a year or two ago that the need existed for experiments to be carried out with a short-wave transmitter in the home country, with the idea of establishing a broadcasting service to the Empire. The need was considered sufficient to justify the expenditure of public money, and the project was entrusted to the British Broadcasting Corporation. It was thought at the time that this would be the surest way of guaranteeing the speedy realisation of a satisfactory service. But what has been the result of putting our trust in the B.B.C. as a suitable authority to develop an Empire short-wave broadcasting service? One can only describe the result as deplorable. There has been an utter lack of enterprise on the part of the B.B.C., and to-day there is practically no improvement either in the transmissions, matter broadcast, or in the suitability of the times of transmission, since the station was first started. Any other authority, had it been entrusted with the job, would have found it difficult to achieve a less enterprising or more disappointing result. At the time when the Empire broadcasting station was first discussed the Marconi Company would, we believe, have been ready to proceed at once to develop it on their own lines, but they were hampered by the fact that the B.B.C. looked upon the task as coming within their own sphere of operations, and the Marconi Company did not wish to jeopardise its commercial relations with the B.B.C. by pressing the matter. Now we have the position that the Marconi Company is running the station but under the name of the B.B.C., and there is naturally no obligation or inducement to the Marconi Company to put up a performance beyond what is required to satisfy the B.B.C.

If we could be persuaded that the technical considerations hampered any progress beyond what has already been achieved, it would be different, but in the light of the achievements of other countries, notably Holland, in the way of establishing short-wave world-wide communication, there is conclusive evidence that the thing can be done if only the B.B.C. will drop its present attitude and either get on with the job or be prepared to hand it over to some more enthusiastic authority.

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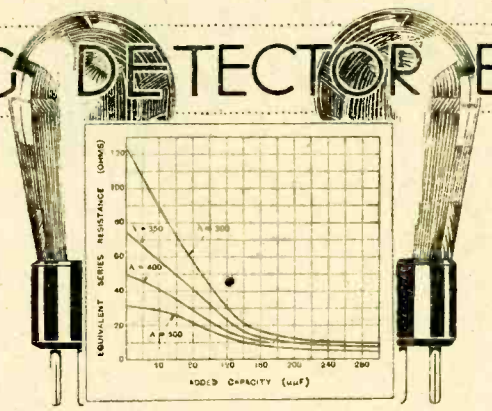
DETECTOR EFFICIENCY.

IN this issue we publish an important article discussing the question of methods to be adopted for improving the efficiency of the detector stage. The position to-day is that the H.F. stage has been developed to a point where it becomes apparent that its performance reaches a limit which is largely decided by the degree of damping effected by the detector stage on the tuned circuit of the H.F. stage. The anode bend detector has been hitherto regarded as providing a minimum damping effect in this way, but in the article in this issue the author discusses the load which is due to the inter-electrode capacity of the detector valve, and shows that under certain working conditions this may be responsible for reducing signal strength by more than 50 per cent. The article leads us to the conclusion that special choice or special design of the detector valve is necessary if we are to conserve the utmost possible of the amplification now obtainable with H.F. stages.

IMPROVING DETECTOR EFFICIENCY



How the Valve Capacity of an Anode Bend Detector Affects the Input Circuit.

By W. B. MEDLAM, B.Sc., A.M.I.E.E.

The anode bend detector has always been regarded as an arrangement which provides a minimum damping effect upon the preceding tuned circuit. In the accompanying article attention is drawn to a hitherto unsuspected load due to the interelectrode capacity of the valve which may reduce the signal voltage, under certain working conditions, by more than fifty per cent. It is possible that the results of the experimental data here given may bring about a revision of ideas as to the most suitable valve and circuit to use for anode bend detection.

IT is generally considered that an anode bend detector has but a slight reaction on the H.F. input circuit to which it is coupled, assuming, of course, that the operating conditions are such that there is no grid current. Actually it is possible for such a detector to have a very considerable loading effect, under normal working conditions, owing to H.F. feed-back through the anode-grid capacity of the valve. Reference has already been made to the writer's work on this subject in an article entitled "The Valve as an Anode-bend Detector." [1]

As a triode is not a perfect rectifier, there will be H.F. currents in the anode circuit of the same frequency as the voltage applied to the grid. To these anode currents the external anode circuit behaves, usually, as an almost pure capacitative load, whether the detector is resistance- or transformer-coupled to the L.F. amplifier. The external anode circuit capacity comprises that between anode and filament of the detector, that across the external anode resistance or L.F. transformer primary, that of the input circuit of the subsequent L.F. valve, and some capacity due to the wiring. It would be difficult to reduce the total capacity due to all these causes below, say, 10 micromicrofarads. The reactance of this capacity is only 20,000 ohms on a wavelength of 375 metres.

As, in practice, a capacity of from 100 to 300 micromicrofarads is usually added across the external anode load, the capacity reactance in this case may be less than 700 ohms to H.F. currents. Consequently, these currents prefer the capacity path to that through an external anode resistance of 100,000 ohms or more, or the large inductance of the primary winding of a low-frequency transformer.

Now, when the anode load is capacitative, the feed-back across the anode-grid capacity is such as to produce an anti-reaction effect on the tuned input circuit. The general effect of this is equivalent to an increase in the resistance of the input circuit, leading to loss of signal strength and selectivity. The magnitude of this effect depends on many factors, and some experimental results obtained under various conditions with a PM4DX valve are given below.

For these tests a screened oscillator (Fig. 1) energised the tuned input circuit. The voltage developed across this circuit was applied across the grid-filament connections of the detector under test, and was measured by a thermionic voltmeter of the slide-back type. A steady bias of −4 volts was maintained on the grid of the detector. The input voltage was noted with the detector filament (1) off and (2) on. The filament connection was broken or made at the positive terminal of the filament battery. The change in voltage between (2) and (1) was taken as a measure of the loading effect due to the functioning of the detector, as no change was made in the oscillator output. The input circuit was, of course, retuned each time. From a separate test with a constant *maintained* input, the optimum H.T. for rectifying was found to be about 90 volts (with 4 volts negative bias), and this value was used in the subsequent tests. The optimum H.T. varies but little with change in the anode circuit resistance.

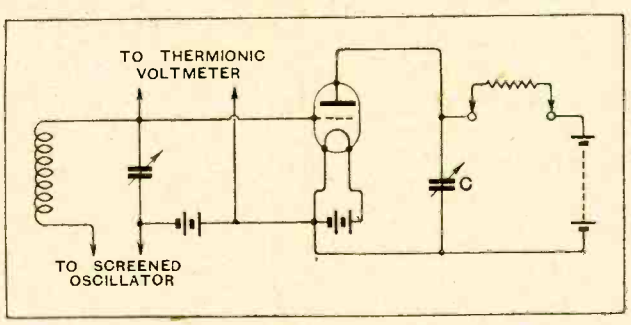


Fig. 1.—Connections for measuring the input load of the detector.

The effect on the input voltage (when the detector filament is on) of the shunt capacity C (Fig. 1) added across the external anode circuit is shown in Fig. 2, for

[1] *The Wireless World*, March 13th and 27th, 1929.

Improving Detector Efficiency.—

anode resistance values of approximately 60,000, 200,000, and 400,000 ohms; and for a H.F. choke of inductance about 0.1 henry, having a comparatively

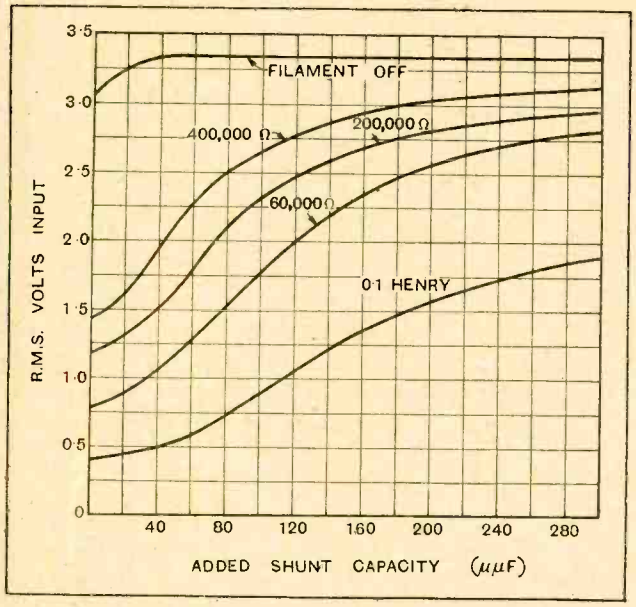


Fig. 2.—Curves showing effect of shunt capacity in the anode circuit on the input voltage with various values of external anode resistance, and a H.F. choke to represent the case of L.F. transformer coupling. The input circuit inductance is 100 microhenrys, the resistance 9.3 ohms and the wavelength 240 metres. The loading gets worse as the anode resistance and the shunted capacity are reduced.

small D.C. resistance. The choke represents the conditions obtaining with a L.F. transformer, the effective capacity of the latter being assumed to be part of the added shunt capacity. The anode resistances were of the non-inductive carborundum type, of the given values when carrying the currents obtained in these tests.

The curves in Fig. 2 show, first, that as the shunt capacity is increased the input voltage (with the filament on) steadily rises. With very large capacities the resultant input voltage would rise in all cases to the limiting value of 3·35 volts—the value obtained with the filament of the detector switched off. The second point is that, for a given capacity, the loading effect is increased by reducing the external anode resistance. However, it may be mentioned that there is a certain "worst" value of anode resistance, usually in the region of 30,000 ohms, where the loading effect is greatest. The input voltage is maintained at a higher value with resistances either side of this "worst" value.

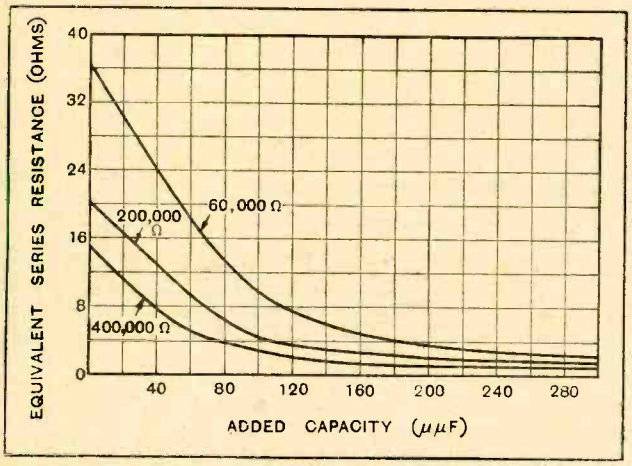


Fig. 3.—Relation between anode circuit capacity and equivalent series resistance of detector, for various values of external anode resistance. It should be noted that the equivalent series resistance due to the feed-back has a more marked effect on low-loss coils.

Loading Effect Worse with Low-loss Coils.

Thus, with resistance coupling, the conditions for minimum loading of the input circuit are, unfortunately, the highest possible anode resistance shunted by a large capacity; or, alternatively, the use of a very low resistance. The former condition leads to high-note loss in the L.F. output; the latter leads to inefficiency and poor amplification.

The last point is the very large drop in input due to the choke (or L.F. transformer), unless a compara-

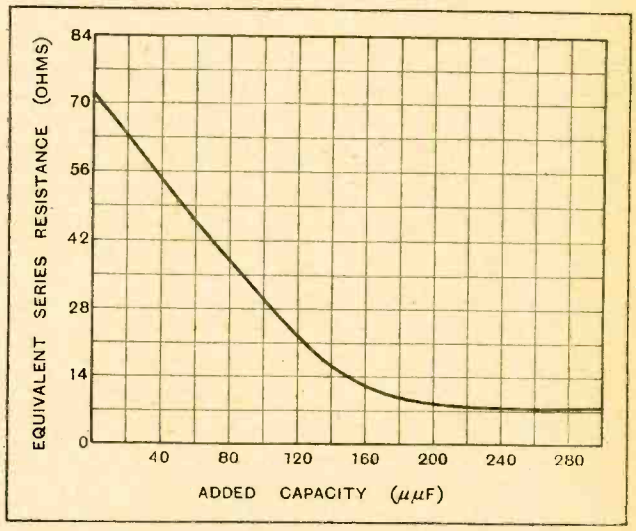


Fig. 4.—Curve representing the effect of capacity across the primary of an L.F. transformer on the equivalent series input resistance of the detector. With 0.0001 mfd. across the transformer primary there is a load equivalent to about 30 ohms added to the tuning coil.

tively large value of added shunt capacity is used. This result is due to the fact that the internal resistance of the valve is lower under these conditions than when there is a large external resistance.

The effect of the valve load on the input voltage depends on the resistance of the input circuit. A low-resistance circuit will be more sensitive to a given additional load than a high-resistance circuit will be. Thus the results in Fig. 2 would be made more definite if this factor is taken into account. The resistance of the input circuit, including the voltmeter, and detector valve with all connections completed, but with the filament off, was 9.3 ohms (when the added anode capacity exceeded about 50 micromicrofarads). The same drop in input voltage that occurs on switching on the filament can be produced instead by increasing the resistance of the input circuit by a certain amount. This extra resistance required to produce the same loading

Improving Detector Efficiency.—

effect as the valve produces may be termed the equivalent series resistance of the valve. The values of this equivalent series resistance are shown in Figs. 3 and 4. In this and all the following tests, except that on the effect of wavelength, the input inductance was 100 microhenrys and the wavelength 240 metres.

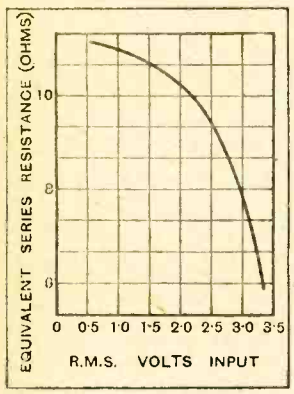


Fig. 5.—Variation of equivalent series resistance of the detector with signal strength. External anode resistance 200,000 ohms; added shunt capacity 55 micro-microfarads, wavelength 240 metres; input circuit inductance 100 microhenrys.

The above results were all obtained with a constant input voltage (detector filament off). The general effect on the detector load of changing the input voltage is shown in Fig. 5. This test shows that the detector load is increased with reduced signal strength—a result apparently due to the detector becoming less efficient on small inputs, thus leaving a greater proportion of H.F. active in the anode circuit.

As the results in Figs. 3 and 4 were obtained with large inputs, one may infer that, with smaller inputs, the equivalent series resistance of the detector in operation would be considerably greater than the values shown.

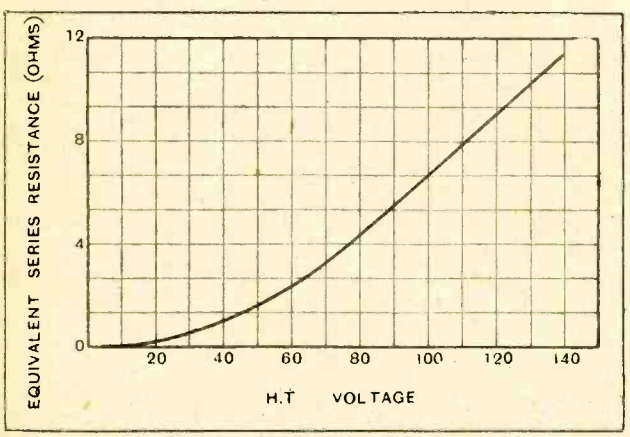


Fig. 6.—Effect of H.T. voltage on the input load of curvature detector. External anode resistance 60,000 ohms; added shunt capacity 135 micromicrofarads; wavelength 240 metres.

The variation with H.T. of the equivalent series resistance of the detector for one value of the anode resistance (60,000 ohms) and added shunt capacity (135 micromicrofarads) is shown in Fig. 6. The curve is steep in the region of the optimum H.T. for rectifying (90 volts), indicating that an improved performance might be obtained using a somewhat lower H.T. voltage. While a reduction to 80 volts will have little effect on the efficiency of the valve as a rectifier, it reduces the equivalent series resistance by 23 per cent. in this particular case.

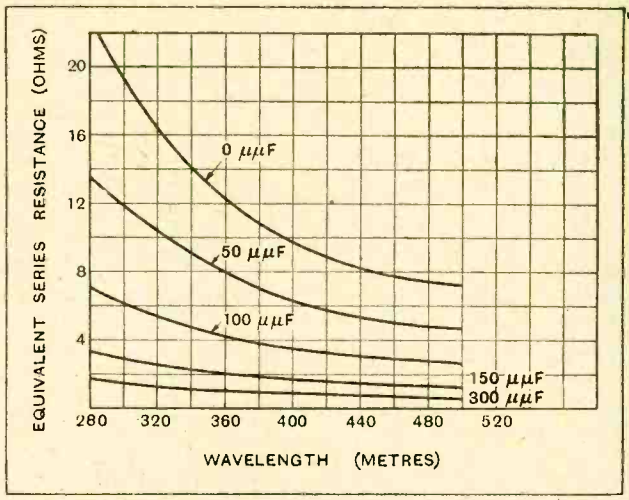


Fig. 7.—Effect of wavelength on the input load of detector for various values of capacity across an external anode resistance of 200,000 ohms. Input circuit inductance 160 microhenrys. As the wavelength is reduced the loading effect is increased.

Effect of Wavelength.

The general effect of wavelength on the equivalent series resistance is shown in Fig. 7 for an external resistance of 200,000 ohms and various shunting capacities. Similar results for the H.F. choke are given in Fig. 8. In the latter case the equivalent series resistance rose to about 120 ohms at 300 metres, with no added capacity. In all cases the equivalent series resistance falls as the wavelength is increased; very roughly, it varies inversely as the square of the wavelength. The same results are shown on a capacity

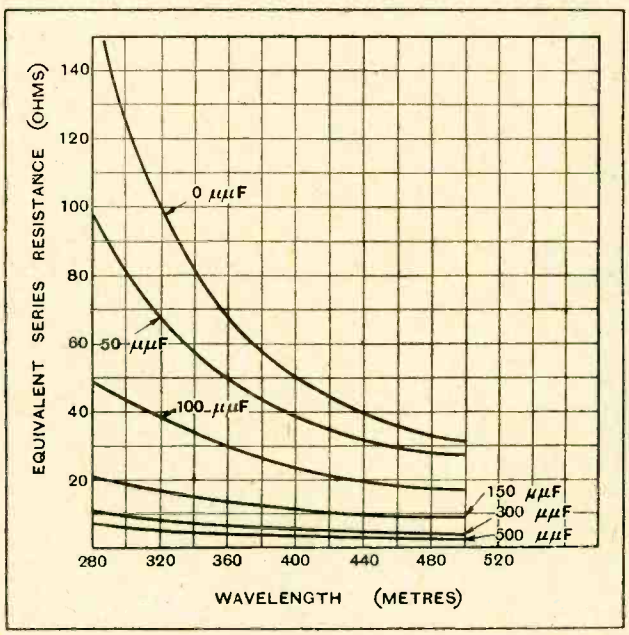


Fig. 8.—Similar curves to those in Fig. 7 for transformer coupling. It will be seen that with a shunted capacity of 0.0003 mfd. on a wavelength of 280 metres, the equivalent load resistance is about 11 ohms. A low-loss coil for this wavelength might have a high-frequency resistance of, say, 3 ohms; under the conditions specified this would in effect be increased to 14 ohms.

Improving Detector Efficiency.—

base in Figs. 9 and 10, for wavelengths of 500, 400, 350, and 300 metres. All the curves in Figs. 9 and 10 have one feature in common: they show a rapid increase in the equivalent series resistance with anode capacities below 150 micromicrofarads.

In the wavelength tests the resistance of the tuning coil varied, of course, with the wavelength. This was taken into account in calculating the equivalent series resistance at different wavelengths. The input voltage (with filament off) was maintained at the same value (3.25 volts R.M.S.) at all wavelengths.

The loading effects dealt with above are those occurring on the frequency to which the input circuit is tuned, i.e., on the carrier frequency. On this frequency the input voltage suffers its maximum decrease owing to the feed-back action. The side-band frequencies are affected less and less as they get farther from the carrier. Thus the higher audio frequencies tend to be maintained at the expense of the carrier and lower audio

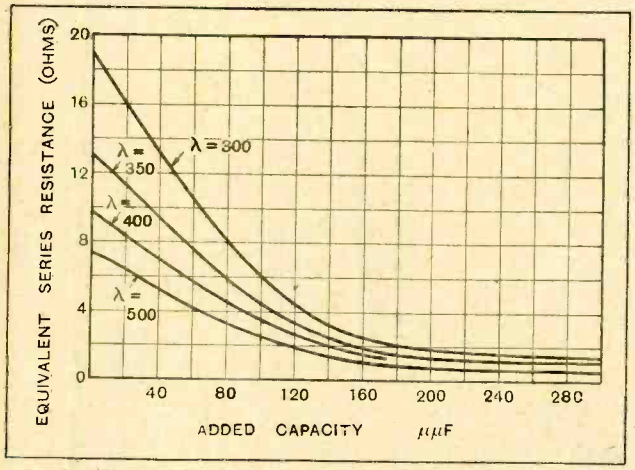


Fig. 9.—The results of Fig. 7 plotted on a capacity base for a number of fixed wavelengths.

frequencies. While in some cases this flattening of the audio-frequency characteristic may be desirable, generally it would be preferable to have under control whatever damping was required; full use might then be made of a low-loss circuit when this was necessary. Some experimental results obtained with a beat-note oscillator on one side band are given in Fig. 11.

Elimination of Input Load.

Probably the most satisfactory way of eliminating the feed-back load of a curvature detector is by use of the well-known centre-tapped input circuit (Fig. 12). The neutralising condenser NC may be adjusted so that on switching on the filament (and retuning the input circuit) the input voltage remains unaffected. The adjustment for exact compensation for feed-back through the anode grid capacity is quite definite. If the capacity is too small, the input drops when the filament is on; if too large, the input rises.

Another method which has been used successfully by the author is shown in Fig. 13. A series tuned circuit is connected across the external anode load, or what is equivalent to this—from anode to filament—whether resistance- or L.F. transformer-coupling is employed. This circuit is tuned to the carrier frequency with a capacity as small as may be necessary to prevent high-note loss in the L.F. output—say, not more

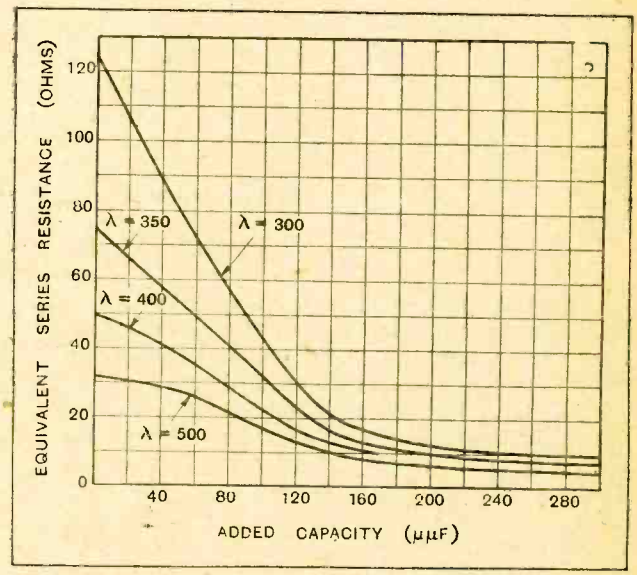


Fig. 10.—The results of Fig. 8 plotted on a capacity base for various wavelengths.

than 100 micromicrofarads with resistance coupling, and 300 micromicrofarads with transformer coupling. While this method has the very serious disadvantage of adding another tuning control, it is very effective as a means of preventing H.F. potentials from reaching the grid of the first L.F. amplifier.

Finally, the feed-back effect may be eliminated by use of a pentode. This valve is an excellent rectifier, but the author has not yet made any measurements on its performance under working conditions as a detector on a modulated input.

In conclusion, it will be evident from the above

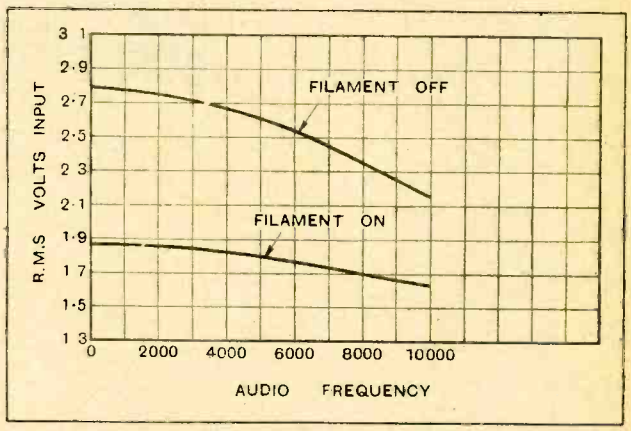


Fig. 11.—The upper curve shows the audio frequency characteristic of the input circuit unloaded by the detector. The lower curve shows the characteristic as modified by feed-back when the detector is in operation. Anode resistance 60,000 ohms; added capacity 135 micromicrofarads; wavelength 240 metres.

Improving Detector Efficiency.—

results that the input load effect due to feed-back, when not compensated for, depends on so many variables that it is impossible to give, in a short article, more than an idea as to the order of magnitude of the effect in certain selected cases. It may be pointed out that it is advisable to allow for the input load of the detector when estimating the gain of an H.F. stage. The figures generally quoted for the gain refer to the stage *tested by itself*. The actual amplification may be much less when the stage is coupled, as it must be, to the detector. If allowance for this is not made the detector may not be efficiently loaded. The value of the equivalent series resistance is affected not only by the wavelength, signal strength, anode load, anode shunt capacity, H.T. voltage, and side-band frequency, which are all mentioned above, but also by the filament current, inductance and resistance of the input circuit, the depth of the modulation, and also, of course, on the type of valve. Suffice it to say that the load imposed by an anode-bend detector valve on the high-frequency input may be sufficient under certain conditions to reduce the signal voltage by over 50 per cent.

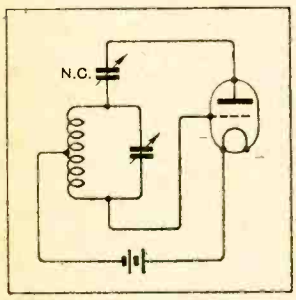


Fig. 12.—Divided or neutralised circuit to eliminate feed-back.

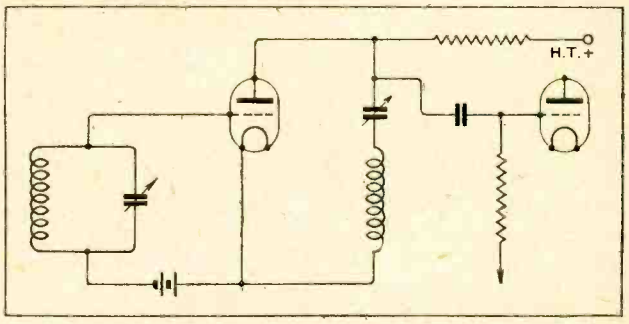


Fig. 13.—Series tuned circuit across external anode load to short-circuit virtually the H.F. component so that feed-back is eliminated. The low potential end of the coil can either be connected to L.T. negative (as shown) or to H.T. positive.

Nationality Prefixes.

If we may judge by a letter from EB 4SF (who, we believe, is the hon. secretary of the Radio Club Socialiste, Brussels), which appears in a Belgian contemporary, there is still a diversity of opinion among amateurs in Belgium about the adoption of the authorised prefix ON. We remember similar opposition to the use of the I.A.R.U. intermediates, which certainly had the disadvantage of the easily-missed letter "E" for all European countries. The new prefixes may cause confusion at first, but should be welcomed as an indication of official recognition of the amateur position in allotting to private individuals the nationality letters which distinguish the commercial stations of their respective countries.

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The 7 Megacycle Band.

A correspondent suggests that European transmitters should agree to a restriction of telephony on the 7 M.C. band to stated times in the morning and evening and thereby leave the ether free for low-power experimenters. He states that transmitters in Northern Ireland have already given the lead in this direction by banning it altogether on Sundays.

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Ultra Low-powered Stations.

G 2ZN, Mr. J. E. Johnson, 7, Chestnut Avenue, London, E.17, wishes to get into touch with other amateurs experimenting in very low-powered transmission.

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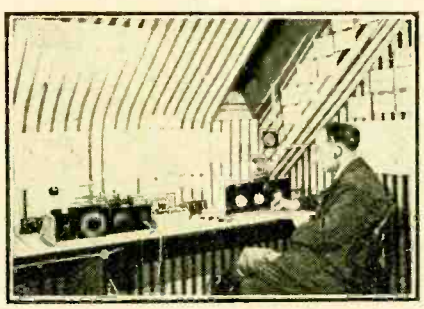
General Notes.

We have had very little of late to record in these notes. Is amateur transmission on the wane, or have long-distance and "freak" working become so commonplace that experimenters do not consider it worth while to inform us of their notable accomplishments? The main object of these "notes and queries" is to keep experimenters in touch with one another and to record any facts likely to be of general interest to them, and we cordially welcome information of this nature from all sources.

TRANSMITTERS' NOTES



The French Amateur Station F8XZ at Saint Dizier, Haute Marne, has been in touch with most parts of the world with an input of 25 watts to a Colpitts circuit.

Russian Amateurs.

We have received from a correspondent in Reading the following list of amateur and experimental stations in the Russian 5th District which he has received from EU 5KAD. This is stated to be up to date and corrects some of the Q.R.A.s given in the March "Call Book." We would remind our readers that Clubs, Institutions and Schools use three-letter call-signs beginning with the letter K.

CLUBS, ETC.

EU 5KAD (ex RA58), Polytechnic Institute, Kiev.
EU 5KAE (ex RA87), The Radio Society, Kiev.
EU 5KAH (ex RB32), Electrical Institute, Kiev.
EU 5KAJ (ex RB56), Club of Metallurgists, Kiev.
EU 5KAK (ex RB57), Club of Constructors, Kiev.

PRIVATE STATIONS.

EU 5AB (ex 28RW), M. Aaronov, Kiev.
EU 5AC (ex 83RB), M. Valfenzon, Kiev.
EU 5AL (ex 07RA), M. Skotsky, Kiev.
EU 5AM (ex 16RB), M. Shestakov, Kiev.
EU 5AR (ex 21RB), M. Tetellaum, Kiev.
EU 5AT (ex 87RB), M. Zagurmak, Kiev.
EU 5AZ (ex 42RW), M. Yankovski, Kiev.
EU 5BA (ex 43RW), M. Kuzneeov, Kiev.
EU 5BC (ex 71RB), M. Bako, Kiev.
EU 5BB (ex 64RW), M. Laufer, Kiev.
EU 5BD (ex 77RW), M. Vitkevski, Kiev.
EU 5BE (ex 78RW), M. Konushevski, Kiev.
EU 5CP M. Shaparenko, Kiev (Chief Operator of 5KAD).

QSL cards may be sent via Mr. A. Lambourne, 43, Bramshaw Rd., Norcot, Reading.

EU 5KAD is experimenting in television and telephony on short waves and will welcome reports.

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New Call-Signs and Stations Identified.

G 5PJ C. G. Phillips, Trewyth, Kewferry Hill, Northwood, Middlesex.
G 5QF S. Buckingham, 19, Oakleigh Rd. North, London, N.20. (Change of address.)
2AJC D. J. Beattie, 14, Rosehill Mount, Manchester Rd., Burnley. (Change of address.)
2AOZ (ex 6JS) Percy R. Solder, 6, Churston Gardens Blake Rd., New Southgate, London, N.11 (New call sign and address.)
2ASA John H. Hopkins, Kildare, Winscombe, Somerset.
2AVR E. R. Cook, 122, Archer Road, Millhouses, Sheffield. (Also owns 6UO.)
2AWH J. Armstrong, 109, Rupert St., Bolton.
2 AZQ R. J. Fox, De Grey House, Grosvenor Rd., Batley, Yorks.
2 BOQ H. E. Bottle, 27, Stormont Rd., London, S.W.11.

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Correction.

The correct address of Mr. Alan Reid's amateur station G2RC is 171, Reads Avenue, *Blackpool*, and not Liverpool as printed in error in our issue of March 13th.

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Q.R.A.s Wanted.

Aeroplane B2D, 2GA.

AN ELIMINATOR for TWO-VALVE SETS

The D.C. "JUNIOR"

An Inexpensive Unit for Simple Receivers.

By N. P. VINCER-MINTER.

LEST it be thought that the title of this article is intended to mean that "the D.C. Junior" is suitable for a small set used in conjunction with a twelve-and-sixpenny loud speaker, the writer would state forthwith that the instrument is quite satisfactory when used with a "local and Daventry" set employing a moving coil loud speaker, and has been tested on such a set with results sufficient to satisfy all but those who desire the elephantine trumpetings that nowadays so frequently pass as resembling the human voice. This instrument is, of course, suitable for use with any type of two-valve set except those of the super-regenerative class.

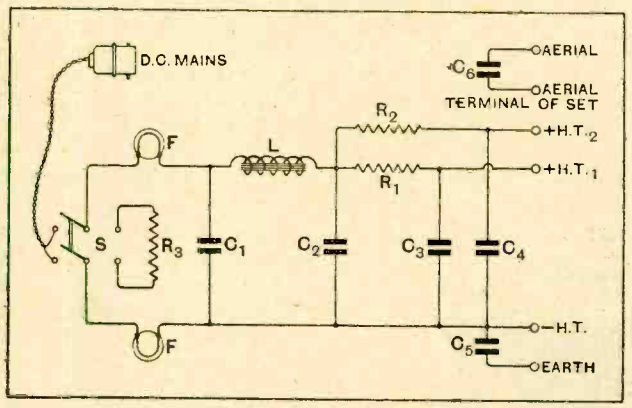


Fig. 1.—The theoretical circuit diagram. Values are as follows: C_1, C_2, C_3, C_4 and C_5, 4 mfds.; C_6, 1 mfd.; L, 30 henrys; F, 3.5-volt flash-lamp bulb; R_1, R_2, according to mains voltage and valves used; R_3, 40,000 ohms.

This eliminator pairs very nicely with the two-valve set described in the issue of this journal for February 6th. Is its use limited to a two-valve set only? By no means; it will, as it stands, cater for a three-valve set using a triode, and by slight addition to the components (for which ample space has been left in the completed instrument) it will be all that is needed for a modern screen-grid set like the "S.G. Regional Three," published in the March 27th and April 3rd, 1929, issues of this journal. A pentode? Certainly.

The real purpose for which the eliminator was designed, however, was for the two-valve set whose owner wants to build an instrument which is not unnecessarily elaborate, is neat, and sure of giving good results, and, in particular, will not set up "motor boating," which surely is one of the biggest curses under which wireless users groan in spirit to-day.

Now what about the nervous person? Is it possible to get a shock by touching anything on the panel? Does the eliminator possess fuses and a double-pole switch as the regulations demand? It does all this and no fears need be entertained on this score. The metal parts of the switch, which are above the panel surface and therefore liable to come into contact with hands, are entirely insulated from the switch blades, and the switch is indeed of a type suitable for use with mains.

Safety Devices Included.

The fuses consist of two ordinary flash-lamp bulbs whose normal consumption is about 0.2 ampere at 3.5 volts. It is impossible to receive a shock from this source as the bulbs screw flush into the panel. It should be pointed out that, when switching on, these bulbs will light momentarily (a dull red glow), and they will light rather more brilliantly when the eliminator is switched off, as the condensers discharge themselves *via* the fuses and the wire-wound resistance provided for that purpose. Owing to the presence of this "discharge resistance" it is quite immaterial in the case of this eliminator whether the set or the eliminator is switched on or off first.

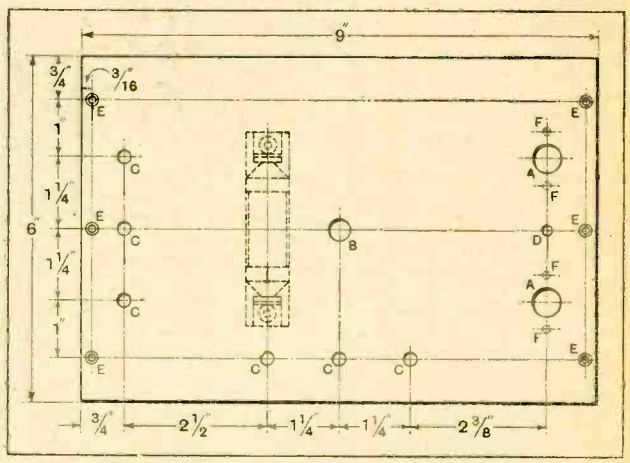


Fig. 2.—Layout of ebonite panel. Drilling sizes are as follows: A, ¼in. diameter. B, ⅜in. diameter. C, ⅛in. diameter. D, ⅝in. diameter. E, ⅛in. diameter and countersunk for No. 4 wood screws. F, drilled and tapped 6 B.A. blind.

LIST OF PARTS.

1 Ebonite panel, 9 × 6 × ¼in.
1 L.F. choke, 32 henrys (Pye).
5 Fixed condensers, 4 mfd., 500-volt D.C. test (Compeia. A. F Bulgin & Co.).
1 Fixed condenser, 0.1 mfd., 500-volt D.C. test (Compeia, A. F. Bulgin & Co).
1 Wirewound resistance, 3,000 ohms and holder (Ferranti).
1 Wirewound resistance, 40,000 ohms and holder (Ferranti).
1 Wirewound resistance, 75,000 ohms and holder (Ferranti).
2 Flashlamp bulbs.
1 Push-pull switch, 2-pole change-over (Utility).
2 Resistor holders (Burndept).
6 Main terminals (Belling-Lee).
2 yds. flex.
1 Lamp-holder adaptor.
1 Cabinet, 9 × 6 × 6in.
Systoflex, wire, screws, wood, etc.
Approximate cost of above parts £3 16s.

In addition, the earth condenser and also the aerial condenser should be noted. These components are absolutely essential, irrespective of whether positive or negative main is earthed, and they must, as in the case of all the other condensers in the instrument, be tested to twice the mains voltage. It may be thought that these condensers might not be needed if the negative main is earthed, but this is not so, as earthing either main is contrary to law. This law was not made in order to create jobs for inspectors, magistrates, and warders, but for the very good reason that it is usually found that there may be several volts difference of potential between the earthed end of a main at the generating station and the far end of it at the consumer's house when current is flowing through it (Ohm's law again). If it is earthed at the consumer's house, a nice little earth current is set up which, besides upsetting the engineer at the power station, causes a certain amount of energy to be wasted, so that the situation is rather similar to that of people who "earth" their water taps *via* the scullery sink during frosty weather.

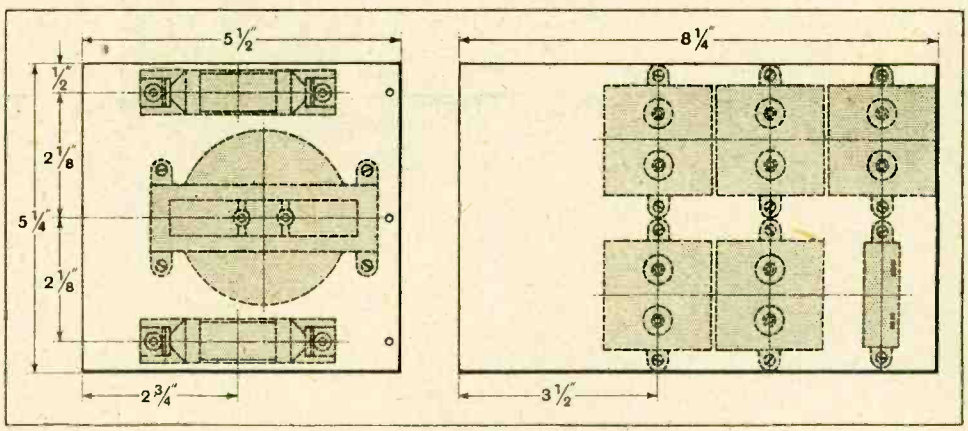
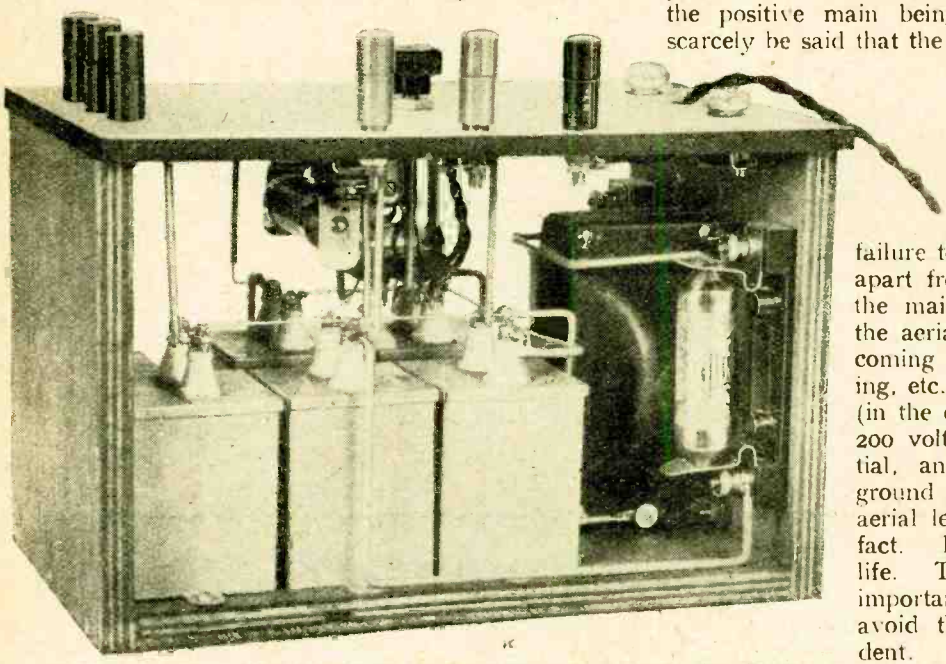


Fig. 3.—Layout of baseboard and side panel.

Importance of Aerial and Earth Condensers.

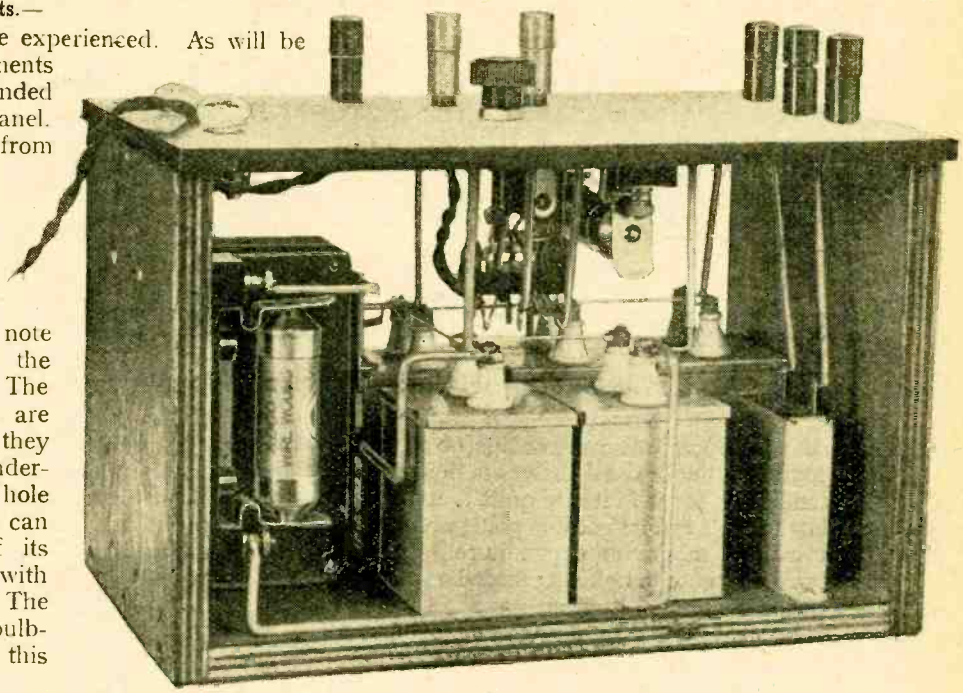
The need for a series aerial condenser is important, because it must not be forgotten that in the majority of sets there is a straight-through connection from H.T.– (or in other words, the negative main) to the aerial, and in wet weather considerable leakage can take place *via* insulators and lead-in tubes. In the case of the positive main being earthed, of course it need scarcely be said that the absence of the earth condenser would mean that the mains were short-circuited and the fuses blown, which is really a more satisfactory state of affairs from the point of view of the power station authorities. It will be realised that failure to use a series aerial condenser, apart from the risk of short-circuiting the mains caused by the collapse of the aerial in a gale or its accidentally coming into contact with gutter spouting, etc., will result in the aerial being (in the case of 200- to 250-volt mains) 200 volts or more above earth potential, and anyone standing on damp ground and accidentally touching the aerial lead-in will speedily realise this fact. It is, of course, dangerous to life. Therefore, it will be seen how important this condenser is in order to avoid the possibility of a fatal accident.



View of interior. The terminals at the left-hand side are for the connection of aerial, the aerial connection to set and the earth.

With regard to the constructional

An Eliminator for Two-valve Sets.—



View of interior showing double-pole change-over switch.

work, no difficulty should be experienced. As will be seen, the whole of the components are carried in a chassis suspended from the underside of the panel. This chassis is assembled from three pieces of plywood having the dimensions given in Fig. 3. No difficulty should be met in mounting the components in the position shown on the various panels. A point to note is the method of fixing the holders for the flash-lamps. The particular holders used are specially recommended, as they can be fitted neatly to the underside of the panel, a $\frac{3}{8}$in. hole being drilled so that the bulb can be inserted without any of its metal parts being exposed, with consequent risk of shock. The ordinary type of miniature bulb-holder would not permit of this being done effectively.

As much of the wiring as possible should be carried out before assembly of the four panels. The two side panels should be screwed on to the baseboard first, before the ebonite panel is placed in position, in order to facilitate wiring. Finally, the ebonite panel should be placed in position and screwed to the top edges of the side panels with No. 4 wood screws and the final connections made. The whole chassis can then be dropped into the plain box provided for it, and the task is complete. There is no objection to this casing being of wood, but many may prefer to use a metal case, which is perfectly permissible, of course, but if used it should be earthed. There is no need to adhere strictly to the author's lay-out as in the case of a modern receiver, although it must be said that the layout used makes the whole instrument very compact. Those desiring to use a bigger choke, or to add an extra choke in the negative lead, can easily solve their difficulties by making the instrument larger or adopting a different layout.

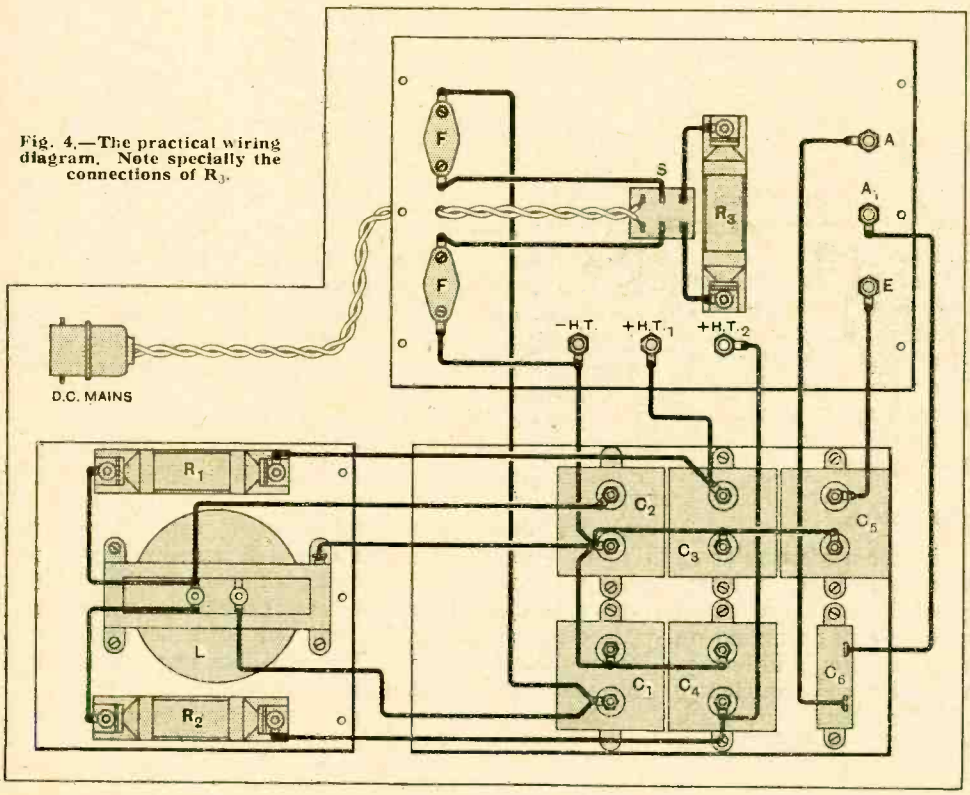


Fig. 4.—The practical wiring diagram. Note specially the connections of R_3.

Adequate output for a loud speaker can be got when using super-power valves with voltages of 120 to 150, but it must be understood that these values can only be obtained when the mains voltage is in the 200-250 class. The value of two voltage-dropping resistances R_1 and R_2 depends, of course, solely on the

An Eliminator for Two-valve Sets.—voltage of the mains, the voltage required on the anode of the valve, and the plate current of the valve, and the aid of Old Man Ohm must again be invoked. If in doubt, readers should refer to an article on the matter entitled "Dropping Volts," by W. I. G. Page, which appeared in the November 28th, 1928, issue of this journal. By perusing this they will find that they can quickly arrive at the correct value of resistance for their own practical needs. Those on 110-volt mains must, of course, be content with the results obtainable with this voltage. In this case no resistance will be required at R_2, but using leaky-grid rectification one must be included at R_1, since H.T.+$_1$ supplies the detector valve, which will require a value between 40 and 60 volts.

SOME USES FOR THE NEUTRALISING CONDENSER.

Various Applications in High-frequency Circuits.

ONE of the handiest little components of all those to be found on the dealers' shelves is the neutralising condenser, for with its aid quite a number of workshop "hook-ups" can be got into going order very rapidly, and with a minimum expenditure of work. These small condensers are too often regarded as suitable only for the purpose, implied by their name, of balancing out the grid-plate capacity of a valve employed as a high-frequency amplifier, whereas they have in reality many varied applications, and can be turned to account in half a dozen different ways.

Their versatility is chiefly due to the fact that it is so often convenient to have some simple means of providing a variable coupling between one tuned circuit and another, and the connection of a small variable condenser is generally the quickest way of achieving this end. Now that the plug-in coil and the three-way coil-holder have fallen into disrepute, the alternative possibility of coupling circuits magnetically in a variable manner is generally rather difficult to arrange hastily, while the use of a variable condenser of the type usually employed for tuning implies the use of a proper panel as a support for it. The neutralising condenser, which is easily variable and can be mounted on a baseboard or even, at a pinch, can be slung just anyhow by its connecting wires, is therefore of very great value when it is desired to try out a circuit in the minimum of time.

As an example of the kind of use for which the neutralising condenser is particularly adapted, let us suppose that it is desired to put together, at short notice, a single-valve receiver consisting of a grid detector with reaction. To connect up the electrical circuit is quick enough work, and, if the components are to hand, need only take half an hour or so; the difficulty invariably arises in providing the variable reaction.

The Readily Wired Hartley.

Variable magnetic coupling, with the modern solenoid coils, means the construction of some kind of vario-coupler, which involves a good deal of mechanical work. A Reinartz type of circuit means mounting an extra variable condenser to control reaction, and implies also the provision of an extra reaction coil, coupled to the tuning inductance. But a Hartley circuit, in which a neutralising condenser is used for the reaction control, needs neither of these, and can be put together very speedily, the only unusual requirement being a centre-tap on the tuning coil. Any coil wound solenoid-fashion with solid wire can have a centre-tap added in a few moments, and the circuit, which is too well known for a diagram to be needed, is very rapidly completed.

An Aid to Selectivity.

As another example, it may be that it is desired to add a temporary loose-coupler to a finished receiver, either with a view to finding out whether such an addition would be desirable as a permanent measure, or simply because it is desired, for some special reason, to listen to a station that is normally considered too close in wavelength to the local station to be heard. In either case it would be highly undesirable to make any irrevocable alteration to the permanent receiver until some idea of the probable effect of the addition had been gained.

In such a case it is only necessary to rig up a temporary tuned circuit, to which the aerial is attached, and then to couple this circuit, through the variable capacity of the neutralising condenser, to the upper end of the first tuned circuit of the receiver. In this way a variable coupling can be achieved in the simplest way possible, in a minimum of time, and without any alteration whatever to the completed receiver.

A third unorthodox use, but this time a permanent one, for the tiny variable condenser occurs where there are two or more tuned circuits in a receiver, and it is desired to match the various tuning condensers so that they read alike, within a degree or so, over the entire scale. If logarithmic condensers of the same capacity are used throughout, any variations in inductance between the coils will not matter, but even in this most favourable case it is essential that the minimum capacities of the different circuits should be identical within narrow limits. Owing to the connection of the aerial to the first tuned circuit the minimum capacity will be higher here than elsewhere; but if a neutralising condenser is connected in parallel with each of the remaining tuned circuits, and the correct setting for it is found, this discrepancy can be removed, and there will then be no difficulty in matching up within reasonable limits the readings of all the tuning condensers.

These suggestions are perhaps enough to draw attention to the many uses that can be found for the neutralising condenser, apart from its original purpose.

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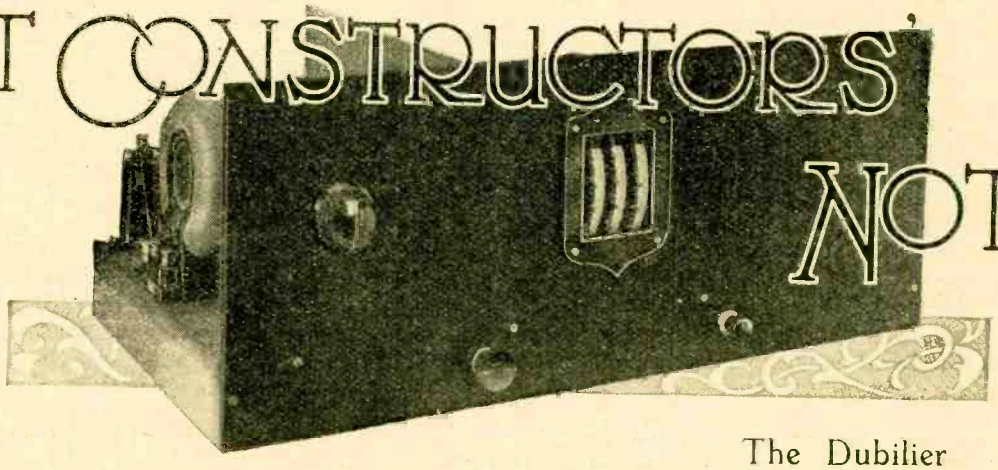
KIT CONSTRUCTORS' NOTES



The Dubilier "Toreador Screened Grid Four."

SMALL details, of apparently minor importance in themselves, can contribute a great deal towards the success or failure of a receiver from the average user's point of view; no apology is needed for beginning a description of the Dubilier "Toreador Screened Grid Four" by drawing attention to a point which, though in no way a part of its fundamental design, is believed to be unique as far as "kit" sets are concerned. This is the provision of means whereby two circuits may be tuned either simultaneously or individually, at the will of the operator. In America, where the average broadcast receiver is required to cover but a single waveband of strictly limited width, complete ganging of tuning controls is commonplace: here, in Europe, where we must concern ourselves with two bands, it is the exception rather than the rule. Successful results can be achieved, in spite of this handicap, but with one or two exceptions, the scheme of one-knob tuning is more properly applicable to factory-built sets, in which uniformity is ensured by standardised manufacturing processes. For the home constructor, the plan embodied in the Dubilier receiver is specially attractive, as it confers most of the advantages of a single control without the need for observing any extraordinary precautions, and it adds nothing to the normal risk of encountering difficulties.

As will be seen from the accompanying illustrations, three condensers are mounted in a single assembly with

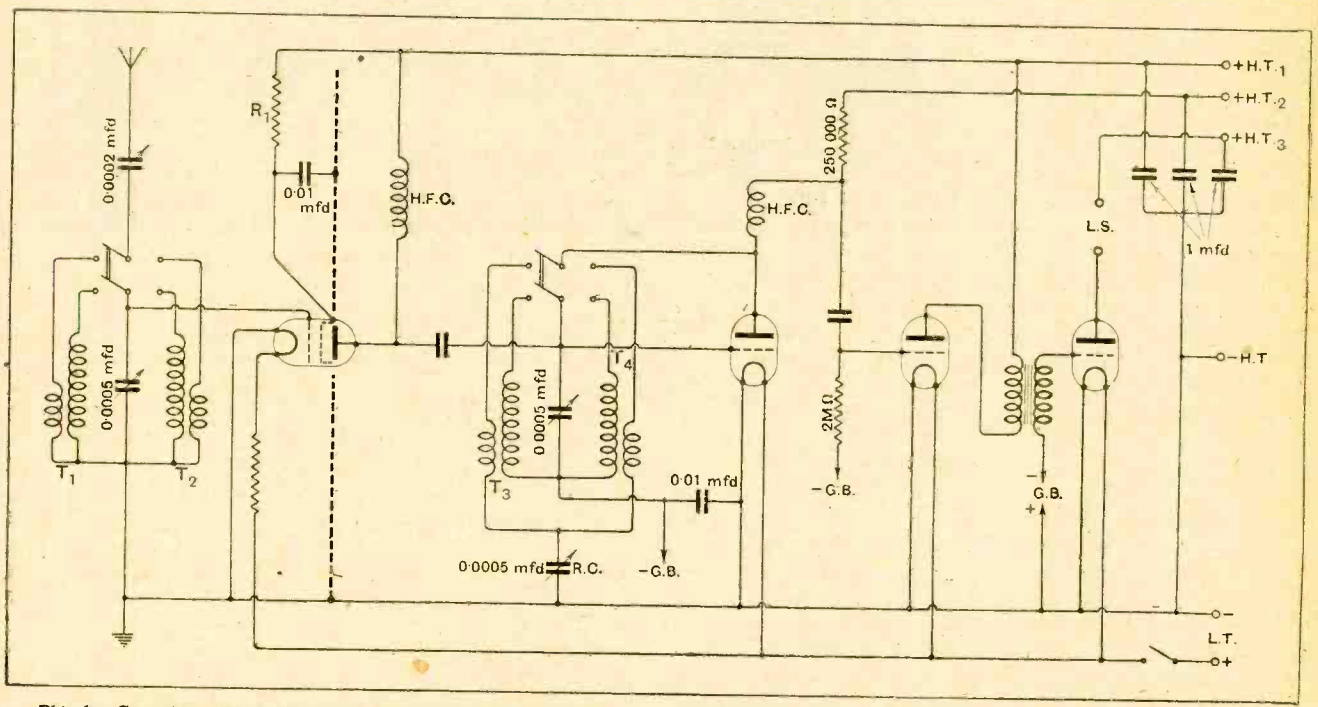


Fig. 1.—Complete circuit diagram. Wave-changing switches, shown separately to avoid complication, are actually linked together. T_1, T_2, aerial-grid transformers; T_3, T_4, detector grid coils with reaction windings.

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Kit Constructors' Notes.—

concentric shafts, their operating drums being fitted side by side, and in such close proximity that the two controls may be actuated by a single finger. This means that operation is greatly simplified; when starting operations, it is advisable to note the dial readings of these two controls corresponding to some three or four stations, preferably well spread over the tuning scale, and then to use these calibrated settings as starting points when searching for transmissions on adjacent wavelengths.

Parallel-feed H.F. Coupling.

The circuit diagram of the complete receiver, given in Fig. 1, shows a fairly conventional arrangement of S.G. high-frequency amplifier, anode-bend detector, and two L.F. magnifiers (resistance- and transformer-coupled). Aerial coupling is by means of double-wound "aperiodic" transformers, a variable condenser being connected in series as an aid to preventing interference. The well-known Dubilier "Toroid" coils, which are substantially fieldless, are used as inductances, suitable transformers for medium and long wavebands being thrown into circuit by means of a switch.

A so-called "tuned grid" coupling is used for the H.F. stage, H.T. being fed to the valve anode through an H.F. choke. There was at one time a certain amount of prejudice against this method, but it has now been proved that it is capable of affording a considerably larger measure of H.F. amplification than was generally thought possible, and, most important of all, it is realised that it confers all the benefits of a double-wound transformer in the matter of preventing L.F. feed-back to the detector grid.

Capacity-controlled reaction between anode and grid circuits of the detector valve is provided; the "primary" windings of the "Toroid" H.F. grid coils (which are similar to those used for aerial coupling) in this case serve the purpose of reaction coils.

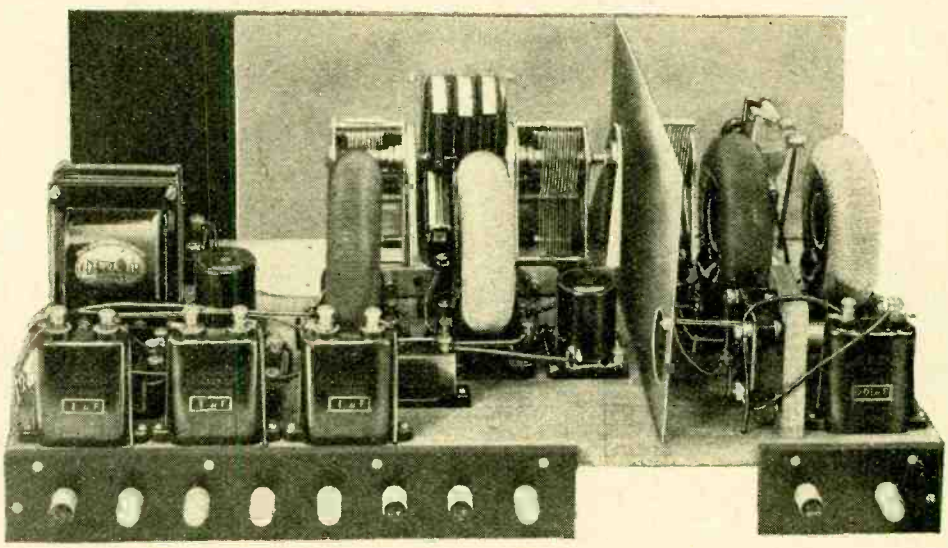
Measurement of Screening Grid Voltage.

Before leaving the H.F. stage, it should be pointed out that screen-grid voltage is regulated by means of a simple series resistance. This plan is not always to be recommended—it will obviously fail if current in this circuit is negative—but with the Mullard valve used for tests it seems to be quite satisfactory. A voltage-reducing resistance (R_1 in Fig. 1) of 80,000 ohms was actually fitted to the set as received; with this in circuit and 120 volts applied to the +1 terminal, it was found that the working pressure on the screen was 78 volts, which is sufficiently close to the optimum value for all practical purposes.

A resistance of 250,000 ohms, as specified for the detector anode circuit, is nowadays considered to be rather on the high side, particularly when reaction control is provided. Overall L.F. magnification is considerable, as the second stage is transformer-coupled, and care must accordingly be taken to avoid the use of an H.T. supply having an appreciable internal resistance common to the last three anode circuits. It was found that reaction control is somewhat improved by reducing detector bias to a value slightly less negative than that giving best detection; the user should bear this point in mind if he has any difficulty in obtaining full reaction on both tuning ranges.

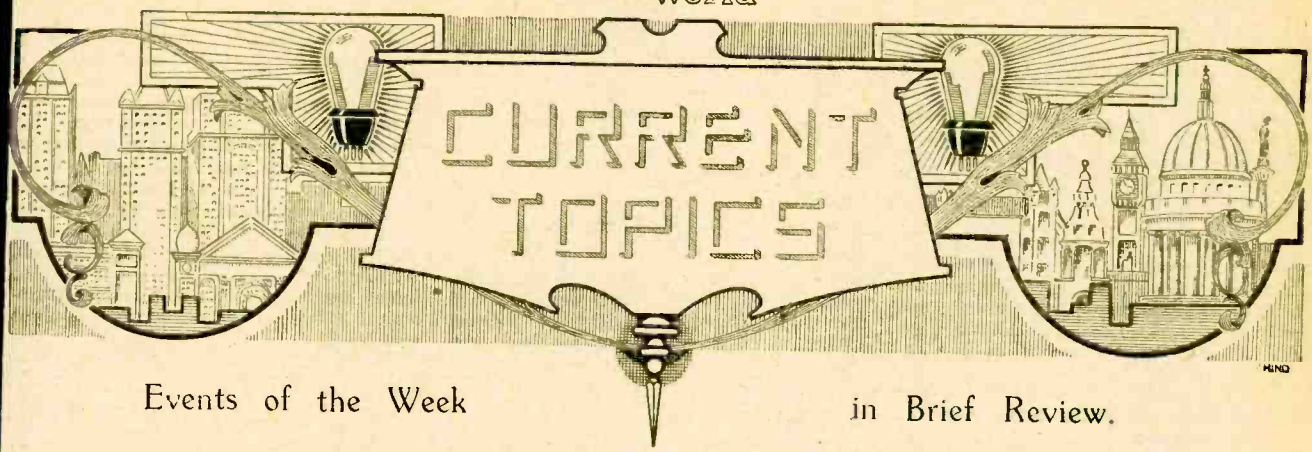
Simplified Constructional Details.

Disposition of components has been carefully arranged, with the result that the majority of wires are short. In almost every case, wiring points are easily accessible; this, added to the fact that soldering is rendered unnecessary by the provision of terminals on all components, will commend the set to those with limited workshop experience and equipment.



Rear view of receiver. Note triple condenser assembly, horizontal H.F. valve mount, and metal screen behind panel.

Reference has already been made to the "semi-ganged" method of tuning; operation of the edgewise drums may at first seem strange to those accustomed to ordinary dials, but the necessary knack is soon acquired. A reduction gear is not fitted, and, indeed, is quite unnecessary; thanks to the fact that the drums are of large diameter and that the coils have a fairly high H.F. resistance, tuning is quite easy. Selectivity is rather above the average standard, due largely to the use of anode-bend detection; in the matter of sensitivity, a high magnification L.F. amplifier, in conjunction with a reasonably effective H.F. stage, renders the set capable of loud speaker reception at long distances.



Events of the Week in Brief Review.

COMPULSORY AUTO-ALARM.

The Australian Federal Government has amended the navigation regulations to provide that vessels which carry fewer than three operators shall be equipped with a wireless auto-alarm.

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R.A.F. DISPLAY.

The tenth Royal Air Force Display is to be held at Hendon on Saturday, July 13th, a fortnight later than usual to enable visitors to London to attend both the Display and the International Aeronautical Exhibition, which opens at Olympia on Tuesday, July 16th.

In an advance notice of the Display, the R.A.F. promises the public "five to six thrilling hours of continuous interest." Many old favourites will be presented, in which wireless will play an important part, while chief among the new events will be an air attack on a fortified port, the most modern tactical ideas being introduced. "Enemy" ships will receive spectacular treatment.

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THE FIRST BROADCASTER?

The claim of being the first individual to initiate a public broadcasting service is being advanced by Mynheer H. S. à Steringa Idzerda, of The Hague, who states that broadcasting history was begun when he conducted public demonstrations in Utrecht in 1919 at the Third Dutch Trade Fair.

From a room at one end of the town he transmitted a flute solo with an aerial power of 5 watts, being heard not only at the Fair, but over 100 kilometres away. Early in 1920 the concerts became a weekly feature, and a timetable appeared in *The Wireless World* of June 26th, 1920. KDKA, Pittsburgh, which has often claimed pioneer honours, did not begin regular programmes until the autumn of that year

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CANADIAN BROADCASTING DILEMMA.

A widespread fear that Government-controlled broadcasting in Canada would involve an annual radio tax of between $15 and $25 per valve is responsible for listeners' opposition to the proposals of the Canadian Radio Commission for the establishment of a publicly owned service on the lines of our own B.B.C. It is contended, says a Toronto message, that only heavy taxation would meet the high cost of buying up existing stations and erecting new ones to cover the whole Dominion.

Commercial interests are also opposing the scheme on the grounds that broadcast advertisements would not be permissible under Government control. Meanwhile the Canadian broadcasting stations are all operating without licences.

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SUMMER EVENING COURSES.

A short series of summer evening classes in various technical subjects, including electrical engineering and wireless, is announced by the Manchester Municipal College of Technology. The classes begin on June 3rd and continue until July 23rd. Full particulars are obtainable from the Principal of the College.

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ORGANISING FRENCH BROADCASTING.

The French broadcasting Bill, which is certain to be passed in the next parliamentary session, aims at conciliation between the State and private enterprise, writes our Paris correspondent. While the Government stations will be controlled from a National Bureau, the private stations will continue under their present owners, who will be granted concessions to broadcast on their own responsibility.

With regard to revenue for the broadcasting service, the Bill provides not only for annual receiving licences at 3s. for crystal sets and 9s. for valve sets, but for a separate tax on each valve manufactured

To assist in the preparation of programmes a Broadcast Council is to be set up, composed of representative artists, scientists, writers, journalists and listeners.

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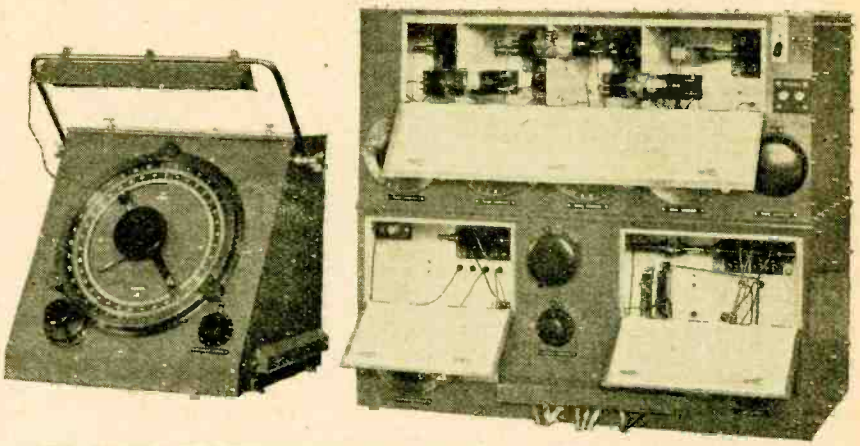
D.F. IN THE NAVY.

Experience has shown that a wireless direction finder, to meet naval requirements, must be capable of taking accurate bearings from continuous wave, interrupted continuous wave, spark or telephone transmitters over a wide range of wavelengths

To comply with these needs a new wireless direction finder, Type D.F.M.4, has been developed by the Research Department of the Marconi Company.

The equipment comprises three units—the frame aerial, the radio-goniometer, and the tuner and amplifier. The frame aerial, working on the well-known Marconi-Bellini Tosi principle, consists of two fixed loops, totally enclosed in strong metal tubes mounted on a pedestal, which is rigidly fixed to the deck In the receiver the tuner and amplifier are combined as one compact unit and cover a range of from 300 to 4,000 metres. Three



THE LATEST DIRECTION FINDER. New D.F. equipment specially designed for naval work by the Marconi Company's research department. On the left is the radio-goniometer. The amplifier and tuner are combined in a single unit.

shielded valves are used to provide high-frequency amplification and four tuning condensers, which are calibrated in metres, are used to tune the grid circuits of the high-frequency and detector valves. Each of these condensers can be adjusted independently, but a common control enables them to be varied over a range of approximately 10 per cent. on either side of the wavelength to which they are set.

For reception of continuous waves a separate heterodyne, mounted in the amplifier, is employed. In all seven valves are used, three high-frequency amplifiers, one oscillator generator, which can be used as an additional note magnifier if required, and one coupling valve.

In order that the "sense" of bearings over the whole waveband of the receiver can be obtained with the use of only a short vertical aerial a stage valve amplification using the coupling valve is employed for the vertical component.

The radio-goniometer is constructed as a separate unit, which can be fixed in any convenient position. Two calibrated scales from which the bearings are read are mounted on the face of the unit. The inner scale is fixed, and bearings taken from this scale are relative to the centre line of the ship. The outer scale can be rotated until the figure indicating the ship's true course is at the top of the dial opposite the zero mark of the inner scale: and then, if the ship is steady on her course, the bearings read from the outer scale are true bearings.

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"BRATISLAVA CALLING."

Reports of test transmissions of the new Marconi broadcasting station at Bratislava, Czecho-Slovakia, show that this station will provide a fresh source of entertainment and interest for British listeners.

The tests were heard in all parts of the British Isles, and both speech and music were generally agreed to be of excellent quality and of good strength. One London listener reported that he heard the station on a crystal set, but the majority report good loud speaker strength with small valve sets.

Out of 479 reports from Great Britain that were specially analysed only 20 indicate the use of more than four valves, the most popular receiver appearing to be the three-valve type.

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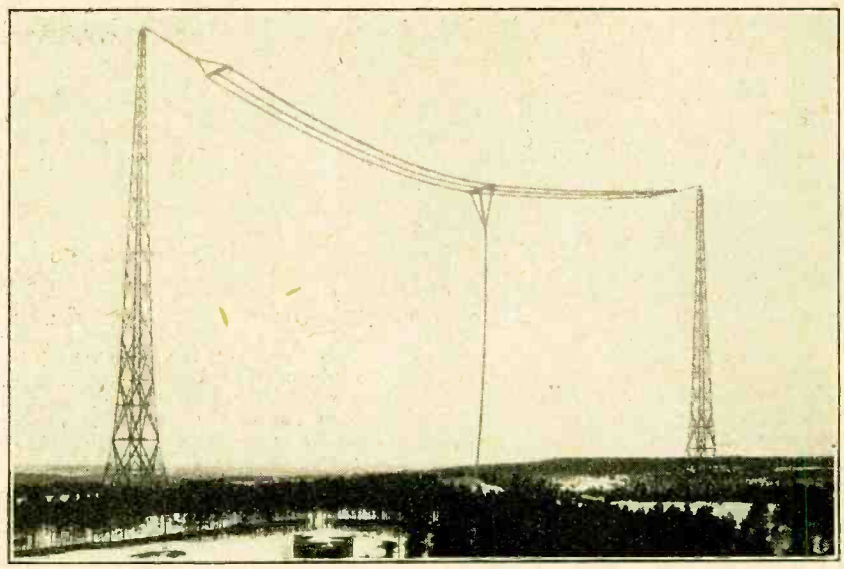
BROADCAST RECEIVER FOR THE DEAF.

The many readers from whom we have received inquiries regarding the loud speaker unit for the deaf, described by Mr. Balbi in our issue of May 8th, will be interested to learn that a model is on view at the showroom of Oravox, Ltd., 26, Langham Street, Oxford Circus, London, W.1. Demonstrations are given during broadcasting hours.

SAFETY AT SEA.

New provisions for the use of wireless in navigation are being considered by the International Conference on Safety of Life at Sea now meeting in London.

Since the previous conference in 1914 the science of meteorology has made great strides, and it is considered that much can be done to promote safety of life at sea through the collection of meteorological data by ships at sea and the use of such data to enable weather bulletins and warnings of gales or hurricanes to be issued by the various national meteorological services. Useful results might also be obtained by arranging for certain selected ships to transmit observations taken at specified hours, and by encouraging all ships to send in such observations during the hurricane season.



A CONTINENTAL GIANT. A general view of Finland's famous station at Lahti, which operates with 35 kilowatts on a wavelength of 1,504 metres.

NEWS FROM THE CLUBS.

Club Boom Approaching?

Attendances at the meetings of the Leytonstone and South Woodford and District Radio Society have been so well maintained in recent weeks that it has been decided to continue meetings into the summertime as long as 75 per cent. of the members assemble for lectures and demonstrations. The Society anticipates a big accession to the membership when the Brookmans Park station begins operations, as it is expected that many people in the neighbourhood will then discover that their sets are unselective and will require advice.

The subjects dealt with at recent meetings have included "High Frequency Amplification," "Anode-Bend v. Leaky Grid," "Aerials and their Rigging," and "The Use of the Pentode."

Hon. Secretary, Mr. E. J. Turbyfield, 42, Alexandra Road, S. Woodford, E.18.

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Field Day Plans.

An ambitious programme of field days is being prepared by the Kentish Town and District Radio Society, which is now in a more flourishing condition than for several years past. Meetings are held every Tuesday and Friday at 8 p.m. under the direction of Mr. A. F. Hemsbury (G6AY). Interest has recently been centred on a competition for the construction of home-made loud speakers. After severe tests the prize medal was won by Mr. J. Batchelor. New members will be welcomed by the Hon. Secretary, Mr. A. H. Sartain (2ACN), 40, Harrington Street, Regent's Park, N.W.1.

South Croydon's Annual Dinner.

A big factor in the success of the recent annual dinner of the South Croydon and District Radio Society was the entertainment provided by the "All Mains" receiver brought by Mr. F. E. T. Clark, the hon treasurer. During the dinner the programmes of 2LO and 5GB were reproduced, and as the company became bolder, Mr. Clark was strongly urged to capture a few foreign programmes; a number of Continental stations were soon heard. The Society has enjoyed a very successful period of work during the winter, and the speeches at the dinner demonstrated that if confidence could aid the Society its success was assured.

Hon. Secretary, Mr. E. L. Cumbers, 14, Camden Road, S. Croydon.

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Transmission and Reception Indoors.

A practical demonstration of transmission made a fitting conclusion to a series of winter lectures given by Dr. N. S. Walls, M.Sc., before the Wigan and District Technical College Radio Society. The transmitter was placed in a distant room and the receiver was operated in the lecture room, gramophone records being reproduced on a loud speaker. The quality of both music and speech suffered nothing in transmission.

The Society is in its third year of existence, and it is hoped in the coming summer there will be no diminution of interest, a number of interesting visits to places of interest having been arranged.

Hon. Secretary, Mr. M. M. Das, B.Sc., Library Street, Wigan.

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Behind the Scenes in Radio Drama.

A former "noise expert" of the B.B.C., Mr. A. Whitman, lectured before Slade Radio, Birmingham, on May 9th, on the subject of "Radio Drama." His reminiscences of early difficulties "held" the meeting from start to finish, and gave the members a sympathetic insight into the troubles which the blasé listener is inclined to overlook.

The club has been very active in the last few weeks; notable events have been the Third Whist Drive and Dance at Headquarters, a talk on "A.C. Valves, Receivers and Eliminators" by a representative of Messrs. Philips Lamps, Ltd., and a demonstration of electrical reproduction of gramophone records given by Mr. F. B. Jackson, who also described some interesting experiences in public address work. To-morrow night (Thursday, May 23rd) the Society will discuss an "oscillation test," to be held on June 9th.

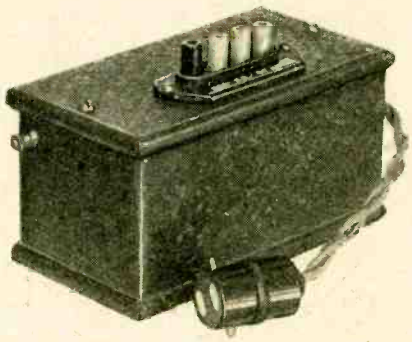
Hon. Secretary, Mr. H. Clews, 52, St. Thomas Road, Erdington, Birmingham.

A Review of Manufacturers' Recent Products.

EKCO H.T. SUPPLY UNIT. Model 3F.12.

This H.T. battery eliminator, which is for use on D.C. supply mains, has been designed particularly for sets fitted with a screen-grid H.F. valve. A separate tapping is provided, which, under normal operating conditions, supplies the screen-grid with the necessary potential. Two other tappings are provided; one gives an output voltage of the order of 60 for the detector, and the other between 120 and 150 volts for the last valve. The outpnt voltages were measured under varying load conditions, and these are shown graphically. These measurements were taken independently, but since it was found that the voltages were governed by the current taken from each tapping, the curves will be slightly modified under working conditions.

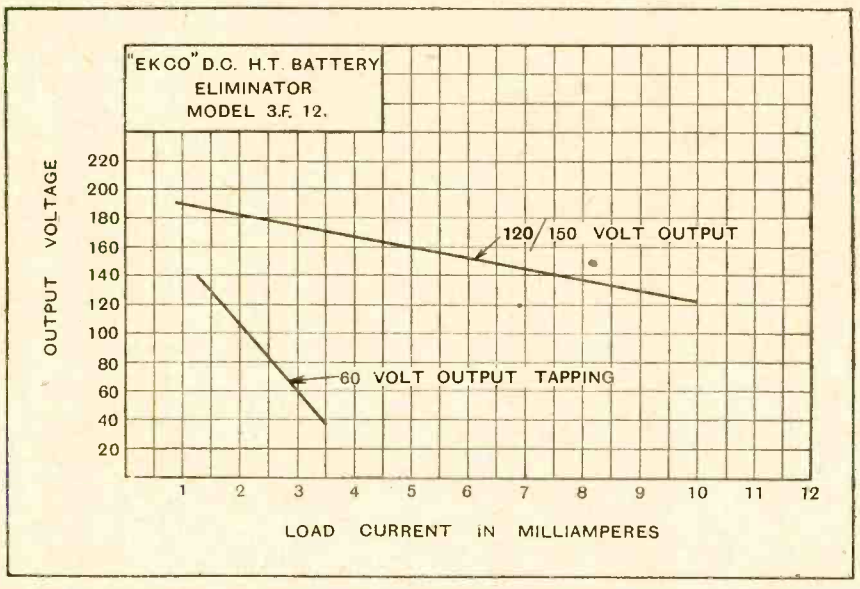
The nominal voltages were obtained when a load of 1.8 mA. was taken from the S.G. tapping; 1.1 mA. from the 60-volt socket, and 9 mA., at 120 volts, from the last socket. The input voltage was 200 at the time of test. A practical test was made with a three-valve set, the total current required being 7 mA. The maximum voltage available for the output



Ekco H.T. D.C. Eliminator. Model 3F.12.

valve was found to be 140. At first a slight hum was noticed, but this was eliminated by connecting an earth wire to the small terminal on the side of the case. Telephones could then be used without any inconvenience from mains ripple.

This model is very compact, measuring only 5½in. × 3in. × 3in. high. The "live" sockets are accommodated in a bakelite moulding, so designed as to give adequate protection to the user. The unit is enclosed in a neat metal case finished in brown crystallate, and the price is 37s. 6d. The makers are Messrs. E. K. Cole, Ltd., "Ekco" Works, London Road, Leigh-on-Sea, Essex.



Voltage regulation curves for EKCO D.C. battery eliminator.

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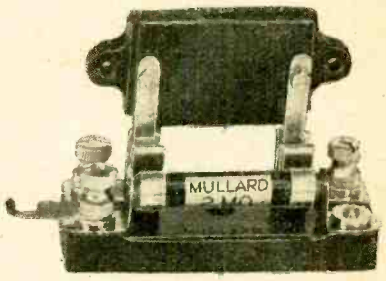
P.M. GRID LEAK AND CONDENSER HOLDER.

This holder has been designed to provide a ready means of using the grid leak in parallel with the condenser or connected to one side only as in resistance-capacity coupling units. This change is made by linking together the two small terminals at one end of the holder for the first-mentioned arrangement, or in the second case by simply joining the three terminals to their respective points in the circuit. The holder, 0.0003 mfd. fixed condenser, and 2-megohm grid leak can be obtained complete in a carton for 7s. 6d. Separately, the prices are as follows:—Holder only, 3s.; condenser with special clips, 2s. 6d. for values 0.0001 mfd. to 0.0009 mfd., 3s. for values 0.001 mfd. to 0.01 mfd. Grid leaks cost 2s. 6d. each for all values from 0.1 megohm to 5 megohms.

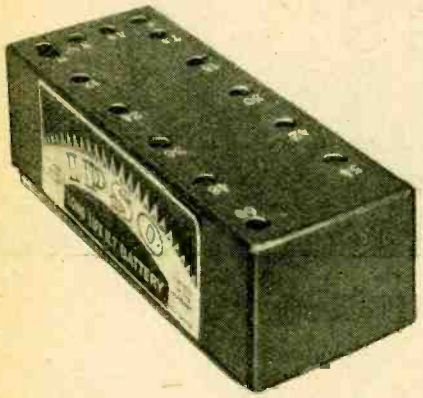


Compact combination grid leak and condenser holder; a Mullard product.

The makers are the Mullard Wireless Service Co., Ltd., Mullard House, Denmark Street, London, W.C.2.

"IPSO" H.T. BATTERIES.

These batteries, which are of German make, are being handled in this country by Messrs. D. Grabow, 19, Minster Road, W. Hampstead, London, N.W.2, and are available in 60-, 100- and 120-volt units.



"Ipso" 60-volt dry-cell battery. These are made in one capacity only.

One size of cell only is employed; this represents what in the British-made type is rated as the small capacity size. A 60-volt dry-cell battery was submitted for test, and in view of its small physical dimensions, was discharged at an initial current of 6mA. The "life" of the battery was exceptionally satisfactory for a unit of this size, and we consider that it would have been quite in order to commence the discharge at a higher rate than that chosen.

After the first rapid fall the voltage remained practically unchanged for nearly 100 hours, and from thence onwards showed a steady decline. The natural cut-off was not reached until the battery had been on discharge for 500 hours, but the voltage had fallen to just under 30. This corresponds to a fall in voltage per cell to 0.75. It will be seen from the discharge curve that the voltage remains in the region of 30 for approximately 150 hours after reaching this value, indicating that there is a partial recovery and an arresting of the chemical action for a period.

The "life" of the battery, assuming that it is kept in use until the voltage per cell drops to 0.9, will be 310 hours, but the battery is, nevertheless, good for another 200 hours, providing some "boosting" cells are employed to bring the voltage up to the working value demanded by the valves.

Prices of these batteries are as follows: 60-volts, 6s. 6d.; 100-volts, 10s.; and 120-volts, 11s. 6d. Nine-volt grid batteries, tapped in 1½-volt steps, are available also at 1s. 3d. each.

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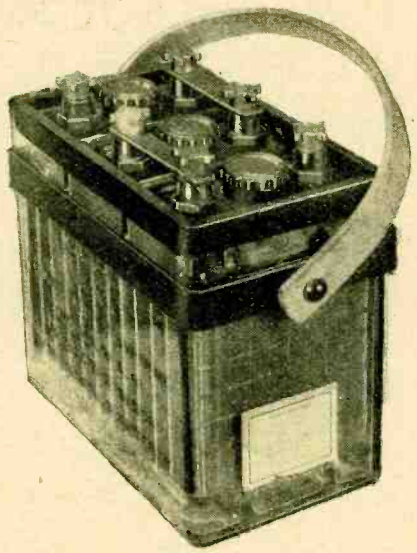
TUDOR "MONOLT" UNIT.

This is a 6-volt L.T. accumulator with a rated capacity of 30-ampere-hours and is assembled in a monobloc glass container. A feature of particular interest is the inclusion of two floats in the centre cell as indicators as to the state of the battery.



Tudor "Monolt" 6-volt unit with charge-indicating floats in the centre cell.

These take the form of two small balls, one red and one white. When both balls are floating the cells are fully charged, but when the white ball commences to sink the time is approaching when the battery should be put on charge. The red ball going down indicates that the cells should be put on charge forthwith.

Tests showed that the specific gravity (S.G.) of the electrolyte was 1,280 when both balls were right up, and when the white commenced to fall the S.G. was down to 1,230, and with both balls down the S.G. was 1,160 only. During our tests it was noticed that the balls in the particular sample available did not fall during the first discharge, and it was necessary to shake the battery to loosen them. This should be done with all new cells and also occasionally during use to prevent the floats jamming. The price of this unit is 40s., complete with carrier, and the makers are the Tudor Accumulator Co., Ltd., 2, Norfolk Street, Strand, London, W.C.2.

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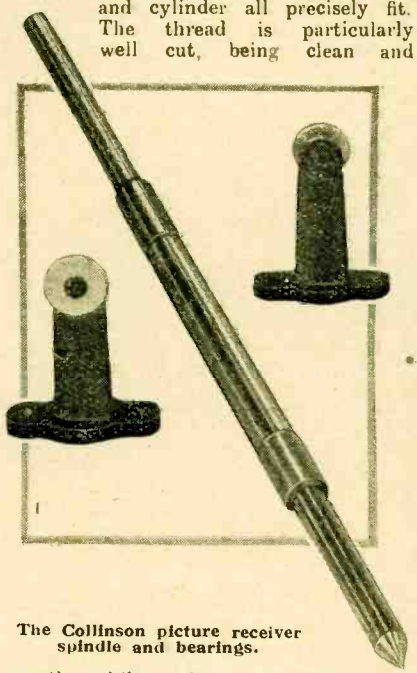
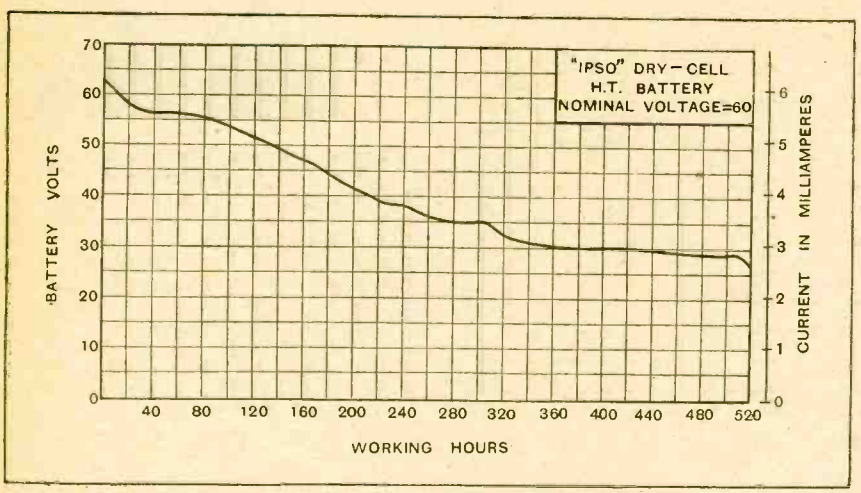
PICTURE RECEIVER SPINDLE.

A well-finished spindle is available from Collinson's Precision Screws Co., Ltd., Provost Works, Macdonald Road, Walthamstow, London, E.17, made in accordance with the details given in the recent article which appeared in these pages.

Examination with a micrometer revealed that the dimensions were accurate, and, as a result, clutch, clutch plate, and cylinder all precisely fit. The thread is particularly well cut, being clean and smooth, while under a magnifier there were no bruised or torn parts visible. To simplify the construction of the machine this spindle is supplied complete with adjustable bearings.



The Collinson picture receiver spindle and bearings.



Discharge curve of the "Ipso" 60-volt dry-cell battery.

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TRADE NOTES.

A Correction.

Owing to an unfortunate typographical error, the price of the Ferranti Valve Tester reviewed in our issue of May 1st last was erroneously given as £5 5s. The actual retail price of this instrument is £5 15s.

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The Climax Radio Electric, Ltd., Quill Works, Putney, London, S.W.15, have moved to larger premises at Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.

THEY ALSO SERVE.....

. . . Who Only Stand and Wait for Empire News.

THE SCENE.—*The outer verandah of a bush bungalow in West Africa, just after chop, or evening meal. The only occupant of the verandah is a white man, who, lounging in a long chair, mops his brow with a sodden handkerchief in his right hand whilst making feeble swipes at mosquitoes buzzing around his head with his left hand.*

The furniture on the verandah comprises the long chair and an empty petrol case. But in the shadows of the far end is a table on which is heaped weird-looking apparatus, which on closer investigation proves to be a varied assortment of wireless gadgets.

[*Enter native house boy.*]

BOY: All work done. Finish, massa. Gooda-night.

THE EUROPEAN (*Mr. Coaster by name*): Good-night, boy.

[*Exit boy.*]

MR. COASTER (*to a fat lizard which is lapping up ants from the verandah floor*): Ye gods, only half-past eight! At least another couple of hours to pass before I push off to bed, otherwise I shall spend most of the night awake. What a life! Why, lemme see. It's now over two months since I saw a jolly old white man. Hope somebody happens along soon. Jolly good job I've got the old box of wireless tricks here, because, by Jove! it does help the time to slide along in this hole. It's been a bit rotten lately. Too many atmospherics and a bit of fading. Still, what about a spot of old London?

This playlet is a genuine slice of real life. The author, who appears here under the name of "Coaster," sends his contribution from Geidam, Northern Nigeria, 185 miles from the nearest haunt of white men. The incidents so vividly described actually took place.

[*Places phones on his head, and settles down to listen in.*]

VOICE (*from the phones*): . . . is obtained from the Acacies Prorabi plant, and from the Arabies Tanires comes a similar substance which is used for ——

COASTER: Oh, Lor'! That again!

[*Enter boy, looking rather excited.*]

BOY: Massa, one white man he go come for here.

COASTER: Oh, jolly good; who is it? When did he arrive? Where is he now?

BOY: His boy he tell me his massa horse be lame, so he catch so late for night along the same for this. Me I no sevvey who he be this massa.

COASTER (*switching off the wireless, and rising to his feet*): Go quickly to the rest house and tell the massa I go come one time to see him.

VOICE (*from the doorway*): No need to, old son, here I am. And it's no use you coming round to see me because I haven't got any.

COASTER: Dempster, by all that's wonderful! Gad, but I am pleased to see your ugly old face. Haven't seen anyone since you were here last about two months ago. Have a seat. Have a drink. Have a cigarette.

DEMPSTER: I don't see a seat, don't want a cigarette, but did you mention something about a drink?

[*Enter boy with drinks and glasses on a tray. The two Europeans fill out pegs, and for the next half-hour swop local news.*]

DEMPSTER: I met Jackson about a week ago, but as he has been in bush for about a month he couldn't give me any home news. Have you heard any news of the King?

COASTER (*grinning*): Rather; you want to be more up to date, laddie, and get a wireless set. Behold! (*pointing to the wireless corner*).

DEMPSTER: A wireless set. That's jolly good. Then you will know all the news. I mean the very latest news about everything?

COASTER (*a bit awkwardly*): Er, not quite. But I am pleased to say that last night's news about the King was much better, and he seems to be making good progress.

[COASTER *and* DEMPSTER *sit down at the wireless set.* COASTER *connects up a second pair of phones which* DEMPSTER *places on his head.* COASTER *switches on, and they both hear the concluding strains of an orchestra. There is silence for a moment or two.*]

They Also Serve . . .

VOICE (*from the phones*): This is 5SW, the Experimental Empire Short-wave Station. His Majesty the King: The latest bulletin published this evening is as follows——

[*They hear a reassuring account of the King's condition, which to the two white men, Britishers, out in the heart of the bush, seems to take them back to the Old Country. There is a feeling of gratitude to the Old Country, for they realise that this bulletin, sent out from 5SW, is specially radiated to reach out over the world to all British possessions, and is for the benefit of such as they, exiled from their fellowmen in the performance of their duty to the Empire. The bulletin concludes, and* COASTER *switches off, but turns to* DEMPSTER *with the remark: "I expect there will be some music on in a minute. Would you care to listen for a while?"*]

DEMPSTER: Oh, yes, music by all means, but what about the old news bulletin first? I hear that there is rather a rumpus on in Afghanistan. What about listening to the news of old Blighty?

COASTER (*somewhat apologetically*): I-I-I'm afraid we can't, old man; you see, they don't send out news.

DEMPSTER: Don't send out news? But, good Lor', isn't this London we are listening to?

COASTER: Yes, but, you see, it is sent out from 5SW on short waves, and they say it is only an experimental station; news is not transmitted. They close down during the news bulletins.

DEMPSTER: Well, I'm damned!

COASTER: Of course, they send out the special bulletins about the King, but it is heart-breaking to sit here night after night listening to the programme, and when the news, the most important part, comes along—nothing doing.

DEMPSTER: I should say so. Why, hang it all, you might as well have a gramophone as that box of tricks if you can't get any news. How long have they been on the go now? A month? Two months?

COASTER: Well, as a matter of fact, I don't understand it. They have been sending out quite good stuff now for well over a year, but, so far, there is no sign of a regular service including news.

[COASTER *switches off, the boy appears, and is instructed to bring coffee and more drinks. For the next hour the two white men discuss things in general.*

Midnight.]

COASTER (*suddenly*): Why, I'd almost forgotten! 2XAD, in America, will be transmitting this evening, and it is just on time for their summary of the world's news. Let's cut over there and see what's doing.

[*He re-tunes, performs a few other operations to the set, and presently, in a most astoundingly clear and loud tone, comes the rather nasal speech of the announcer many thousands of miles away in America.*]

COASTER: Hope he hasn't passed the home news.

VOICE (*from the phones*): England: A serious railway accident occurred to-day at ——. The reported death of Mr. —— is announced in ——. The results of the inter-Varsity match at ——, etc., etc., etc.

[*The announcer then commences to read American stock news, and* COASTER *switches off.*]

DEMPSTER: Wonderful! But, look here, old bean, I'll have to toddle back to the rest house and have some sleep. I've had a pretty long day on the road.

COASTER: Well, good-night, old man. You say you will be here a couple of days, so come round and have a spot of chop with me to-morrow night.

DEMPSTER: Thanks awfully. Delighted. We can also listen again to the jolly old dance music and imagine we are having a bonzo Saturday evening in London.

COASTER: I-I-I'm sorry, old man, but, you see, to-morrow is Saturday, and 5SW doesn't transmit during the week-ends.

DEMPSTER: Lord! They don't transmit news and don't transmit on week-ends! Laddie, the gramophone for me every time!

[DEMPSTER *descends the few steps to the compound, and waves to* COASTER.]

DEMPSTER: Good-night, old man.

COASTER: Cheerio, old top.

[COASTER *stands alone at the doorway for a few minutes. Suddenly, some little way off, in the direction taken by* DEMPSTER, *comes a shout: "*COASTER! "]

COASTER: Hullo, yes?

VOICE (*from the darkness*): I forgot to ask you, old man, but what does your Empire station do on the first of April?

CURTAIN.

USEFUL DATA CHARTS. No. 24 (e).

The Design of Mains Transformers.

(*Concluded from page 441 of the issue dated 24th April*).

THE magnetising current, which is necessary to magnetise the iron to the flux density which has been chosen, namely, 50 kilo-lines per square inch, is given by the formula—

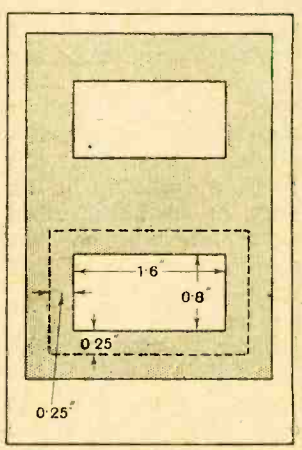
Magnetising current = mean iron path × ampere turns per inch / 1.41 × primary turns.

The ampere turns per inch depend only on the flux density, and can be found from a curve. The primary turns have already been obtained, and it only remains to calculate the mean iron path, which is shown by the figure to be—

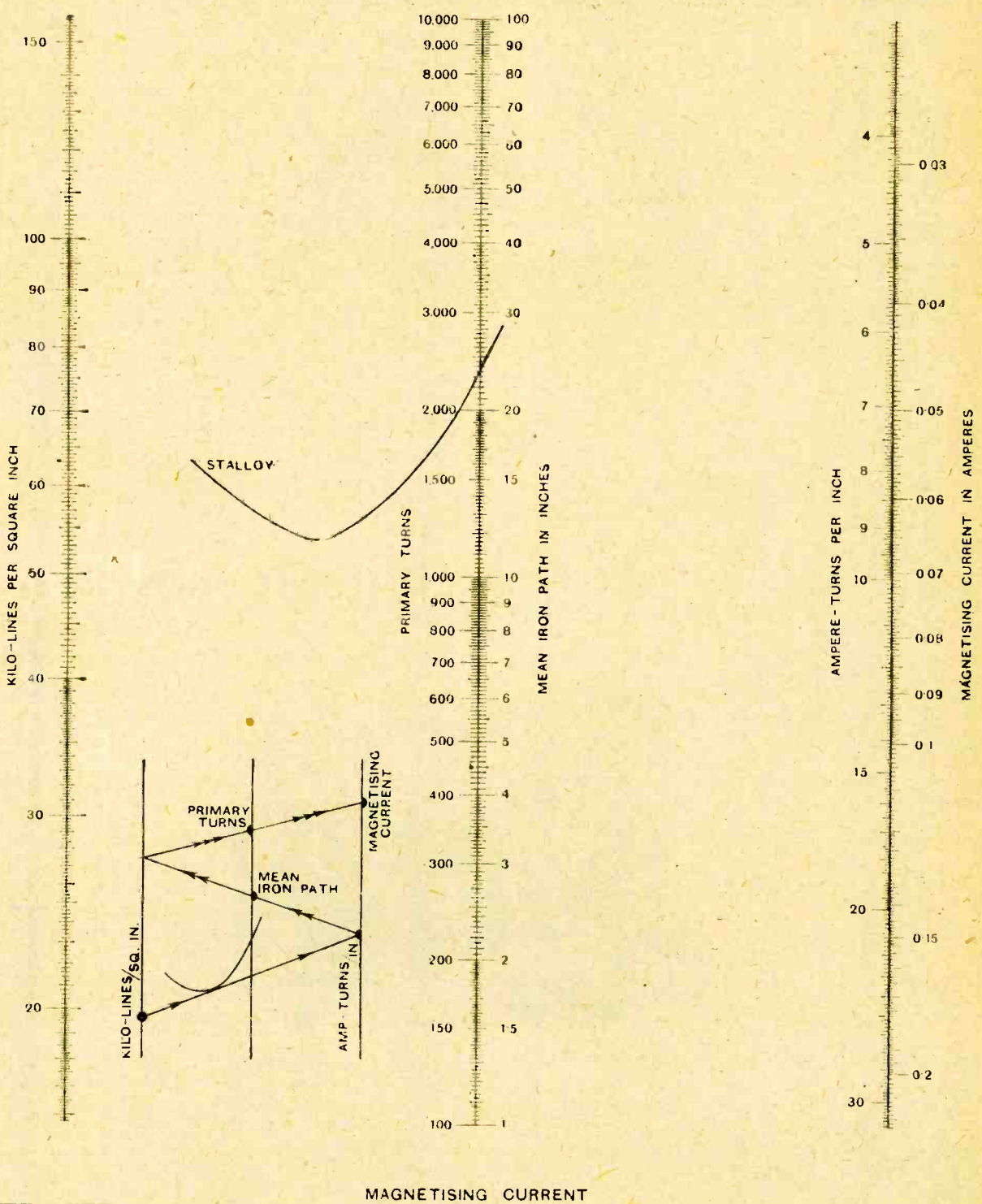
$$2\,(2.1+1.3)=6.8\text{in.}$$

The abac shows that at 50 kilo-lines per square inch the ampere turns are 8, and on passing through the mean iron path of 6.8in. and the value of 1,440 for the primary turns, the magnetising current is found to be 0.0263 amp., corresponding to the calculation $8\times 6.8/1.41\times 1{,}440$.

R. T. B.



The mean iron path is shown by the dotted line and is 2[(1.6 + 0.5) + (0.8 + 0.5)] in. = 6.8in.



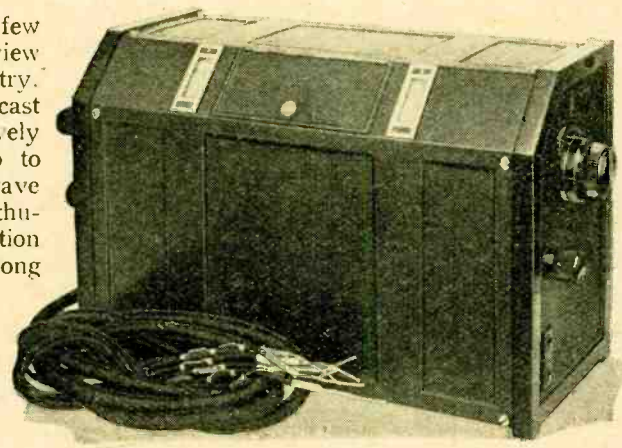
Broadcast Receivers PHILIPS Type 2802

A Four-valve Set, Tuning from 10 to 2,400 Metres.

WITHOUT being unfair to our Continental competitors there is ample evidence to support the observation that British-built receivers are the best. The exception that proves the rule are the products of the Dutch firm of Philips, and if we dare venture a comparison in this instance one might give Philips the credit of producing much apparatus that is unrivalled. Appreciating that the valve is the heart of a receiver and that progress in receiver design is subsidiary to valve development, it is obvious that the progressive valve maker is in a favoured position when it comes to set manufacture. The advancement made in valve technique by the Philips Research Department is known to every user of P.M. valves, and we turn, therefore, with interest to the new Philips receiving sets expecting to find similar leadership.

Short-wave H.F. Stage.

It is only during the past few weeks that the set under review has arrived in this country. Essentially, it is not a broadcast receiver in that it effectively covers a wave range of 10 to 2,400 metres. A short-wave receiver for the long-range enthusiast with provision for reception on both the normal and long broadcast wave bands is a fitting description. Thus it is a receiver designed for world-wide short-wave listening, yet equipped for broadcast reception. In this respect it will satisfy the amateur who may demur when an endeavour to listen to American short-wave broadcasting means disorganising the home broadcast receiving set. For the Colonial listener, also, it is the set which will give him the best possible chance of getting 5SW or other short-wave broadcasting without preventing him from readily tuning to a local station.



The metal cover between the condenser scales gives access to the tuning coil.

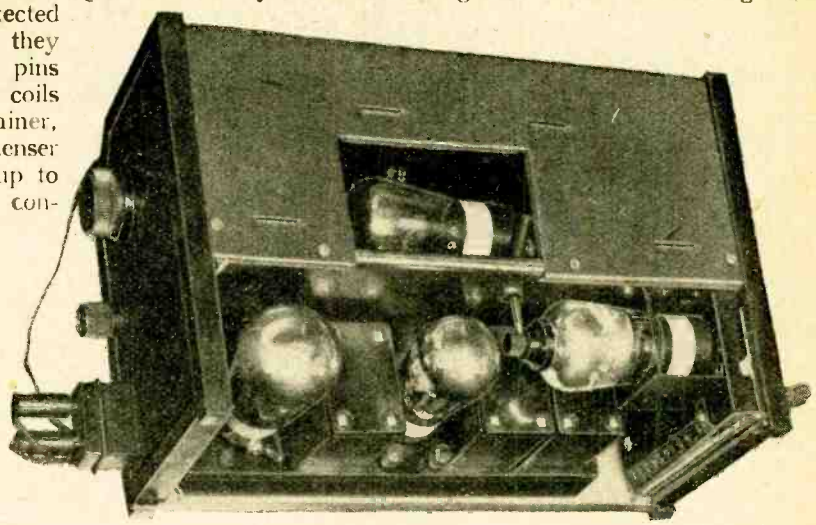
It is a four-valve set with one high-frequency and two low-frequency stages. That an H.F. stage should be used in a short-wave set is an unusual feature, and this is the first instance in which the adoption of an H.F. amplifier is to be found in a commercially built short-wave set arranged for home reception. Its inclusion is boldly opposed to accepted amateur practice, and the short-wave enthusiast will note with some surprise that the H.F. amplifier is resistance-coupled to the detector. Precise details of the method of coupling were not extracted, for in the course of examining the set, the seals were not broken. This H.F. stage probably gives an exceedingly small degree of amplification, and yet as a passenger it is, nevertheless, important. It is responsible for providing a fineness of reaction control unobtainable with the orthodox circuits, and remembering that reaction can provide considerable amplification when capable of critical adjustment the inclusion of the H.F. stage gives a definite advantage. A screen grid valve is used in the H.F. stage, this being the P.M.14. In order to provide sensitiveness to small inputs leaky grid detection is used, the valve being the P.M.4DX "star." This is a valve specially designed to be non-microphonic, a very necessary feature when followed by two transformer-coupled L.F. stages. A high degree of amplification is provided by both the L.F. valves, these being the P.M.4DX and the P.M.24. The latter is, of course, a pentode. To adopt a pentode in a second L.F. stage is unusual, overloading at once suggesting itself. Remembering the form of detection that is used—the leaky grid which will function on weak signals—it will be seen that the L.F. amplifier is working normally and is not overloaded when the detector is dealing with exceedingly small signal inputs. A control knob operates a totally enclosed switch which, as well as providing an "off" position, switches the pentode stage out of circuit when the strength of the incoming signal causes overloading.

Plug-in Tuning Coils.

There is only one tuning control operated by a small knurled knob which connects to the tuning condenser

Broadcast Receivers.—

through a reduction gear. Accurate reading of the condenser setting scale is obtained by a scratch line on a small window through which the edgewise dial is viewed. A similar arrangement is provided for the reaction condenser control. An additional fine tuning control is fitted to the tuning condenser with a pointer indicator. In addition to the reaction adjustment there is an independent volume control which, in view of the fact that it controls selectivity, is probably a variable loose coupling. The receiver is all-metal enclosed, is dustproof and robust. A metal flap between the two tuning scales provides for inserting the interchangeable tuning coils. These coils are well protected and engage in guides. When engaging they are easily pressed home and their four pins make a perfectly reliable contact. Six coils are supplied in a separate metal container, while tuning charts reveal the condenser settings in respect of three of the coils up to a wavelength of 160 metres. Aerial connection is by plug and socket and the battery connections by cable. A two-pin connector interposed in the loud speaker leads produces a lowering of tone which may be desired owing to the use of a pentode.



Underside view of receiver with back cover plate removed, showing the arrangement of the valves and L.F. equipment.

On Test.

Tested first as a broadcast receiver on a normal aerial in a good situation and during daylight many Continental stations were tuned in. Tuning was sufficiently sharp to provide good separation on the normal broadcast band, though reaction was necessary to provide absolute separation between Paris, Daventry, and Königswusterhausen on the wave-range around 1,600 metres. Quality, as judged by one in the habit of using a moving coil loud speaker, was particularly good and tends to give confidence in the possibilities of the pentode. Some listeners may prefer the shunt condenser across the loud speaker for broadcast reception. The cheaper model Philips loud speaker was used for the test.

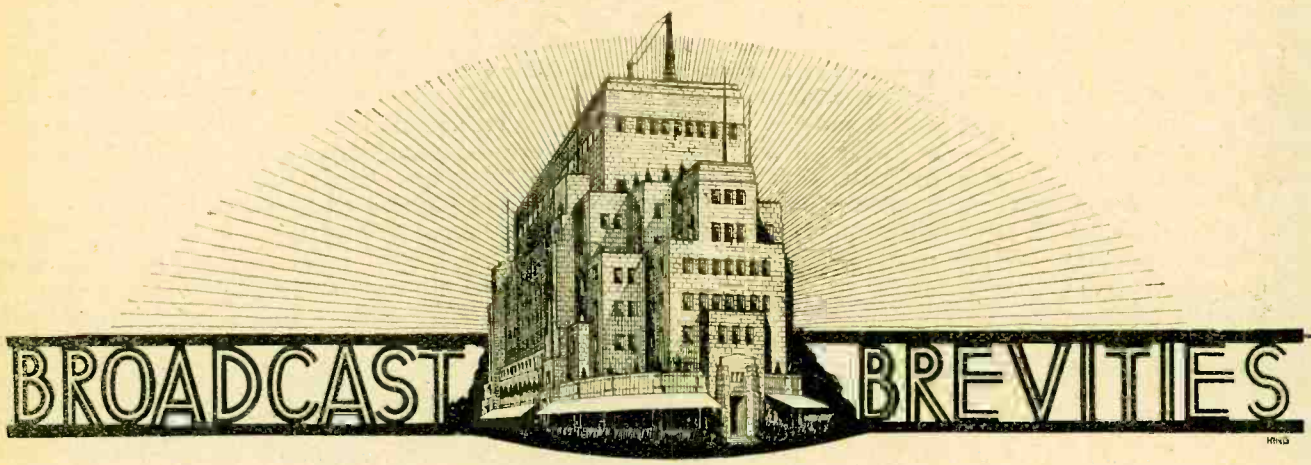
A current of only 11 mA. was passed by the pentode, and with moderately strong signals this reading was swept, at times, down to 6 mA. In spite of this condition, which occurred when using the voltages recommended in the instructional booklet, quality was unquestionably good. With the switch turned to disconnect the pentode the loud speaker current fell to 4 mA. Dry batteries of small size can thus be used to operate the set. The loud speaker could be brought into contact with the receiver without microphonic effects resulting.

On the short wave band the station of outstanding interest was 2XAO, received at full loud speaker strength. This station takes its programme from New York, and working on 21.96 metres is heard between 8 and 10 o'clock (B.S.T.) in the evening. Signal strength and quality of reception gave a local station atmosphere to the reception, although fading caused periodic weakening of the signal. Pittsburg was received on 19.5 metres, as well as 2XAF. The Australian stations 2FC and 2ME, which are normally louder than these American transmissions, were not operating at the time of test. In operating the reaction control there was no audible howl, while one was independent of the natural wavelength of the aerial in that there were no "flat spots." Receiver, batteries, and aerial wire could be handled while the receiver was critically tuned to a distant station with scarcely any change in the signal resulting. Short-wave reception is in no way impaired when H.T. current is derived from a mains unit. The Morse code enthusiast will readily identify stations working over an area extending from North America to Egypt. Comment may be made in that the tuning condensers are of the straight-line capacity type. This fact is revealed from an examination of the calibration charts from which it will be seen that 10 degrees rotation of the tuning condenser produces a greater wavelength change at the minimum than at the maximum setting. Although obvious advantages would be gained by the substitution of condensers of the straight-line wavelength (square law) or logarithmic types there was no inconvenient crowding together of stations at the lower end of the condenser.

As the use of reaction generally implies the passing back of energy to the aerial to the annoyance of other listeners, the manufacturers state that the H.F. stage effectively serves on the broadcast band as a barrier and prevents the locally generated oscillatory energy reaching the aerial circuit. When tuning to the ultra short waves, however, the inclusion of a high frequency choke coil in the earth connection is suggested, and constructional details of a suitable choke are given.

Terminals are fitted for introducing a gramophone pick-up, an external potentiometer being necessary to control volume.

The receiver is supplied complete with valves at £30. Compared with other Philips receivers, this seems high, and in spite of the excellence of performance the price may tend to limit the well-deserved popularity of this set.



By Our Special Correspondent.

Programmes from America?

The Americans have always seemed tremendously keen to bring about an exchange of programmes with this country, so it comes as no shock to read of Mr. Merlin Aylesworth, president of the U.S. National Broadcasting Company, telling New York reporters of plans for the early inauguration of a "vast radio hook-up" across the Atlantic.

This statement may be taken with as much seriousness as most which are wrung out of jaded travellers staggering ashore at Long Island; but, after all, Mr. Aylesworth is a person of authority in the broadcasting world and is not likely to be cajoled into wholly imaginative forecasts.

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B.B.C.'s New Receiving Station.

At Savoy Hill the question of Transatlantic exchanges is discussed in an entirely non-committal manner, but a new shibboleth has arisen, viz., "Tatsfield." The new Tatsfield receiving station, which received first exclusive mention in these columns, is expected to achieve things far beyond the capabilities of the Keston station.

I understand that during his recent visit to Savoy Hill Mr. Aylesworth paid particular attention to the B.B.C.'s plans on the receiving side, and his statement to the New York Press is undoubtedly founded upon what he saw and heard at B.B.C. headquarters.

o o o o

Comparisons?

Whether or not British listeners are really anxious to hear what is going on in American broadcasting studios is a question which will have to be seriously considered. If the B.B.C. *does* attempt a series of relays from America it may be for a very subtle reason.

o o o o

"Talkies" Filch Broadcasting Material.

The advent of talking films is robbing the B.B.C. of a valuable source of programme material. On June 7th listeners will hear the last broadcast by Frank Westfield and his orchestra from the Prince of Wales' Playhouse, Lewisham. The installation of sound film apparatus at this and other cinemas means "more talk, less music," and although the broadcasting of a "talkie" might make an interesting novelty for a "surprise item," I imagine its intrinsic entertainment value to the microphone would about equal that of a waxworks.

o o o o

Politics and Music.

It is to be hoped that the Wireless Orchestra will choose soothing music for the night of May 30th-31st, when the election results are being broadcast. The first results are likely to be announced soon after 10.30 p.m., when the Wireless Orchestra begins a long programme, lasting, with breaks, until 1.30 a.m., at which time the Gershom Parkington Quintette takes over until 2 o'clock. It is expected that between the items the election results will be given in batches of three or four.

o o o o

The Cup of Tantalus.

I have every sympathy with the Belfast listener who is pleading for one of two things. He asks the B.B.C. either to allow Belfast listeners to enjoy concerts from London or to cut out Mr. Harvey Grace's Saturday talk on "Next Week's Broadcast Music." This talk is broadcast from Belfast, in common with other stations, yet the music described, with rare exceptions, is excluded from Belfast's programmes!

What about it, Savoy Hill?

o o o o

Broadcasting House, Manchester.

The first opportunity which 5CB listeners will have of hearing a transmission from the new Broadcasting House in Piccadilly, Manchester, will occur on Tuesday, May 28th, when a performance of Coleridge-Taylor's "Hiawatha" will be given by Dr. Henry Coward and his Sheffield Choir.

o o o o

Scottish Thoroughness.

I hear that members of the Scottish Flying Club have co-operated with the B.B.C. in the preparation of "Airways"—a special feature programme to be given from all Scottish stations on Tuesday, June 4th—all the incidental effects being guaranteed "O.K."

It is even rumoured that the producer is so thorough in his methods that he is insisting on taking some of the cast up for a short flight before the show so that they may get the proper "atmosphere."

o o o o

A Unexciting Report.

Sensationalism is not to be expected in the B.B.C. Annual Report, but last week's publication—issued nearly five months after the conclusion of the period under review—contains several outspoken references to the year's toil. It is admitted, for instance, that 1928 did not witness perfection in radio drama ("complete satisfaction will not be attained until more specialist artists have been found"); on the other hand, there was "much matter of a generally accepted nature" and an increasing number of programmes were given of a type which only broadcasting could provide.

Expenditure on programmes and plant maintenance accounted for about 80 per cent. of the total—63 per cent. for programmes and 17 per cent. for plant and power; and the Corporation started the New Year with the comfortable balance of £123,181 4s. 1d., the corresponding figure for 1927 being £128,338.

FUTURE FEATURES.

London and Daventry.

MAY 29TH.—"The Juggler of Notre Dame," an opera by J. Massenet, libretto by Maurice Lena.

MAY 31ST.—"Kaleidoscope No. 2."

Daventry Experimental (5GB).

MAY 27TH.—"The Juggler of Notre Dame."

MAY 29TH.—"Love Magic," a comedy by G. Martinez Sierra, translated by John Garrett Underhill.

Cardiff.

MAY 30TH.—"The Turn of the Tramp," a play by Constance Smedley.

Manchester.

JUNE 1ST.—"Bill Brown, M.P.," by Edwin Lewis.

Newcastle.

MAY 31ST.—A Concert from the North-East Coast Exhibition.

Glasgow.

MAY 27TH.—"Clyde-Built," a play by George Blake.

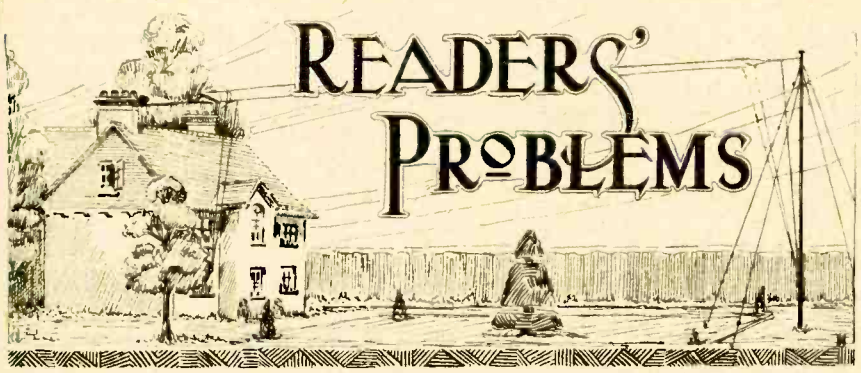
Aberdeen.

MAY 27TH.—A Scottish Programme.

MAY 31ST.—"Shakespeareana."

Belfast.

MAY 30TH.—A Scandinavian Programme.



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

An Intermittent Disconnection.

I have a set with one screen-grid H.F. stage, anode bend detector, and two resistance-coupled L.F. valves. H.T. is obtained from A.C. mains. When the filaments are first switched on, it works well, but after a time signals suddenly become weak and, occasionally, fade out altogether. It has been observed that matters are put right if the lighting switch in the same room is opened or closed; the eliminator is joined to this circuit. Can you tell me what is wrong, and how the fault may be remedied? S. F.

If you were using transformers as L.F. couplings, we should say that your trouble is almost certainly due to a defective primary winding in one of these components; the effects you describe are by no means uncommon, and are almost invariably due to a peculiar form of fracture in an inductive winding, the ends of the wire being separated by an extremely small space. Continuity is temporarily restored by surge currents induced from the lighting circuit when it is interrupted.

In your particular case, as L.F. transformers are not used, we expect that the trouble will be traced to the windings of an L.F. choke forming part either of the eliminator smoothing system or of an output device (transformer or choke filter). We assume that you have proved that the loud speaker itself is not to blame.

o o o o

"Flat Dwellers' A.C. Three" on an Open Aerial.

I should welcome some hints as to how the "Flat Dwellers' A.C. Three," described in your issues of May 1st and 8th, may be altered for use on an outside aerial of normal dimensions—provided, of course, that this modification is practicable.

D. F. B.

We suggest that the grid circuit should be modified in the manner shown in Fig. 1: this is the conventional type of "aperiodic" aerial coupler with waveband switching.

With regard to practical details, it would be satisfactory to use a coil assembly exactly the same as that specified for the detector grid circuit of the receiver in question, adding taps for the aerial connections; on the short-wave winding this tap might be at the twelfth turn, and on the long-wave coil at the thirtieth turn, in each case counting from the low-potential end of the winding.

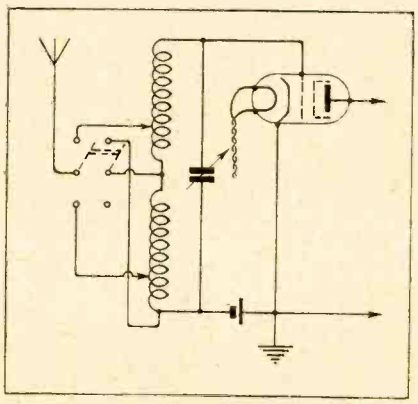


Fig. 1.—Modified grid circuit of A.C./S. valve with simple waveband switching.

RULES.

(1.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(2.) Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(3.) Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufactured receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

The coil may be accommodated between the front panel and the screening box, but it would be necessary to increase the spacing between these to something greater than that specified.

It should perhaps be pointed out that the set is primarily designed for use with a frame, and that the form of intervalve coupling adopted does not confer any very high degree of selectivity. However, the performance of the set modified in the way we have suggested will be above the average standard in this respect.

o o o o

Valve Makers Benefit Circuits.

I am told that the present-day extensive use of metal screening increases risk of accidentally burning out valves. Do you agree with this statement?

I do not remember having seen in your journal any warning as to special precautions to be taken.

J. R. M.

If matters are properly arranged, the presence of earthed metal work should in no way increase the risk of burning out valves, although it does introduce the obvious possibility of H.T. battery short-circuits at a number of points.

Sufficient thought is not always devoted to this subject, and it is unfortunately a fact that arrangements are sometimes put forward in which an accidental contact between a "live" wire and the screen may be attended by dire results as far as the filaments are concerned.

You can rest assured that adequate precautions are taken by contributors of practical articles to this journal, and that it is a complete fallacy to imagine that the adoption of metal construction need be responsible for a heavier valve bill.

o o o o

Wavetrap Adjustments.

With the help of information given in a back number of The Wireless World *I have added an absorption wavetrap to my receiver. It has answered its purpose surprisingly well; signals from the local station previously spread over the whole of the tuning scale on the medium band, but it is now possible to receive a number of other transmissions at each end of the scale. My trouble is that the tuning of the set seems to be "dead" at dial settings on each side of the adjustment corresponding to the local station. Is this normal? and, if not, will you give me an idea as to how matters may be improved?* C. S. J.

From your description, we think that the wavetrap is functioning in a fairly normal manner; if its coil is tightly coupled to the input tuning coil, the absorption device will tend to "pull" this circuit into tune with it, and a band of wavelength of a width depending on the degree of coupling will be unreceivable. You should experiment with this coupling; it may be possible to eliminate the local signals sufficiently if the spacing between the coils is considerably increased, and at the same time the width of the "lost" waveband will be narrowed.

I.F. Amplifiers.

Is it not possible to take advantage of screen-grid valves for use in the intermediate frequency amplifier of a superheterodyne? D. L. C.

There is no fundamental reason why these valves should not replace the ordinary triode for this purpose; indeed, they have been so used with complete satisfaction. It should be realised, however, that the couplings between the valves should be specially designed.

oooo

Terminal Voltage.

(Referring to a previous letter.) . . . You say that the voltages marked on the terminals of my eliminator may be different from those actually delivered under working conditions. Is this deviation likely to be very large? For instance, between what limits is the 60-volt tapping likely to vary? N. M. N.

We expect that the 60-volt terminal of your eliminator is intended to give its rated voltage under a load of about two or three milliamps; it is quite impossible to say to what extent this will change under varying loads without full knowledge of the technical details of the instrument, but it is quite reasonable to assume that it will vary between perhaps 40 and 150 volts; the latter figure might apply if it were connected to an anode bend detector consuming a comparatively small current.

oooo

Safe L.F. Switching.

I am aware that the introduction of switching into an L.F. amplifier is generally deprecated nowadays, but occasions often arise when I should like to eliminate the first L.F. amplifier of my set, feeding the output valve direct from the detector. My receiver comprises an H.F. stage and anode bend detector, followed by resistance- and transformer-coupled L.F. valves (in that order). If there is any safe way of making the desired modifications, will you please give me particulars of it? W. H. D.

By adopting the simple plug-and-socket arrangement shown in Fig. 2, it is possible to make provision for cutting out the intermediate L.F. valve without any risk of causing L.F. instability. As you will see from the diagram, pairs of sockets marked AB, CD, are inserted in the grid circuits of each of the L.F. amplifiers; to use all the four valves, bridging connections are made between AB and CD; while to cut out the first L.F. valve these links are removed and connection is made between sockets A and D.

It will hardly be necessary to add that provision should be made (if it is not already included) for breaking the filament circuit of the valve not in use.

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For Headphone Work.

I am thinking of making up a set, as inexpensively as possible, for long-distance reception on phones, and have decided upon a single-valve reacting detector circuit. On account of the fact that I live about eighteen miles from Daventry, it is essential that selectivity should be well above the average; this I know from experience, having tried most of the conventional circuits. Can you refer me to the published description of a suitable receiver? V. P. B.

We cannot call to mind any description of a really suitable arrangement in exact accordance with your requirements, and think that our best course is to refer you to the article describing the "Two-Circuit Two" in our issue of February 6th. This is a two-valve set, but it is quite possible to omit the L.F. magnifying valve, inserting the phones in the position at present occupied by the primary of the L.F. transformer.

oooo

Why Anode Current Rises.

By accident, I recently reversed the connections of the L.T. battery to my receiver. The fact that something was not normal was brought to my notice by an increased reading of the milliammeter, which is permanently connected in the anode circuit of the last valve: the current consumption was actually increased by over three milliamps. I cannot see how the anode circuits can be affected by this reversal; will you explain? B. P. S.

There is a very simple explanation for this effect. With normal connections, the grid of the output valve is biased to a certain negative value with respect to the negative end of the filament by means of a bias battery, of which the positive side is connected to L.T. negative. On reversing the battery, the positive G.B. connection is changed over to L.T.+, and negative grid voltage is reduced by the voltage of the low-tension battery. As you are no doubt aware, a reduction in grid negative causes an increase in anode current.

oooo

Flat Tuning Wanted.

With the object of obtaining flat tuning, and consequently easy operation for the inexperienced members of my household, I have adopted a directly-coupled aerial circuit; but in spite of this, and also in spite of the fact that my aerial is large, it is found that tuning is quite sharp, and worse still, that hand-capacity effects are troublesome. In addition, signal strength seems to be much less than it should be. The set consists of a detector with reaction followed by two L.F. stages, and all its connections and components have been tested by the "point-to-point" method. Is this information sufficient to enable you to diagnose my trouble? S. H. M.

We think it very likely that a careful examination will reveal the fact that your set is not "earthed." Possibly there is a break in the earth lead; or alternatively, it may not be properly connected to the buried plate or waterpipe (whichever is used). Equally, there may be a disconnection on the earth terminal of the set itself.

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An L.F. Short Circuit.

It has been pointed out that the tuned anode method of coupling a screen-grid H.F. valve suffers from the disadvantage that the necessary inter-valve condenser allows voltages set up across common resistances in the H.T. supply to be passed back to the detector grid; also that ripples due to imperfect smoothing in an eliminator may similarly be impressed across this grid circuit and consequently magnified in intensity by the whole L.F. amplifier. Is it not a fact that the same drawback exists in the case of a parallel-feed circuit such as that forming part of the A.C. frame aerial set described in your issue of May 1st? P. S. H.

Although low-frequency energy may be passed back to the detector-grid circuit in this particular arrangement, it is a mistake to assume that it is comparable in this respect to the tuned anode coupling. A consideration of the circuit diagram in question will show you that the detector grid-cathode path is bridged by an inductance coil of low resistance which offers a negligible impedance to low-frequency or pulsating currents. Consequently, no appreciable unwanted voltages can be set up across these points, and the circuit is virtually as "safe" in this respect as when an H.F. transformer is used.

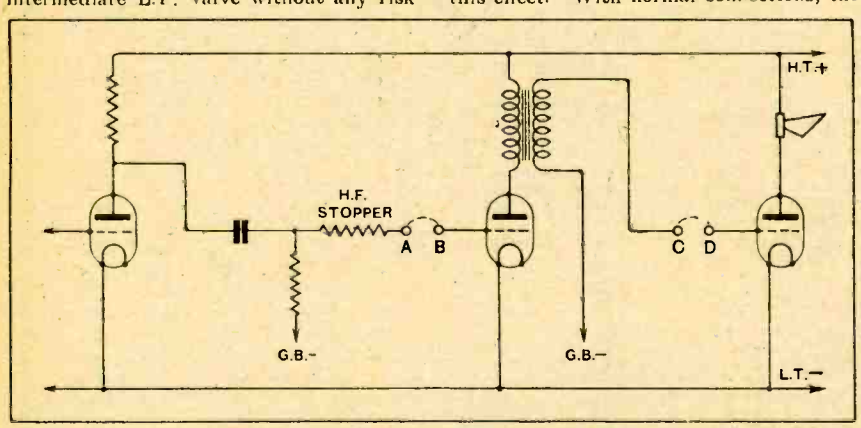

Fig. 2.—A safe method of providing for optional elimination of an intermediate L.F. stage.

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(17th Year of Publication)

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OLD LAMPS FOR NEW.

IT is not the first time that we have had occasion to draw attention editorially to the opportunity which exists for retailers of wireless valves to use valves for demonstration purposes and subsequently to sell them to a customer as new, and attention was drawn to this matter again in a letter published in our correspondence columns recently. We did not at the time attach much importance to the matter because we felt that the practice was not likely to be at all prevalent, but we must confess that we have been forced to change our opinions as the result of a letter received from a reader which we published in our issue of May 15th.

In this letter the reader expressed the view that a valve did not suffer by judicious use over a short period and that no harm was done to the purchaser if the retailer or his friends did happen to make prior use temporarily of the valves which he subsequently sold as new.

In this issue, in replying to this view, another correspondent, quite rightly, we think, expresses amazement that any attempt should be made to justify such a practice. The valve is, even to-day, an exceedingly delicate piece of apparatus, and a little mishandling will very substantially impair its life; moreover, the vast majority of those who purchase valves are not in a position, or have not the necessary technical knowledge, to be able to test the valve and be satisfied that its performance is up to standard. The manufacturer, we believe, goes to some pains to see that valves when they leave the works are up to the proper average standard of performance, and in view of the disclosures which have been made through our correspondence columns, we consider that it is now up to the manufacturers to see that some steps are taken to insure that their valves cannot be used or loaned by unscrupulous retailers and then replaced in their boxes for sale to a customer. It is the business of the manufacturer to protect the customer from the effects of such a practice.

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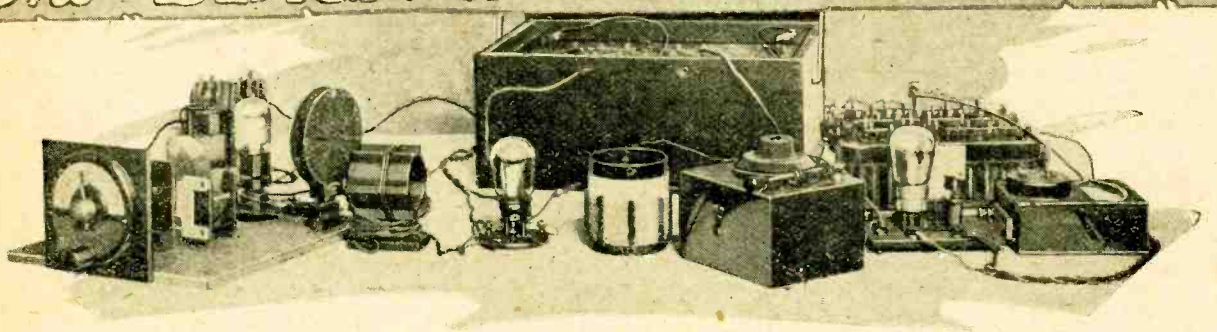
SIGNS OF ACTIVITY.

FROM information which we have just received it would appear that our efforts, supported by the co-operation of our readers, have not proved entirely ineffective in rousing the B.B.C. to the realisation that the standard of performance and service of the short-wave Empire station 5SW cannot be tolerated much longer on its present basis.

Empire Day appears to have reminded the B.B.C., as we suggested in our last issue, that it would be a fitting occasion on which to show some sign of a renewal of interest in the short-wave station, for we understand that a meeting has been held at the headquarters of the B.B.C. to decide what action shall be taken in regard to the broadcasting of election results and other news items through 5SW to those parts of the Empire which are at present in a position to receive the transmissions.

It is gratifying to feel that at long last some stir is being made in the matter, but there is room for considerable activity yet, for not only do we require that news shall be broadcast and the transmissions generally improved, but these transmissions must be made over a sufficient period of the twenty-four hours to ensure reception in the various parts of the Empire, and attention must be paid to the general efficiency of the transmitter, even (if necessary) obtaining the requisite permission to make changes in the wavelength, so that the wavelengths most suitable for transmission at different times of the day are utilised to ensure regular reception. We draw attention to further letters in the Correspondence columns of this issue, which bear on the subject of Empire broadcasting.

The DESIGN of H.F. TRANSFORMERS



The Essential Theory Concerning the Interdependence of Valve and Transformer.

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

FROM time to time designs for receivers embodying high-frequency amplification are published in the pages of this journal, and in those designs in which an ordinary three-electrode valve is used as the high-frequency amplifier a high-frequency transformer is normally used as the coupling between that valve and the detector. The use of a transformer for this purpose, instead of the "tuned anode" arrangement that was once almost universal, has had a twofold origin; first, because it is not possible to attain stability in any simple way while using the tuned anode circuit, and, secondly, because that type of circuit, even if stability could be achieved satisfactorily, will not give the maximum amplification of which the valve is capable.

How to arrive at the design details of H.F. transformer windings most suited to valve conditions is the subject of this article. The requirements for maximum H.F. amplification are clearly explained while the results predicted by theory are borne out by practical measurements. Many determinations of H.F. stage gain have been made in the course of compiling this article so that one can now readily arrive at constructional data which in practice will give the best results.

In the published designs already mentioned it is usual for the designer to specify with some exactness the valve that is to be used as high-frequency amplifier; this is necessary because the transformer that follows it has to be designed to suit the valve with which it is to be used if the fullest degree of amplification is to be extracted from the stage in question. There is, however, no reason why the valve specified should not be replaced by any other that the constructor of the set may prefer, provided that the necessary readjustments to the transformer are made. The present article, in which the dependence of valve and transformer upon one another will be discussed fairly fully, will, it is hoped, be of interest to those who wish to perform this feat of redesigning, and it will, in addition, be found that certain factors commonly overlooked altogether have quite a big bearing on the performance of a receiver.

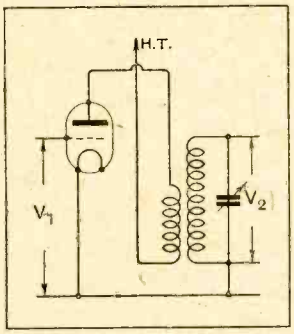


Fig. 1.—Skeleton diagram of H.F. stage using a transformer. The input voltage is V_1, the output voltage (to next valve) is V_2. The ratio V_2/V_1 is the amplification afforded by the stage.

The circuit with which we shall concern ourselves is simple enough; it is given in Fig. 1, while Fig. 2 shows the practical equivalent of it. It will be seen that the high-frequency amplifying valve has a signal voltage V_1 applied to its grid; Fig. 2 suggests that this voltage is derived from an aerial, and is fed to the grid by a tuned circuit. With the details of this we shall, however, not concern ourselves, since we are primarily interested in the plate circuit of the valve. Nor shall we consider the means adopted to secure stability, except to remember that it must be done by neutralisation in some form; we will take all that for granted, simply assuming that any feed-back across the valve has been nullified in some way, and that the stage is supplied from some unspecified source with an input voltage V_1.

In the plate circuit of the valve there is the primary of the transformer, closely coupled to the secondary. Across this, in turn, is connected the detector valve, with valve-holder and any other such components that the practical needs of the circuit may involve. It is our problem to decide how to obtain in any given case the maximum signal voltage across the tuning condenser C, so that any set we may design, or the design of which we require to alter, may be as efficient as we can make it.[1]

The problem can be approached from several different

[1] For a mathematical discussion of the problem, see N. W. McLachlan, "Radio-frequency Transformers," *Experimental Wireless*, October, 1927, p. 597 to 600.

The Design of H.F. Transformers.—

angles, but it is proposed here to assume that a decision has already been reached in the choice of amplifying valve and of the coil to be used as the transformer secondary. It therefore remains to choose the number of turns on the primary in such a way as to make the most of the valve and coil already selected. To do this intelligently, it will clearly be necessary to have available all the necessary data concerning both these components.

So far as the valve is concerned we require no more for design purposes than a knowledge of the A.C. resistance (" impedance ") that it will assume when actually working in the receiver. This is easily obtained from the ordinary valve curves by reading off the usual figures from those parts of the curves that correspond to the grid and plate voltages it is proposed to apply to the valve in use. A knowledge of the amplification factor of the valve, though not essential for our purpose, will nevertheless add a great deal of interest to our work, for it will enable us to arrive at an estimate for the overall amplification of the stage. Since this figure does not vary much as between one set of operating conditions and another, the figure given by the makers may be taken.

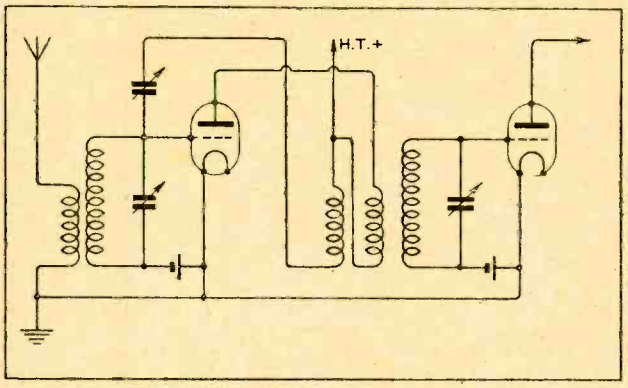


Fig. 2.—Practical receiver corresponding to Fig. 1.

Relation Between Dynamic and High-frequency Resistance.

For the tuned circuit—the secondary of our proposed transformer—we need some rather less easily acquired information. It is necessary to know the high-frequency resistance of the circuit, including any losses or damping due to the valve in the grid circuit of which it is connected.[2] It is not, of course, practicable to make individual measurements of every tuned circuit, so that the figures obtained by measurement of a Litz-wound coil of 68 turns on a 3in. paxolin former (a standard " Everyman Four " coil) are given in Table I. It should be noted that losses due to the tuning condenser, the various connecting wires, and the presence of a high-resistance valve used as anode rectifier, as well as the resistance of the coil itself, are all included; the sum-total of all these was measured as " equivalent series resistance," and is given for different wavelengths in the column headed " r."

Although one has to measure the equivalent series resistance r, the results obtained have to be expressed

TABLE I.

Wavelength Metres.	Equiv. Series Resistance r. Ohms.	Dynamic Resistance R. Ohms.
200	24.30	245,000
225	17.80	264,000
250	14.10	269,000
300	9.4	280,000
400	5.73	259,000
550	3.55	221,000

The figures of the third column are plotted in Figure 3.

in a different form before they can be used as a basis for receiver design. We require for this purpose the " dynamic resistance," symbolised by R, which is found from r by the relation $R = \frac{L}{Cr}$, where L is the inductance of the coil and C the capacity tuning it to the wavelength for which the value of R is wanted.[3] The actual dynamic resistances resulting from this calculation are given in the column headed R in the table. The values for R, which we shall use throughout, are given for convenience in the curves of Fig. 3, from which it will be seen that the dynamic resistance is approximately constant over the whole waveband considered. This simplifies very considerably the problem in receiver design which we are considering.

Tuned Transformer versus Tuned Anode.

If the connections of the high-frequency stage are those of a simple " tuned anode " circuit, as shown in Fig. 4, the tuned circuit would be exactly equivalent, for the wavelength to which it is tuned, to a pure resistance of some 200,000 ohms. The amplification afforded by such a stage can be calculated by the usual formula employed for resistance-coupled amplifiers, namely: Amplification $= \frac{\mu R}{R + R_a}$, where μ and R_a are respectively the amplification factor and the A.C. resistance of the

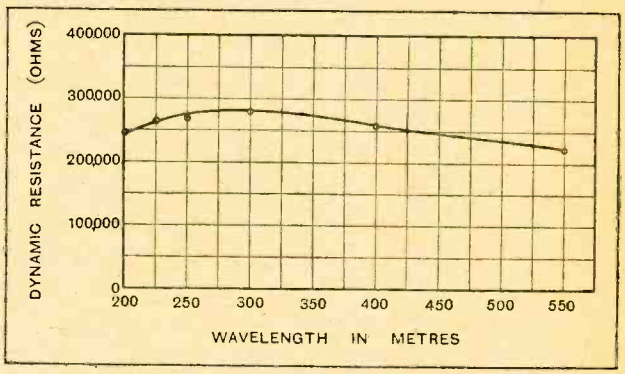


Fig. 3.—It will be seen from this curve that the dynamic resistance is approximately constant for the 200–550-metre waveband.

[2] See " High Frequency Resistance," *The Wireless World*, December 19th and 26th, 1928.

[3] For a fuller discussion of the relation between r and R, see " Dynamic Resistance," *The Wireless World*, March 13th, 1929.

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valve used. It will be seen that whatever may be the dynamic resistance of the tuned circuit, the amplification attained cannot rise to a figure higher than "μ," since the fraction $\frac{R}{R+R_0}$ is always less than one.

Let us suppose now that the circuit of Fig. 4 is changed to that of Fig. 5, the sole alteration being that the connection from the anode of the valve is now joined to a tapping on the coil instead of to one end. This

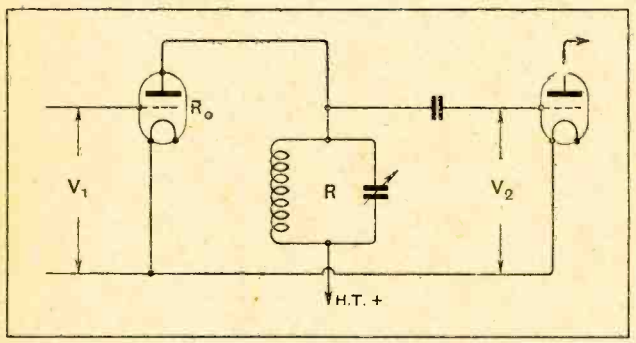

Fig. 4.—In this tuned anode circuit the overall amplification $V_2/V_1 = \frac{\mu R}{R+R_0}$

change brings about two alterations in the conditions of the circuit. Instead of having a dynamic resistance of some 200,000 ohms in the plate circuit of the valve, we have only *part* of this resistance connected between anode and "H.T.+." The dynamic resistance between the mid-point of a tuned coil and one end is not, as might perhaps be expected, one-half of the dynamic resistance of the whole circuit, but one-quarter only, so that if the position of the tapping in Fig. 5 is half-way up the coil, the equivalent resistance in the plate circuit of the valve is reduced to $\frac{1}{4}R$, and this value must be substituted for R in the formula for the stage amplification.

Transformer Ratio Depends on Valve Impedance.

But the figure obtained by doing this refers to the voltage developed across that portion of the coil which is included in the plate circuit of the valve; we are interested in this only indirectly, and really require the voltage applied to the grid of the next valve. Owing to the fact that there is now a two-to-one step-up of voltage in the circuit, half the coil acting as primary of an auto-transformer, and the whole coil acting as secondary, we have to *double* the result of our calculation to find the amplification of the combination of valve *plus* transformer.

The amplification of the stage has thus been altered by moving the connection of the anode of the valve from its original value of $\mu \frac{R}{R+R_0}$ to $2\mu \frac{\frac{1}{4}R}{\frac{1}{4}R+R_0}$. Clearly, $\frac{\frac{1}{4}R}{\frac{1}{4}R+R_0}$ is smaller than $\frac{R}{R+R_0}$; will or will not the multiplication of 2 make up for this? In other words, have we gained amplification or lost it by tapping the coil at the mid-point? Normally, with any ordinary three-electrode valve and a tuned circuit of fairly high R, there is a gain; with a 200,000-ohm tuned circuit and an HL610 valve, the amplification rises from 26 times to 37½ times. But if, with the same valve and the same tuned circuit, we make the tappings at two turns from the H.T.+ end of the coil, the amplification falls to only about two times! It is clear, therefore, that somewhere between one end of the coil and the other there is a point at which the amplification rises to its highest value, falling away below this on either side. How are we to determine the position of the optimum tap? Or, if we are going to make the primary of the transformer a separate winding in place of using part of the secondary for the purpose, how many turns should this primary comprise?

How to Calculate H.F. Stage Gain.

We have seen that if the transformer-ratio is 1 : 2 (or if the coil is centre-tapped, which comes to the same thing) the dynamic resistance of the primary is one-quarter of that of the secondary, and that we have a 2 : 1 voltage step-up ratio between them. Generalising this, if the step-up ratio is 1 : n, the dynamic resistance of the primary is $1/n^2$ of that of the secondary; that is, if the step-up ratio is 3, the primary has a dynamic resistance of one-ninth that of the secondary; if 4, one-sixteenth, and so on. Thus the dynamic resistance of the primary decreases much more rapidly than the step-up ratio, so that if, in an endeavour to get this high, the primary is wound of very few turns, the voltage developed across it will be vanishingly small on account of its minute dynamic resistance, and though our step-up ratio will be there, there will be, so to speak, almost nothing to step.

We see, therefore, that the variation of the number of turns in the primary of a high-frequency transformer has, as its main result, a variation in the dynamic resistance of that primary; the step-up ratio *per se* is really only of interest to us in so far as it affects this dynamic

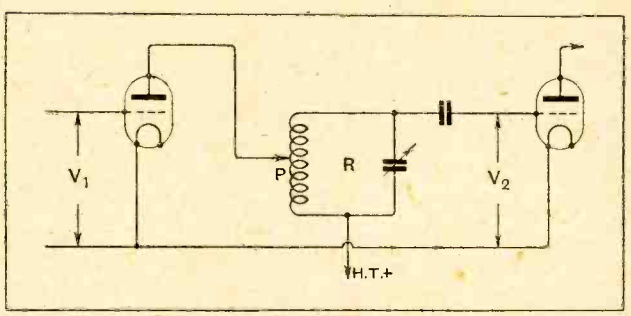

Fig. 5.—Here the amplification attained is variable within wide limits by changing the tapping point P. There is an optimum position for P.

resistance. If we can find the correct primary dynamic resistance to use, the conversion of the figure so obtained into terms of transformer ratio in the light of the points already discussed will not be very difficult.

Let us return to our fundamental need for maximum signal voltage across the secondary. Since the size of the condenser will be fixed by the requirements of tuning we cannot control the voltage by manipulating this, but must turn our attention to developing the greatest

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possible high-frequency voltage across it by other means. As the voltage across any fixed impedance, whether a condenser or a resistance, is proportional to the current flowing through it we shall achieve our purpose by getting as large a circulating current as possible in the secondary of the transformer. Since this secondary has resistance, power will be lost in it, and the greater the current is made the greater will be the amount of power so lost. Our condition that we require maximum current in the secondary thus boils down to requiring maximum *power* in that circuit.

The power developed in the secondary is entirely derived from the primary, which in turn gets it from the valve in the plate circuit of which it is connected; we shall therefore obtain maximum amplification if we so dimension the primary that it takes the greatest possible amount of power from the plate circuit of the high-frequency valve.

The condition for this, as is proved in all elementary text-books on electricity, is that primary and valve should offer the same impedance to high-frequency currents, in which case half the high-frequency power developed by the valve will be wasted in its own internal resistance, while the other half will be transferred to the primary, there being used to set up as large a current as possible in the secondary.

Now we have seen that for the case of a close-coupled transformer that if R is the dynamic resistance of the secondary and n is the step-up ratio, the dynamic resistance of the primary R_p is given by $R_p = \frac{R}{n^2}$. But this, we have just concluded, must be made equal to R_0, the A.C. resistance of the valve. We may therefore write $R_0 = \frac{R}{n^2}$, or $n^2 = \frac{R}{R_0}$, from which $n = \sqrt{\frac{R}{R_0}}$.

Here, then, we have a very simple formula for deciding the correct step-up ratio for a transformer to be used with any given valve. We have to divide the dynamic resistance of the secondary coil by the A.C. resistance of the valve, and find the square root of the result. Dividing the answer into the number of turns on the secondary will give the correct number of turns for the primary.

The Screen-grid Valve and the H.F. Transformer.

As an example of the application of this formula, we will work out the optimum step-up ratio for the case already mentioned of an HL610 valve ($\mu = 30$, $R_0 = 30{,}000$ ohms) in conjunction with a tuned circuit (secondary) for which R = 200,000 ohms. Here $\frac{R}{R_0} = \frac{200{,}000}{30{,}000} = 6.67$. The square root of this is 2.58, which is the step-up ratio we require. If the secondary has 68 turns, the primary should therefore have $\frac{68}{2.58} = 26$ turns.

It will by now be evident that, as the internal resistance of the valve is the only factor determining the step-up ratio that will be required, there is no reason why the conclusions and the formula that have been found for the ordinary triode should not be used to find the correct ratio to employ when a screen-grid valve is chosen as the high-frequency amplifier. The presence of the fourth electrode, apart from its influence on the A.C. resistance and amplification factor of the valve, will not necessitate any departure from the simple calculation given.

For the case of the Ediswan SG610 valve, for example, for which μ and R_0 are given by the makers as 140 and 100,000 ohms respectively, used with the same 200,000-ohm tuned circuit, we have $\frac{R}{R_0} = \frac{200{,}000}{100{,}000} = 2$. The square root of this is 1.41, the step-up ratio, so that the primary should have $\frac{68}{1.41} = 48$ turns. With the valve and circuit figures given, such a transformer will increase the amplification by about 16 per cent., as compared with tuned anode.

Most other screen-grid valves have a resistance round about 200,000 ohms, so that $\frac{R}{R_0} = 1$, leading to a primary having the same number of turns as the secondary. A 1:1 transformer is thus the best to use with these valves and an average tuned circuit, though if there is no intention of introducing the danger of inter-stage coupling that generally accompanies H.T. from the mains, the simpler tuned anode circuit, where the one coil does duty simultaneously for both primary and secondary, may equally well be substituted. Parallel feed, as used in the "Flat-dweller's A.C. Three," recently described, is another convenient alternative.

Consideration of a Special Case.

The Ediswan valve, as has been mentioned, is an exception, since it requires a small step-up ratio for optimum amplification. In the Cosmos AC/S we have another valve of unusual type, in that its A.C. resistance is given as 800,000 ohms. Applying the formula to this case, we find $\frac{R}{R_0} = \frac{200{,}000}{800{,}000} = \frac{1}{4}$. The step-up ratio should thus be $\frac{1}{2}$, which is the same as a *step-down* ratio of 2:1, i.e., the primary should have twice as many turns as the secondary.

A transformer of this kind would be quite unpractical, for the high inductance of such a primary would make it impossible to tune down to the lower part of the waveband for which the secondary was designed. Bearing in mind that the A.C. resistance of a screen-grid valve can be varied within very wide limits by manipulation of the operating voltages, and that 200,000 ohms is by no means the highest attainable value for the dynamic resistance of a tuned circuit, one would meet such a case as this by lowering the former and raising the latter until the ratio $\frac{R}{R_0}$ was approximately equal to one, and would then use a 1:1 transformer or its equivalent.

The amplification to be expected from a stage in which the transformer is correctly proportioned is extremely simply calculated. Since the dynamic resistance of the primary is equal to the internal resistance of the valve.

The Design of H.F. Transformers.—

one-half of the voltage generated within the valve in response to the signals on its grid will be dropped across the valve itself, and one-half across the primary. For one volt of signals on the grid, μ volts altogether are developed in the valve; so that $\frac{1}{2}\mu$ volts are developed across the primary. There is a step-up of 1 : n in the transformer, so that the voltage on the secondary will be n times that on the primary, giving an amplification for the stage of $\frac{1}{2}\mu \times n$. For the case of the HL610 valve, for which the correct ratio was found to be 2.58, the amplification to be expected will therefore be $\frac{1}{2} \times 30 \times 2.58 = 38.7$ times.

If we combine the formula $n = \sqrt{\frac{R}{R_0}}$ with that for the amplification of the stage $A = \frac{1}{2}\mu n$, we get the most useful and informative formula that can be found anywhere in the range of H.F. amplifier design. It is $A = \frac{1}{2}\mu\sqrt{\frac{R}{R_0}}$. From this several interesting points may be deduced, especially in connection with the choice of a valve.

If we consider R to be fixed, and examine the effect on the amplification of the valve alone, we see that its contribution is the term $\frac{\mu}{\sqrt{R_0}}$. There is no definite term in England for this expression; inventing one, we will call it the "amplification number" of the valve. It should be noted that this is *not* the same as the mutual conductance or slope with which valve-makers make such play in their advertisements. The difference may most readily be seen from Table II, which gives figures for several different valves.

TABLE II.

Valve.	Amp. Factor.	R_0.	Slope.	"Amp. Number."
1. HL610	30	30,000	1.0	0.173
2. DEL610 ..	15	7,500	2.0	0.173
3. P625A	3.7	1,600	2.3	0.0925
4. AC/G	35	14,000	2.5	0.296
5. PM14	200	230,000	0.87	0.417
6. AC/S.	4,200.	800,000.	1·5.	1·393.

The difference between slope and "amplification number" is shown particularly well by Nos. 1 and 2; the mutual conductance of 2 is exactly double that of 1, but the two valves are of exactly equal value as high-frequency amplifiers. Valve 3 has a very high slope, but is extremely ineffective from our present point of view; of course, it was designed as an output valve. To show that where a high slope and a high amplification factor exist together in a three-electrode valve, the amplification number is phenomenally high, valve 4 has been included. The fifth example is a screen-grid valve.

It must not be forgotten that in making these comparisons it is taken for granted that the transformer ratio will be correctly adapted for each valve; if a practical comparison were made by simply interchanging these valves in a set, then whichever valve of the series happened to suit the transformer in the set would appear to be the "best high-frequency amplifier." The utter futility of such a mode of comparison has only to be pointed out to be appreciated.

Reverting to the general formula once more, the remaining term to be considered is R, the dynamic resistance of the secondary. This, while of importance, is not a factor of which much need be said here, other than to draw attention to the obvious by pointing out that the greater it can be made, by the elimination of losses, the greater will be the amplification attained. Since a limit to progress in this direction is set by the increase in high-note loss due to enhanced selectivity and to reverse reaction effects produced by unsuitable detector valves, it is clearly to the valve makers that we must turn for any considerable advance in the possible amplification per stage in high-frequency amplifiers of the type here discussed.

(*To be concluded in the issue of June 12th.*)

CLUB NEWS.

Summer Plans.

To the more active wireless societies the present season is not a time for putting up the shutters, but actually the reverse. The practice of holding field days has grown enormously in the last two or three years, so that not a few clubs spend quite as busy a time in summer as in winter.

Reception in the open air, hunts for concealed transmitters, tests for fading due to geological formations, and many other activities, which can only be treated theoretically in the club room, all provide opportunities for the preparation of an attractive summer programme.

The vogue of the portable set simplifies the task of secretaries and others upon whom the task falls of compiling the field day syllabus.

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Appeal to Peckham Enthusiasts.

An appeal for new members is issued by the Peckham Radio Society, the headquarters of which are at the Literary Evening Institute, Peckham Road, London, S.E.15. Lectures and demonstrations by representatives of the leading manufacturers are a feature of the Society's meetings. From time to time visits are paid to various places of wireless interest, such as the B.B.C. headquarters.

Hon. Secretary, Mr. A. E. Petett, 192, Hollydale Road, S.E.15.

Battery Construction on the Films.

Messrs. Siemens Bros.' film, now famous among radio societies, was exhibited before the Bec Radio Society, Balham, on May 7th. 4,500 feet of film were shown, covering many of the products of the company, the most interesting film dealing with the construction of the Siemens radio high tension batteries. The picture explained in a way which no lecturer could achieve, the extraordinary care and attention to detail throughout each separate stage of manufacture from the selection of the raw materials to the testing of the finished product. The manufacture of the zinc containers from pure zinc sheets of standard gauge, of the electrolyte, and of the carbons of the depolarising agent were clearly seen.

During short intervals between the films the London programme was reproduced on a moving coil loud speaker.

Hon. Secretary, Mr. A. L. Odell, 171, Tranmere Road, S.W.18.

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For Kentish Town Enthusiasts.

The Kentish Town and District Radio Society after a highly successful winter session, has commenced a new series of meetings at the Carlton Road Schools, Kentish Town, N.W., and all radio enthusiasts are heartily welcomed. Meetings are held every Friday at 8 p.m.

Hon. Secretary, Mr. A. H. Sartain, 40, Harrington Street, N.W.1.

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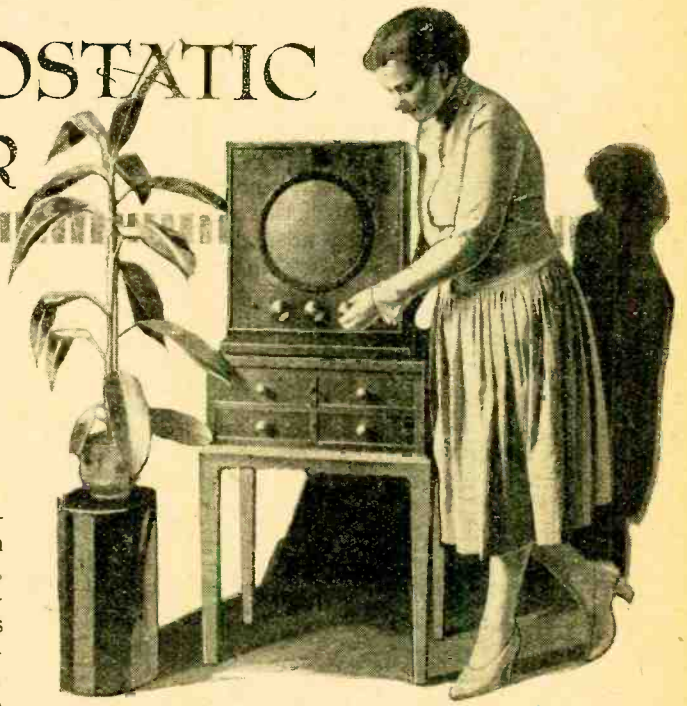
New Members Wanted.

The Wimbledon Radio Society issues a welcome to new members, and applications should be addressed to the Hon. Secretary, Mr. P. G. West, 11, Montana Road, Wimbledon, S.W.20. At a recent meeting Messrs. Siemens Brothers displayed their film illustrating the manufacture of dry batteries.

NEXT WEEK:

SPECIAL PORTABLE SET NUMBER.

VOGT ELECTROSTATIC LOUD SPEAKER



Technical Details of a New and Improved Type with Differential Movement.

(From a Berlin Correspondent.)

THE earliest type of Vogt loud speaker was described in *The Wireless World* in connection with the report of the 1927 Berlin Radio Exhibition, so that readers will be already acquainted with its principle. In its new form the Vogt loud speaker functions on the differential system, and the quality of reproduction and sound output have been considerably improved. Herr Vogt is one of the three inventors known as the "Triergon" who have recently come to the fore as a result of their work in connection with talking films. The differential Vogt loud speaker has been developed primarily for talking films, and the output obtainable is stated to be comparable in quality and volume to that of the moving coil loud speaker.

The new loud speaker is about 15in. in diameter and only 2in. in thickness. The weight is approximately 9½ lb., and the electrostatic capacity is of the order of 0.001 mfd. On account of its simplicity of construction it is readily fitted to a baffle, and only a small space is occupied behind the board.

The construction of the electrostatic loud speaker is as simple as its external appearance would suggest. It consists, as shown diagrammatically in Fig. 1 (*a*), of the two plates P_1 and P_2, both of which are perforated with large holes. Between them is stretched a very thin metal foil M, which serves as the diaphragm, and is separated from the plates by the two rings I_1 and I_2 of insulating material.

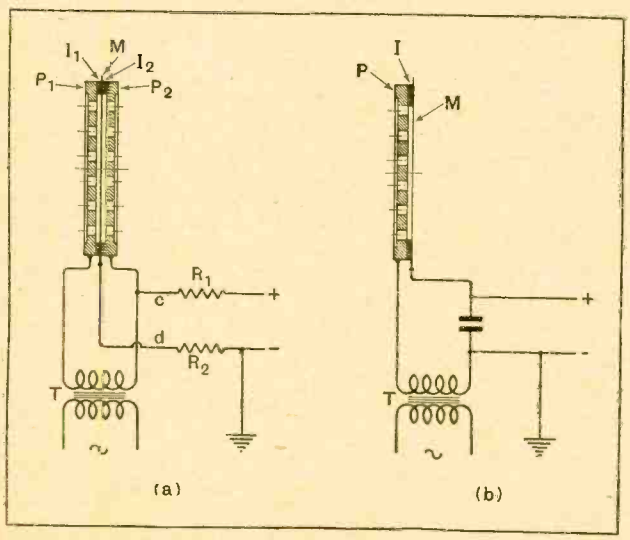


Fig. 1.—Diagrammatic cross-sections of the new differential and earlier single-acting Vogt electrostatic loud speakers.

Polarising Potential.

A supply of constant voltage is required for the electrostatic speaker. There is, however, no current consumption from the source of direct voltage, but the latter must provide from 500 to 700 volts. As the speaker will usually be used in connection with a receiver or amplifier fed from A.C. mains, this steady voltage can conveniently be drawn from the H.T. supply provided by the battery eliminator. The positive potential is usually applied to the two plates, reaching one of them, as Fig. 1 (*a*) shows, through the secondary winding of the transformer T, while the diaphragm is connected to the negative pole. The two high resistances R_1 and R_2 in the leads *c* and *d* carrying the voltage are placed there to prevent a heavy current flow such as might arise by accidental contact between the plates or breakdown by sparking. If the current taken persists more than a few moments one of these resistances is burnt out, thus isolating the instrument from the high potential source.

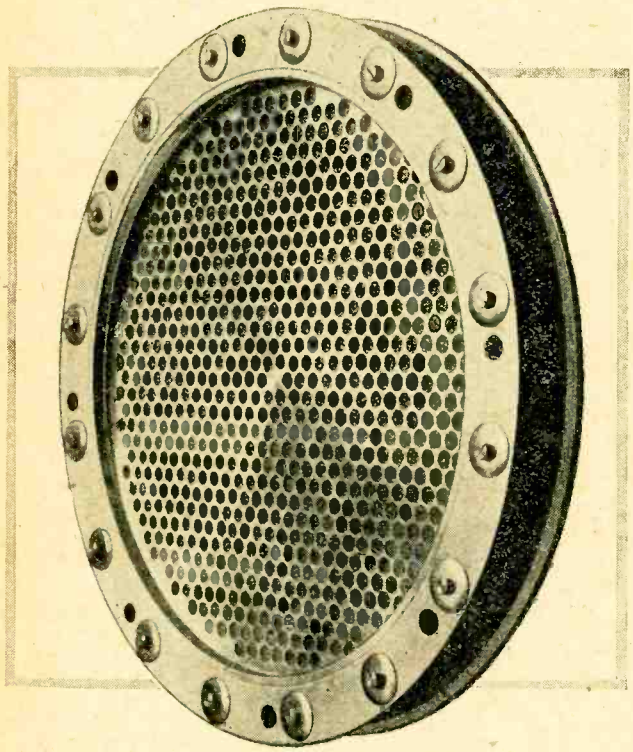
The positive potential on the two plates naturally exerts an attractive force on the negatively charged membrane. But these two attracting forces nullify each other, provided that the membrane is situated exactly centrally between the two plates. This conveys the principle of differential control, which is that the *difference* between the potentials on the two plates alone

Vogt Electrostatic Loud Speaker.—

affects the membrane. So far as the steady voltage is concerned this difference is zero, so that the membrane remains quite flat so long as no alternating currents are applied.

The alternating (signal) voltages from the output valve are transmitted to the loud speaker through the transformer T. As the load provided by the loud speaker is that of a condenser, and so is very high compared with the internal resistance of the last valve (0.001 mfd. = 330,000 ohms at a frequency of 500 cycles per sec.), it is necessary that the number of turns on the secondary of the transformer should be many times greater than on the primary. The transformer thus steps up the signal voltage.

The alternating voltages delivered by the transformer are superimposed in opposite phase upon the direct voltage of the two plates. Fig. 2 makes this clear; Fig. 2 (*a*) represents the conditions at the plate P_1, and Fig. 2 (*b*) those at plate P_2. The dotted curves represent the signal voltages at the ends of the transformer secondary, and therefore at the plates themselves. The dotted straight lines correspond to the direct voltages on the plates, and, by combining this with each of the



The movement of the new differential Vogt loud speaker is simple in design and can be easily mounted in a baffle.

two signal voltages, we obtain the total voltages indicated by the full lines.

The *difference* between the voltages on the two plates is therefore alone effective in causing movement of the membrane, and this difference is shown in the curve of Fig. 3. First one plate and then the other has momentarily the higher voltage, so that the membrane must alternately approach one plate or the other, moving in sympathy with these voltages. It is clear that in this way the diaphragm will make equal excursions outwards in both directions from its central position of rest, provided that it was originally exactly midway between

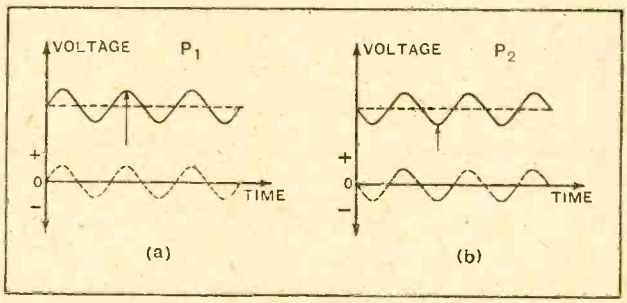


Fig. 2.—Curves representing the voltage conditions at the two outer plates of the Vogt differential loud speaker.

the two plates. This condition is naturally very carefully fulfilled in the construction of the electrostatic loud speaker, as otherwise the "bias" of the membrane, which has been so carefully eliminated by the differential principle, will once more make its appearance.

The Differential Principle.

In Hans Vogt's earlier electrostatic loud speaker, and also in that of Eugen Reisz, the well-known inventor of the famous Reisz microphone, there was only one plate, situated, as seen in Fig. 1 (*b*), on one side of the membrane. The voltage on this single plate, acting on the membrane from one side, pulled it into a concave form, so giving it a mechanical bias.

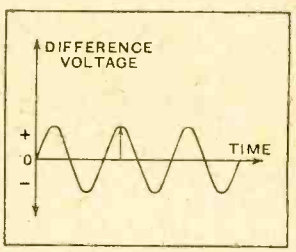
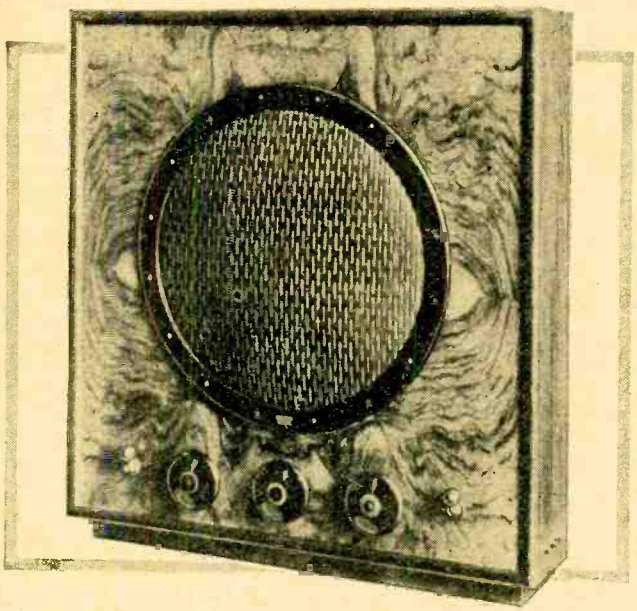


Fig. 3.—Resultant force on the diaphragm due to the alternating voltage applied to the two plates of the differential loud speaker.

For the complete avoidance of movements of the membrane corresponding to higher harmonics, which would result in spurious overtones, the absence of a bias on the membrane is not, strictly speaking, alone sufficient, although very great importance must be attached to the fulfilment of this condition. A diaphragm free from bias will certainly make equal excursions in both directions, but it does not necessarily follow that these movements will have the right form. It is also required that the movements of the diaphragm shall be exactly proportional to the alternating voltages applied to the speaker, so that the movement shall be a faithful reproduction of the wave-form of the voltages. This second condition is not fulfilled by the differential loud speaker as such, for the forces operating on the membrane are not solely dependent upon the difference between the voltages on the plates, but depend also upon the difference of the two spaces between membrane and plates. The attractive force exerted upon the membrane by one of the

Vogt Electrostatic Loud Speaker.—

plates increases with increase of the voltage on the plate, and also increases as the membrane approaches the one plate and recedes from the other. For small oscillations, during which the membrane moves but a little to either side of the central position, the difference of the separation between the membrane and the two plates remains within very narrow limits, and so may be ignored. For larger movements, however, this difference becomes appreciable, rising to the same order of magnitude as the distance between the two plates. Under these conditions the plate which has the higher voltage and is at the smallest distance from the membrane attracts the latter considerably more strongly than it really should. Thus if the alternating voltage applied to the loud speaker is a pure sine-wave, the diaphragm will depart



Completely enclosed and shock-proof unit comprising loud speaker, receiver, amplifier and battery eliminator.

in its movement from the pure sine-wave. This distortion of the shape of the oscillation implies the introduction of higher harmonics.

Distortion Correcting.

As a set-off to this fault we must not forget the elastic force set up in a membrane stretched tight and held by the edges. This force tends to hold the membrane back as soon as it tries to approach one of the plates. Like the electrical attraction, this force increases as the membrane bulges out and approaches the plate, but it acts in opposition to the electric force. By suitable choice of the material for the membrane, and of its thickness, it is therefore possible to arrange that the increase of the attractive force as the diaphragm approaches one of the plates is approximately counterbalanced by the corresponding increase in the elastic pull. It would appear that in the construction already detailed of the new Hans Vogt speaker this condition is very nearly fulfilled, for even at great signal strength, equal to that which can be obtained from a moving coil speaker, no trace of the production of overtones can be detected.

In order to see quite clearly the difference in the mode of operation between the older types of electrostatic loud speaker and the latest differentially operated pattern, Figs. 4 (*a*) and 4 (*b*) should be compared. In the earlier type (Fig. 4 (*b*)), which has only one plate, the membrane, even in the absence of alternating voltages, is bowed by the polarising voltage. On the application of a sine-wave voltage the amplitude of movement of the membrane is not the same in the two directions, so that harmonics are introduced to a very appreciable extent. On account of the rapid increase in the elastic force the movements of the diaphragm towards the plate, which involve an increase in the bending, are definitely smaller than the movements away from the plate, during which the bending is decreased. This effect is only very inadequately compensated by the increase in the electrical attraction brought about by the approach of the membrane to the plate. In the differential loud speaker the membrane makes equal excursions in both directions. Distortion of the wave-form can here only enter to a much smaller extent, through a too rapid increase of the attractive force as the membrane approaches the plates. This, however, can be compensated through suitable choice of the size of the membrane and correct adjustment of its elasticity, as has apparently been done with complete success in Hans Vogt's latest model.

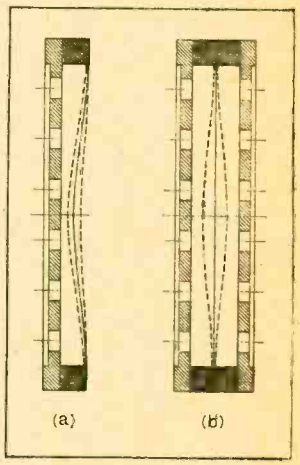


Fig. 4.—Comparison of the diaphragm movement in the earlier and new type Vogt loud speakers.

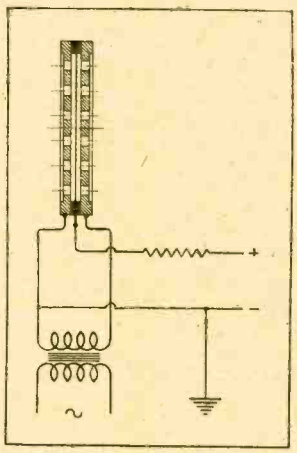


Fig. 5.—Circuit in which the outer plates are kept at low D.C. potential.

From the point of view of efficiency the electrostatic loud speaker must be regarded as good. Copper and eddy-current losses do not arise. Only dielectric losses need to be taken into consideration, and even these must be negligibly small, for the dielectric is nearly all air. Losses through imperfect elasticity of the membrane will not be greater than with any other type of diaphragm. On the other hand, it must not be forgotten that the high ratio of the transformer which is necessary with an electrostatic loud speaker will introduce losses that will at least be appreciable.

Vogt Electrostatic Loud Speaker.—

On account of the high voltages, both direct and alternating, that are applied to the loud speaker, touching the plates must be regarded as dangerous; even the leads to it are not safe. For this reason Vogt builds the loud speaker, receiver, amplifier and battery eliminator all into one case.

The danger of receiving serious shocks from the plates of the loud speaker can be very considerably minimised by the writer's scheme of connections, shown in Fig. 5. In this circuit arrangement one plate, which would be the outer one in the case of a speaker built into a case, is at earth potential, while the other plate only carries the signal voltage, which would usually be considerably smaller than the direct voltage, which is here applied to the membrane.

THE INVENTOR AND THE MANUFACTURER.

The Development and Disposal of an Invention.

THE average impression that persists with regard to inventors in general is that they are people who light on brainy ideas whilst shaving in the bathroom, and who forthwith are able to retire on the proceeds. One seldom finds general impressions agreeing with the true state of affairs, and this particular one is as misleading as most. The lot of the free-lance inventor—as distinct from the inventor attached to a large organisation—is not a happy one. His resources are very limited, he has no capital to develop his invention, and invariably he is without facilities for collaboration or directing advice which in most cases are essential for the complete success of the invention. Once he has made his invention and satisfied himself that it is a practical and commercial proposition, then his real difficulties begin.

Many Wireless Inventors.

In the field of wireless there are perhaps more potential free-lance inventors than in other industries, owing to the large number of amateur and experimental investigators. Let us assume that one of these enthusiasts invents a novel construction of some wireless component. His first step—if he seriously wishes to develop it—is to file a provisional patent application. This he may do himself, but if he is wise he will seek the services of a patent agent. It is the more expensive course, but it is the wisest, and in the long run the cheapest. Having lodged his specification at the Patent Office, he is at liberty to divulge the invention, and should take steps to have his article manufactured and commercially developed.

His first impulse is to submit the invention to one of the large concerns whose names are household words in the wireless industry. Many hundreds are so submitted, but very few successfully. The reason is not far to seek, and lies in the methods of organisation which such concerns must of necessity adopt if they are to keep out of the liquidator's hands. For each particular product or article a certain procedure is adopted. Someone is detailed to design a suitable model to fill the particular need, and when this design is approved a model is built in the model shop. This itself is subjected to the inspection of various people, and when finally approved, with such modifications as are deemed necessary, is passed for standardisation. Plant is then laid down and manufacture begun. It will be seen, therefore, that a definite line of development is to be followed and a definite sum of money must be set aside for it.

Suppose the inventor submits his invention to such a concern. If it is an invention of detail not within one of their determined lines of development, there is little or no chance of inducing them to deviate upon another line which has not had the inspiration and direction of their own staff. It is most unlikely they will throw overboard plans which have been evolved after very careful consideration. On the other hand, if it is within their line of development, the device or article must be an equivalent of one already contemplated or manufactured. All inventions are, of course, submitted to the development or research department, and it will be seen therefore that the very people who are to adjudge the submitted invention are those who have been instructed to design a similar apparatus. There is no doubt that all submitted inventions are given most careful and conscientious consideration, but can it be expected that men whose whole time is spent on research and development will approve and adopt instead of their own design the design of an unknown outsider? It will be seen, therefore, that the inventor is either uselessly asking the firm to abandon a prearranged course of development, or he is actually competing with the firm's own research workers—the very people who are the ultimate judges of his own invention. The chances of an invention by a free-lance inventor being "taken up" by a large industrial concern are practically nil.

Final Advice.

What, then, is the best course to adopt? If the inventor has no facilities whatever for standardising and manufacturing his article, his best course is to approach a small firm or a local engineering concern. Such firms are only too pleased as a rule to be able to adopt and sell a new "line"; they have no heavy commitments in the nature of manufacturing programmes; they have no research staffs, who spend their lives doing what the free-lance inventor does in his spare time.

The best advice is, therefore, obtain provisional protection and then seek out some small local enterprising concern and submit the invention to them. The big firms should be left to themselves unless the invention is one of outstanding importance.

THE PHOTO-ELECTRIC CELL.

Its Working Principles Explained.

By H. de A. DONISTHORPE.

ARDENT followers of the science of radio will have seen frequent reference of late to the photo-electric cell—known sometimes as the "electric eye"—in connection with experiments in television and the transmission by wireless of still pictures. In these instances the cell is employed for the purpose of converting light variations into electrical changes, these changes being rendered tangible through the aid of the thermionic valve which amplifies the feeble electric currents dealt with so that they can be employed for useful purposes.

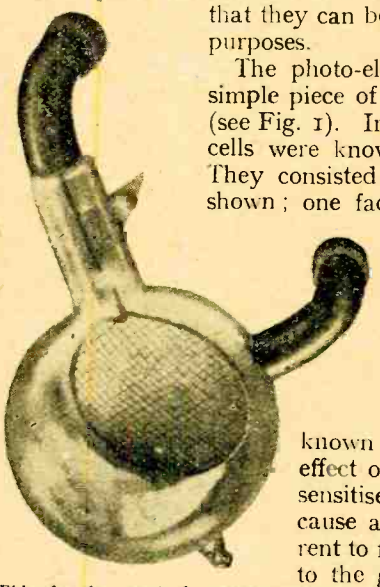


Fig. 1.—A typical photo-electric cell. When light falls on the inner surface of the bulb which is painted with sensitised potassium, electrons are liberated and attracted to an anode kept at a positive potential. Modern cells are gas-filled, and owing to the formation of secondary electrons have greatly improved sensitivity.

The photo-electric cell is quite a simple piece of apparatus to look at (see Fig. 1). In the early days these cells were known as vacuum cells. They consisted of a glass bulb, as shown; one face was silvered electrically, upon which a coating of sensitised potassium was painted. In front of this coating there was a perforated grid after the fashion shown, and known as the anode. The effect of light falling on the sensitised potassium was to cause a feeble electron current to flow from the coating to the grid when the usual H.T. battery was connected in the circuit. The silvered surface was made so that an external connection could be made to the sensitised potassium. In such cells the density of the light could be accurately measured by the electron emission or thermionic current formed by the effect of that light on the cell. The current thus produced, however, was so small that it was rather difficult to make use of it, and thermionic valve amplification was really insufficient to render its application valuable.

The New Gas-filled Photo-cell.

To-day, photo-electric cells are being manufactured known as gas-filled cells, and these produce a greater current for a given change in light densities owing to the effect of the gas in the cell producing secondary electrons after the fashion of "soft" valves, which renders them very sensitive and useful for commercial applications. The inert gas that is inserted into these cells is argon, and during the life of the cell it is not expended. A pressure of about 0.15 mm. is maintained.

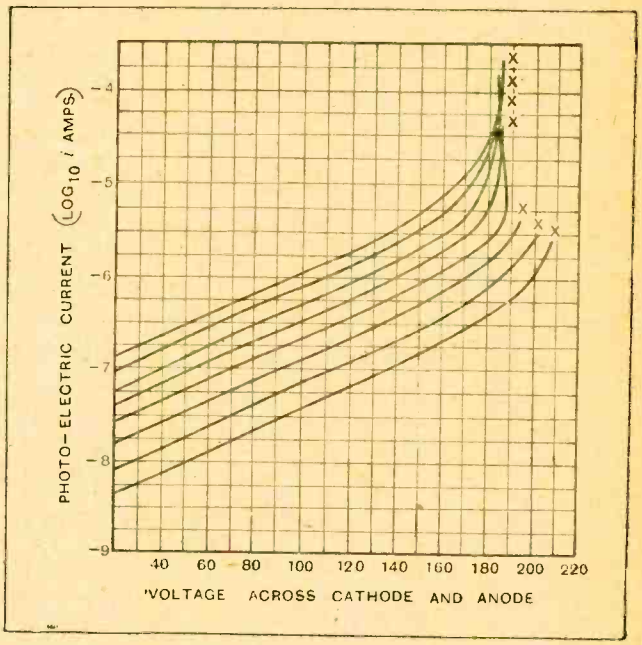


Fig. 2.—Curves showing relation between photo-electric current and anode-cathode voltage for various light intensities falling on the cell.

In a vacuum cell the current is almost independent of the potential difference between the sensitised cathode and the grid-wire anode. The anode, of course, is made in the form of a perforated grid so that the light falling on it can have access to the sensitised cathode. In a gas-filled photo-electric cell, on the other hand, the resulting current depends greatly on the potential difference, which must always be adjusted correctly if the cell is to give the best performance. There is direct connection between

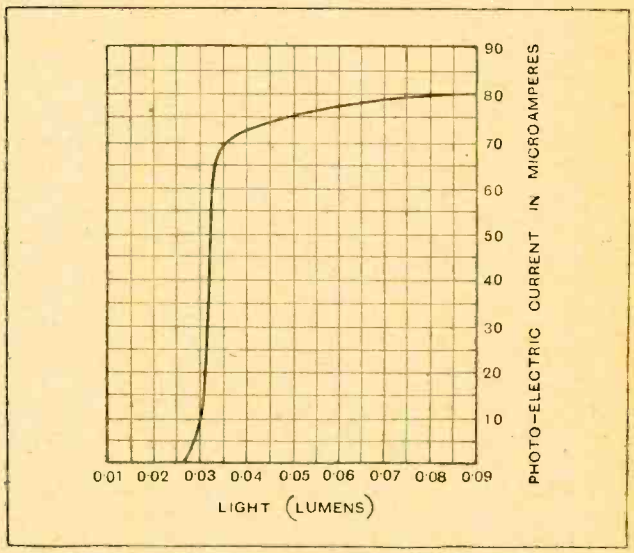


Fig. 3.—The photo-electric current plotted against light intensities when a constant anode-cathode voltage is applied

The Photo-Electric Cell.—the photo-electric current produced and the potential difference between the cathode and anode. Curves illustrating this are shown in Fig. 2 for different amounts of light falling on the cell. All the curves are of the same general form, being nearly straight at the lower voltages and rising steeply at the higher extremities, each terminating at a definite point, marked by an X.

At this specific point on the curve a discharge passes through the cell, accompanied by a purple glow such as was associated with the early "soft" thermionic valves when too much H.T. battery voltage was impressed across the anode and filament. This is an interesting point on the curves, as it represents the greatest voltages that can be applied for the individual curves and the maximum photo-electric current that can be obtained with a given amount of light. The student of photo-electrics should carefully study the general principles of these curves, as in this manner he can understand how the cells work.

Another interesting curve illustrating the functioning of the photo-electric cell is shown in Fig. 3. When a constant voltage is applied across the electrodes of the cell the relation between the current and the light falling on the cell is of the type shown.

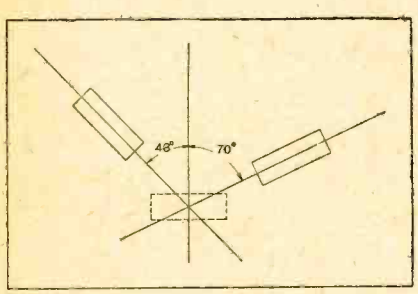
By examining these two curves it will be seen how the best use of the photo-electric cell can be made. Cells have also been produced that are responsive to infra-red rays so that they will react to light waves that are invisible to the human eye.

To-day applications other than radio are being found which are of a more domestic nature. These embody such inventions as automatic street lighting apparatus and fog and burglar alarms. In this last named device the cell used is one of the infra-red responding type. The cell is so arranged that a beam of these invisible rays falls continuously upon it; should a burglar intercept the rays if he is, for instance, tampering with the office safe, the photo-electric cell operates a relay and rings an alarm bell.

There is little doubt that in the near future this new addition to science will find many applications, and may become a serious rival to the ubiquitous thermionic valve.

Cutting Piezo Crystals.

It has been discovered that specially good results can be obtained by cutting a quartz crystal so that the direction of the mechanical vibrations, when in operation, take place along a plane inclined either at 70° or 48° to the optical axis of the motor crystal. Both planes appear to be peculiarly distinguished from all others. In the first place the crystal structure is particularly regular, and in the second place both have equal and optimum sensitivity as regards piezo vibration. They differ in certain other physical aspects, however. For instance, the velocity of sound propagation is found to be only 5,400 metres per second in the 70° plane, whilst in the 48° plane



Showing the optimum cutting angles for quartz crystals.

it is 7,700 metres per second. The discovery is due to investigations recently carried out by the staff of the Telefunken Co. (Patent No. 294,174.)

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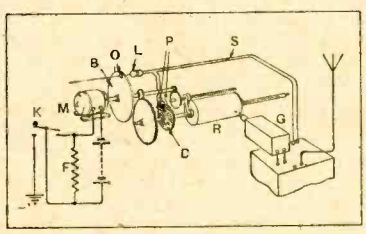
Receiving Broadcast Pictures.

The problem of ensuring an accurate synchronisation of the recording drum used in reception with that used in transmission has been tackled in various ingenious ways. The figure illustrates a method recently protected by the British Thomson-Houston Co., which is particularly suitable for broadcast reception, since it provides for a continuous supervision and control of the driving-



Schematic diagram showing synchronising equipment for picture reception.

motor throughout the whole period of reception.

At the transmitting end a special synchronising signal is sent out at regular intervals corresponding to each complete revolution of the picture-carrying cylinder. At the receiving end this signal is separated out from the ordinary light-modulated signal, the latter being distributed over the recording-drum R in the form of a fluctuating light-ray by an oscillograph G.

The synchronising signal passes *via* leads S and contacts P to a lamp L. The lamp will only be lit up provided the contacts P occupy a certain segment on the surface of the disc D, which is keyed to the shaft of the drum R. If the rotation of the local motor M is exactly in step with that used at the transmitter, the position of the flicker from the lamp L, as viewed through a hole O in a rotating obturator disc B, will remain stationary.

If, on the other hand, the local motor is either leading or lagging the transmitting motor, the direction of "drift" will be indicated by the stroboscopic movement of the lamp image. This enables the operator to increase or lessen the speed as required, by tapping on a key K which short-circuits a regulating-resistance F in the field circuit of the local motor.—Patent No. 294546.

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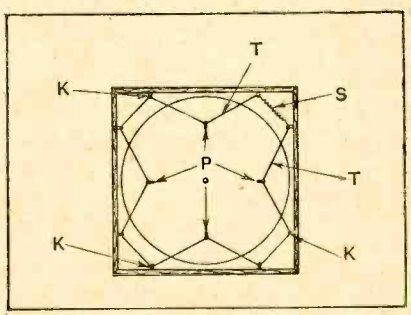
Loud Speaker Diaphragms.

In order to reduce inherent resonance and to increase the efficiency and tone-response of a loud speaker diaphragm, the cone is suspended from several points P arranged along the external surface and approximately along a plane containing its centre of gravity. Loops of silk are fixed to the points P, and a continuous silken line is threaded through them and through hooks K on the framework as shown.



Loud speaker cone suspension to minimise resonance.

The ends of the thread T are connected to a coiled spring S, which maintains a constant tension on the supporting system. In this way the cone is held free to respond accurately to the impulses imparted to it by the reed or other driving movement. (Patent No. 297,539.)

Patent Novelties.

CURRENT TOPICS

Events of the Week in Brief Review.

NO SIGNALS, NO LICENCE.

Purchasers of wireless sets in Austria are to be allowed a three months' trial period before taking out a receiving licence.

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MEXICAN NEWS ON SHORT WAVES.

Authoritative news on the situation in Mexico is now transmitted by the Trens Agency through the short-wave station XDA, Mexico City, owned by the National Telegraph Company. As XDA has a power of 20 kilowatts it should be heard in this country. The wavelength is 32 metres. Reports from readers will be welcomed.

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GERMANY EXCHANGES PROGRAMMES WITH THE ARGENTINE.

When the Radio Exhibition at Buenos Aires was opened on May 19th, a portion of the Berlin wireless entertainment was relayed to Nauen and Monte Grande for rebroadcast in the Argentine capital. On Saturday last Berlin gave its listeners a sample of the South American broadcasting.

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RIVAL SHOWS IN PARIS?

Two rival wireless shows running simultaneously in Paris during the autumn is a serious possibility unless an agreement is arrived at between the French Radio Manufacturers' Union and an independent organisation which is determined that an international exhibition shall be held, writes our Paris correspondent. The Manufacturers' Union recently declined to create a foreign section.

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WIRELESS IN FOUR LANGUAGES.

A polyglot phrase book entitled "The Electrotecnical Letter-Writer" is described in an interesting leaflet we have received from the publishers, Hachmeister and Thal, of Leipsic. A specimen page of the wireless section shows that the fortunate owner of this book will be nearly a master of four languages, viz., German, French, English, and Spanish. The same phrase in each language appears in parallel columns, making reference extremely easy, and it is evident that Herr Hugo Lœwe, the compiler, has brought to his task considerable powers of imagination and foresight.

"Les rogamos que nos ofrezcan un aparato cuyo manejo sea lo más sencillo posible" means "Please quote us an apparatus on which the greatest attention has been given to the question of easy attendance."

BIRDS OF A FEATHER.

The gregarian instinct operates in most industries, and wireless is no exception. In London the West Central district is fast becoming the mecca of big radio firms. Trinity Street is now claiming to be the hub of Dublin's wireless industry.

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WIRELESS ON THE "FLYING SCOTSMAN."

As last year, passengers on the "Flying Scotsman" non-stop expresses, both North- and South-bound, will have an opportunity of picking up the B.B.C.'s running commentary on the Derby on June 5th. A receiver and loud speaker will be installed in one of the coaches, while all passengers out of earshot will be presented with stamped cards bearing the names of the winning horses.

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SHORT-WAVE TELEVISION TESTS.

Considerable progress has been made in the construction of the Koenigswusterhausen short-wave telephony high-power transmitter, and it is hoped, says a correspondent, that within the next few weeks regular tests may be carried out. Attempts will be made to establish a television service through the same station. Two different systems are being tried out, viz., those of von Mihaly and Professor Karolus. The Berlin authorities are anxious that Germany should be the first European State to carry out television tests on short wavelengths.

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CHINESE WIRELESS GEAR.

Chinese-made wireless apparatus was on view at the recent Chinese National Products Exhibition in Shanghai. The constructors, the Amateur Home Radio Co., started business in Shanghai in 1924, and now own a factory employing forty workmen.

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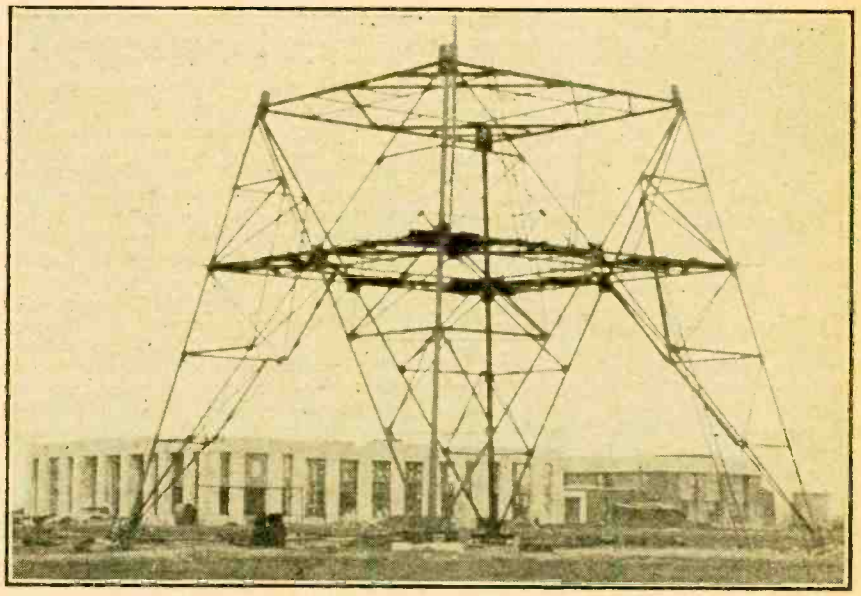
THE "BALKY TALKIE."

A touching story of a "balky talkie" is told in the *New York Times*, which states that several hundred persons walked out of the Apollo Theatre, New York, on May 6th, when a buzzing sound caused by mechanical trouble in a sound projection machine made it impossible to hear the dialogue in a talking version of *Bulldog Drummond*.

The treasurer refunded the admission money to those who left before the film's conclusion, but resisted the claims of people who stayed till the end, but who



LONDON REGIONAL. The first photograph at Brookmans Park to show one of the masts under construction. It will be noticed that the mast is of the traitic self-supporting type—an innovation in B.B.C. practice.

argued that, as they had seen the film but had not heard it, some of their money should be returned. "A mounted policeman was called in to quiet those who milled about the box office."

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MUSIC—BUT NO NEWS—FOR TRISTAN.

At long last the inhabitants of the world's loneliest island—Tristan da Cunha—are probably listening to 5SW, the short-wave broadcasting station at Chelmsford.

It will be remembered that in January last a Marconiphone short-wave set was presented to the island by the Editor and friends of *The African World*, and taken out by the Rev. A. G. Partridge on his way to assume the chaplaincy of this remote parish.

The Marconi Company has now received a letter from Mr F. A. Bradley, the wireless operator of the S.S. *Duchess of Atholl*, who installed the set and explained its mysteries to the chaplain. The writer reports that 5SW was heard clearly every night between Montevideo and Tristan (6,000 miles from Chelmsford) on the outward journey, and that when on the island he heard short-wave Morse stations at good strength. Unfortunately, he had to leave Tristan before 5SW started up in the evening, but he states that he has not the slightest doubt that the islanders picked up the station immediately it began transmission.

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SPANISH SHORT-WAVE ENTERPRISE.

Spain is going ahead with its policy of establishing reliable wireless communication between Madrid and the Spanish Colony of Fernando Po, in Equatorial Africa. The new Marconi short-wave station at Fernando Po has given excellent results on test and is expected to be put into regular operation in the near future.

The transmitter is of the type supplied by the Marconi Company for use in the British Imperial Beam stations, but is of smaller power and simpler design owing to the fact that it is required to work on one wavelength only. A medium-wave transmitter has also been supplied for communication with ships.

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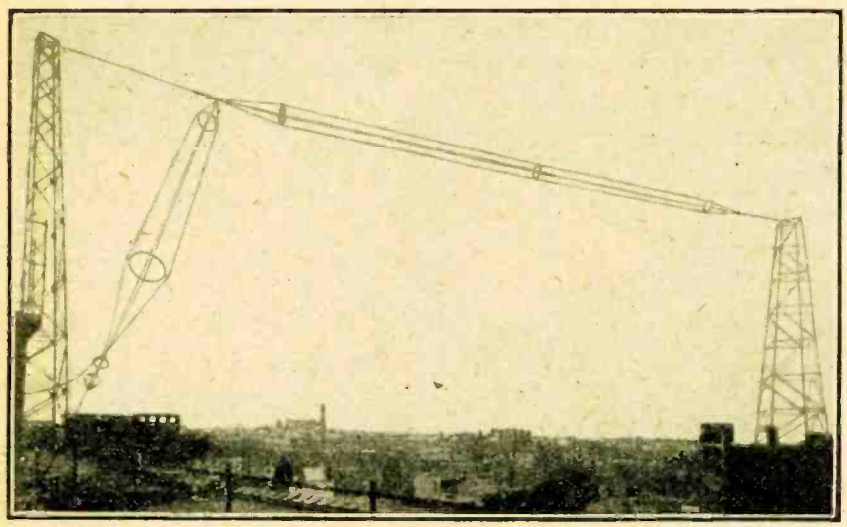
"AMERICANISING" CANADA BY WIRELESS.

The dangers of delay in regularising Canadian broadcasting are illustrated by a message from Washington, which states that negotiations have been concluded for the dissemination of American programmes throughout Canada by the Trans-Canada Broadcasting Co. A large quantity of American advertising will be included in these transmissions, which will be supplied by the U.S. National Broadcasting Co., the Buffalo Broadcasting Corporation, and the Columbia Company.

Canadian broadcasting is at present in a chaotic state pending the decisions of the Royal Commission on broadcasting.



A POPULAR STATION. The aerial system at Brussels, one of the best known of the nearer Continental stations. Its wavelength is 512 metres.

SETBACK FOR SWISS BROADCASTING.

Swiss broadcasting appears to be undergoing an eclipse, but it is hoped that it will emerge with a brighter lustre than before. A drop in the licence figures is ascribed to the peculiar difficulties confronting the authorities, who find that broadcasting, to appeal to all, must include announcements in French, German, and Italian.

Technical problems are introduced by the mountainous nature of the country, but it is expected that these will be overcome by the projected network of two high-power stations and numerous relays. The proposed main stations will be in the Vaux Canton and in a Swiss-German centre respectively.

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THE END OF A SQUABBLE.

A recent broadcasting feud in the South of France is recalled by the news that the French Ministry of Posts and Telegraphs has now permitted Radio Toulouse, a private station, to use a permanent microphone in the Capitole Theatre in conjunction with an exclusive landline. This decision is in response to a joint protest by Haute Garonne deputies, Chambers of Commerce, the Mayor of Toulouse, and numerous radio clubs. Radio Toulouse has recently been relaying the theatre performances by means of a short-wave transmitter installed in the building.

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RECORD PICTURE TRANSMISSION?

What is believed to be the longest wireless transmission of pictures yet achieved was carried out on May 17th, when photographs were picked up at Radio House, the City office of the Marconi Company, from San Francisco, 7,000 miles away.

The pictures were sent by the Marconi radio-photo process from R.K.O. Pictures Corporation, a subsidiary of the Radio Corporation of America, to Mr. S. G. Newman, their London representative. Reception was regarded as very satisfactory, though it was marred at times by atmospherics and fading.

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SHORT WAVES TO FRENCH COLONIES.

An official Decree is shortly to be signed by the French Foreign Office authorising an expenditure of about 40 million francs on the establishment of short-wave services between (*a*) France and Algeria, and (*b*) between France and North and South America, besides other distant countries.

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"EXPERIMENTAL WIRELESS."

For our more advanced readers the June number of our sister journal *Experimental Wireless* should have a special appeal. An article by S. Butterworth, M.Sc., deals with the design of radio-frequency transformers as applied to screen-grid valves. There is also a contribution entitled "Measurements of the Grid-Anode Capacity of Screen-Grid Valves" and an article describing a new push-pull circuit.

In *Experimental Wireless* each month many pages are devoted to abstracts and references relating to wireless literature throughout the world, every article of importance being mentioned under a classified heading. This service is invaluable, especially to those who may be interested in the study of some particular branch of radio engineering. Copies of *Experimental Wireless* can be obtained from our publishers, Dorset House, Tudor Street, London, E.C.4, price 2s. 8d. post free. The subscription for one year is 32s., and for six months, 16s.

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NEW JOBS FOR WIRELESS OPERATORS.

Wider scope for the American wireless operator, whose profession is generally regarded as overcrowded, is promised by new aviation regulations prepared by the U.S. Department of Commerce. If the regulations become law every large transport plane will be required to carry a certificated wireless operator, and in view of the fact that new air lines are being rapidly opened up all over the American Continent, there is a definite prospect that the wireless operator "waiting for a berth" will be a phenomenon of the past.

DESIGN DATA FOR THE MOVING COIL.

Some Notes on the Most Efficient Coil and its Correct Design.

By L. E. T. BRANCH, B.Sc.

THOSE who seek after perfection and power nearly always concentrate all their efforts upon increasing the power handling capacity of the valve or valves by using larger valves taking considerable high tension and grid bias. They usually overlook the fact that the continued use of a moving coil, made for a single-valve output stage, takes from the more liberal equipment much of the improvement they are hoping to get. The response curve, in fact, begins to assume quite an alarming shape, as was pointed out previously in the original article which appeared in the issue of June 6th, 1928. More recent experiments of Dr. N. W. McLachlan[1] have shown that in actual practice the result is even worse than would appear theoretically.

In the earlier article full graphs were given to enable anyone to make up the most efficient moving coils for all cases where the standard size 2in. coil is used in a field strength of 10,000 lines per sq. cm., and operated by a single valve or several valves in parallel, either employing choke output or a step-down transformer. There are many cases, however, which are outside the field covered by the earlier article. It is proposed, therefore, to treat the subject rather more generally, so as to include all possibilities met with in practice at the present day. It will be assumed that the reader has digested the main principles worked out previously, but for the sake of those who have not they will be briefly referred to during the course of the following notes.

The proper design of the moving coil, meaning thereby the optimum number of turns and gauge of wire to be used in order to obtain maximum volume throughout the whole range of audible frequencies, depends upon (1) the effective impedance of the output stage, (2) the diameter of the coil, (3) the field strength, (4) the total weight of the coil and cone, including the mass due to inertia. Since the volume output decreases rapidly with increasing weight of the coil and cone, it is clearly advisable to keep the cone as light as possible. Many of the earlier outfits possessed a coil and cone weighing about 18 to 20 grams, whereas it has now been recognised that a very strong cone, or at least a sufficiently strong cone, can be made of light and thin paper, especially now that the cone is usually only 6in. diameter, so that a weight of 8 to 10 grams for the coil plus cone can be taken as a fair starting-point. A cone of 6in. diameter has now proved in the majority of cases to be superior to the 10in. cone which was favoured in the early days, a crisper and brighter tone being evident with the smaller cone, due among other things to the lessened effect of focusing. We will assume, therefore, that a suitable light former will be used for the coil and a light 6in. cone, giving a total weight of about 9 grams. We can take the mass due to inertia on the lowest frequencies to be about 2 grams, giving a total effective weight of 11 grams. Above about 1,000 cycles the mass due to inertia is negligible.

The Weight of the Coil and Cone.

Compared with the heavier cone of about 18 grams there will be in general a slight loss below 100 cycles, but this is not serious. In fact, where the set is giving practically a straight line L.F. amplication curve between 50 and 6,000 cycles, this drop will be rather an advantage, as it will tend to counteract the relative strengthening of the lowest notes due to the H.F. side of the receiver.

Having fixed the weight of the coil and cone, we may therefore proceed to deal with the effect of the other three factors.

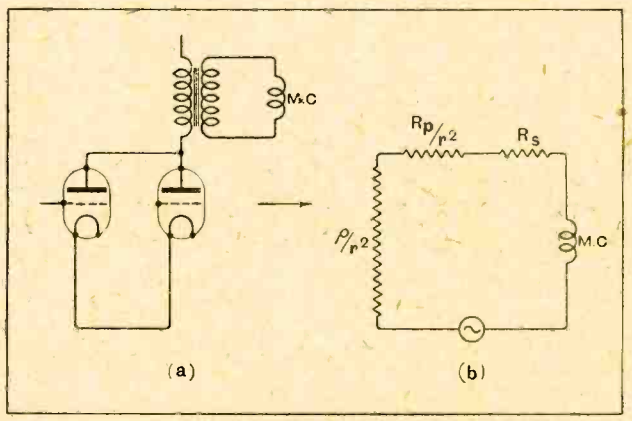

Fig. 1.—The output stage and its equivalent impedances. ρ = valve impedance, r = transformer ratio, R_p = resistance of primary, R_s = resistance of secondary.

The Effective Impedance of the Output Stage.

For a single valve working with a choke and condenser the effective impedance is simply the actual impedance of the valve, or when a 1 : 1 output transformer is used it is the impedance of the valve plus the sum of the resistances of the primary and secondary windings of the transformer. When several similar valves are used in parallel, their combined impedance is found by dividing the impedance of one of the valves by the number of valves. It is possible to use valves in parallel which have different impedances so long as the bias they require is the same for the same H.T. voltage. For example, a P.M.256 (impedance 3,500 ohms) and a Marconi P.625A (impedance 1,600 ohms) will work perfectly well together, since both these valves will work at 20 volts bias at 150 volts H.T. Their combined impedance is then found by taking the reciprocal of the sum of the reciprocals of their separate impedances,

$$\frac{1}{\frac{1}{3500}+\frac{1}{1600}} = 1110 \text{ ohms.}$$

[1] *The Wireless World*, August 8th, 1928, p. 156.

Design Data for the Moving Coil.—

or again, the L.S.5A and B.T.H.PX650 both take about 40 volts bias at 200 volts H.T., so we may take for example two L.S.5A valves and one PX650 all in parallel, and their combined impedance is

$$\frac{1}{\frac{1}{2750}+\frac{1}{2750}+\frac{1}{1750}} = 770 \text{ ohms.}$$

When a step down transformer is used the effective output impedance is enormously lowered. It can be taken as the combined impedance of the valves plus the resistance of the transformer windings all referred to the secondary of the transformer.

The equivalent circuit is shown in Fig. 1 (a) and (b), where $\frac{\rho}{r^2}$ is the combined impedance of the valves referred to the secondary, r being the step-down ratio, and $\frac{R_p}{r^2}$ is the resistance of the primary winding referred to the secondary, and R_s the resistance of the secondary winding. The inductance of the transformer should, of course, be included, but in a good transformer the inductance will be sufficiently high as not to shunt any appreciable amount of current. In a well-made transformer R_p is of the magnitude of 250 to 100 ohms, and R_s for a ratio of 15 : 1 or 25 : 1 is in the neighbourhood of 1 ohm, or less.

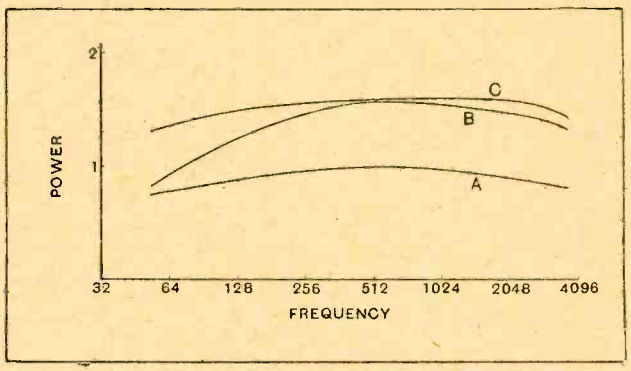

Fig. 2.—These curves show the change in frequency response of a given moving coil with changes in field strength. A, normal result with a field strength of 10,000 lines. B, field increased to 15,000 lines—note the relative lowering in the bass frequencies. C, the result of decreasing the number of turns, though maintaining the D.C. resistance, as well as reducing the weight, by using a smaller gauge of wire.

Now the resistance of R_p when referred to the secondary, i.e., its effective value in the moving-coil circuit which is really the value we want to find, is obtained by dividing R_p by the transformer ratio. For example, R_p in a B.T.H. 15 : 1 transformer is 75 ohms, hence $\frac{R_p}{r^2} = 0.35$ ohm, while R_s is 1.75 ohms. Now adding these together we have a total of 2.1 ohms as the effective resistance of the transformer windings in series with the moving coil. The effective impedance of the valves is then their combined impedance divided by the square of the transformer ratio. Thus, two L.S.5A valves and one P.X.650 all in parallel and used with say a 25 : 1 transformer would have in the moving-coil circuit an effective impedance of $\frac{770}{25^2} = 1.24$ ohms, or if we were to use a single L.S.5A with a 15 : 1 transformer, its effective impedance would be $\frac{2750}{15^2} = 12.2$ ohms.

Now the total effective impedance of the valves and transformer is the sum of the effective valve impedance plus that due to the resistance of the windings, i.e.,

$$\frac{\rho}{r^2}+\frac{R_p}{r^2}+R_s$$

We are assuming that the leads from the transformer to the coil are short, and have a negligible resistance, otherwise such resistance must also be added.

In the earlier article on the design of the moving coil the terms $\frac{R_p}{r^2}$ and R_s were neglected, since in a transformer designed to suit the value of ρ these terms are small. Greater accuracy is, of course, obtained by including them, and they certainly should be included when the value of ρ is low, say, below about 1,000 ohms. It will readily be seen that when the effective valve impedance $\frac{\rho}{r^2}$ is relatively large, say, 10 ohms, a resistance of 2.1 ohms for $\frac{R_p}{r^2}+R_s$ is not highly important, although, of course, it does mean a proportionate amount of loss, but when the effective valve impedance is low, for example, in the case of 1.24 ohms cited above, a resistance of 2.1 ohms would produce a notable loss. In fact, the effect is as though we were using valves of more than double the impedance in conjunction with a choke output, or if it were possible with a transformer having no resistance at all. Hence it is clear that a transformer which would be suitable in the one case is by no means the best for the other case.

Choke Output.

When the combined impedance of the valves is below about 1,000, and it is desired to preserve the utmost maximum of power, a choke output is to be advised in the absence of a special low-resistance transformer. It should be remembered that in the case of a choke output the choke is not actually in the moving-coil circuit, so that its resistance is of no consequence. Were it not for the inconvenient voltage drop produced in the H.T. a pure resistance in place of the choke would be just as satisfactory, in fact, often better at the lowest frequencies where the impedance of an inductance falls off. Such a resistance should, of course, have a value of at least four times the combined impedance of the valves. Actually, the choke is in shunt with the moving coil, and its correct impedance is governed thereby, but as a properly designed coil has an impedance near the value of the valve impedance, we can for simplicity refer the choke inductance to the valve impedance.

It should be noted that in the case of the pentode which has a very high impedance, a special high inductance transformer or choke must be used when a correctly designed moving coil is employed, otherwise there will be a loss on the low frequencies. In the case of valves in push-pull, whether a centre-tapped choke is used or a transformer having a centre-tapped primary, the correct winding for the moving coil is obtained by

Design Data for the Moving Coil.—

taking the combined valve impedance to be the sum of the impedances of the push-pull valves.

The number of turns only and not the gauge of the wire is affected by the diameter of the coil, the reason for this being that the characteristics of the coil, i.e., its resistance, inductance, etc., are determined when other things are equal, by the total length of wire the coil contains. We can look upon the coil as being a long straight piece of wire cutting lines of force in a magnetic field, the wire being bent round to form a coil solely for practical considerations. Hence a 1½in. coil should only contain ⅔rds the number of turns of a corresponding 1in. coil to give similar characteristics. For convenience in working we shall consider a 1in. coil as a basis, and then for converting to other sizes we merely have to divide the number of turns for the 1in. coil by the diameter of the coil we propose to use.

The Effect of the Field Strength.

The impedance of the coil, more particularly at low frequencies is dependent upon the strength of the magnetic field in which it moves. At low frequencies the impedance of the coil is due in the main to its so-called motional capacity, which is given by the expression

$$C_m = \frac{m \times 10}{(n\pi \times L)^2} \text{ microfarads,}$$

where m is the total mass of the coil and cone, n is the strength of the magnetic field in lines per square cm., and L is the total length of wire on the coil measured in cms. The impedance at low frequencies is then given by $\frac{1}{2\pi f.C_m}$ where f is the frequency. Hence a decrease in the value of n will lower the impedance at low frequencies, thereby giving a still more even response curve with, of course, decreased volume overall. On the other hand, an increase in the field strength will cause a lowering of C_m with a consequent raising of the impedance, the result being a relative loss of the low frequencies, although the volume as a whole is increased. Now, if the product nL be kept constant, then C_m remains unchanged, other things being equal. Hence, if it is desired to conserve the approximate shape of the response curve on raising the field strength we should decrease the length of wire on the coil in the same proportion as we increase the field strength. This will produce a small decrease in weight which will tend to lower C_m very slightly. The net gain is then that the output is increased at all frequencies owing to the decrease in the weight of the coil. To obtain the full benefit of the change, we can arrange to use a slightly thinner wire, thus keeping the D.C. resistance of the coil the same and so further decreasing the weight. Thus a 2in. coil of 1,000 turns, working in a field of 10,000 lines, should be modified to 850 turns for a field strength of 12,000 lines, and No. 47 wire should be used instead of No. 46.

In the case of the 18 gram coil and cone working in a field strength of 10,000 lines, we had an impedance at 54 and 4,000 cycles of little more than the total effective impedance of the output valve or valves. Remembering that with a 9-gram coil and cone the impedance will be a little higher, at 54 cycles, we can maintain our new standard by decreasing the number of turns for field strengths greater than 10,000. Were it not for the increased weight and resistance of the wire we could easily compensate for a weak field by using a coil of more turns. However, when the field is below about 10,000 lines, the gain effected by increasing the number of turns is just counterbalanced by the loss brought about by the increase in weight, the power output depending on the inverse of the square of the weight, so that for any field strength below 10,000 lines the most efficient coil can be taken as that suitable for 10,000 lines

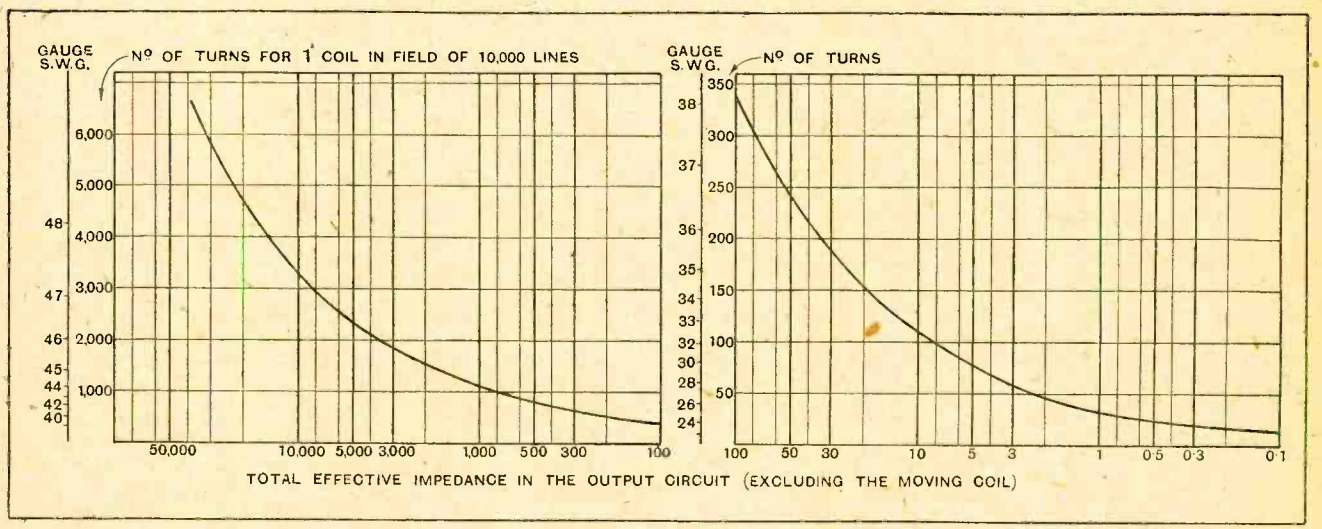

Fig. 3.—Curves giving the number of turns and gauge of wire for making a moving coil to match suitably the output impedance. It is a simple matter to adjust those figures for larger diameter coils and various field strengths.

per square cm. Above this field strength the modification is certainly worth considering. This is illustrated by the curves in Fig. 2. A coil designed for a field strength of 10,000 lines will give a response curve A when in that field, while curve B represents its output when the field is increased to 15,000 lines. Note the relative

Design Data for the Moving Coil.—

lowering of the low frequencies. If the number of turns on the coil is decreased in the proportion 1.5 to 1, and the next, or next but one, smaller gauge of wire is used so as to maintain the total D.C. resistance of the coil as near the same as possible, the impedance characteristics of the coil are improved, and there is a gain of about 50 per cent. in the output at all frequencies due to the fall in weight. The response curve then approximates to the curve C.

If we know the correct number of turns (N) to use for a 1in. coil in a field strength of 10,000 lines per square cm., then the number of turns for a coil of diameter D inches in a field of n lines will be $N \times \frac{1}{D} \times \frac{10,000}{n}$.

It is now necessary to have some sort of method for arriving at the value of n. This can only be done accurately as would be required in a laboratory by actual measurement since it depends on so many factors, e.g., permeability of the iron, thickness and size of the iron pot, diameter of the core, shape of the gap, etc., but such exactness is not at all necessary for ordinary purposes.

When the pot and core are made of cast-iron, as they are in the majority of cases, the field strength in the iron cannot be greater than approximately 8,000 lines per square cm., this being the saturation value for cast-iron, whereas with steel, the saturation is nearer 12,000, while with annealed wrought-iron it rises to 17,000.

Now since about nine-tenths of the magnetising current is used in producing the field in the gap and allowing 33 per cent. loss due to the spreading of the lines in the gap, we can take as a sufficiently close approximation for our purpose that the field strength in the gap is

$$n = \frac{2.4 \times M \times c}{w \times 10}$$

where M is the number of turns on the field magnetising coil, c the current, and w is the width of the gap. With large gaps there will be a slight spreading of the lines, and then n will be a little lower than the value found by the above expression.

Conclusion.

To design a moving coil so as to make it highly efficient, we adopt the following procedure.

According to whether we are using a single valve or several in parallel with a choke output or a step-down transformer we first calculate the total effective output impedance, as explained in the earlier part of this article. Then by referring to the graphs in Fig. 3, read off the number of turns and gauge of wire suitable for a 1in. coil in a field strength of 10,000 lines per square cm. Next we find the field strength n by means of the formula already given, and if it is greater than 10,000 lines substitute it in the formula $N \times \frac{1}{D} \times \frac{10,000}{n}$, and this gives us straight away the number of turns required. If n is less than 10,000 we take the number of turns as $N \times \frac{1}{D}$. If n is greater than 10,000 we use the next, or next but one, gauge of wire smaller than that specified in the graph.

Finally, let us consider a hypothetical example:—Three D.E.5A valves are working in parallel with an output transformer of ratio 25 : 1. The resistance of the primary (R_p) is 100 ohms and the secondary (R_s) is 0.5 ohm. The pot is made of good wrought iron and has 2,000 turns of wire taking 1.8 amperes on a 12-volt supply. The coil required is 1¾in. diameter and the gap is $\frac{1}{16}$in., i.e., 0.157 cm. Now the impedance of the three D.E.5A valves referred to the secondary of the transformer is $\frac{3500}{3} \times \frac{1}{25^2} = 1.97$ ohms. Adding to this the value of $\frac{R_p}{r^2} + R_s$ we have a further $\frac{100}{25^2} + 0.5 = 0.66$ ohm. The total is thus $1.97 + 0.66 = 2.63$ ohms. From the graph we see that for a 1in. coil in a field of 10,000 lines we should wind 52 turns of No. 27 S.W.G. Now the field strength in this example is given by

$$n = \frac{2.4 \times \pi \times 2000 \times 1.8}{0.157 \times 10} = 17,000 \text{ lines per square cm.}$$

The number of turns we require will therefore be

$$52 \times \frac{1}{1\frac{3}{4}} \times \frac{10,000}{17,000} = 18 \text{ (very nearly).}$$

The D.C. resistance of the 52-turn 1in. coil would have been 0.54 ohm, hence the 1¾in. coil should be wound with No. 30 S.W.G. in order to maintain the resistance about the same value. The coil is, therefore, 18 turns of No. 30 S.W.G.

Catalogues Received.

Messrs. Macnamaras, 116, Spring Hill, Birmingham. Illustrated leaflet of electrical gramophone equipment, also moving-coil loud speakers.

oooo

Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2. Illustrated leaflet of gramophone amplifier and pick-up device, also a descriptive folder of all-mains operated A.C. receivers.

oooo

Messrs. Ferranti, Ltd., Hollinwood, Lancashire. Constructors' broadsheet, giving full details for building the Ferranti two- and three-valve receivers. These are supplied free on request.

The "Pandona" Co., 3, Edmund Street, Birmingham. Descriptive leaflet of the "Pandona" screened IV de luxe transportable set.

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Messrs. E. R. Morton, Ltd., 117, Charlotte Street, London.—Descriptive leaflet of the "Wirt" lightning arrester.

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Messrs. Beagley and Bristo, 47, Cranbourn Street, London, W.C.2. Descriptive leaflets of gramophone equipment for electrical reproduction of records.

Messrs. Claude Lyons, Ltd., 76, Oldhall Street, Liverpool.—Twenty-page handbook illustrating the many uses of Clarostat resistances, also illustrated leaflet of the "Raytheon" eliminator kit.

oooo

The Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.4.—Illustrated leaflet describing the "J" type L.F. transformer.

oooo

The Anto Electrical Service Co., Ltd., 519, Green Lane, Goodmayes, Ilford. Folder describing the loud-speaker demonstration system and service inaugurated by this firm.

A Review of the Latest Products of the Manufacturers.

BURNDEPT CABINET CONE LOUD SPEAKER. Model 1675.

This loud speaker is fitted with an adjustable reed movement working into a cone 11in. in diameter. A semi-free edged mounting is favoured, the periphery of the cone lightly resting against a felt ring attached to a spider-web frame, which supports the movement. The cabinet is acoustically open at both sides, and there is no trace of cabinet resonance.

The loud speaker is reasonably sensitive, and should give pleasing results when used in conjunction with a medium power output valve. The response over the major portion of the audible scale is good, and both high and low frequencies are present in good proportion. A slight resonance appears about the middle of the audible band, but this is not sufficiently pronounced to trouble the average listener.

Made by the Burndept Wireless (1928), Ltd., Aerial Works, Blackheath, London,

Burndept cabinet cone loud speaker with adjustable reed movement.

S.E.3, it is being offered at £3 in a mahogany or oak cabinet, and can be regarded as good value at this price.

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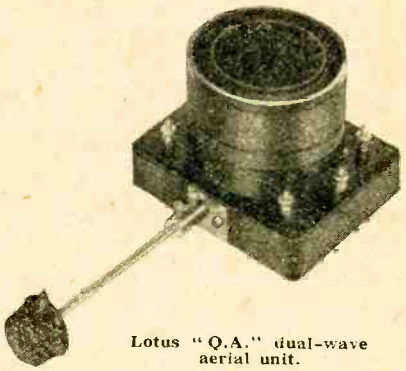
LOTUS DUAL-WAVE COILS.

These dual-wave coils have been designed to meet the requirements of those desiring a compact self-contained unit which will cover both medium and long wavelengths without recourse to interchangeable coils. The aerial unit, "Q.A." coil, carries a reaction winding in addition to the tuned coil, and the high-frequency transformer is provided with a primary and a neutralising winding, so that it can be used in stabilised H.F. circuits. Since the general construction is the same in both units, it will suffice to describe one only.



Lotus "Q.A." dual-wave aerial unit.

The device consists of two coils mounted concentrically, the inner being wound on a 2in. former and the outer on a 2¾in. former. For medium-wavelengths the two coils are connected in parallel, and for long-wave reception a series arrangement is adopted. These changes are made by a switch housed in the hollow base. The switch has an extension on the spindle to provide a means of "ganging" two or more units, so that one operation of the control knob will change over a number of units.

The nominal wave-range covered on the medium waveband is 200 to 550 metres when tuned by a 0.0005 mfd. variable condenser. The measured waveband without an aerial was found to be 194 to 550 metres, and with a standard size P.M.G. receiving aerial connected *via* a 0.0001 mfd. fixed condenser to the grid end of the coil, 253 to 590 metres.

On the long waves the range without aerial was 670 to 2,150 metres, and with an aerial, 940 to 2,200. The makers give the long-wave band as 1,000 to 2,000 metres.

These coils are made by Messrs. Garnett, Whiteley and Co., Ltd., Lotus Works, Broad Green Road, Liverpool, and the prices are as follows: "Q.A." aerial coil, 15s.; "Q.S.P." high-frequency transformer, 21s.

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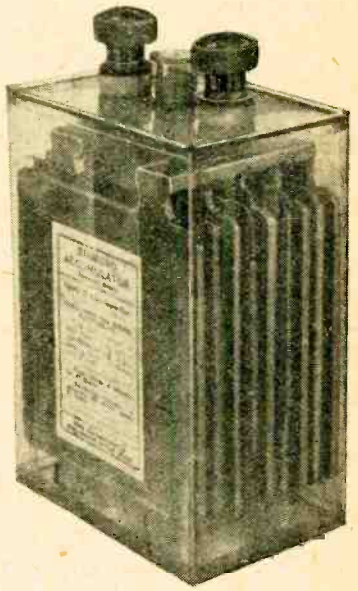
DIAMOND ACCUMULATORS.

Diamond accumulators are made in all sizes, ranging from car-starting batteries to small cells suitable for wireless purposes. Perhaps the most popular size used by the radio listener is the 40-ampere-hour capacity cell, either in 2-, 4-, or 6-volt units. The 2-volt Diamond accumulator of the capacity is listed at 16s., the 4- and 6-volt units costing 22s. 6d. and 31s. respectively. These are made in celluloid cases.

The assembly is carried out on clean lines, and particular attention has been given to the attachment of the terminals to the lead lugs. The lugs are brought out well above the top of the case, and rubber acid traps prevent creeping of the electrolyte and give adequate protection to the brass terminals. On the whole these are a sound job and can be confidently recommended. Prices of other 2-volt sizes are as follows:—20-ampere-hour, 11s. 6d.; 30-ampere-hour, 13s. 5d.; and 60-ampere-hour, 20s.



Diamond 2-volt 40-ampere hour L.T. accumulator.

The makers are The Diamond Accumulator Co., The Chase, Bournemouth Park Road, Southend-on-Sea, Essex.

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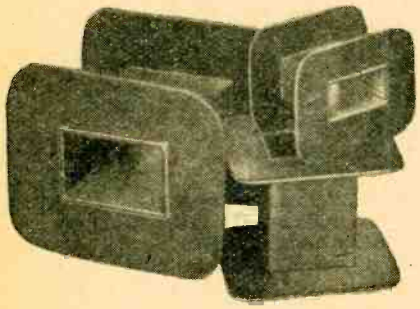
MAINS TRANSFORMER MATERIAL.

Readers desiring to make up mains transformers for eliminators, trickle chargers, or for any other purpose, will be interested to learn that core stampings

of a larger size than the familiar "No. 4" are now being offered by Messrs. W. B. Savage, 146, Bishopsgate, London, E.C.2, at the price of 11s. 9d. per gross pairs.

The outside dimensions of the stampings are 5in. × 4¼in., the centre limb, which carries the coils, being 1¼in. wide. The area of each window is just over 3½ square inches, so that very generous winding space is available.



Savage's bakelite bobbins for transformer construction. Note the various sizes now available.

Bakelite bobbins known as type "No. 25F" cost 2s. 6d. each, and accommodate 10 dozen pairs of stampings, which will give a core section of 2in. × 1¼in. or 2½ square inches cross-sectional area. A new bobbin for "No. 4" stampings is available also; this is known as type "No. 4F," and sells at 1s. 3d. It is similar to the "No. 4H" bobbin illustrated on page 744 in our issue of November 28th, 1928, but is twice the length.

We illustrate as well a small bakelite bobbin, "No. 15F," for use in smaller transformers or chokes. This takes the No. 15 stampings, and sells at 11d.

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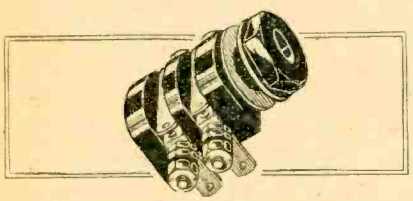
IGRANIC-PACENT MIDGET JACKS.

These jacks possess certain features worthy of special mention. In the first case, they are extremely compact, occupying a depth behind the panel of one inch only. Secondly, particular attention has been given to reducing the capacity between the contact leaves to the smallest value possible with this design. Last, but by no means least in importance, comes the matter of insulation. The body of the jack consists of a bakelite moulding provided with a brass inset arranged so that the fixing bush is entirely insulated from the panel. This enables the jacks to be mounted on a metal panel, even though both contacting points of the jack are at high potential with reference to the panel, and this obviates the necessity of first "bushing" the hole with insulating material. Midget jacks are made in three different types; single open circuit, single closed circuit, and double circuit; the prices being 1s. 4d., 1s. 6d. and 1s. 9d. respectively. The makers are the Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.4.



Igranic-Pacent double circuit midget jack with insulated fixing bush.

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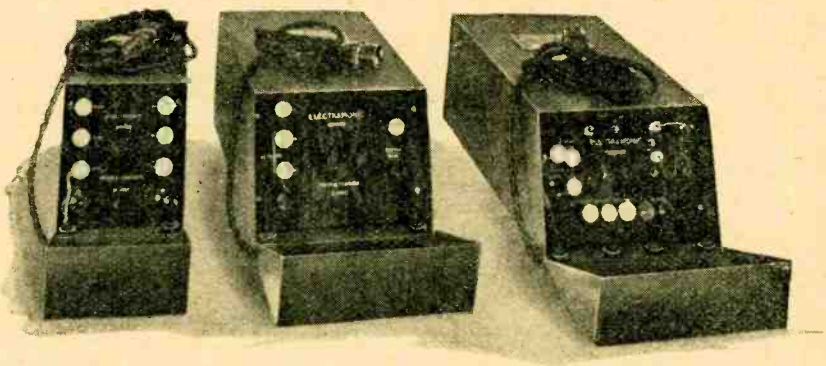
ELECTRAMONIC ELIMINATORS AND BATTERY CHARGERS.

Three new rectifying equipments have recently been placed on the market by The Electramonic Co., Ltd., Bear Gardens, Park Street, Southwark, London, S.E.1. Two of the models are for battery charging and the other an H.T. eliminator. As to external finish, these rectifiers represent a new departure in mains apparatus. Their design is interesting in that they are totally enclosed and form complete units perfectly rectangular in shape with absence of ornamental or other projections, thus making them suited for inclusion as components in receiving sets of the completely mains-operated type. They are nevertheless attractive as battery chargers and eliminators for use with existing receiving sets, while the entire absence of projecting controls and live terminals renders them entirely safe.

Metal oxide rectifiers are used in these units. A small low-voltage model is produced for charging 2-, 4- or 6-volt accumulators at about 0.5 amp. They are made available for all mains voltages, and terminals are provided on the 200-240-volt model to provide for the intermediate voltages met with on this range. Tested on a 200-volt supply and charging a 6-volt battery, the rate was found to be 0.25 amp. The charging rate of 2- and 4-volt accumulators was slightly greater. Another, and more generous, battery charger is rated to give an output of 2 amperes. This model when connected to a 6-volt accumulator gave a charging rate of 2.3 amps. These chargers were entirely silent in operation, mechanical hum being absent.

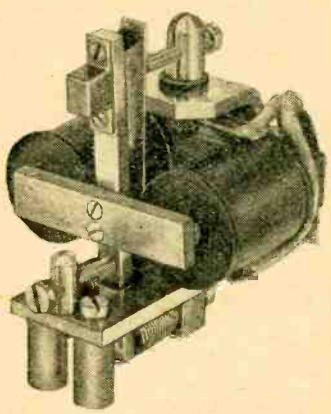
The Electramonic A.C. eliminator Type A gives a generous output suitable for operating three- and four-valve sets having a maker's rating of 200 volts when delivering an anode current of 30 mA. Provision is made for four voltage outputs, three being given by tapping points across a potential divider. The heavy current output is adjusted by a variable series resistance, this arrangement being adopted to prevent interaction between the stages in the receiver. It is to be noted that output potentials varying in steps are provided as an alternative to the use of continuously variable feed resistances. Constancy of adjustment is the aim, and the adjustable voltages provided meet all receiver requirements. The eliminator was connected to a four-valve receiver having a single H.F. amplifier, and in which no precautions had been taken to avoid "motor boating." The results obtained correspond with those produced by the use of an H.T. accumulator source. When the output valve was adjusted to the generous value of 30 mA. the anode potential was 195 volts. By means of parallel connected valves the load was increased to 40 mA., the output potential only falling to 170 volts. In this condition the output was entirely free from hum, neither was there mechanical vibration of the eliminator.



Totally enclosed Electramonic battery chargers and eliminator. They are convenient for accommodating within the cabinet work of the receiving set.

PICTURE RECEIVER PARTS.

The illustration shows the trigger manufactured by A. Baker, 89, Selhurst Road, S. Norwood, London, S.E.25, for use in the construction of *The Wireless World* Picture Receiver. It conforms to the design given, exactly resembling the original, and can therefore be fitted to the standard drilled panel without modification.



Baker's trigger release for use in building a picture receiver.

BROADCAST BREVITIES

By Our Special Correspondent.

Broadcasting Election Results.—News for the Empire.—Programmes in Emergencies.

Election Night.

The arrangements for the broadcasting of election results have been revised, and the B.B.C. has now decided to keep all its stations open until 4 o'clock on Friday morning, May 31st.

In addition to broadcasting the results as they are received, the B.B.C. will give a summary of the state of the parties every half-hour.

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No News from 5SW.

The B.B.C. Programme Control Board met in solemn conclave on Thursday last to decide whether or not 5SW should relay the Election results. I am not surprised that their decision has been kept secret, for disclosure would not have been a cheerful communication.

However, the fact that the question actually came up for consideration is a hopeful sign. The B.B.C. is beginning to realise that sooner or later the Empire as a whole will demand more than truncated excerpts from programmes which are intended to serve purely local needs.

o o o o

Searching for an Explanation.

It is difficult to obtain a satisfactory explanation at Savoy Hill for the complete elimination of news from the Chelmsford transmissions. The old excuse that the station, being experimental, did not warrant special arrangements with the news agencies, can no longer be accepted; even the B.B.C. recognises that an "experiment" cannot last for ever.

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New Arrangements Necessary.

If the news agencies offer an objection to the inclusion of news, surely it is incumbent upon the B.B.C. to come to terms. It can be explained that transmissions by short waves cannot possibly compete with news organisations in this country, and if the agencies are still unsatisfied on this point, the B.B.C. might consider an additional payment which would entitle them to transmit at least one of the daily bulletins.

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Wanted: A New Department.

The need for a new department—an "understudy" branch—was clearly revealed last week when an eleventh-hour hitch which prevented the broadcasting of the Covent Garden opera found the B.B.C. Programme Department "all dressed up and nowhere to go."

I hear that an S.O.S. was sent out for any artistes who might be available. The response must have been pretty meagre, judging from the mixture of gramophone music and comic patter which filled the gap. Anything less appropriate in the circumstances would be difficult to imagine.

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A Haphazard Policy.

With an eye to emergencies of this sort, the programme people have satisfied themselves that there are always three sources of talent which can be tapped at short notice. There are (a) programmes from other stations, (b) artistes "hanging about" Savoy Hill at the critical moment, and (c) gramophone records.

In last week's test case only (b) and (c) were available. The opera was to have been S.B. to all stations except 5GB, and it is an inviolable rule that the alternative programme must not be commandeered. With the elimination of (a), the other two made a poor showing.

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A Suggestion.

Probably the best permanent "understudy" would be a small orchestra with a big repertoire. Besides being readily accessible, this orchestra would be able to furnish music specially suited to replace the missing item. Disappointed opera lovers are not appeased even by the brightest gems of knockabout comedy.

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Motor Cycle Thrills.

"Ixion," of *The Motor Cycle* fame, will give an eye-witness account of the Senior T.T. Race from Liverpool on June 14th. His story will be relayed to 2LO.

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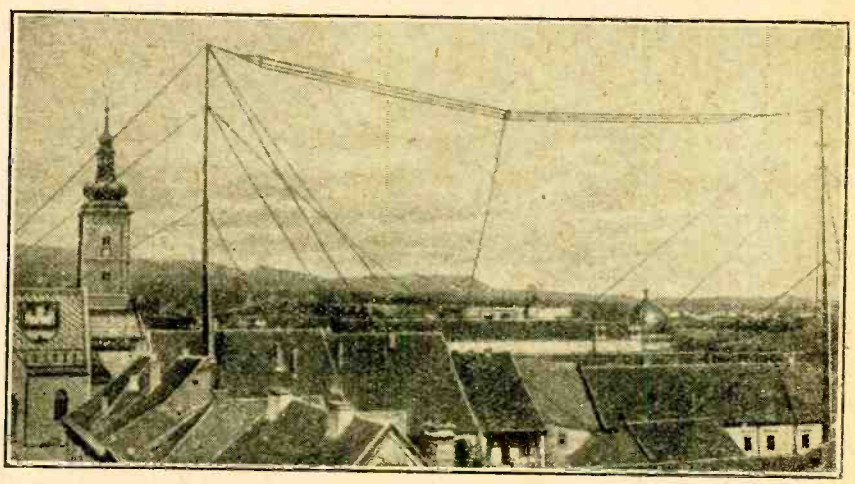
The Thoughts of a Nobody.

I can think of no character in literature more beautifully futile than Charles Pooter, the late Victorian hero of "The Diary of a Nobody," that immortal book by the Brothers George and Weedon Grossmith. On June 25th the B.B.C. will broadcast the first of a series of extracts in which the character part will be taken by Mr. George Grossmith, son of the original "Gee Gee." No one should miss this item, but I would recommend it specially to all who are temporarily tired of the humour of 1929.

o o o o

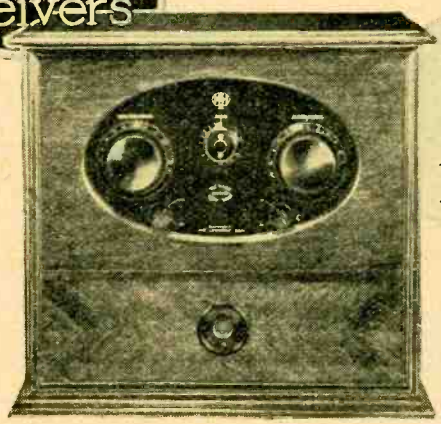
A Derby Rehearsal.

A rehearsal of the running commentary on the Derby is to be held on the previous day—June 4th—when the commentators will give a description of the Norbury Handicap. This will be broadcast on a closed circuit, the only listeners being a few picked judges at Savoy Hill.



BROADCASTING IN EASTERN EUROPE. The little town of Zagreb, Yugo Slavia, has earned international repute through its broadcasting station, seen above, which relays the programmes from Belgrade.

Broadcast Receivers



THE MAINS SCREENED DIMIC THREE

A Well-known McMichael Receiver Adapted for Operation from A.C. Mains.

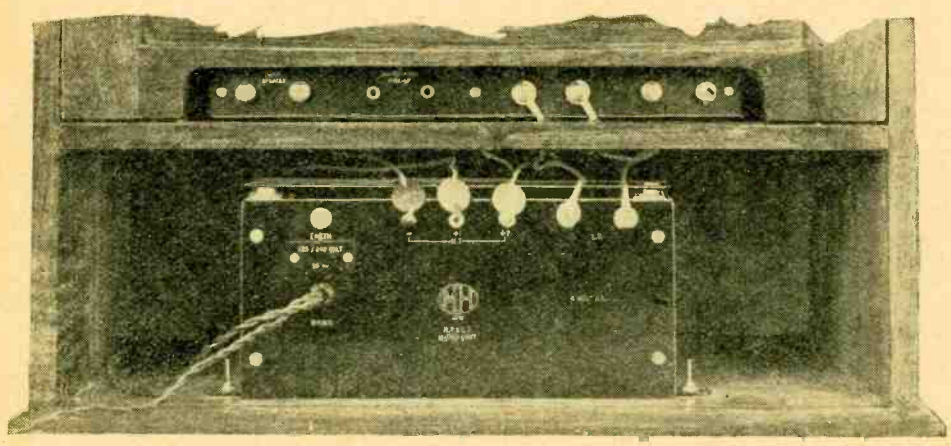
A DETAILED review of the original Screened Dimic Three appeared in the issue of this journal for August 8th, 1928. In converting this receiver for mains drive the makers have made few alterations to the design, and the mains equipment is largely supplementary. The following notes, therefore, are concerned mainly with differences between the two receivers, and readers desiring fuller details of the circuit should refer to the previous review.

The cabinet has been redesigned and is now made deeper to accommodate the H.T. eliminator. It is, however, correspondingly narrower as there is no longer any need to provide battery compartments at the sides. The total bulk is therefore little different from the original cabinet.

The circuit remains substantially the same as that of the original Screened Dimic Three. A choke-capacity filter circuit has, however, been incorporated in the output circuit to the loud speaker. This is a distinct advantage since it not only diverts direct current from the loud speaker windings but helps to keep low-frequency currents out of the H.T. supply.

Indirectly heated valves are used in the detector and output stages and a standard 2-volt screen grid valve in the H.F. stage. Consequently, the filament circuit of the original receiver has been considerably modified. On the terminal strip at the back of the panel there are two L.T. terminals, which are supplied from the eliminator transformer with 4 volts A.C. The heater terminals of the detector and output valves are connected directly to the 4-volt supply, but the screen grid filament is connected across a potentiometer device to preserve symmetry. The centre section of this potentiometer is fixed and accurately centre-tapped so that the grid bias for the screen grid valve is always returned to the mid-point of its filament circuit. The volume control filament resistance on one side of this fixed potentiometer is balanced on the other side by a fixed resistance, so that when the volume control is operated the middle section of the potentiometer system is thrown out of centre. This cannot affect the grid circuit of the screen grid valve, however, as the grid bias is always returned to the mid-point of its filament whatever position the 2-volt filament may occupy in the 4-volt supply. In the case of the indirectly heated valves, too, no hum is introduced by this lack of symmetry since the cathodes are tied down to the common negative and are independent of the filaments. This method provides a very neat solution of the problem of supplying directly- and indirectly-heated filaments from the same circuit, while legislating for volume control by dimming the filament of the directly-heated valve.

A Westinghouse copper-oxide rectifier forms the nucleus of the H.T. battery eliminator. The output from the rectifier is smoothed by a substantial choke and two high-voltage 4 mfd. condensers before passing to a section-wound potential divider from which the two +H.T. tappings to the set are taken. The potential divider is quite safe from the point of view of back coupling in a three-valve circuit of this type, and as an added precaution decoupling resistances are incorporated in the receiver itself. The eliminator is built in a well-ventilated iron case, which is provided with an earth-

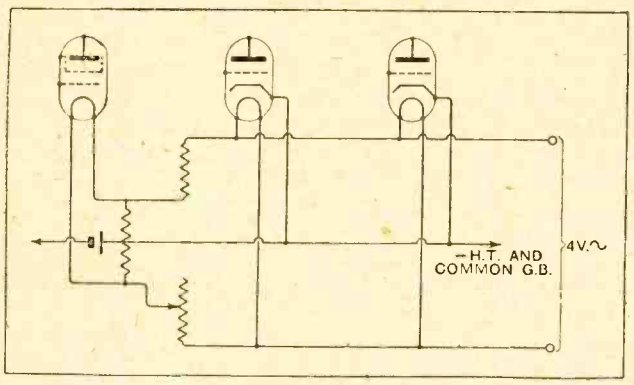


Back view of cabinet showing eliminator and H.T. and L.T. connections.

Broadcast Receivers.—

ing terminal. A main switch is incorporated in the front panel of the cabinet. The arrangement of the output terminals corresponds with the L.T. and H.T. terminals on the set so that the connecting leads are short and direct.

In testing the receiver our first concern was the performance on short waves. Many people are firmly of the opinion that short-wave receivers cannot be worked from the mains. It is true that early attempts to do so met with small success, but the performance of the McMichael set supports the contention of theory that there is no fundamental reason why a short-wave set should not work as well from the mains as from batteries. The residual hum is somewhat more marked on ultra-short waves than on the broadcast band, but it is not sufficiently serious to interfere with the reception of Melbourne, Australia (31.55 metres). This station was well received during the tests, and the A.C. hum was definitely below the level of extraneous noise due

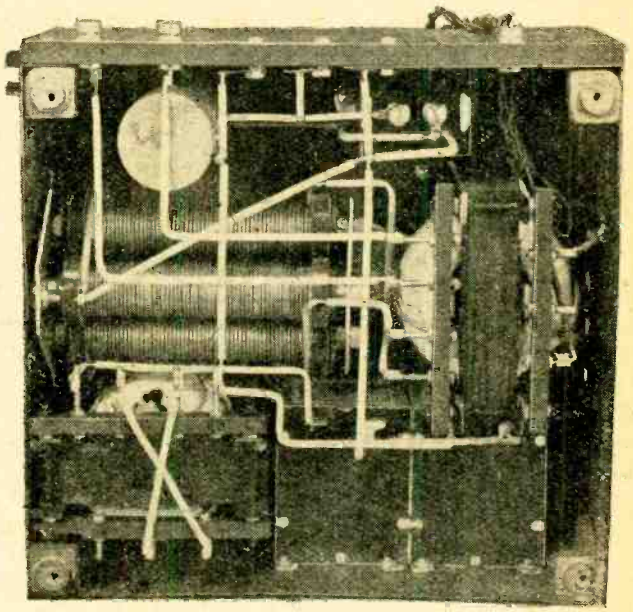


Schematic diagram of A.C. filament circuit.

to atmospherics. Schenectady, 2XAF (31.48 metres), was also well received. It is only when the receiver is in the oscillating condition that the hum becomes troublesome and causes modulation of C.W. signals.

Improved Sensitivity.

On the normal broadcast band the performance shows a marked improvement over the original Screened Dimic Three. It is still necessary to use reaction to obtain adequate selectivity, but the sensitivity has been considerably increased. Twenty miles north of 2LO, between twenty and thirty stations were identified on the 250-500-metre band. In the London area, of course, interference from 2LO reduces the number of stations receivable by at least half.



Plan view of interior of eliminator with cover plate removed.

As in the original Screened Dimic Three, the long-wave performance is excellent. There is no difficulty in separating Radio Paris from 5XX, and all the high-powered Continental stations are well received.

The mains-driven Screened Dimic Three can therefore be recommended for use principally as a receiver for good quality reception of the B.B.C. programme with occasional excursions to the Continent of Europe on the normal broadcast wavelengths and the possibility of receiving signals on short waves from other continents as a trump card. It is easy to install—all that is necessary is to insert the flexible cord connection in the nearest lamp socket or wall plug—and the first cost is the only cost apart from possible valve renewals. The price of 33 guineas includes royalties, valves and mains equipment, and the makers are Messrs. L. McMichael, Ltd., Wexham Road, Slough, Bucks, and 179, Strand, London, W.C.2.

LETTERS TO THE EDITOR.

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.

OLD LAMPS FOR NEW.

Sir,—One does not often meet with a gentleman as outspoken in cold print as Mr. Patrick King, so I hasten to take off my hat to him. The calm assurance with which he pleads the cause of the poor "experimenter" (who might otherwise have to buy every valve he tries in a set) is most refreshing. One appreciates the term "a gentleman's agreement" applied to an arrangement by which the "experimenter" and his dealer contrive to steal some of the hours of life for which the unwary will afterwards pay the full price!

If Mr. King saw my 10s. 6d. lying on the counter to pay for a valve, would he feel equally entitled to remove 2d. which I should have to make up?

No wonder that people who know that this goes on sigh for a return of the days when cartons were sealed and will only buy their valves direct from the manufacturer.

Furthermore, anyone worthy of the name of experimenter would know enough about his subject to be able to tell from published valve curves the type of valve required in any part of any given design of set without helping himself to another man's rights.

I. A. J. DUFF.

Pinner.

GRAMOPHONE REPRODUCTION.

Sir,—The efforts of the B.B.C. control engineers to vary the volume inversely to the conductor of the orchestra have waned since attention was drawn to this anomaly in these columns. The "de-conductor" has passed away, and it seems, too, as if the engineers' dream of a transmission of pure sine wave form, possibly of varying frequency, but at a constant audibility level, is, as a means of musical entertainment, severely shattered.

May I express the hope that these columns may be used with equal success to secure an improvement in the quality of the London and 5XX transmissions of gramophone records?

These, in my view, are inexcusably bad, and are certainly the inferior of some Continental transmissions. It may be that they are as bad as they are, because, if they were transmitted as well as our present knowledge and equipment permits, the contrast with many of the studio transmissions would be too striking. It may also be that the B.B.C. are using a type of pick-up with but little intentional damping, but which has a reed of relatively large dimensions that suffers from appalling inertia effects on the higher frequencies.

Whatever the cause, however, the need for improvement is both obvious and pressing. C. E. WOOD.

Parkstone, Dorset.

EMPIRE BROADCASTING.

Sir,—With reference to the correspondence in your columns re 5SW and Empire broadcasting, an interesting situation has arisen now that PHA, Huizen, is broadcasting on about 16 metres.

These programmes come through in *daylight* at comfortable phone strength, using your original Empire short-wave receiver, with a four-turn grid coil instead of the nine-turn coil originally specified. On the other hand, I can get little of the 5SW lunch-time programme except a faint carrier. Their evening programmes are quite loud and clear. But one cannot sit up till 2330 hours every night to listen to a programme (which invariably starts with a talk), as one has no means of knowing whether the remainder of the programme is worth sitting up for or not. Couldn't the engineer at 5SW give a brief summary of the evening programme, say, just before Big Ben strikes?

One occasionally hears 5SW testing with an American station (2XO?), and we know that they are trying out various aerial systems. What listeners in India and the East would like to see is some evidence of testing with stations east of the Greenwich meridian, because, owing to the proximity of the U.S.A., Canada is surely served better in radio matters than this country, and if we are to have Empire broadcasting our needs are at least as great as those parts of the Empire lying west of Greenwich.

One other point—there is a good deal more atmospheric interference on 24 metres than there is on 16 metres, and I think it would pay our people to experiment with various wavelengths as well as with aerial systems.

One cannot help feeling that our Dutch friends are putting up a better performance than our people and one cannot help admiring their efforts. One small point is their announcing in so many different languages—both PCJ and PHA do it. 5SW appears to think that the world is populated entirely by English-speaking people, though there must be many foreigners who look forward to 5SW's programmes as much as Englishmen domiciled abroad look forward to the Dutch transmissions.

Is it not time that the B.B.C. took us a little more into their confidence and gave us some idea of their aims and policy?

An account of the experiments at 5SW and their results and what they hope to do in the future would make interesting reading. F. C. B.

Lahore, India.
April 25th, 1929.

Sir,—You must be tired of complaints about 5SW being addressed to you, but if you realise how much your readers in distant parts of the Empire appreciate your continued struggle to move the B.B.C. in the matter, you will perhaps feel rewarded.

Incidentally, reception of 5SW in India has, to the best of my knowledge, practically ceased owing to poor signal strength and the late hour. We, in India, have to rely almost entirely on short waves in the hot weather and now have several good stations to draw on—Bandoing, PCJ, PCLL, 7LO, and one or two French and German stations. Now we are promised a possible regular service from the German "World Sender" and from Zoffen. Others will undoubtedly follow. It appears, then, that the B.B.C. must at once make up their minds about 5SW. It has been said that the B.B.C. are not justified in using British licence money for Empire broadcasting. They have used that money for nearly two years to study the possibilities of short waves. They are "still learning." Other stations, notably 7LO, learned how to do it in as many months. Clearly the B.B.C. are not justified in carrying on as they are in respect of 5SW. If they have not learned the secret yet they had better close down and devote the money to some more useful purpose, and leave British Empire listeners to turn to foreign stations for their entertainment, at what a loss to British prestige and initiative I leave you to estimate. There will be, I admit, many minor considerations, but the main one is money, and in the interests of economy alone I suggest that the British Empire Broadcasting Station must either "open out" or "close down."

Again thanking you for your enthusiastic support of Empire listeners and wishing you all success. G. S. R. WEBB, Capt. (Q.C.M.).

Punjab, India.
April 22nd, 1929.

SCRAPPY PROGRAMMES.

Sir,—May I be permitted a short rejoinder to the letter of Mr. Bertram Munn in the current issue on the subject of "scrappy programmes"?

Every thinking person has, regretfully, to admit the truth underlying Mr. Munn's pithy and humorous letter. The syndicated "popular" Press deliberately fosters the imbibing of "sensationalism" and "sentimentalism" in potted or tabloid form, but Mr. Munn must not suppose that the *whole* of the British public demands this type of thing, either in news or broadcast entertainment. Our economic and social system is based upon fallacies, and one of them is that a newspaper reflects the opinions and desires of its readers: the direct contrary is in fact the truth, and we have the public taking its opinions from its particular pet organ of *thought* (spare the word!). The popular Press simply reflects the opinions and desires of its rich owners, who all have personal axes to grind, and use their readers as the grindstone. The readers, being to all intents and purposes inarticulate, cannot protest, neither can they do without the Press.

But Mr. Munn must remember that there is *quality* and *quantity*, and that, however popular "quantity" may be at any one time, "quality" outlasts it and wins in the long run (unless human nature can be *permanently* warped). For instance, papers like the *Times* or *Post*, that have been in existence for more years than any man living can remember, will still be national organs when their upstart contemporaries are forgotten or absorbed in yet bigger amalgamations and syndicates. One copy of the *Times* and its reader is worth more than twenty copies of the "Penny Puff" and its twenty readers, just as one copy of *The Wireless World* is worth more than one hundred of its contemporaries. Why? Because in the former case the journal is written for, and by, "thinkers" and one thinking brain will always ultimately be superior to the total of machine-made mass-produced brains.

But to return to the main subject of this correspondence: Does Mr. Munn contend that the B.B.C. are deliberately sharing a bed with the sensation-mongers of the low brow Press in their pandering to the supposed desires of their public? If so, what of their high ideals for the betterment of the listening public? What of the ever-increasing seas of ink expended in moral-uplift publicity by the smug scribes of *The Radio Times* and *The Listener*, etc.?

In conclusion, may I thank all those who have taken the trouble to commend or criticise my plea for a solid homogeneous programme between 7 and 10 p.m.? I am a vain man, and my vanity is gratified to know that I am not such a self-centred crank as the B.B.C. pretended to believe when they replied to my criticism of the 9.0 to 9.40 p.m. break, that "mine was the only condemnatory letter received." L. PHILLIPS.

London, E.C.2.

READERS' PROBLEMS ANSWERED

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced in the interest of readers themselves.

A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

"The Wireless World" Supplies a Free Service of Technical Information.

Neutralising the Screen-grid Valve.

Can you give me an idea as to how much extra H.F. amplification could be obtained from my "Megavox" receiver by applying the neutralising scheme suggested in your recent article, "More Amplification from Screen-grid Valves"? J. B. S.

We think that you are under a misapprehension with regard to the question of neutralising. This refinement confers a benefit only when the H.F. resistance of the coils associated with the valve is so low that stability would not be attained without its use. Strictly speaking, the scheme is not applicable to any of the "S.G." receivers described in this journal, which are all so designed that stability is achieved without its use. In other words, neutralising will not be necessary or beneficial unless the H.F. circuits are completely redesigned.

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The "Kilo-Mag Four."

Will you please tell me where I can obtain full particulars of the "Kilo-Mag Four" receiver, mentioned in an article by B. H. Davies in your issue of May 8th? A. G. D.

This set was described, with full constructional details, in the issues of *The Wireless World* for October 24th and 31st, 1928. We understand that these back numbers are now out of print, but would inform you that arrangements are being made to publish a description of a revised version of this set in the near future.

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"Schools Demonstration Receiver."

I understand that it is possible to operate the "Schools Demonstration Receiver" from an H.T. accumulator battery of about 160 volts in conjunction with D.C. mains of 220 volts, the latter being connected in series with the accumulator for feeding the bank of output valves. Will you show me how a switch may be connected in order that the necessary connections may be made both for supplying the set and for charging the battery from the mains? P. A. H.

A convenient method of connection is shown in Fig. 1. When the switch blades are thrown to the right the accumulator battery is charged from the mains through the current-limiting resistance R. In the other position the voltage

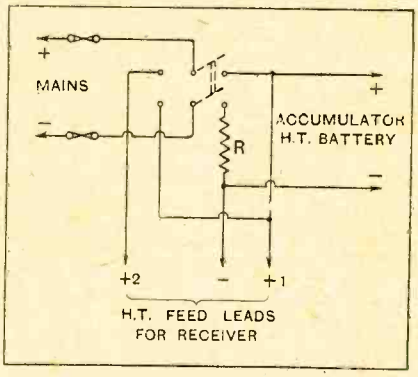

Fig. 1.—Switching scheme for connecting mains in series with H.T. accumulators for output valves.

of battery and mains in series is applied to the output stage, the first three valves being fed direct from the cells.

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"Everyman Four" Reaction.

Have you ever published instructions for adding reaction to the "Everyman Four" (for long-wave reception only)? If so, will you please give me the necessary reference? M. D. D.

This matter was discussed in the "Readers' Problems" section of our issue for August 29th, 1928.

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given: under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufactured receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Worth Waiting For.

Will you please give me a design for a three-valve set (H.F.-det.-L.F.) of high efficiency embodying a neutralised H.F. coupling on the lines of that suggested in your recent article entitled "More Amplification from Screen-grid Valves," in which I am deeply interested? D. R.

We fear that an adequate treatment of this query is quite beyond the scope of the Information Department (see Rule 3), but you will be glad to hear we have made arrangements to publish constructional details of a receiver embodying the new form of neutralised coupling. The article should appear at an early date, and we think that the receiver to be described will meet your needs.

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The Effect of Reducing Screening.

I have noticed that when the lid of the screening box in my receiver is removed signals increase in strength quite appreciably—in fact, the gain is so marked that I am working with an open box. The set is a 1-v-2 combination, with a screen-grid H.F. valve. Can you explain this effect? R. M.

This is quite normal. There is always a certain amount of stray reaction in a screen-grid valve circuit; by removing some of the shielding this is increased, and signals become louder. It is usual to design sets of this kind with a fair margin of safety as far as screening is concerned, and you may find that the lid becomes necessary if your present valve is replaced by one of higher efficiency.

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Megavox Modification.

The use of a variable resistance across the primary of the L.F. transformer seems nowadays to be a favourite form of volume control. Would this device be applicable to my Megavox set—of course as an addition to the present pre-detection regulation of input? F. T. T.

There is no reason why this addition should not be made to the Megavox receiver; indeed, it would confer some advantage, particularly when operating the detector on the anode bend principle.

Testing an L.F. Transformer.

I am almost certain that the primary winding of my L.F. transformer is "burnt out"; on replacing this component with a borrowed one, the set works as well as ever. This would appear to be a sufficient proof, but, on testing the winding with phones and a dry cell, quite a loud "click" is heard, indicating continuity. Can you explain? C. T. D

We agree that the effect of substitution would show almost conclusively that the transformer is faulty. With regard to the phone test, we think that you may have been misled by the fact that the break exists at a point near the centre of the winding, with the result that there is an appreciable capacity between the broken sections: the phones are operated by the charging current flowing into this capacity when the testing circuit is "made." If this assumption is correct, you will find that a click of comparatively much less intensity is produced when this circuit is "broken."

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Differential Reaction Control.

With reference to the article "Improving Selectivity" in your issue of May 8th, I should be obliged if you would criticise the circuit diagram of my proposed receiver; it embodies an arrangement similar to that of Fig. 2 of the article in question, but has a differential three-electrode condenser for reaction control. Will this modification be satisfactory? E. W. F.

We think that the arrangement you show should work quite well, although we have not tried the differential reaction condenser in conjunction with a combined aerial - coupling - and - reaction winding. The scheme would appear to have a theoretical weakness, as in certain circumstances there will be a parallel path of fairly low impedance for aerial circuit impulses to earth *via* the upper part of the primary reaction coil and the reaction condenser; currents flowing in this section of the coil will induce, into the secondary, voltages in opposition to those due to the coupling turns. It is likely that this may slightly impair the performance of the set: a great deal depends on the position of the aerial coupling tap, and the consequent relative impedances of the two parts of this coil.

We think you would be well advised to retain the original arrangement, as this seems to be a case where differential reaction control is unlikely to work its best.

Except for this point, we have no criticism to offer.

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Selectivity and H.F. Transformer Windings.

I am thinking of making a set with a single stage of H.F. amplification, using an A.C./S. valve. From a recent article I gather that a transformer with a ratio of 1 : 1 is generally to be recommended. Under my own receiving conditions, a degree of selectivity well above the average is essential, and I am wondering whether it would not be possible to improve the overall performance of the set in this respect by reducing the number of primary turns. However, if this plan would entail a very serious reduction in amplification, I must adopt some other expedient. Your advice on this matter would be greatly appreciated. C. B. P.

Your proposed scheme is quite a good one, and, provided that the secondary winding is of low H.F. resistance, there is no reason why exceptionally good amplification should not be obtained with a transformer ratio of 1½ : 1, or perhaps even 2 : 1. In any case, the final ratio can best be determined by trial and error, and we suggest that you should make up your transformers with a rather larger primary than it is expected will be required. It will then be easy to make the best compromise between selectivity and amplification by removing a few turns at a time. When making this adjustment it will be convenient to connect a milliammeter in series with the detector anode circuit (assuming that you are using anode bend rectification), and to use the readings of this meter as an indication of relative signal strength.

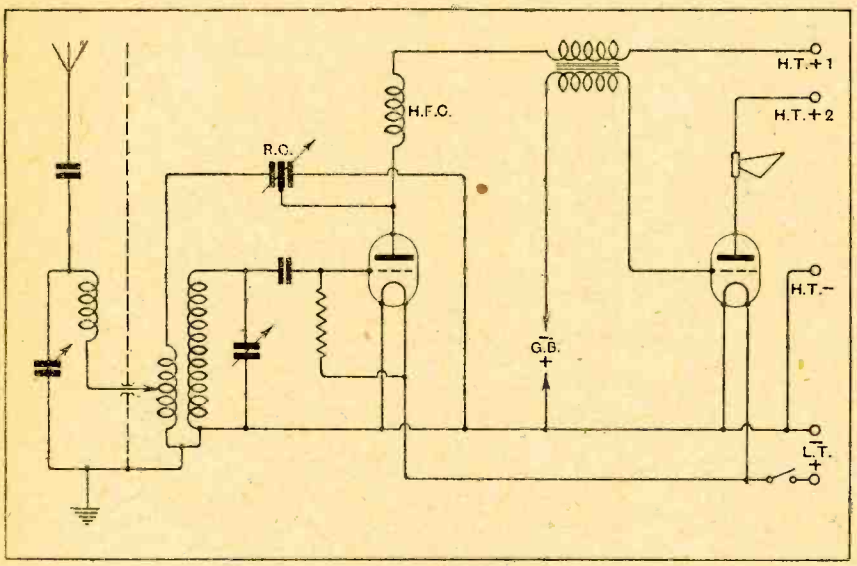

Fig. 2.—Tuned auto-coupled aerial circuit with reaction controlled by a differential condenser.

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Sensitivity and Selectivity Needed.

Will you please tell me if the "Alternative Programme Quality Receiver," published in your issue of December 28th, 1927, would be suitable for reception of the two Daventry programmes in this locality? If it is considered to be unsuitable, will you recommend some other design, bearing in mind my unfortunate situation (from the wireless point of view) and the fact that I require reproduction of moderate volume? H. M.

We do not consider that this receiver, which has an anode bend detector and two L.F. stages, is sufficiently sensitive for use on the south coast; also, it is doubtful whether its selectivity would be sufficient. A better set for your purpose would be the "S.G. Regional," described in our issues of March 27th and April 3rd.

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Modern Valves.

You have pointed out that the substitution of modern high-efficiency valves for out-of-date specimens may result in H.F. instability; does the same principle hold good in dealing with the L.F. side of the receiver? I am thinking of obtaining a new set of valves for my detector-L.F. set, to replace the comparatively inefficient ones at present in use, and am wondering if there is any chance of encountering trouble due to L.F. reaction. H. B.

It is a fact that any tendency that may exist in your set towards L.F. instability will be increased by using "better" valves. This is because the overall magnification obtainable will be increased. It may be pointed out, however, that these troubles may be overcome by including the various precautionary measures, such as decoupling, etc., that have been discussed from time to time in the pages of this journal, and there is no need for you to put up with results less good than can be obtained on this score.

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Increased Volume on Short Waves.

Is there any objection to using a pentode valve, in place of ordinary triode, in my short-wave receiver? My object is to increase volume in order that loud speaker reception may be obtained on some stations that are at present insufficiently strong for reproduction in this manner. F. J. H.

There is no reason whatsoever why this valve should not be used in a short-wave set, and no special precautions need be observed.