THE ALL D.C. THREE

The Wireless World

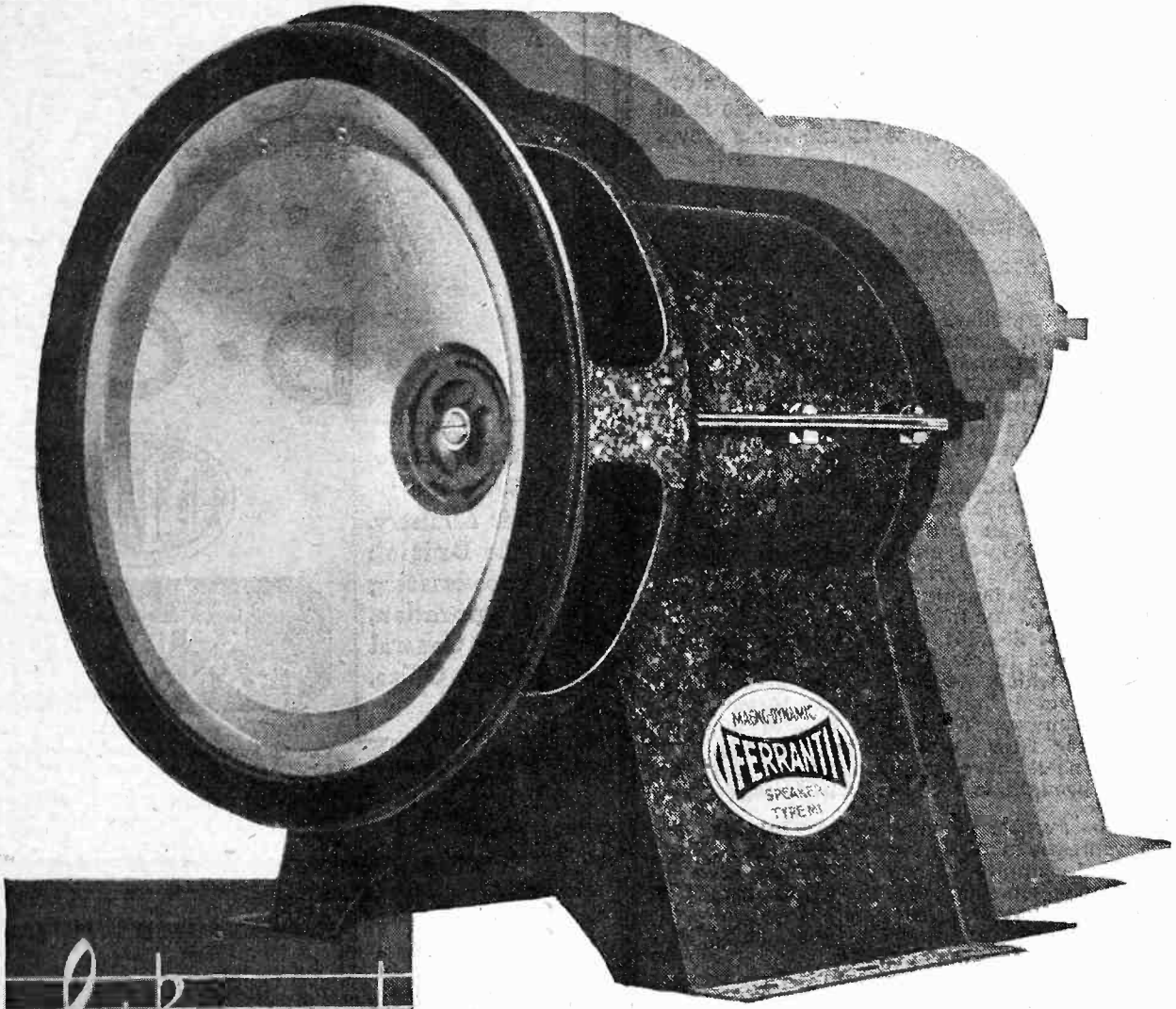
AND RADIO REVIEW

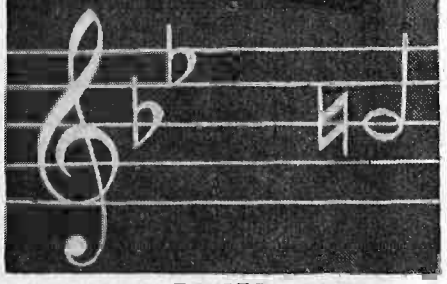
4D

The Paper for Every Wireless Amateur

Wednesday, August 20th, 1930.

No. 573. Vol. XXVII. No. 8





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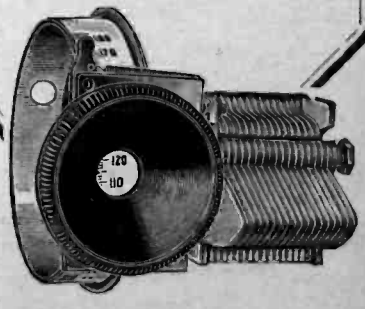

The Wireless World AND RADIO REVIEW

(18th Year of Publication)

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CONTENTS OF THIS ISSUE.

THE B.B.C. MACHINE.

A VISITOR from the Continent, giving us his impressions of our broadcasting organisation recently, described it as an extraordinarily efficient machine which turned out high-class programmes as monotonously as tunes on a hurdy-gurdy, but was, in fact, as inhuman and soulless as the most ideal of red tape Government Departments.

We thought this rather a scathing comment to make on broadcasting, because the microphone is generally regarded as providing a much more human atmosphere than can be attained through the medium of books or mechanically reproduced music. But apparently it was not this aspect of the question which our friend had been considering. He had a high opinion of the programmes and of the material used in their composition, but he contended that there was no individuality in the B.B.C. constitution. This probably arises from the fact that the B.B.C. is not authorised to comment officially on current events; that is to say, there must be no equivalent to an editorial introduction to programme items which might be construed as an official expression of opinion by the Corporation. Is there not, however, some means of compromising with this stipulation? Cannot something be devised to give the B.B.C. a soul; that is to say, to bring it more into sympathy with the listener, and remove from the microphone the impersonal and almost mechanical atmosphere in which it is being slowly enveloped?

We believe that if Sir John Reith and members of the Governing Board would come to the microphone from time to time and talk to listeners on such questions as the aims and policy of the B.B.C., it would produce a very good effect. The talks could also provide the opportunity for sympathetically replying to well-meaning current criticisms levelled at the Corporation. These talks would have the effect, as it were, of taking the listener into confidence, and might do much to assist listeners to realise that, after all, the B.B.C. is a human organisation rather than a programme-producing machine.

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ULTRA SHORT WAVES.

IT is generally conceded that it is to the amateurs that we are indebted for hastening the development of the use of short waves for practical communication, for it will be recalled that at a time when the short waves had been allotted for amateur use because they were considered to be of little use for commercial communication, amateurs in this country, in Australia and America, astonished the world by establishing inter-communication on low power on short wavelengths. That is some five or six years ago, and since that time considerable attention has been focused on wavelengths of a still lower order, particularly between 5 and 2.5 metres, and although much remains to be learned concerning this band, there is already sufficient evidence to indicate that it has great possibilities.

Previously *The Wireless World* has had the opportunity of acting as a medium for bringing into touch those amateurs who were undertaking short-wave experimental work, and we feel that we should like once more to act as the means of assisting amateurs working on the new wavelengths to co-operate. Naturally, a transmitting licence is necessary before transmitting on these wavelengths can be undertaken, but reception can be carried out by a large number of observers, and the results obtainable from such observations would be of the utmost interest in establishing data on range, screening, and other effects. We shall welcome correspondence from any amateurs interested in experimental work on this band.

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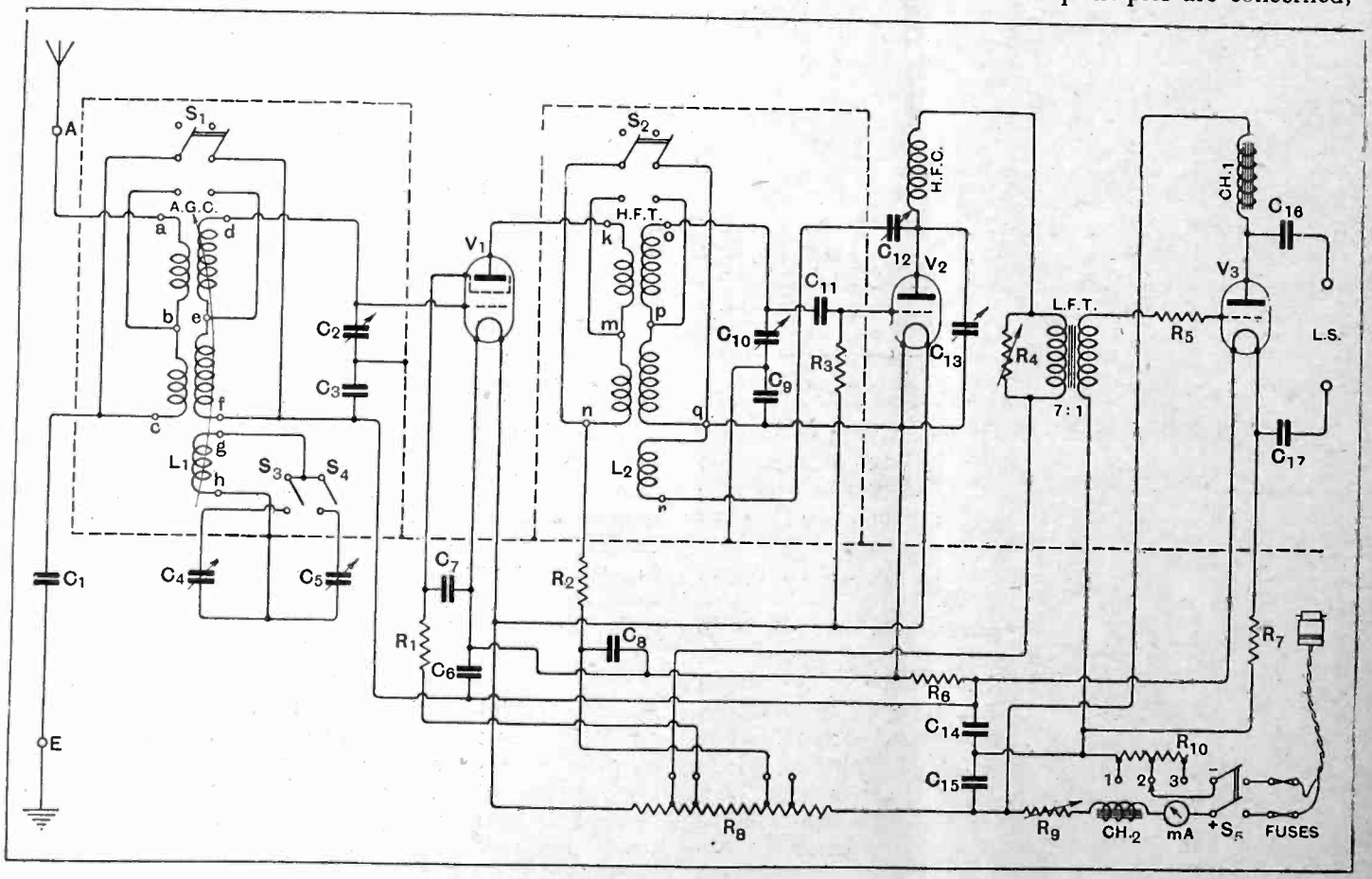
Batteryless Three-Valve Receiver with Rejectors.

By H. B. DENT.

ABOUT six months ago the writer discussed in these pages a few of the more economical methods of deriving the filament current for a receiver from the D.C. mains,[1] and concluded by giving a theoretical diagram of a set embodying the principal features mentioned. As a number of readers have expressed a desire for more detailed information, especially as regards values for the various components required, it was thought that these could best be supplied by submitting the design of a complete three-valve set embodying the main features discussed at that time, and also any new developments that may have come to light more recently.

So far as the fundamental principles are concerned,

[1] *The Wireless World*, February 19th, 1930.



Theoretical circuit. Values are as follows:—C_1, C_3, C_7, C_8, C_9 and C_{14} = 1 mfd.; C_6 = 0.1 mfd.; C_2, C_{10} and C_{12} = 0.0005 mfd. variable; C_4 and C_5 semi-variable with maximum of 0.001 mfd.; C_{16} and C_{17} = 2 mfds.; C_{11} = 0.0002 mfd.; C_{13} = 0.0003 mfd. semi-variable; C_{15} = 8 mfds.; R_1 and R_2 = 600 ohms; R_3 = 2 megohms; R_4 = 25,000 ohms variable; R_5 = 0.25 megohm; R_6 = 4 ohms; R_7 = 54 ohms; R_8 = 630 ohms total; R_9 = 50 ohms variable; R_{10} = 160 ohms total.

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the article mentioned above may be regarded as a theoretical treatment of this particular set, so that it is unnecessary to repeat them here. The space available will be devoted entirely to practical matters, but in cases where there has been any material deviation from the theoretical conception, a few words of explanation will be given.

From the theoretical diagram of the receiver illustrated here, it will be seen that the H.F. and detector valves, V_1 and V_2, have their filaments connected in parallel, and that the power valve filament is in series with these. The grid bias resistances are suitably disposed in series with the valve filaments. This particular scheme has been illustrated and discussed fully in the earlier article. In the present version, however, it has been thought advisable to adopt the leaky-grid method of detection on the grounds of sensitivity, and to enable reaction to be employed. This is followed by a 7 : 1 ratio L.F. transformer feeding into a three-electrode power valve of the 6-volt 0.25 amp. filament class. The combination gives ample L.F. amplification, and dispenses with the slight additional complications involved by the use of a pentode.

One other feature has been introduced, this being the inclusion of a rejector circuit in lieu of a separately tuned aerial circuit, as by its aid the effective selectivity, when relatively close to a powerful broadcast station, can be enhanced without adding to the complication of tuning.

Provision is made for reception over the whole of the present broadcast waveband, switches being included to short-circuit the loading coils associated with each circuit. By suitably disposing the reaction coil, and carefully adjusting its turns, reaction can be obtained over the whole of the waveband covered without the need for two separate coils. This simplifies the switching on the intervalve H.F. transformer.

One other point of interest regarding the design is that all the metal work, and exposed conducting parts, are isolated from the D.C. circuit by large-capacity condensers. Thus there is practically no danger from electric shocks, even when the set is used on a supply main in which the positive conductor is earthed at the generating station.

A little thought will show that, to comply with these conditions, the tuning condensers C_2 and C_{10} should be insulated from the metal boxes, which would entail bushing the fixing holes with insulating material. Although this is not really troublesome to effect in practice, it was decided to fix them in the usual way and to insert 1-mfd. condensers, shown at C_3 and C_9, which would achieve the desired result in a more simple constructional manner. Condenser C_1 has been included in the earth lead to complete the scheme, and to isolate fully the wireless earth from the lighting system should the turns on the aerial-grid coil inadvertently short-circuit.

The output end of the set has been similarly treated and the additional feed condenser C_{17} included to isolate totally the loud speaker terminals from the mains. A 1 : 1 output transformer would serve the same purpose from this point of view, but it might encourage L.F. instability unless certain precautions were taken.

As there seems to be little more to be said about the general features of the set, attention can now be

SPECIFICATION.

A selective receiver in which both filaments and anodes derive their current from D.C. mains. A specially designed L.F. choke ensures freedom from hum.

Rejectors *are included. The effective selectivity can be enhanced when working close to a powerful station without adding to the complication of tuning.*

Single Screen Grid H.F. Stage *with transformer coupling.*

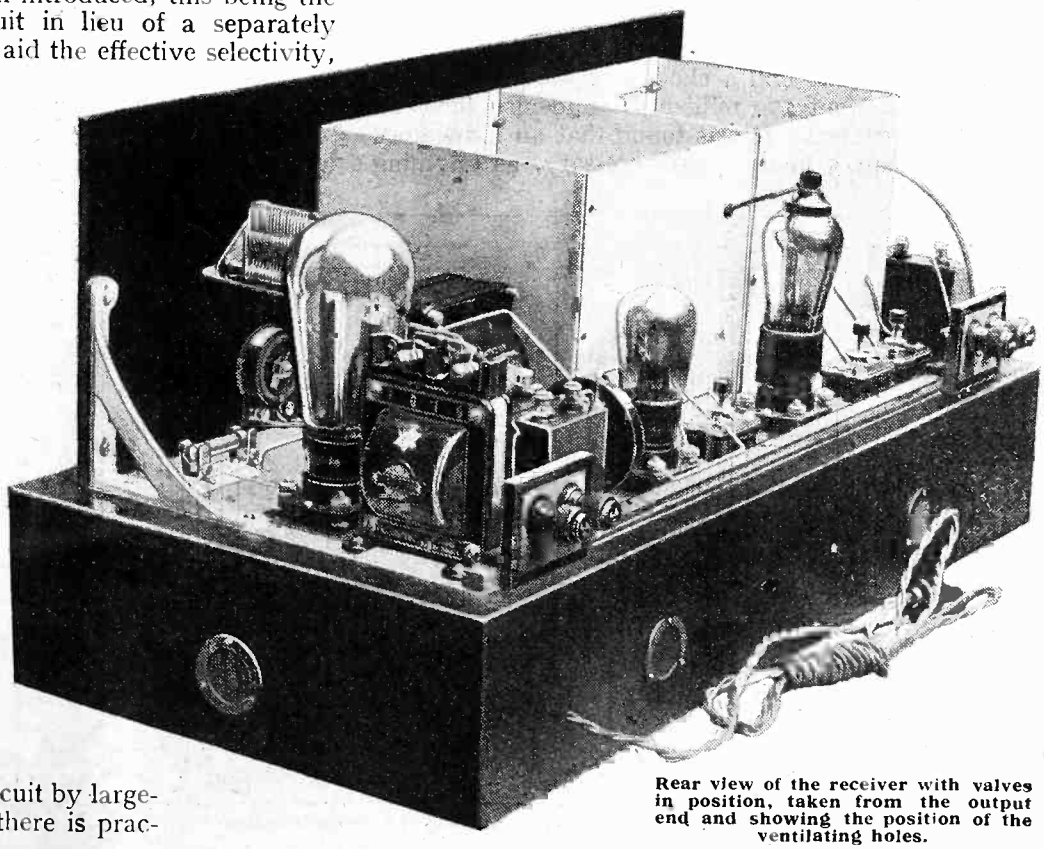
Leaky Grid Detector *coupled by 7 : 1 L.F. transformer to triode output valve.*

Reaction *applied to intervalve coupling.*

Grid Bias *obtained automatically from voltage dropping resistances.*

Waveband Switching *is incorporated.*

Metal Screening *isolated from mains, thus preventing shock when positive mains conductor is earthed.*



Rear view of the receiver with valves in position, taken from the output end and showing the position of the ventilating holes.

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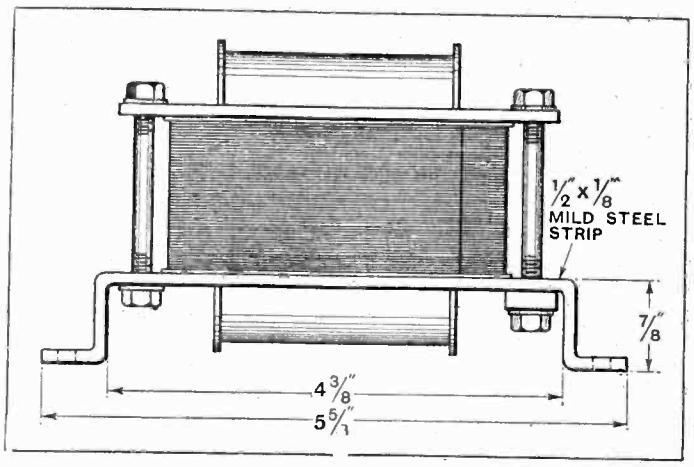
directed to the construction of the few special parts that cannot, to the best of the writer's knowledge, be purchased at present. These include the special L.T. choke, CH_2; the resistances R_6, R_7, R_8, and R_{10}; the aerial-grid coil, and the high-frequency transformer.

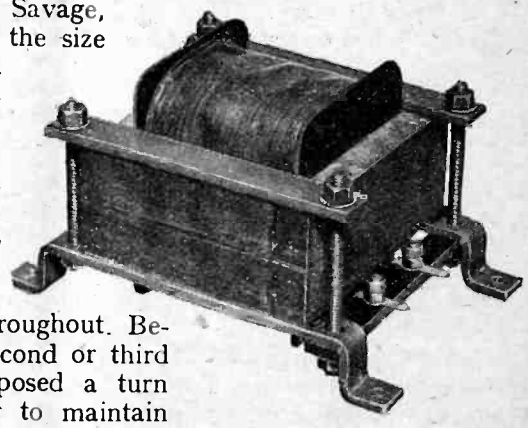


Dimensional data of the L.T. smoothing choke giving about 5 henrys when passing 275 milliamperes of D.C.

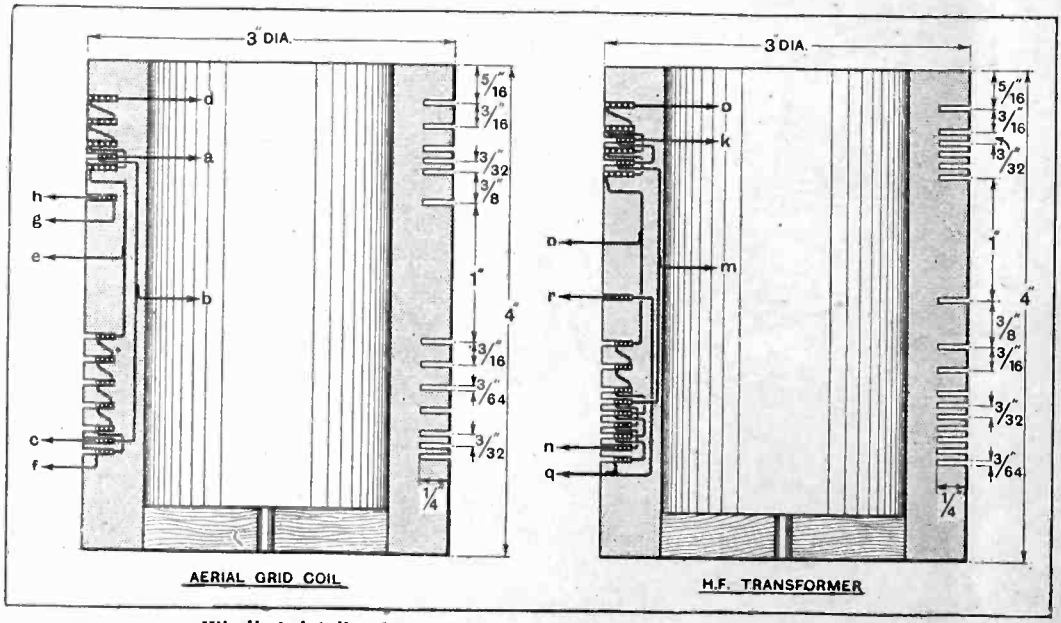
The smoothing choke is of particular interest, as its function is to smooth out the superimposed ripple, thus rendering the D.C. suitable for both filament heating and H.T. Experiments have shown that, unless the filament supply, which also provides grid bias, is entirely free from ripple, no amount of smoothing of the H.T. will give a silent background. Furthermore, having acquired a satisfactory L.T. supply, it is quite unnecessary to include further smoothing equipment in the anode supply. Having arrived at this conclusion, the next step was to find a choke that would carry the total current—about 270 milliamps—and also show an adequate inductance. It was found that an inductance of not less than 5 henrys was necessary, as anything below this would not put up a high enough impedance to the lowest ripple frequency likely to be encountered, which was adjudged to be of the order of 50 cycles.

Unfortunately, the writer was unable to trace a commercially made article complying with these specifications, and as a consequence attention was given to the question of designing one for this particular set. It is a relatively simple piece of apparatus to construct, albeit a little tedious, perhaps, but, as it is virtually the key component in the set, the need for the exercise of care in its construction is essential and cannot be too well stressed.

The core is built up from the No. 4 size transformer stampings—familiar to most readers by now, as they have been used from time to time in the small power transformers described in this journal. The winding is carried on one of the special bakelised formers sold by W. Bryan Savage, and listed as the size No. 4F. On this bobbin is wound 3,000 turns of No. 28 enamelled wire with consecutive turns touching, and wound in layer form throughout. Between each second or third layer is interposed a turn of thin paper to maintain an even winding surface. The wire must be kept fairly taut throughout the winding process, as otherwise there may be some difficulty in accommodating the requisite number of turns. The casual method of winding in which the turns are run on in no particular sequence is definitely not advised, since this takes up too much space for the given number of turns.



The L.T. smoothing choke.



Winding details of the aerial-grid coil and H.F. transformer.

To obviate magnetic saturation of the iron, an air-gap must be left in the core, so that it is not practicable to assemble the laminations in the order described for the small power transformers mentioned above. It will be recalled that in these each pair of stampings—a pair comprising one "T"- and one "U"-shaped piece—were assembled, so that the joint in one pair did not coincide with the joint in the consecutive pairs. In the present case all "T" pieces are inserted into the bobbin from the same side, and this applies to the "U" pieces also, so that the joints come together. Actually, there

LIST OF PARTS.

3 Variable condensers with dial, 0.0005 mfd. (Utility "Mite").
2 Change-over switches, 2-pole, lever pattern (Wearite 1.12).
3 Valve holders (Benjamin "Vibroholder").
1 L.F. transformer, ratio 7 : 1 (Ferranti A.F.6).
1 L.F. choke (Igranic "F").
1 H.F. choke (Igranic).
1 Porcelain rheostat, 50 ohms. (Igranic P56-E).
1 Grid leak, 2 megohms.
1 Grid leak, 0.25 megohm.
1 Porcelain grid leak holder.
4 Ventilation windows (Bulgin).
2 Dial indicators (Bulgin).
2 Screening boxes, 6½ × 6½ × 6in. aluminium (Magnum).
2 Coil formers, 9-ribbed, 3in. dia. × 4in. length (Becol 9a).
1 Variable resistance, 25,000 ohms. (Rotor-ohm).
1 Push-button mains switch, 2-way, 5 amp. (G.E.C. S.2304).
1 Escutcheon plate for above (G.E.C.).
2 Cut-outs, 5 amps. (G.E.C. S.845).
2 Decoupling resistances, 600 ohms (Wearite).
100 Pairs No. 4 stampings (Savage).
1 No. 4 F. bobbin (Savage).
1 lb. No. 28 enamelled wire.
8 oz. No. 28 Eureka wire. (L.E.W.).
Quantity No. 28 D.C.C., No. 32 D.S.C., and No. 40 D.S.C.
2 Fixed condensers, 4 mfds., 400 volt D.C. test (Dubilier B.T.).
2 Fixed condensers, 2 mfds., 400 volt D.C. test (Dubilier).
6 Fixed condensers, 1 mfd., 400 volt D.C. test (Dubilier).
1 Fixed condenser, 0.1 mfd. mica (Dubilier B.775/1).
1 Fixed condenser with clips, 0.0002 mfd. (Dubilier No. 620).
2 Terminal mounts (Junit).
4 Terminals, L.S., A and E. (Belling-Lee). Ebonite shrouded.
1 Paxolin panel, 21in. × 7in. × ⅜in.
1 Milliammeter, 0-500 mA. (Hunt 144F.).
2 On-off switches (Wearite).
2 Semi-fixed condensers, 0.00017-001 mfd. (R.I. "Varicap," No. 5).
1 Semi-fixed condenser, 0.00006-0003 mfd. (R.I. "Varicap," No. 3).
1 Sheet aluminium, 27in. × 9in.
Material for cabinet and resistance formers.
Systoflex, wire, screws, plug adaptor, etc.

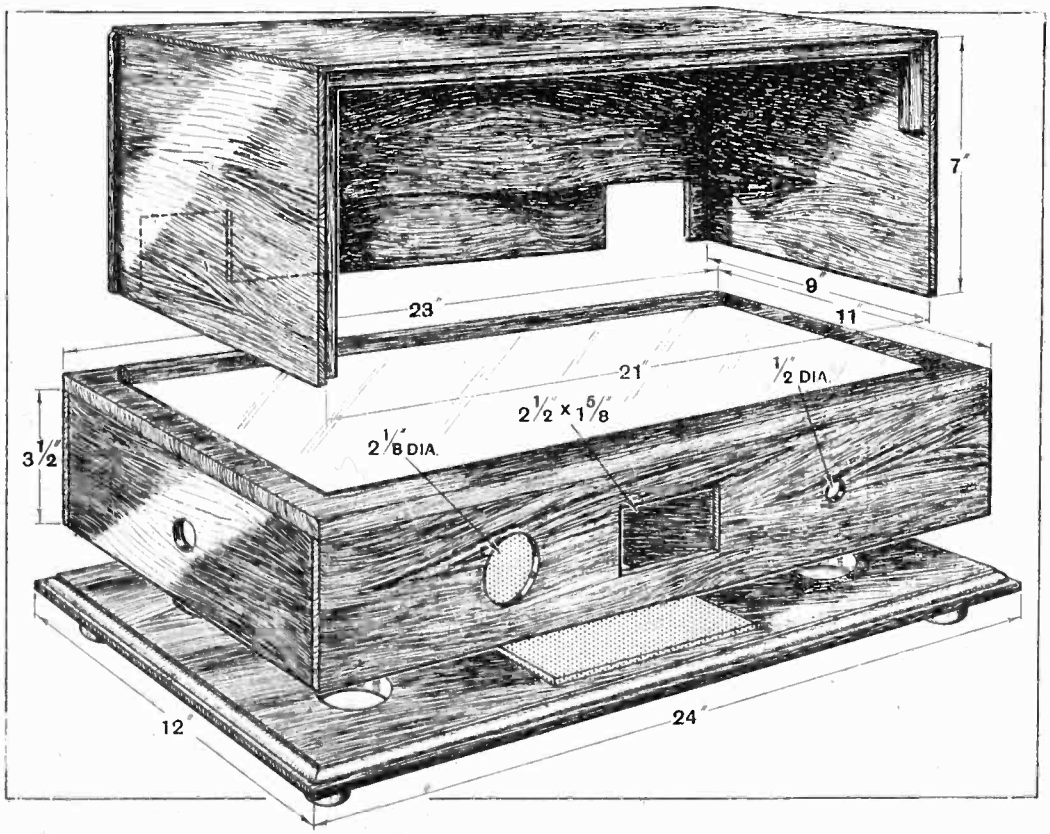
Approximate cost (excluding material for cabinet,) £12.

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.

are three joints in the core—one in the centre limb and one in each of the side members. There is one little matter that has to be seen to before finally clamping the stampings and filling in the gaps with the positioning pieces used for fixing their width.

When the stampings are assembled in this manner there is sometimes a tendency for the two halves of the core to twist so that the tails of the "T" pieces slightly overlap the "U" pieces, and, should this occur, it will introduce a much larger air gap than is desirable or necessary. As a means of obviating this, a "T" and a "U" of the same size as those forming the core should be cut out of thin Paxolin sheet—about $\frac{1}{64}$in. thick—and inserted in the centre of the iron, but put in from the opposite side from their respectively shaped stampings. This positions the stampings and overcomes the trouble mentioned above.

In all, about 100 pairs of stampings are required, and when they have been assembled in the core they can be secured together by the specially shaped iron clamps shown in the drawings and illustrations. Before fixing them in position place a strip of thin paxolin between the core and each clamp, as otherwise the iron will short-circuit the air gaps. The fixing bolts may then be inserted and the nuts run up finger-tight, after which the pieces of paxolin, mica, or other non-magnetic material should be inserted in the gaps in the iron core. These should be 0.02in. in thickness, which is approximately No. 24 S.W.G. The core can then be hammered up so that the iron beds down firmly at all points on to the air-gap retainers, and the clamp nuts tightened up with a spanner. The measured inductance of the choke built to this specification works out at 5.25 henrys at 50 cycles when carrying 275 milliamps of D.C., and with 5 mA. of A.C. superimposed.



The plinth and cabinet, giving general dimensions.

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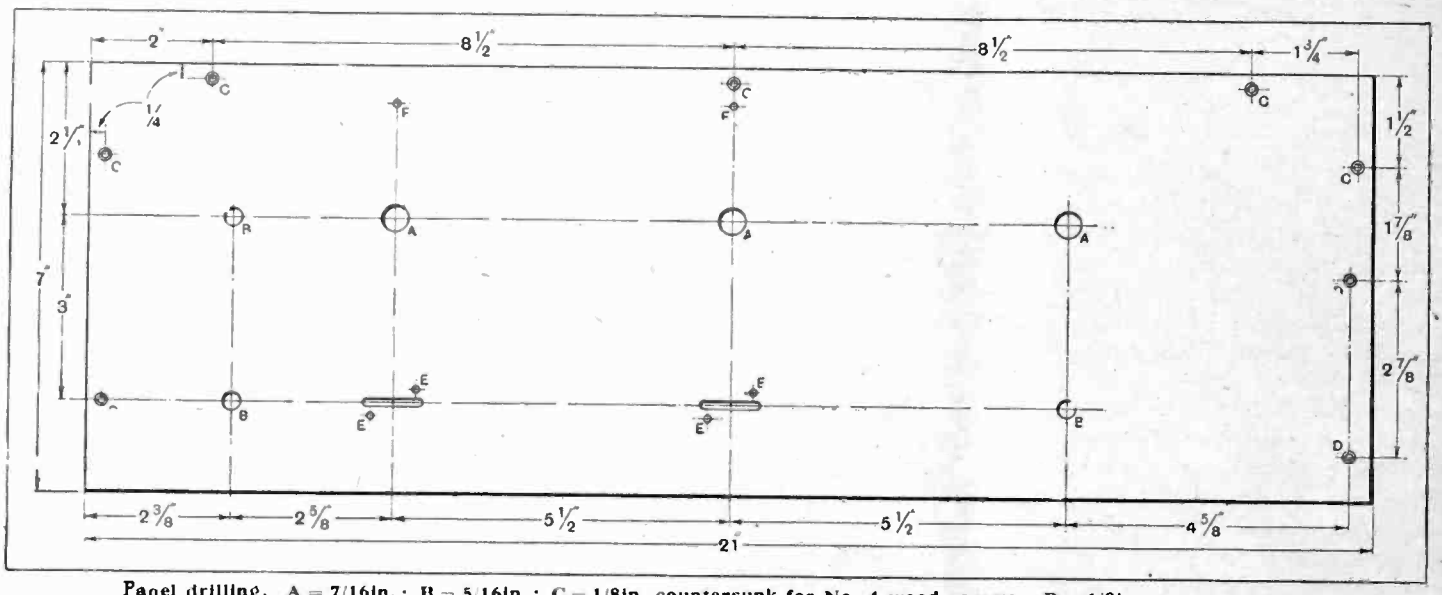
The next job to tackle should be the coils, which follow closely the general lines of those used in the certain *Wireless World* sets. A Becol nine-ribbed former is used in each case, and the various windings are carried in slots, the positions and dimensions of which can be obtained from the dimensional drawings. On the aerial-grid coil, four sections, each wound with 15 turns of No. 28 D.C.C., form the medium-wave coil, while for the long-wave loading coil six slots are used, each carrying 30 turns of No. 32 D.S.C. wire. The aerial winding is split into two parts, one coupling with the medium-wave coil, and the other with the loading coil. A single slot cut in the space between the two end sections at the low potential end of each carries 8 turns of No. 40 D.S.C. in the case of the medium-wave portion, and 20 turns of the same gauge wire for the long-wave section. Both aerial and grid-loading coils are short-circuited when receiving on the 200- to 600-metre band. Spaced $\frac{1}{4}$in. from the low potential end of the medium-wave grid coil is a single slot carrying 20 turns of No. 32 D.S.C.; this is the wave-trap. The grid windings should be put on first, and where the wire passes from the top of one slot down to the bottom of the next, it should be laid well down on to the former, so as to leave a clear space for the aerial coil.

The H.F. transformer is likewise divided in sections, four wound with 15 turns each forming the medium-wave grid coil, and six sections each with 35 turns, in this case of No. 32 D.S.C., form the long-wave loading coil. The primary windings are carried in shallow slots sandwiched between the low potential end sections of each grid winding. For the medium-wave primary, two sections, each with 15 turns of No. 40 D.S.C., are required, while for the long waves there are three sections, each wound with 35 turns of No. 40 D.S.C.

Located between the two banks of windings is the reaction coil, which is wound in one slot spaced 1in. from the low potential end of the medium-wave portion. This slot carries 30 turns of No. 32 D.S.C. wire. As in the case of the aerial-grid coil, the secondary sections can be put on first, and care should be taken to see that where the wire passes from one slot to the next it is made to follow the contour of the former so as to leave room for the primaries. It might be well to place a strip of mica along the length of the former, so as to ensure that these inter-slot connections do not touch the primaries. Similar care should be given to the carrying-over turn linking together the primary sections. In this case the wire is taken over the top of the secondary sections, and a strip of mica might well be placed so as to afford good insulation. The fact that the primaries are at high D.C. potential with respect to the secondaries should be borne in mind when winding the coils.



Panel drilling. A = 7/16in.; B = 5/16in.; C = 1/8in. countersunk for No. 4 wood screws; D = 1/8in. countersunk for No. 6 B.A. screws; E = 1/8in.; F = 3/32in.

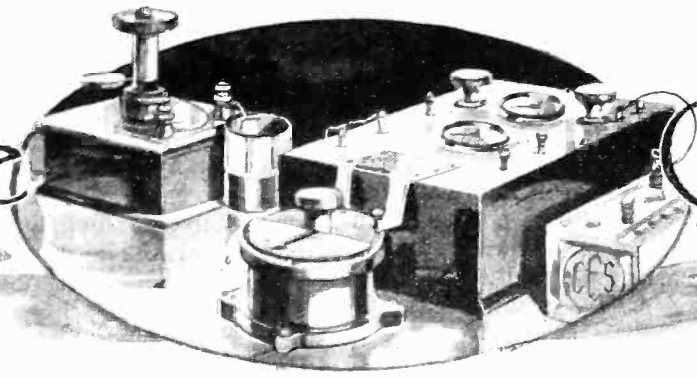
The plinth, which houses the mains equipment, and serves also as a baseboard for the wireless components, measures 23in. × 11in. × $3\frac{7}{8}$in. outside. Any kind of hard wood may be used for this, and the thickness can well be left to the constructor. The essential dimension is the depth inside, which should not be less than $3\frac{1}{2}$in. The model illustrated was built up from three-ply wood, $\frac{3}{16}$in. thick, and oak-faced, for the sides, while the top was a piece of hard wood $\frac{7}{16}$in. thick. Strengthening pieces are glued in the four corners, also at intervals along the sides to facilitate fixing the rather thin sides to the top. There is no objection to the use of thicker material for the sides if this is desired.

The top of the plinth is covered by an aluminium plate measuring 21in. × 9in., and this is held in position by the screws fixing the various components to the base. Its object is to afford a measure of screening between the unscreened portions of the detector and L.F. circuits and the mains equipment. Next drill the ventilation holes and holes to take the mains switch, the meter, and the variable resistance in the plinth.

When the paxolin panel has been drilled according to the details given in the drawings, it can be placed in position and the corresponding holes in the aluminium boxes marked off, using the panel as a template.

(To be concluded.)

Response Curves



Determination of Response Curves. An Experimental Method of Approximate Accuracy.

By PROFESSOR C. F. JENKIN.

ALL readers of *The Wireless World* must be grateful for the various articles published early this year on filter circuits and their response curves, and particularly for the advice as to the best ways of arranging the coupling so as to get the results desired; but most experimenters will wish to know what response curves they are actually obtaining when they have made up the circuits recommended. A simple method of experimentally measuring the response curve for any particular receiving set is therefore rather urgently needed. The method described below has been successfully used by the author; it is simple, but it is only applicable to sets which use the type of anode bend detection recommended in *The Wireless World* (e.g., in an article by W. I. G. Page, March 27th, 1929) and are fitted (or can be fitted) with a milliammeter in the detector plate circuit, as recommended in that article. It cannot lay claim to great accuracy, but appears to be amply accurate enough for most purposes, and to be devoid of complicated measurement.

A SIMPLE method is described for measuring experimentally the response curve of a particular receiving set. The response curves so obtained show the effect produced when certain constants of the circuit are varied or adjustments made.

To make the measurements it is necessary to rig up an oscillation generator to induce oscillations of the desired frequency in the aerial. The circuits are shown in Fig. 1. On the left is the generator with tuned grid circuit; on the right is the receiving set; the filter, H.F.S.G. valve and detector valve only are shown, the other parts of the set do not concern us. The filter is arranged in the way A. L. M. Sowerby recommended in *The Wireless World* of February 26th, 1930, and shown in his Fig. 4b, the two tuned circuits being coupled by a small coil M. Coils with 10, 11, 12, 13 and 14 turns, 1in. diameter, have been made and can be plugged in as desired. The generator is loosely coupled to the aerial and induces in it currents of any desired frequency. The response of the set is shown by the milliammeter. Thus we can read the response as the frequency changes, i.e., we

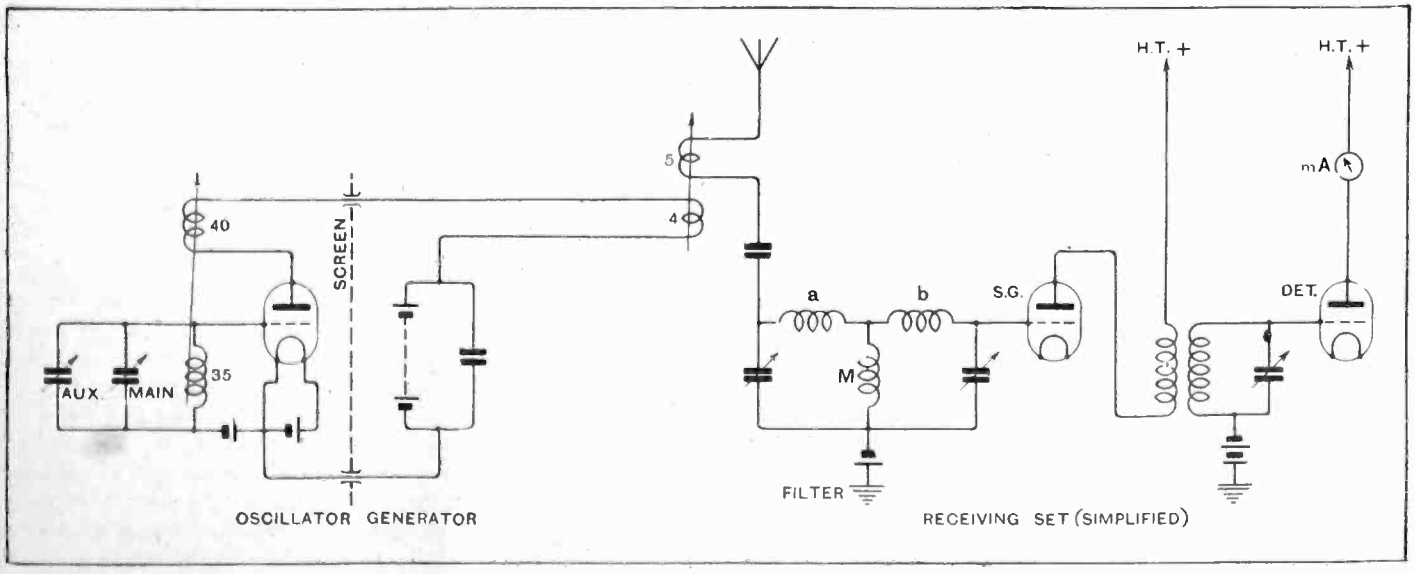


Fig. 1.—Circuit used for the measurements.

Response Curves.—

obtain the co-ordinates of the response curve. No special apparatus is required, but the main condenser used in the oscillation generator must be calibrated; a condenser with circular plates (straight line capacity) is the most convenient. The auxiliary condenser should also have circular plates; it can be calibrated from the main condenser during the test. It should have a capacity of about one-tenth that of the main condenser.

Tests can only be made when the B.B.C. is silent. The procedure is as follows. In the evening leave the

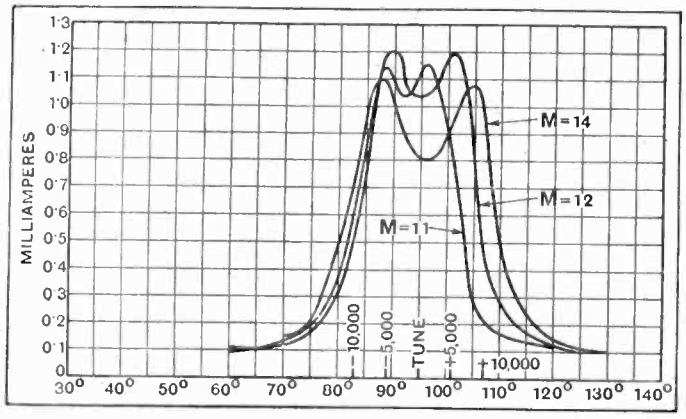


Fig. 2.—NATIONAL. Various filter couplings.

set tuned to, say, the National programme. Next morning (or after the B.B.C. shuts down) switch on the generator and tune it till it gives the maximum response as shown by the milliammeter (loosening the couplings till a convenient reading is obtained). The generator frequency is now known, viz., 1,148 kc. Next vary the frequency by small amounts up and down, by means of the auxiliary condenser, and note the corresponding milliammeter readings for each position of the auxiliary condenser. Plot the milliammeter readings as ordinates and the dial readings of the auxiliary condenser as abscissæ. The curve so obtained is the response curve of the set for the National programme frequency, but to use it we must add proper scales. The vertical scale is to read from 0 to 100 per cent. response. The zero is the milliammeter reading before we switch on the generator; it is convenient to adjust it to the constant value of 0.1 milliamps. The 100 per cent. corresponds to the maximum reading of the milliammeter during the test, or more strictly (when the response curve has a double peak) to the reading when the generator is in tune with the set—or to the reading mid-way between the peaks, when they are equal. It is hardly worth putting on this scale; the response at any frequency is merely the height of the curve above the 0.1 m.a. line divided by the maximum height.

Taking a Measurement.

The frequency scale is more difficult to calculate. If a wavemeter is available, the frequency corresponding to the settings of the auxiliary condenser can be measured at once and the scale of frequencies marked on the response curve. But a wavemeter is not a necessity. We already know the frequency of the mid-point of our curve (1,148 kc.), and we only want to add a scale of "Cycles off tune." These will be small percentages of the central known frequency; for example, 10 kc. off tune is 10/1,148=.0087 or 0.87 per cent. of the National programme frequency. To produce this change of frequency the capacity must be altered twice as much (Frequency varies as $\sqrt{\text{Capacity}}$) or 1.74 per cent. So we mark "10 kc. off tune" at the point corresponding to 1.74 per cent. change of capacity. Thus the horizontal scale is determined. The only difficulty in applying this method is that the generator capacity is a little bigger than the sum of the two condenser capacities owing to the effects of screens, and the self-capacity of the coil and connecting wires. A simple method of finding this extra capacity is given in the appendix.

Checking the Oscillation Generator.

It is assumed that during any test the oscillating current produced by the generator will remain constant. To ensure this the current must be fairly large and the coupling to the aerial as loose as possible. The coils used had four and five turns respectively, 3in. diameter, and a few inches apart. If the coupling is too close the set reacts on the generator. The generator should have separate batteries from the receiving set so as to avoid unwanted couplings. To ascertain whether the oscillating current did remain constant in his test the author coupled it to a crystal and high resistance in series with a sensitive mirror galvanometer. With small generator currents changes were observed when the generator came into tune with the set, but when large oscillating currents were used, with looser couplings, this defect disappeared. The author's generator is made up of a P.M.254 valve with 100 volts H.T. and −10 volts grid bias; the grid coil is a Lewcos 35 coil and the reaction coil a Lewcos 40 coil. The coils are about 3in.

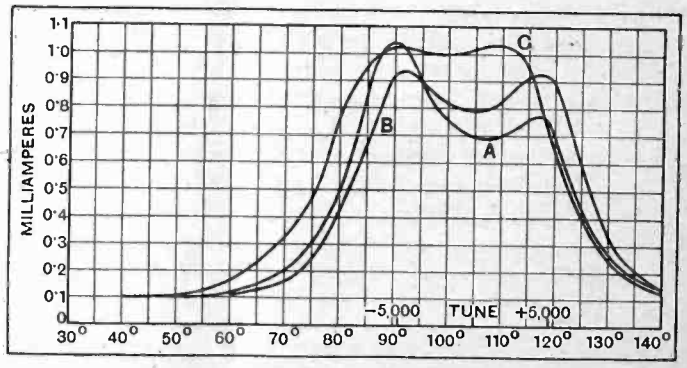


Fig. 3.—REGIONAL. M=12 turns; B, distuning 3rd circuit; C, distuning 3rd circuit and adding resistance.

apart in a screening box. The main condenser has a capacity of 0.001 mfd. and the auxiliary condenser 0.0001 mfd. It will tune to the National programme and to the Midland Regional. The coupling between reaction and grid coil should be as loose as possible.

The following results are selected from a number which the author has already obtained. Fig. 2 shows how the response curve changes with the filter coupling M. They are for the National frequency, and all show small double peaks. To obtain two equal peaks special tuning is necessary. This is illustrated in Fig. 3 (London

Response Curves.—

Regional frequency). Curve A with unequal peaks was obtained when all three circuits were adjusted to give the maximum response when in tune; curve B shows how these peaks were equalised by very slightly distuning the third circuit (tuned transformer). Finally, curve C shows how the peaks were flattened by adding $3\frac{1}{2}$ ohms resistance in each filter circuit. The reason for the inequality of the peaks[1] is twofold; the coil (*a*) in the first filter circuit has (as is usual) fewer turns than that (*b*) in the second circuit, and the first circuit is coupled to the

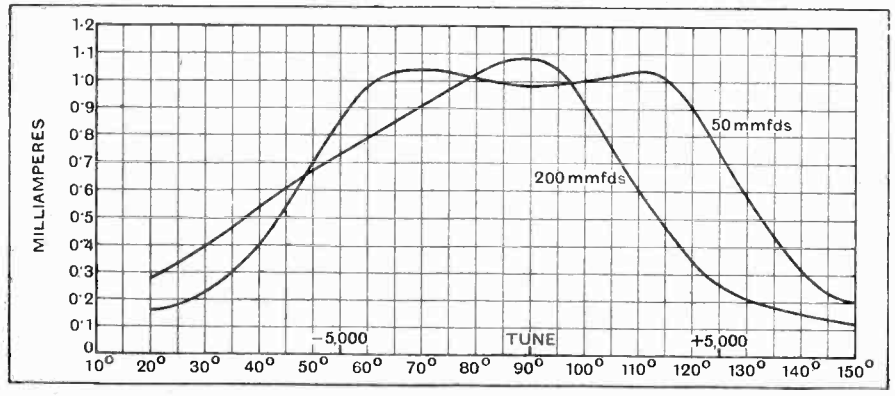


Fig. 4.—MIDLAND REGIONAL. M=13 turns. Showing effect of aerial coupling.

aerial, which affects its tuning. The effect of the aerial in disturbing the action of the filter is not referred to in either of A. L. M. Sowerby's articles. That it may be serious is shown in Fig 4. (Midland Regional frequency), where one curve was obtained when the aerial coupling condenser was small (50 $\mu\mu$F.), and the other when the coupling was increased to 200 $\mu\mu$F.

Some Unexpected Results.

Fig. 5 shows how a serious and quite unsuspected defect was found in the receiving set. To reduce the signal strength (the author's house is only six miles from Brookmans Park) a potentiometer feed to the grid of the first valve was used, as recommended by Dr. McLachlan for the "Megavox Three" and illustrated in W. I. G. Page's article already referred to. The potentiometer has ten steps and was mounted in the first screening box. When the contact arm was on the first step (full volts to grid) curve A was obtained. When the contact arm was

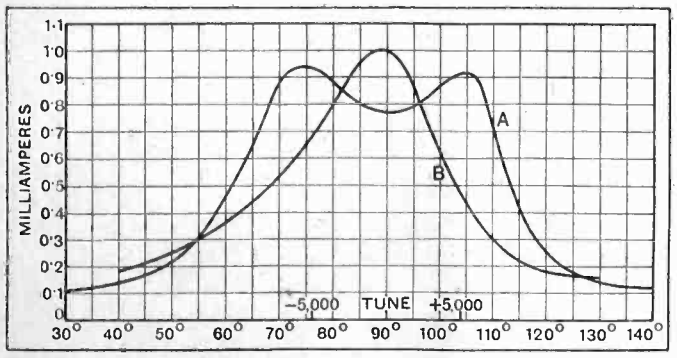


Fig. 5.—REGIONAL. M=14 turns. Effect of defective potentiometer control.

[1] See the end of this article for a more accurate discussion of this point.

on the second step curve B was obtained. The cause of the complete distortion of the tuning curve is believed to have been the capacity between the contact arm (with its spindle) and the screening box. In the first position this capacity is merely in parallel with the tuning condenser and does no harm, but in the second position this capacity is in series with the resistance of the first part of the potentiometer. The potentiometer was, of course, removed and others methods of control adopted.

Fig. 6 shows the effect of reaction; curve A (Regional frequency) was the response curve without reaction, curve B with reaction, the input having been reduced to about one-fifth. When more reaction was used the flat top of the curve disappeared and curve C was the result. The signal strength had been reduced about one-twentieth in this test. The author has not come across the theory of the effect of reaction on a filter circuit.

Finally, Fig. 7 shows the effect of removing coil M from the filter circuit. The two halves of the filter circuit are then in series and the set remains almost in tune, so that a small adjustment of either condenser brings it into perfect tune. (The two condensers are in series, their capacity is halved; the two coils are in series and their inductance is doubled.) The circuit is now the ordinary one without a filter. The response curve is much narrower and only shows 22 per cent.

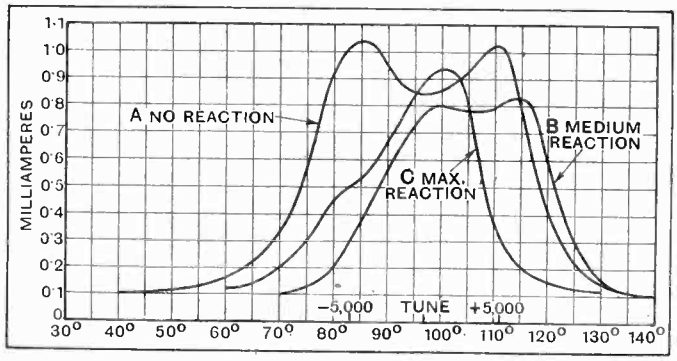


Fig. 6.—REGIONAL. M=12 turns. Showing effect of reaction.

response at 5,000 cycles off tune, which may be compared with the 95 per cent. shown in Fig. 3 for curve C.

Since the above account was written, the cause of the unequal peaks shown in curve A, Fig. 3, has been fully investigated. The inequality is not due to the causes suggested above, but is the necessary result of tuning the set to give the maximum response, when the response curve has a double peak. What we automatically do is to tune the set to a frequency just above or just below the correct one, so that it is working on the lower peak (if tuned too high) or on the upper peak (if tuned too low). When this is realised it is easy to tune so that either the right or left peak shall be the higher, but it is impossible to hit the mid-point, which is what is wanted, without using some special device. A suitable device is to put a temporary resistance in each arm of the filter during tuning; the tuning

Response Curves.—

must not be touched after the resistances are removed.

These examples are sufficient to show that interesting results can be obtained by this test. No great accuracy is claimed for the method, but when dealing with large effects accuracy is not of great importance. It will be noted that the upper parts of the curves are given much more accurately than the lower, so that the curves are more useful for estimating side-band transmission than for estimating selectivity. It is interesting to note that the only piece of calibrated apparatus required for the test (in addition to the detector milliammeter) is the main condenser in the oscillation generator.

APPENDIX.

Method of Finding the Stray Capacity of the Oscillating Generator Circuit.

Tune the generator to three waves of known frequencies, say the National, London Regional, and Midland Regional, noting the total capacity of Main condenser plus Auxiliary condenser for each.

Plot these capacities against the reciprocal of the square of the corresponding frequencies, i.e., plot K against $\frac{1}{f^2}$. The three points so found should lie in a straight line. Produce this line to cut the vertical axis, which it will do below the origin, at, say, $-A$ microfarads. Then A is the stray capacity required.

The total capacity in the generator circuit is the sum of the three parts, Main condenser capacity + Auxiliary condenser capacity + Stray capacity A.

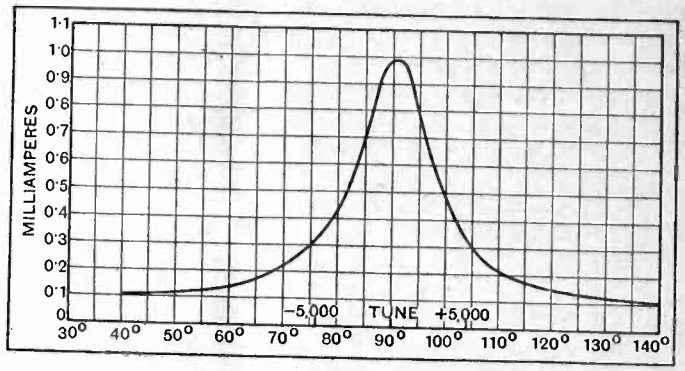


Fig. 7.—REGIONAL. With coil M removed.

Two points would be sufficient to determine the straight line, and thus A, but it is a wise precaution to observe a third, to make sure that they lie in a straight line.

THE NEW HOME OF R.I.

Well Planned Factory at Croydon.

FOR some time past the limited accommodation at the old Hyde Street factory of Radio Instruments, Ltd., has imposed obstacles of increasing difficulty in the way of smooth organisation, and a move has at last been made to new premises at Purley Way, Croydon. This change reflects the stable position reached by the firm to-day and is evidence of a steadily growing business.

R.I. moves to new premises. At the front are the executive offices and showrooms, the nucleus of the building being the main shop.

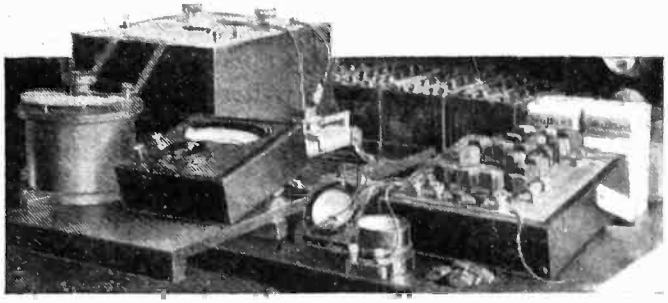
The test room leads off the main shop at the front near the final assembling benches, and has ample accommodation for both routine testing and research and development work. A central switchboard and branch leads duplicate mains and battery supplies on every bench, while standard tests for capacity, inductance, etc., are permanently installed each on separate benches.

The front of the building presents a very pleasing façade, and is occupied by the executive offices and showrooms which have been panelled in grey oak by R.I. cabinet makers.

The layout and organisation in every detail is excellent, and might be taken as a model example of a factory ideally suited to the development and manufacture of radio apparatus.

The new factory has been built to the specifications of Radio Instruments, and the layout is specially adapted to the manufacture of radio sets and components. The nucleus of the building is a large central shop accommodating the whole of the manufacturing processes, including machinery, press-work and assembling. Running down the left-hand side are the stores for raw materials and finished products with doors opening on the outside to a concrete roadway for loading and unloading vans and lorries. The works manager's office is glass-framed and overlooks the whole shop.

INSULATORS TESTED



[4] MYCALEX

A New Insulating Material of Exceptional Interest.

By W. H. F. GRIFFITHS, F.Inst.P., A.M.I.E.E.

THE need has long been felt for an insulating material which could combine the wonderful strength and heat-resisting properties of Bakelite with the low power loss of pure ebonite. In Mycalex we have a material with this strength, with even greater heat-resisting properties, and yet having much lower dielectric loss than ebonite, especially at the higher radio frequencies.

Until recently the best that could be expected in efforts to combine these desirable mechanical and electrical properties was a compromise by scientifically loading ebonite to obtain a material such as Keramot, of moderately good dielectric properties, fairly hard and with a reduced plastic yield. This material, however, as well as being merely a compromise, has a high temperature coefficient of expansion—almost as high as that of true ebonite. The only other alternative, if a really low-loss, heat-resisting, low-expansion, and strong insulator was required, was one built up of a large number of clear mica laminations clamped together with great pressure between flanges—an expensive proposition and one to which one seldom resorted.

Fused silica and pyrex are other insulators sometimes employed in the construction of wireless apparatus in which low dielectric loss and great geometrical permanence are desirable features. These insulators are, however, both difficult to work and very apt to fracture either during the assembly of the apparatus or during its transportation.

Having therefore exhausted our list of likely insulating materials, and having rejected each for one reason or another, it is easy to see why the newly invented Mycalex should be welcomed in the field of radio generally, and more especially, perhaps, by those of us who are directly interested in the design of precision apparatus for the more specialised field of radio measurements.

Mycalex is a British Invention,[1] and, although hitherto it has only been obtainable from Germany and America, production is now commencing at a London factory. In its manufacture finely divided mica and certain silicates are fused together, resulting in a very hard vitreous material of low thermal expansion which can be ground, drilled, tapped, and sawn.

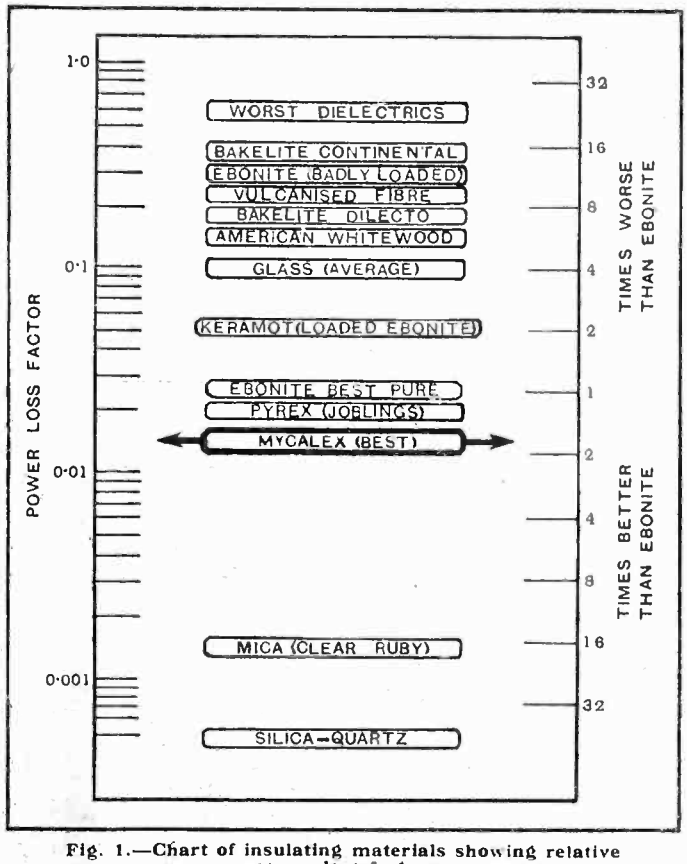


Fig. 1.—Chart of insulating materials showing relative power-loss factors.

When supplied by the manufacturers, Mycalex has a soft crust or skin which is very absorbent and has, at the lower frequencies at any rate, a much greater dielectric loss than that of the really hard homogeneous material which is exposed upon the removal of the skin. The skin thickness varies apparently with slight changes in the method of production, and it is somewhat difficult in some cases to judge the correct amount to grind off owing to the change in nature being ill-defined.

The material is, or will be, used for many purposes in the construction of industrial electrical apparatus[2] where the property with which we, in low-loss radio design, are most concerned—the power-loss factor—is of very little or no importance. This may be the reason for the great varia-

[1] The inventor is P. B. Crossley, F.I.C., M.I.Chem.E.

[2] Mycalex can be moulded with metal inserts and so is ideal for a large number of commercial electrical fittings and domestic appliances.

Insulators Tested—(4) Mycalex.—

tion of power-loss factor which the author has experienced in the various specimens of Mycalex which he has investigated. These original samples, which were supplied some time ago by Messrs. Allgemeine Elektricitats Gesellschaft, in some cases were found to have power-loss factors of from 0.3 to 0.6 at a frequency of 800 cycles per second, although at the medium-high radio frequencies they always improved to a great extent, sometimes to as low a figure as 0.06. Thus at speech frequencies the material appeared to be as bad as the worst dielectrics on the chart of Fig. 1, and at radio frequencies round about 300 metres it exhibited the same loss as Keramot or a little greater.

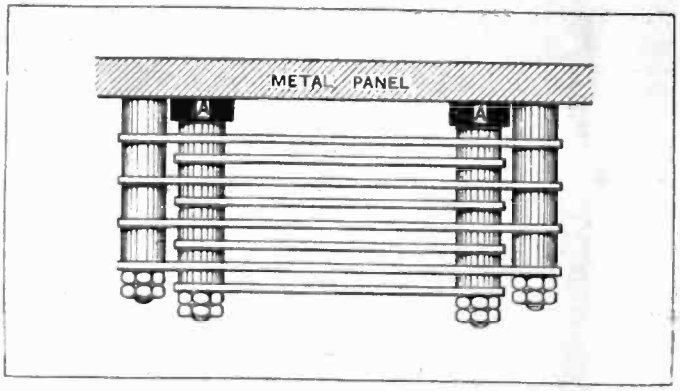


Fig. 2.—Method of supporting the plates of an air dielectric condenser and used to compare the material with ebonite.

It was, however, discovered that the extraordinarily high power loss at speech frequencies was due largely to the soft skin, for the specimens had been tested just as they were received from the makers, and in some cases the skin was a considerable proportion of the total thickness. Even upon the removal of the skin the power-loss factor was, however, still much too high.

Later specimens from the same source are much better and more consistent in dielectric quality, but the behaviour of the material before the removal of its soft crust is most interesting. In almost every case the power-loss factor increased rapidly with a *decrease* of frequency, until at mean speech frequencies it was as high as 0.1—as bad as ordinary glass.

After removing the crust, however, these later specimens of Mycalex were found to be very hard and non-absorbent and to have a very low dielectric loss, especially at the higher radio frequencies with which the wireless amateur is most concerned. At these frequencies (round about 300 metres) the material is twice as good as ebonite, as will be seen in the chart of Fig. 1, which means that the equivalent series resistance of the 250 $\mu\mu$ F air condenser of Fig. 2 would be decreased from 0.2 ohm[1] to 0.1 ohm on this wavelength if the ebonite insulators "AA" were replaced by similar pieces of Mycalex.

Thus it will be seen that Mycalex, as well as being hard, unyielding even at very high temperatures, non-absorbent, and of low thermal expansion, has lower dielectric loss than any of the insulating materials except mica and fused silica. Moreover, the fact that it can be worked cheaply and without *extreme* difficulty makes it a much more desirable material for use in all but the most low-loss designs.

[1] Assuming that 10 $\mu\mu$F of the capacity is due to the field actually passing through the *ebonite* insulators.

NEWS FROM THE CLUBS.

Compiling the Winter Programmes.

A number of the more active clubs are already engaged in the preparation of programmes for the coming session, a task which grows less difficult from year to year owing to the ever-expanding scope of radio research. In the early days repetition of subject was less easily avoided, and although many will argue that oft-repeated lessons are the most valuable, the dangers of monotony have been the undoing of more than one wireless club in the past.

Entertaining and instructive demonstrations are now given by the majority of the better-known wireless firms, and club secretaries labouring to fill gaps in their syllabuses can hardly do better than apply to the trade for the facilities which are so readily supplied.

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Transmitter Hunt in Herts.

A number of members of the North Middlesex Radio Society, equipped with portable direction-finding apparatus, met recently at Croxley Green and spent the afternoon amidst beautiful country in locating a hidden transmitter, which sent out signals every half-hour.

This proved to be at a farm near the village of Newgate Street, some fifteen miles from the start, and the first party to locate it arrived in a little over two hours—a creditable achievement.

The Golders Green and Hendon Radio Society was represented by two well-equipped parties.

Hon. Secretary, Mr. E. H. Laister, "Windflowers," Church Hill, Winchmore Hill, N.21.

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Making Screening Boxes.

"Screening Boxes" was the subject of a lecture given by Mr. R. W. Lawrence at a recent meeting of Slade Radio (Birmingham). Commencing with a brief history of the tinplate industry, the lecturer outlined the reasons which have led up to the present practice of entirely screening the most efficient receivers and proceeded to give details of the methods which are open to the amateur who wishes to make his own screening boxes.

Hints on marking, cutting, bending and soldering were offered, and useful advice was given on how to overcome difficulties. A short practical demonstration was given at the conclusion of the lecture.

Particulars regarding membership of the Society, which holds meetings every Thursday at 8 o'clock at the Parochial Hall, Broomfield Road, Slade Road, Erdington, may be obtained from the Hon. Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham.

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D.F. in the Forest.

The discovery near London of an ideal venue for direction-finding operations was revealed in the course of a field day held recently by the Golders Green and Hendon Radio Society in conjunction with the Muswell Hill, North Middlesex, Western Postal, and Belsize Radio Societies. The locality chosen, *viz.*, the neighbourhood of Epping, provided competitors with opportunities of testing the shielding effect of forests without interference from telegraph wires and other sources.

No reduction in signal strength was reported by the D.F. groups, who were situated nearly four miles from the transmitter and separated from it at most times by a belt of woodland at a greater altitude than the apparatus.

The scheme was divided into two parts. In Part A each group was required to take bearings from three different positions, marks being awarded for accuracy. In Part B groups had actually to discover the transmitter.

Mr. Maurice Child, one of the prize-winners, used a screened grid set installed at the rear of a two-seater car.

The fact that amateurs from all parts of North London were engaged in the afternoon's experiments proves that wireless field days are as popular as ever.

In October members of the Golders Green and Hendon Radio Society will pay a special visit to the B.B.C. transmitters at Brookmans Park.

Full particulars of membership can be obtained on application to the Hon. Secretary, Lt.-Col. Ashley Scarlett, 60, Pattison Road, N.W.2.

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All About Filter Design.

"The A.B.C. of Filter Design" was the title of an unusually interesting lecture given recently by Mr. G. Stewart Halliday before the Radio Experimental Society of Manchester. Touching on most phases of the subject but dealing mainly with L.F. filter circuits, he showed how to design the smoothing circuits of eliminators and how to work out all the necessary figures for band-pass filters in connection with the compensation of uneven frequency output curves for gramophone pick-ups and other apparatus.

The Society still has several vacancies for members and welcomes enquiries from interested amateurs, who are cordially invited to inspect the laboratory at No. 8, Water Street, Manchester.

Particulars from R. M. Kay, B.Sc., Tech., Joint Hon. Sec., at 58, Daisy Bank Road, Victoria Park, Manchester.

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Change of Address.

Mr. Fred J. Waller (5QK), hon. secretary of the Southend and District Radio Society, has now changed his address to 49, Fermoy Road, Thorpe Bay.

CURRENT TOPICS

Events of the Week in Brief Review.

ANOTHER 50-KILOWATTER.

The world's latest 50-kilowatt broadcasting station is KMOX, St. Louis, which is the ninth American station of its class to be granted a licence by the Federal Radio Commission.

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60 KILOWATTS FOR RADIO TOULOUSE.

Radio Toulouse, probably the most popular station in France, is about to be moved to a new site outside the town. The transmitter is to be enlarged with a power increase to 60 kilowatts.

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THE WIRELESS SWIM.

Crowds of holiday-makers lined the banks of the river Severn on August 5th to witness the annual distance swimming race which is held in aid of the Mayoress of Worcester's fund to provide wireless for the blind of the city.

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PARIS RADIO EXHIBITION.

Definite dates have now been fixed for the Paris Autumn Wireless Exhibition, which will open on September 26th at the "International Salon," which is close to the Montparnasse railway station in the Latin Quarter. The Exhibition will remain open until October 9th.

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A SIX MONTHS' SHOW.

A French "Wireless Week" will replace the usual Paris radio show next year. This decision has been arrived at by the French radio manufacturers in view of the fact that a wireless section will be one of the permanent attractions of the Paris International Colonial Exhibition which will open in the Bois de Vincennes in May, 1931, and run for six months.

"Wireless Week" will probably occur in the autumn.

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PROGRAMME POTTING IN U.S.

"Home-recording" is to be the new fashion among American listeners, according to our Washington correspondent, who reports that one of the leading manufacturers is about to announce the production of a radio-gramophone set capable of recording the broadcast programmes as they are received, in addition to performances in the home.

The new set, which will sell in the medium price class, will make its first appearance at the Radio World's Fair, New York, opening on September 22nd.

SCHOOL WIRELESS IN FRANCE.

It is estimated that broadcast receivers are now installed in 2,000 French chools.

o o o o

A NEW NAME.

"Contemptible radi-owe" is a Newcastle journal's description of wireless piracy.

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INTERNATIONAL SHOW IN COLOGNE.

A wireless exhibition will be held in Cologne from September 14th to 19th. Foreign firms are allowed to participate if represented in Germany.

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HOUSE OF COMMONS WIRELESS.

We understand that a large number of signatures have been obtained to a petition for the installation of broadcast receiving apparatus in various rooms in the House of Commons. The organiser of the petition is Mr. E. Edwards, M.P. for Morpeth.

SWISS WIRELESS SHOW.

Lausanne will hold a wireless exhibition from September 13th to 28th.

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AMERICA'S RADIO STATE.

Alabama is reported to be leading all other American States in its enthusiasm for radio. A receiver is now installed in every court house in the State, and the authorities are paying one-third of the cost of all receiving sets installed in the schools.

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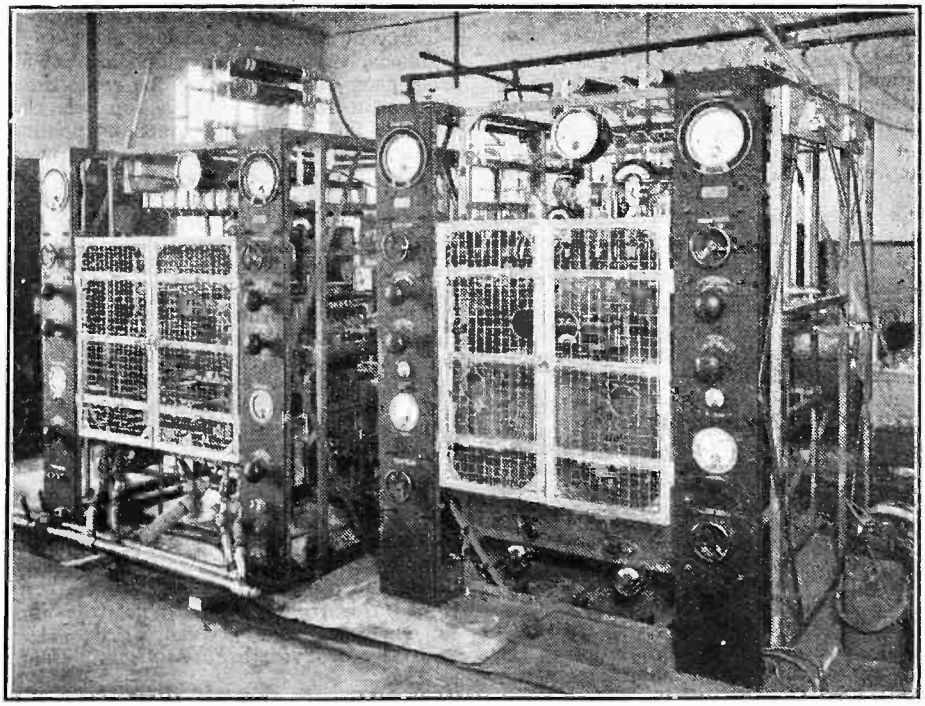
YUGOSLAVIA AND MAN-MADE STATIC.

Clause No. 213 in the country's new Penal Code indicates that the Yugo-Slavian Government is on the side of the angels in cases of electrical interference with wireless installations. The clause runs :—

"Whoever, voluntarily or by negligence, prevents, or interferes with, the functioning of a radio installation by means of



A PIONEER TRANSMITTER. 5SW, the Marconi short-wave transmitter at Chelmsford, whose daily tests extending over three years, have demonstrated the practicability of an Empire broadcasting service. As first exclusively reported in *The Wireless World*, the erection of a new permanent short-wave station has been sanctioned by the Colonial Conference.

electrical installations, or who interferes with or misappropriates the current necessary to the working of a radio installation, will be punished—in the event of a disturbance or stoppage taking place—by one year's imprisonment or a fine of 10,000 dinars (approximately £394)."

oooo

COMPULSORY RELAYS IN URUGUAY.

Theatres and concert halls in Uruguay are now legally compelled to allow the broadcasting of their performances, according to the new radio statute. Apparently theatre managers who refuse facilities will be fined 100 pesos (£20) for each offence!

The radio administration will be supported by listeners' licence fees, the annual contribution being about £2. Revenue will also be drawn from radio import duties.

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FL TO ABANDON BROADCASTING.

The Eiffel Tower station is generally regarded as France's national transmitter. In the near future, however, it is likely to be superseded by the new Paris P.T.T. station which will shortly install apparatus with a power of 12 kilowatts. It is an open secret, writes our Paris correspondent, that the Eiffel Tower will ultimately abandon concert-giving, being reserved for official communications and experiments under the direction of General Ferrié, the Chief of the Army Radio Services.

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NORWEGIAN BROADCASTING UPHEAVAL.

A complete change is about to take place in the administration of Norwegian broadcasting, the Government having decided to take over all existing broadcasting stations in order to form a State service. The programmes will be supplied under contract by private companies. It is expected that the new regime, incorporating 43 main and relay stations, will be in complete operation not later than 1934.

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CANADIAN LISTENERS HEAR AIRSHIP CHAT.

By cable from Montreal details have been received of the broadcast of a two-way wireless telephonic conversation between a land station at Ottawa and the R100 during the passage of the airship over the capital of Canada. The details were arranged through the co-operation of the Royal Canadian Signal Corps in conjunction with the Radio Department of the Canadian National Railways.

The Hon. R. B. Bennett, the Prime Minister, took his place in the studio of CNRO, situated in the Chateau Laurier, and from there spoke to Wing-Commander Colmore, Sir Dennistoun Burney and Major G. H. Scott, and others aboard the R100. In turn those on the R100 addressed the land station CNRO.

Transmission both ways was clear and distinctly audible though reception in the ship was better, due to the greater power available at CNRO. Communication was maintained from 10.34 p.m. to 11.7 p.m., and it is believed that this is the first occasion on which a broadcast of such character has been conducted.

WATCH YOUR MAST!

The latest story from America concerns a family of woodpeckers who, it is stated, recently succeeded in stopping the transmissions of Station WNBO, Philadelphia, for forty-eight hours. This they accomplished by drilling a hole through a 100-foot cedar wireless mast three feet thick. Eventually the mast collapsed.

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A NEW APPOINTMENT.

Mr. W. B. Bartley, who was educated at Winchester and at New College, Oxford, where he obtained his B.A. in the Honours' School of Physics, has joined the technical staff of Murphy Radio, Ltd.

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FRENCH COLONIAL BROADCASTING STATION.

An experimental Colonial broadcasting station for France will be inaugurated at the Paris Colonial Exhibition of 1931, according to a decision of the committee recently nominated to discuss the question. The test station will be erected by the Post Office, writes our Paris correspondent, and the experience gained in its operation will be utilised in the construction of a permanent station at Saint-Germain, to be controlled by a "National Federation of Colonial Broadcasting."

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OLDFIELD IN ANOTHER "TEST."

Mr. Oldfield, the Australian wicket-keeper in the Test matches, recently tested a number of British portable sets to decide the best type for use in Australia, where distances from transmitters are measured in hundreds of miles. We learn from Messrs. Dunhams, Limited, that one of their new S.G. four-valve portable sets was the ultimate choice.

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AMERICAN RADIO COLLAPSE?

Forty of America's precious short-wave channels, the supply of which has otherwise been exhausted, may be recaptured soon as a result of the action of the Chicago federal district court in appointing a receiver for Universal Wireless Communications Co., Inc., which was formed to develop a coast-to-coast radio-telegraph system to compete with the Western Union and Postal Telegraph.

The company was given three years in which to complete and have in operation 110 stations in as many cities (writes our Washington Correspondent). The quota for the first year, 1929, was met with a dozen stations, and construction was begun in other cities to meet the second year's quota. It is understood that most, if not all, of these stations have shut down.

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CONTROL OF INDIAN BROADCASTING.

A decision to place the Calcutta and Bombay broadcasting stations directly under the control of the Indian Government Department of Industries and Labour has been arrived at by the Central Broadcasting Advisory Committee.

The Government is determined that the system shall in time become self-supporting through the contributions of all listeners. In the words of the *Indian Radio Times*, "the service caters for Europeans and Indians equally; it recognises no distinction of cast or creed or colour; it aspires to bring all together into one grand harmony of Union and Happiness."

We hope that the Indian Government will succeed in conquering the two principal foes of broadcasting in India, viz., public apathy and unlicensed listening.

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CROWDING THE FRENCH ETHER.

Several new broadcasting stations are planned for French listeners, including Radio-Touraine, Radio-Fécamp, Rouen, and Clermont-Ferrand. The journal *Intransigeant*, referring to these projected stations, reminds the public that the Plan de Prague, which is still valid, allots only sixteen wavelengths to France. As France already possesses twelve stations beyond her legitimate number, it is predicted that the opening of more stations will cause Germany and England to "howl."

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HOW AUSTRALIA LISTENS.

Victoria still retains the leadership among the Australian States in the number of wireless licences with 141,081. The total number in the Commonwealth on May 30th was 311,322. New South Wales had 110,682 licences in force, Queensland 22,797, South Australia 25,448, Western Australia 5,552, and Tasmania 5,762.

BOOKS RECEIVED.

Development of the Visual Type Airway Radiobeacon System. By J. H. Dellinger, H. Diamond, and F. W. Dunmore. (Bureau of Standards, Research Paper No. 159.) Pp. 25, with 28 illustrations and diagrams, including 9 half-tone plates, price 20 cents.

A Critical Review of Literature on Amplifiers for Radio Reception, issued by the Radio Research Board, of the Department of Scientific and Industrial Research. Special Report No. 9. A review and general bibliography of the more recent literature on the design of radio receivers divided into four main sections: 1, Radio Frequency Amplifiers; 2, Rectification; 3, Audio Frequency Amplifiers; 4, Measurements. Each main section is subdivided and a critical essay based on the study of the literature of each subsection is followed by an abstract of the principal articles reviewed. Sections 1, 3, and 4 compiled by Mr. H. A. Thomas, M.Sc., and Section 2 by Mr. F. M. Colebrook, B.Sc. Pp. 239-VIII. Published by H.M. Stationery Office, price 5s. net.

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A Tuned-Reed Course Indicator for the 4- and 12-Course Aircraft Radio Range. By F. W. Dunmore. (Bureau of Standards, Research Paper No. 160.) Pp. 14, with 14 illustrations and diagrams, including 2 half-tone plates, price 15 cents.

All the above obtainable from the Superintendent of Documents, Washington, D.C., U.S.A.

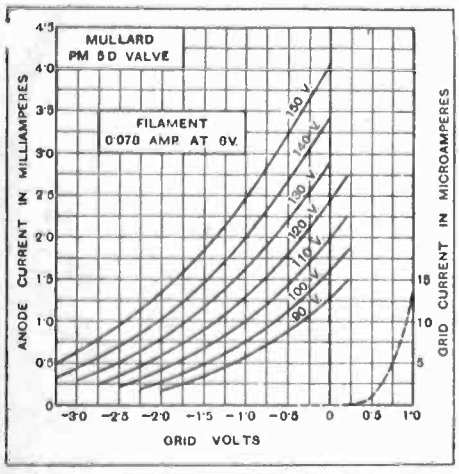
VALVES WE HAVE TESTED

Two New Mullard Valves. The P.M.5D. and P.M.256A.

THE P.M.5D. is a medium impedance valve which occupies an intermediate position between the P.M.5X. and the high-impedance P.M.5B. the rated characteristics being:—

A.C. resistance, 20,000 ohms;
Amplification factor, 26;
Mutual conductance, 1.3 mA./volt;

measured at 100 volts H.T. and zero grid bias, the maximum anode voltage being 150. A specimen valve



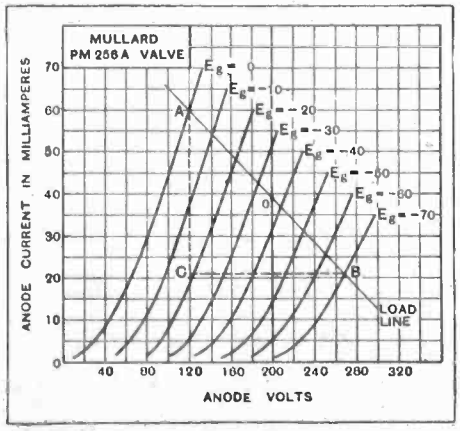
Characteristics under working conditions, average values, A.C. resistance 24,000 ohms, amplification factor 28, mutual conductance 1.12 mA./volt.

measured under the same conditions exhibited slightly less good characteristics than the makers' figures, the A.C. resistance being 27,000 ohms, the amplification factor 29.6, and the mutual conductance 1.1. mA./volt.

This particular sample would appear to be somewhat below standard, as the emission is low at all points on the curves prepared, as compared with the anode current-grid volts curves supplied by the makers. There was no trace of reversed grid current, showing that the vacuum is dead hard. Although the valve is heavily "gettered," it is just possible to discern the nature of the internal construction. The electrodes are of the familiar "flattened" type, and are mounted horizontally in the bulb.

The P.M.256A and P.M.5D valves.

According to the makers' recommendation, this valve requires a grid bias of −3 volts with 150 volts H.T., but it will be seen from the curves taken with the specimen tested that in this particular case a bias of −1.5 volts is adequate for amplifying conditions.



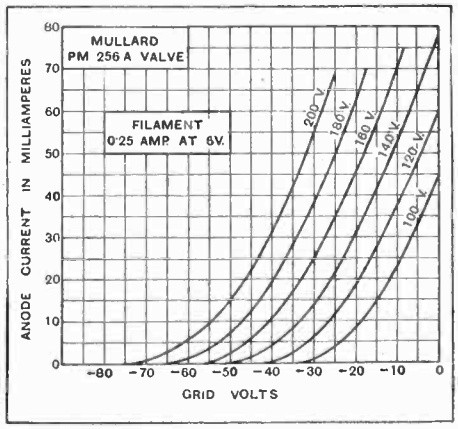
Anode volts/anode current curves of the P.M.256A. From these the maximum undistorted power output, the optimum grid bias and the best loud speaker impedance (load line) can be found.

P.M.256A.

This is a super-power valve capable of handling considerable power without an unduly high anode voltage, and should accordingly meet the requirements of a large number of readers. The rated characteristics are:—

A.C. resistance, 1,400 ohms;
Amplification factor, 3.6;
Mutual conductance, 2.6 mA./volt;

taken as 100 volts H.T. and zero



Characteristics under working conditions: A.C. resistance 1,410 ohms, amplification factor 3.1, mutual conductance 2.2 mA./volt.

grid bias. The maximum anode voltage is 200.

The sample tested appeared to be a good specimen, as the anode current was slightly higher at all points of the anode current-grid volts curves taken as compared with those supplied by the makers. Incidentally, these familiar curves convey very little useful information in the case of a power valve, so it was decided to prepare a second set connecting anode current and anode voltage for equal increments of grid bias from 0 to 70 volts, and with a 50 per cent. increase in anode voltage. From these curves we can ob-

Valves We Have Tested.—

tain such essential information as the maximum undistorted power output, the most suitable loud speaker impedance and the optimum grid bias voltage for any value of H.T.

The sample tested was found to give 726 milliwatts output, after allowing for 5 per cent. second harmonic, and with the maximum of 200 volts H.T. and a grid bias of −36 volts. The distortion introduced by this value of second harmonic is generally agreed as being the maximum that can be tolerated in the majority of cases. The most suitable loud speaker impedance was found to be 3,800 ohms. By reducing the anode voltage to 150, and making the required adjustment to the grid bias, the power output, for the same conditions, falls to 390 milliwatts. The measured characteristics of this valve at 100 volts H.T. and zero grid volts are:

A.C. resistance, 1,300 ohms;
Amplification factor, 3.6;
Mutual conductance, 2.6 mA./volt.

Since precise figures regarding the maximum permissible anode dissipation in watts are not available, it would be advisable to assume that it is of the order of that determined by the operating conditions imposed by the makers. Consequently, care should be exercised at all times where a change in the operating voltages is contemplated, and under no conditions should the valve be run with insufficient grid bias. Should it be required to make any alterations in the bias value, the H.T. should be disconnected.

LABORATORY TESTS.

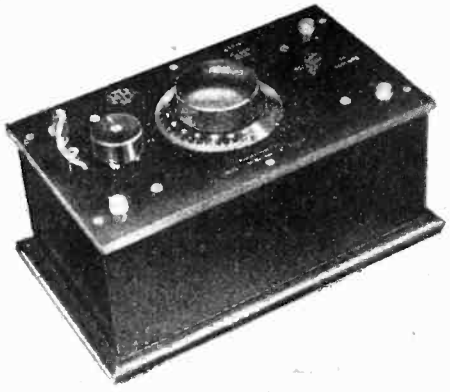
New Apparatus Reviewed.

McMICHAEL RADIO FILTER.

At the time Brookmans Park commenced operations many listeners were still unprepared to cope with the new conditions, and as a consequence numerous units were quickly evolved to improve the apparent selectivity of the simpler type of sets. Many of these were obviously palliatives, albeit commendable prices of apparatus.

Time has now enabled the problem to be approached from a more scientific angle as exemplified by the new Radio Filter produced by Messrs. L. McMichael, Ltd., 179, Strand, London, W.C.2. This is not a wave-trap, but a cleverly devised aerial tuner, which, by varying the coupling between it and the aerial, and also between the tuner and the set, affords a wide range of selectivity. It can be adjusted to admit the London Regional and the National programmes so that either can be received with a minute trace of background from the other, or the response so sharpened that a clear band of approximately 60 metres exists between the two.

These results were achieved with a simple o-v-2 set, which, normally, would not separate the two London transmissions in the northern suburbs.



McMichael Radio Filter.

The tuning inductance is cylindrical and the turns spaced; tappings are provided to give three alternative aerial positions, and the coil is tuned by 0.0005 mfd. variable condenser. A few turns of the coil are used as the coupling to the set, the degree of coupling being variable and capacity controlled. A four-pin plug is used in place of a switch to bring the unit into action when required. The whole is enclosed in polished mahogany case measuring 8½in. × 4¾in. × 4in. deep with a polished ebonite top carrying the controls and terminals. It covers the 200-600 metre waveband, and the price is 37s. 6d.

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VOX VERITAS MOVING-COIL LOUD SPEAKER.

This loud speaker is made by The Morogoro Trading Corporation, Ltd., 12, Union Court, Old Broad Street, London, E.C.2, who make a speciality of supplying moving-coil windings to suit output valves of any given impedance. The specimen tested had a 3,000-turn winding designed to match pentode valves, and its impedance at various frequencies was as follows:—

Frequency.	Impedance (ohms).
50	14,100
100	5,340
200	5,030
400	5,870
800	7,820
1,600	11,550
3,200	21,350
6,400	—

It will be observed that the impedance between 100 and 400 cycles is lower than at any other point in the frequency range, and this would account for the absence of "boom" in the bass and lower middle register, which the makers claim as a feature of this instrument. On the other hand the 50-cycle reproduction is much better than the average moving coil, due to the rise in impedance at this frequency.

The only points of criticism are that the sensitivity is somewhat below the average, and that a slight dip occurs in the frequency characteristic at 2,000 cycles. When listening either to speech or music the effect of this depression is difficult to detect and the general result is entirely satisfactory.

Vox Veritas moving-coil loud speaker.

The field magnet is massive, and consumes 33 watts at 220 volts.

The price of the unit tested is 52s. 6d.; for windings other than the special pentode winding the price is 50s.

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R.K PERMANENT MAGNET LOUD SPEAKER.

In connection with the report on this unit, which appeared in the July 16th issue, it should be noted that the diameter of the diaphragm is 8in., and not 10in. as stated.

This instrument is fitted with dust windows in the fabric spider which centres the cone, and dust particles are effectively prevented from entering the air gap.

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BLUE SPOTS UNIT.

In respect to our review of the new 66R and 66P units on Page 132 of the August 6th issue, F. A. Hughes and Co., Ltd., point out that the 66K model has not been superseded by the new units, but will continue to be marketed concurrently with them.

WIRELESS THEORY SIMPLIFIED

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

(Continued from page 152 of previous issue.)

The Valve as an Amplifier.

HAVING obtained an exact formula for calculating the actual voltage amplification n given by a valve with a non-inductive resistance connected in the anode circuit, the next step is to examine this equation with a view to finding out the manner in which the value of the added resistance in the anode circuit affects the voltage amplification obtained.

The voltage amplification is

$$n = \mu \times \frac{R}{R + R_a} \quad \ldots\ldots\ldots\ldots \quad (1)$$

where R is the series resistance in ohms in the anode circuit and R_a is the A.C. resistance or differential resistance of the valve, μ being the amplification factor. From the curves given in the previous section showing the relationship between grid voltage and anode voltage it was found that with 13,400 ohms in the anode circuit the voltage amplification obtained was somewhere between 18 and 20, as close as it was possible to read from the small-scale curves. The A.C. resistance of the valve itself was 13,400 ohms and its amplification factor 36, and therefore, substituting these values in equation (1) above, we get

$$n = 36 \times \frac{13,400}{13,400 + 13,400} = 18,$$

which is in agreement with the value determined graphically.

From this result it is clear that when the series anode resistance is made equal to the A.C. resistance of the valve the voltage amplification obtained is just half the amplification factor. Of the total alternating E.M.F. introduced into the anode circuit by the action of the grid when an alternating voltage is imposed on it half is absorbed in driving the alternating component of current through the A.C. resistance of the valve and the other half in driving this current through the external anode resistance. It is this latter half only which becomes available for practical use.

If V_g is the alternating voltage imposed on the grid the effective electromotive force in the anode circuit is μV_g volts. This is then divided in the direct ratio of the A.C. resistance of the valve to the external resistance in the anode circuit for all values of R. Thus if R is made three times as great as the internal A.C. resistance of the valve the external resistance R is three-quarters of the *total* resistance, and therefore the voltage amplification will be three-quarters of the amplification factor of the valve. The larger R is made, the greater is its ratio to the total resistance, and therefore the greater will be the voltage amplification.

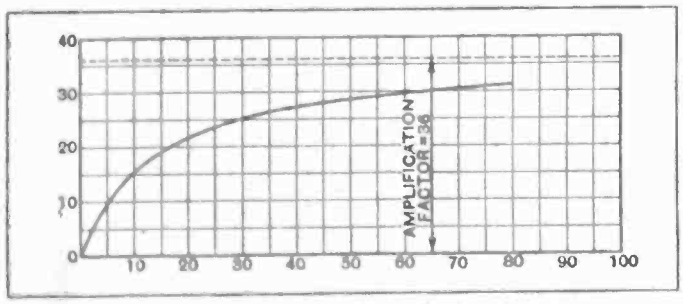

Fig. 1.—Calculated voltage amplification obtained for a valve with $\mu = 36$ and $R_a = 13,400$ ohms for various values of resistance in the anode circuit.

Obtaining Maximum Voltage Amplification.

Continuing along this line of argument, and making the series resistance larger and larger, we reach the limiting condition that when the anode resistance is made infinitely great the voltage amplification becomes actually equal to the amplification factor of the valve. But this is only theoretical, because an infinitely great resistance constitutes an open circuit, and under such conditions there would be no D.C. component of voltage at the anode and the valve would not function. To be strictly correct, then, we should state that the voltage amplification approaches more closely to the theoretical maximum value, namely, the value of the amplification factor, as the value of the anode resistance is raised, until such a point is reached that the mean anode potential becomes too low to allow the valve to function properly.

The voltage amplification obtained with various values of resistance in the anode circuit has been calculated from equation (1) for the same valve as treated throughout. These figures are plotted as a graph in Fig. 1 and enable one to see at a glance how the voltage amplification is determined by the value of the series resistance. When the anode resistance is made equal to 67,000 ohms, or five times the A.C. resistance of the valve, the voltage amplification is 5/6 of the amplification factor, being 30.

The curve of Fig. 1 applies only to the particular valve cited as an example, and so Fig. 2 has been drawn giving the voltage amplification as a percentage of the amplification factor, and the scale on the horizontal axis gives the ratio of the added resistance in the anode circuit to the A.C. resistance of the valve. This curve is applicable to any valve; from it we see that to obtain amplification equal to 90 per cent. of the amplification

Wireless Theory Simplified.—

factor of the valve it would be necessary to connect in the anode circuit a resistance nine times as great as the A.C. resistance of the valve. An amplification of 100 per cent. could never be reached.

By applying in a suitable manner the amplified voltage variation developed across the resistance R in the anode circuit of the valve to the grid circuit of another valve operating under similar conditions the voltage variation would be further amplified, and there-

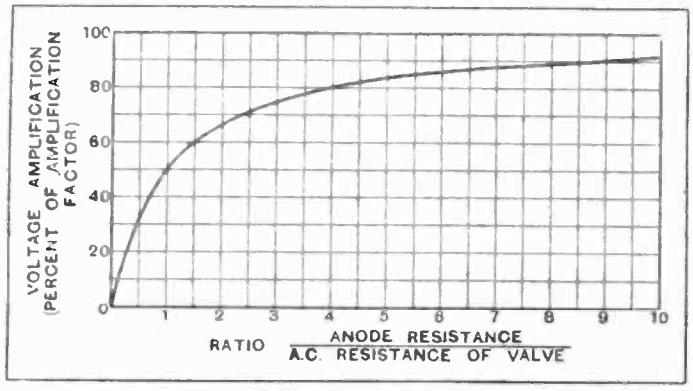

Fig. 2.—Curve showing how the voltage amplification, expressed as a percentage of the amplification factor of the valve, depends on the ratio of anode resistance to A.C. valve resistance. This curve applies to any three-electrode valve.

fore, in theory, we should be able to multiply the minutest voltage variation up to any desired value by the use of a sufficiently large number of valves connected in succession or *in cascade*. But in practice there are conditions which limit the number of valves that can be operated satisfactorily in cascade to quite a few. Details of this nature relating to the operation of cascade amplifiers will be dealt with in due course. At the moment we are concerned with the action of a single valve.

A Satisfactory Compromise.

One of the factors with which we have to contend when a non-inductive resistance is employed in the anode circuit of a valve for the purpose of obtaining voltage amplification is the reduction of the mean anode potential due to the voltage drop in the resistance. In some respects this is an advantage and in others a disadvantage. The chief advantage is that the lowered anode voltage and reduced current result in a very much longer useful life of the valve itself. The principal disadvantages are (*a*) that if the anode potential is reduced below a certain minimum value the amplification factor of the valve is lowered. There is thus an optimum value of anode resistance for which the amplification obtained will be a maximum for a given value of H.T. supply voltage; and (*b*) that with a lowered anode potential there is an increased tendency for grid current to flow when the fluctuating negative grid voltage approaches the zero mark.

These disadvantages can be nullified by increasing the H.T. supply voltage, but this in itself may constitute a further disadvantage in another direction, namely, by way of increased cost and complication. So in practice a compromise is struck; the H.T. voltage is usually made somewhat greater for resistance amplification than for other methods, and the anode resistance is kept sufficiently low not to impair the operation of the valve. An anode resistance from three to five times the A.C. resistance of the valve, together with H.T. supply voltage at least equal to the maximum permissible value given in the maker's rating, constitutes a satisfactory arrangement.

Effects of Frequency on Resistance Amplification.

The relationship between voltage and current is independent of frequency for a pure resistance, and therefore in the case of resistance amplification with a three-electrode valve the voltage amplification obtained would be the same for all frequencies if there were really no capacity or inductance anywhere in the anode circuit. But although the series resistance R in Fig. 3 (*a*) may be made sufficiently free from inductance and capacity to ensure practically constant impedance over the range of frequencies likely to be encountered in practice, a comparatively large amount of capacity exists between the anode and cathode of the valve itself; the anode and cathode constitute the two plates of a "small" condenser. If we denote this *inter-electrode* capacity by C_a in farads we can represent the circuit as in Fig. 3 (*a*), where the valve is assumed to have no capacity whatever, but has a condenser whose capacity is C_a farads connected externally between the anode and the cathode. R_a is the A.C. resistance of the valve and R the added resistance in the anode circuit.

Now, although no direct current can flow through a circuit with a condenser in series, alternating current can, and therefore a fraction of the alternating component of the anode current will flow directly back to the cathode *via* the capacity C_a instead of all passing through the resistance R. Since the amplified voltage

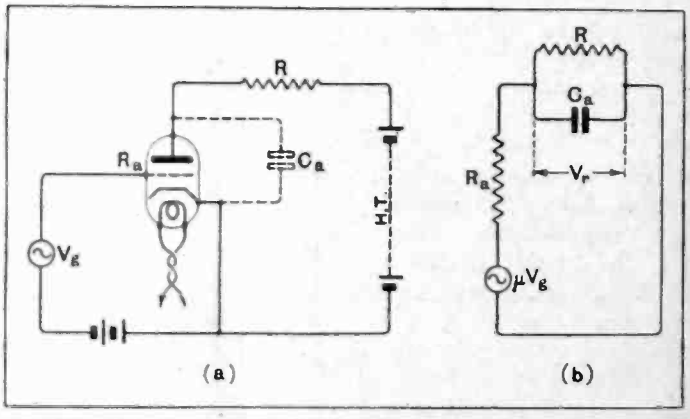

Fig. 3.—Diagrams for illustrating the effect of capacity between the anode and cathode of a valve on the degree of amplification obtained at various frequencies.

developed across R is proportional to the current there, it follows that the by-passing of some of the current through the capacity C_a will result in the alternating voltage across R being less than if no capacity were present, and the efficiency of the arrangement as an amplifier is impaired.

Fig. 3 (*b*) gives the equivalent anode circuit as far as the alternating components are concerned, and from this it will be seen that the anode resistance is virtually

Wireless Theory Simplified.—

shunted by the capacity C_a. The alternating current coming from the anode divides between the resistance branch and the capacity branch of the equivalent circuit.

For a given value of alternating electromotive force the current taken by a condenser is proportional to the frequency and to the capacity. In this particular case, if V_r is the alternating component of the voltage set up between the anode and cathode of the valve, and therefore across both R and C_a in the equivalent circuit, the current in the condenser branch will be $2\pi f C_a V_r$ amps., and that in the resistance will will be V_r/R amps. But it must be remembered that for a resistance the current and voltage are in phase, whereas for a condenser they are 90° out of phase, and therefore, since the same voltage V_r is common to both branches, it follows that the respective currents in them are 90° out of phase. Hence these two currents cannot be added together by simple arithmetic to give the total current. They must be treated as two quantities at right-angles and added as vectors, namely, square each, add the squares together, and then extract the square root.

But at this juncture we shall not make an actual calculation as this subject will be dealt with at greater length under another heading. It is only necessary to state here that the loss of amplification due to the inter-electrode capacity of the valve does not become serious until radio frequencies are reached. Resistance amplification for this reason lends itself admirably to audio-frequency amplification because the degree of amplification obtained is practically uniform over the whole of the audible range, an essential condition for high-quality reproduction from a receiver. On the other hand, at high or radio-frequencies the loss of amplification due to the valve capacity is unduly great when a non-inductive resistance constitutes the "load" impedance in the anode circuit, especially at medium and low wavelengths. Thus it will be found that in an amplifier designed for high-frequency amplification before the detector stage each amplifying valve has connected in the anode circuit either a tuned circuit of some sort or a high-frequency choke across which the amplified radio-frequency variations are developed.

(To be continued.)

TRANSMITTERS' NOTES AND QUERIES.

Short-Wave Working.

Mr. Robert Holmes (G6RH) is now testing on the 5-and 10-metre wavebands, using a self-excited T-P, T-G set, in his station at Allerton, Liverpool. He has experienced some difficulty in getting frequency-doublers to work satisfactorily at the high frequencies, and will be testing on 10 metres every Sunday until about 15.00 B.S.T.

G6RH has lately been working on the 160-metre band with G2QW and G2HP in London, and also finds that conditions are improving on the 40-metre band, though work on the 20-metre band is still difficult. Incidentally, he asks us to correct a slight error in the paragraph on page 68 of our issue of July 16th. The time should read either "11.30 p.m." or "23.30 B.S.T."

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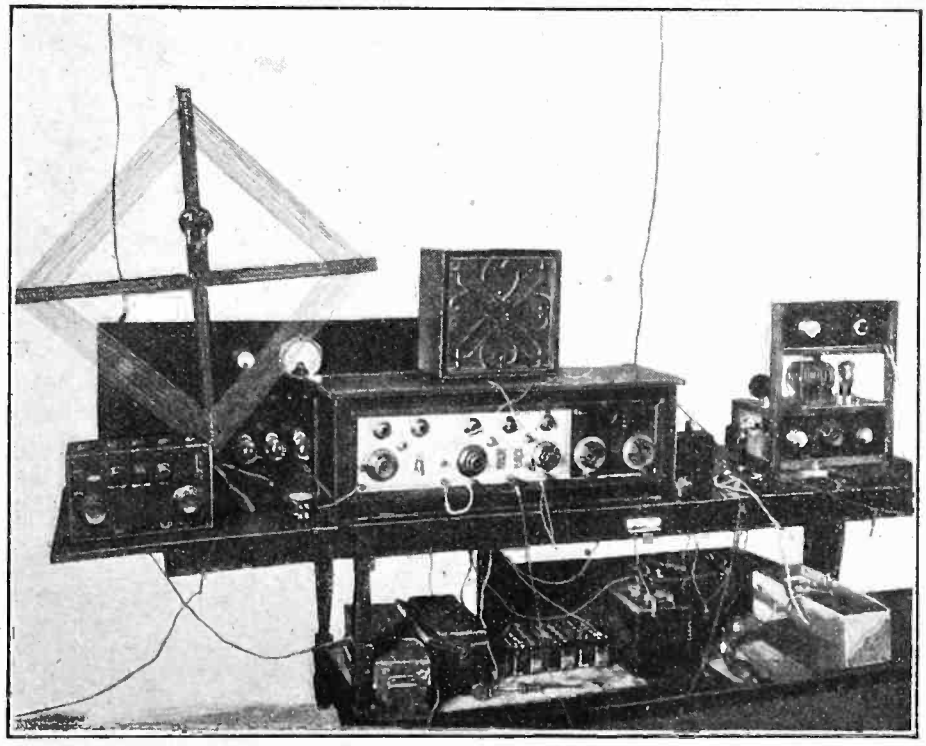
British Arctic Air Route Expedition.

Through the courtesy of the Secretary, Wireless Sub-Committee, B.A.A.R.E., we are able to supplement the information given on page 99 of our issue of July 30th.

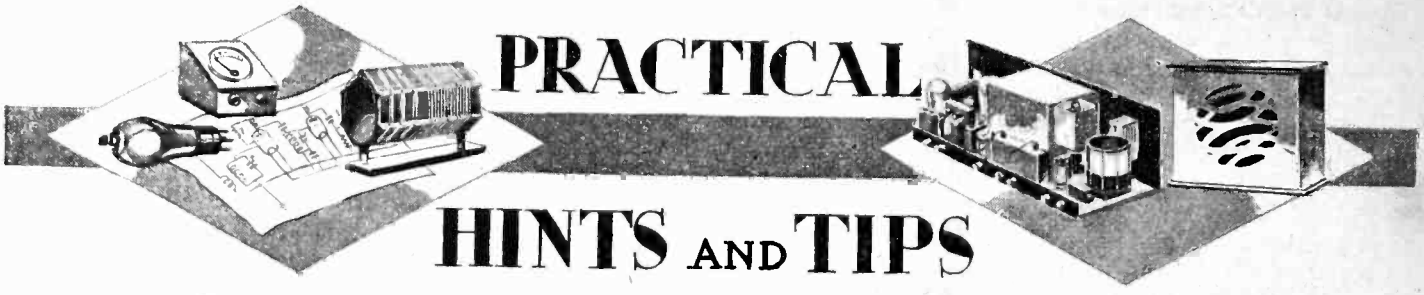
The wireless engineer to the expedition is Capt. P. H. Lemon, Royal Corps of Signals, who has been loaned by the War Office. He is to maintain an internal and an external scheme of communications. Three parties will leave the base of the Expedition for the coast survey and the meteorological station in the interior, and they will each be equipped with Army portable apparatus, and will work with the base on medium wavelengths. A short-wave station of a power of 100 watts will provide communication with England. The call-sign will be GKN, and the wavelength to be used will normally be 29.27 metres. This base station will work on alternate nights with a special station GKM at Aldershot, operated by Army personnel and with GFA, the R.A.F. station at Croydon. GKN will also carry out tests with the amateur stations G2CW and G6CR on a regular schedule. The co-operation of other amateur stations would be welcomed by the Committee. Any traffic from GKN that does not appear to be getting through to the British stations should be sent to the Secretary, Wireless Sub-Committee, B.A.A.R.E., Royal Signals Mess, Aldershot.

New Call-Signs and Changes of Address.

G2QX	(ex 2BJG) A. E. Groom, 13, William St., Luton, Beds., working on 41.6 and 21.4 metres, and welcomes reports.
G2SJ	J. Jones, 42, Fford Estyn, Garden Village, Wrexham.
G6HO	H. L. Holt, 73, Barricroft Rd., Didsbury, Manchester. (Change of address.)
G16NY	W. Locke, Daisy Hill Villa, Newry, Co. Down, N. Ireland.
2ACO	(ex 2AXA) J. A. G. Cole, 33, Grosvenor Rd., Wallington, Surrey. (Change of address.)



CT 2AG owned and operated by Fernando Hinte at Gorreana, San Miguel, Azores. The transmitter, on the right, is a Mesney using about 20 watts to a Philips JB004/10 valve and coupled to a full-wave 42-metre Hertz aerial. The receiver in the foreground is an 8-valve superheterodyne.



PRACTICAL HINTS AND TIPS

Aids to Better Reception.

EARTHING SWITCH CONNECTIONS.

It might seem that the fitting of such a simple device as an aerial earthing switch should be so straightforward that incorrect methods of procedure would be impossible. Actually, unanimity has not yet been reached on this subject, and authorities are apt to disagree even as to whether a safety switch is necessary at all for domestic broadcast receivers, let alone as to the best method of securing immunity from lightning risks.

Without suggesting for a moment that the possibility of damage from this source is anything but remote, it may be pointed out that the user of an external aerial who takes reasonable precautions is in a stronger position with regard to possible liabilities than he who ignores the question of protection altogether. It should be remembered that there is a tendency to blame the wireless installation for eventualities for which it is most unlikely that it can be responsible.

Probably the most popular kind of safety device is in the form of a single-pole, double-throw switch, connected as in Fig. 1A. This arrangement allows the aerial to be connected either to the receiver, or, for safety during electrical storms, directly to earth. To obtain full benefit from this device it is desirable that the switch should be mounted outside the building, and that its earth connection should also be external. The first-mentioned proviso suggests that the switch itself should be capable of withstanding the weather, and so some such material as well-glazed porcelain should be used for insulation. Its contacts, apart from being self-cleaning, should be more robust than would be necessary for ordinary service.

This form of switch connection, though satisfactory enough, is susceptible to criticism on one point: in the event of a discharge actually taking place at the moment when the switch is being changed over, the user may receive a shock, particularly if the insulating knob on the blade is moist, or if the fingers come into contact with the metal blade.

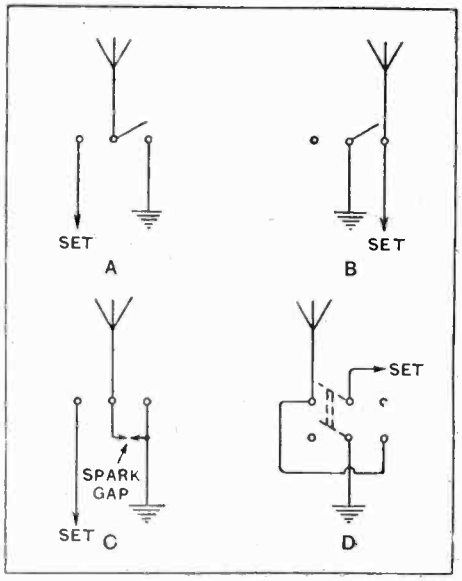


Fig. 1.—Methods of connecting aerial safety switches.

The chance of an accident of this kind is avoided by connecting the switch as in Fig. 1B, so that it acts as a short-circuit across the aerial-earth system. This arrangement has the disadvantage that discharges may be passed into the building, particularly if the external "earth" is of fairly high resistance.

Probably the best form of connection is that given in Fig. 1C, which is similar to that of diagram A, but with the addition of a safety spark gap. This device provides a measure of immunity even if the switch happens to be in the "receive" position, and risk of shock during manipulation is practically non-existent, provided the operating knob is of reasonable dimensions.

Still another way of joining a switch is shown in diagram D. This is free of the objection put forward with regard to arrangements A and B, but has one or two practical weaknesses. Double-pole switches, of the type generally sold for this purpose, have sometimes an insulating bar (between their two blades) of vulcanised fibre or similar material which is distinctly unsuitable for use under open-air conditions, as it absorbs moisture. Any leakage or serious dielectric loss at this point will adversely affect the performance of the receiver.

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IMPROVING SENSITIVITY AND SELECTIVITY.

It is very much easier to deal with a definite fault in a receiver than to overcome the cumulative effects of a number of minor deviations from good practice in its design. We have all encountered the type of set that functions after a fashion, but is lacking, to a greater or less extent, in all the essentials that go to make up a piece of apparatus that is a pleasure to handle; sensitivity just insufficient for proper reception of that rather elusive station, and selectivity just inadequate to prevent an annoying background of signals from the local station. There is a temptation to say outright that the best way to deal with such a set is ruthlessly to dismember it and to use as many of its component parts as possible for constructing an up-to-date outfit free of the original defects.

But such a course is not always practicable; it is the purpose of this

note to indicate one of the most promising lines of attack to those whose "H.F." receivers are suffering from the shortcomings under consideration, which are always due to tuned circuits of poor design or careless construction, or to excessive loads thrown on these circuits.

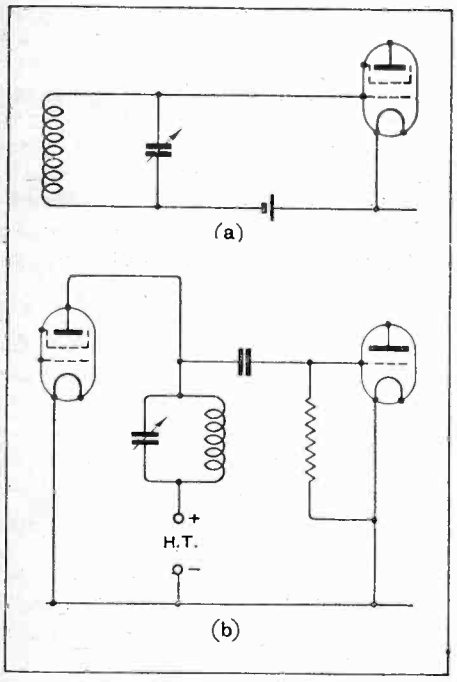

Fig. 2.—Where to look for losses in tuned circuits.

As a beginning we may take the grid circuit of an H.F. amplifying valve (Fig. 2(a)) and see where matters may be improved. First and foremost comes the coil; ignoring all questions of high-note loss and stability, a reduction of the losses due to this component is most likely to be helpful. The physical size of an inductance should be a measure of its "goodness," but this is not always so, and the possibilities of making a better coil to occupy the same space should be investigated if it is found impossible to accommodate a larger winding. If coils of greater size—and consequently with a more extended external field—can be used, one is faced with the probability that more extensive inter-circuit screening will be called for.

Apart from the question of the windings themselves, the dielectric properties of the material supporting them must be considered, and losses are particularly likely to be serious if terminals or contact pins are mounted close together. Useful guidance to the choice of the best substances to use has been published in this journal.

As the tuning condenser is directly in shunt with its associated coil, it is not hard to see that any wastage of energy in this component must be additive to that inherent in the winding. Fortunately, losses in condensers produced by reputable manufacturers have been reduced to a very low figure, but occasionally a noticeable improvement can be effected by making a change.

Another glance at Fig. 2 (a) shows that the remaining component connected across the tuned circuit—and therefore capable of absorbing energy from it—is the valve; to do anything to it, short of drastically replacing an indifferent specimen or removing the cap, is beyond our powers. The latter expedient is hardly likely to appeal except to the most enthusiastic searcher after efficiency. The valve-holder must not be forgotten, and that a shilling or so may be well spent in buying a replacement that is designed to avoid any unnecessary losses.

When a transformer is used for coupling the first H.F. valve to its successor—whether it be another H.F. amplifier or a detector—any shortcomings in the primary or anode circuit are likely to be overshadowed by losses in the tuned secondary. This, of course, is part of the next grid circuit, and so the possibilities of improving matters here should be investigated on the lines indicated in the preceding paragraphs. If grid detection is used, it almost follows that reaction will be provided, so no very determined effort need be made to remove every possible source of inefficiency. For the moment, at any rate, we can "skip" the detector grid circuit, and before attempting to improve it, pass on to the detector anode circuit. It is often possible to improve rectification efficiency, or, more correctly, to minimise the losses thrown back on the detector grid circuit, by reverse reaction through the valve capacity, by maintaining a larger capacity than usual between anode and filament. One must be cautious in making this addition, as there is a risk of impairing high-note reproduction.

If anode-bend detection is used, similar recommendations will still apply, but, due to the absence of direct reaction, it becomes more profitable to reduce losses in the grid circuit by fitting better coils, etc.

A tuned anode intervalve coupling circuit is susceptible to the same treatment as a grid circuit. Indeed, it stands in that relationship with regard to the succeeding valve. This point, not always fully realised, is made clear in Fig. 2 (b), where the conventional circuit is drawn in a rather unconventional way.

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GRID LEAK CONNECTIONS.

In an ordinary grid detector circuit it makes no real difference whether the leak is connected between grid and filament (Fig. 3 (a)) or directly in parallel with its associated condenser (Fig. 3 (b)). This is because its resistance is many times greater than the effective dynamic resistance of the tuned circuit across which it is shunted when the first-mentioned method is adopted.

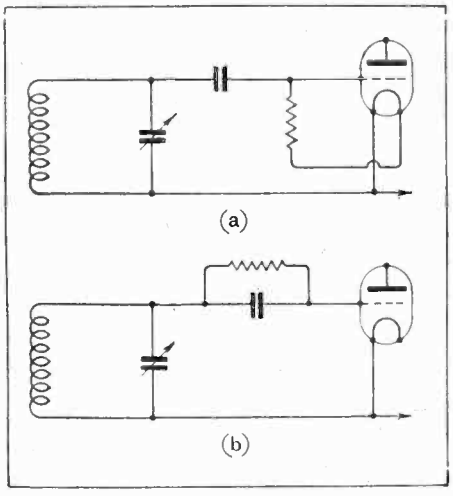
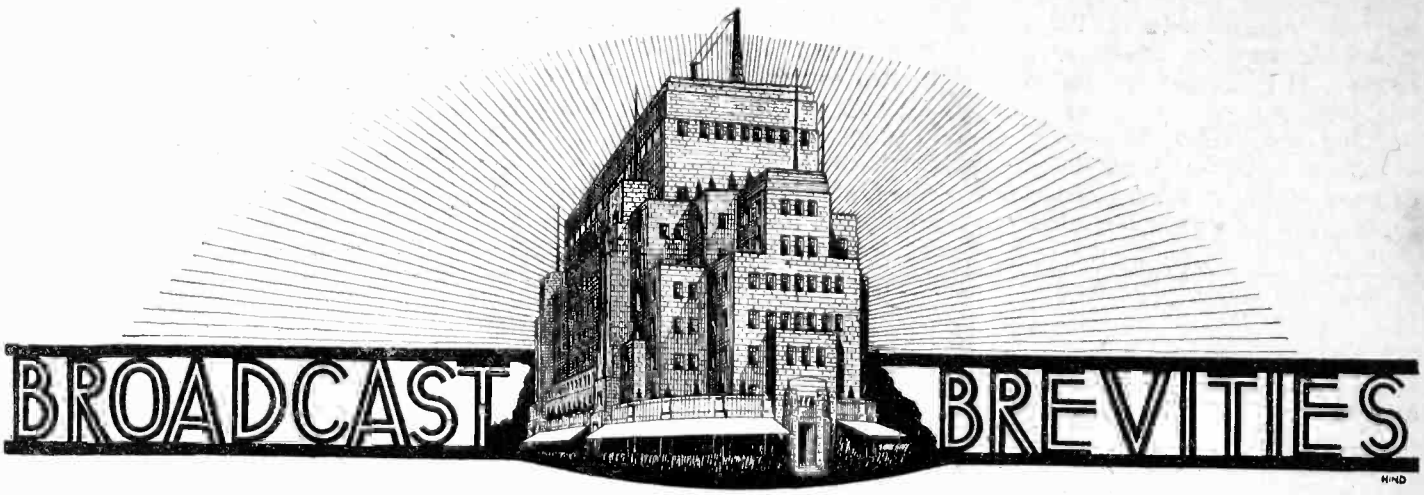


Fig. 3.—Alternative grid leak connections.

The position is rather altered by the introduction of power-grid detection, for which a leak of 0.25 megohm, or even less, is required for proper operation. Now a resistance of this order is almost comparable with the theoretical dynamic resistance of a reasonably good tuned circuit, which, even under working conditions, is unlikely to have a working value many times less than that of the leak. For this reason, the method shown in diagram (b) is generally to be preferred when the new system of rectification is used.



By Our Special Correspondent.

News from Portland Place.—Northern Regional Tests.—Captain Eckersley at the Microphone.—Where are the Radio Plays?—At the "Proms."

'Broadcasting House."

Rumour is now getting busy in connection with "Broadcasting House," which, it is suggested, may not be ready for the opening ceremony until March, 1932.

But the B.B.C.'s civil engineer himself states that the work is "well up to schedule." According to the contract the building is to be ready before the end of next year, and anybody who glances at the tower of steelwork in Portland Place would hesitate before declaring this to be impossible.

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Designing the Studios.

Although the main plans for the interior of the building are complete much of the detail work has still to be decided upon, particularly in regard to the studios. Noel Ashbridge, the Chief Engineer, has some very definite ideas concerning studio design, and many experiments will have to be conducted before the plans are finally passed.

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Transmission Tests from Moorside Edge.

At the time of writing the Chief Engineer and his staff are paying a visit to Moorside Edge, near Slaithwaite, where the Northern Regional station is rapidly nearing completion.

I hear that the first transmission tests may be expected in October.

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Wavelength Changes.

The wavelengths used by Northern Regional will be 479.2 and 301.5 respectively, the former being the present wavelength of Midland Regional (erstwhile 5GB) and the latter that of Aberdeen, which will have to resort to the national common wavelength of 288.5 metres. The Midland station will take Manchester's present wavelength, viz., 377 metres.

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The "Wipe-Out" Area.

Listeners in the West Riding area are beginning to realise that the Northern Regional station may have an uncomfortable "wipe-out" area. The same fears were entertained in regard to the Brookmans Park transmitters, not without reason, but I am afraid that the Northern station will be a greater offender. The station is situated on higher ground than Brookmans Park, and will have higher masts; moreover, it will admittedly have a larger service area than the London transmitters.

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A Question of Selectivity.

Faced with these facts, listeners with unpretentious sets are being told that the new conditions will involve them in extra expense if they desire to receive foreign stations. It seems to be forgotten that listeners with cheap sets never have indulged in foreign reception, while those blessed with better receivers can usually afford the small additional outlay necessary to increase their selectivity.

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A Chief Returns.

Captain Eckersley has not entirely forsaken the B.B.C. On September 23rd he will revisit Savoy Hill to deliver the first of a series of talks by leading authorities. He will deal with electrical engineering.

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Crystal User's Feat.

Recently a restaurant orchestra broadcasting from Birmingham had to pause in the middle of a selection owing to the din created by a passing street band. Next day Savoy Hill received an enthusiastic letter from a crystal user stating that during the break in transmission he had heard loud music from the Continent.

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A Non-existent "Technique."

Where are the new radio plays? What has become of the much-discussed radio dramatic technique which was ushered in with Tyrone Guthrie's play "Squirrel's Cage"? We now know that the success of that play was due largely to the novelty of its underlying dramatic device, viz., the repetition in chorus of a theme phrase which tended to dominate the mind of the listener and produce the appropriate "atmosphere." Subsequent attempts along the same lines have shown that the device has lost its force.

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One New Radio Play.

Only one new play specially written for broadcasting appears in the B.B.C.'s dramatic programme for the coming winter. This is "The Path of Glory," by L. du Garde Peach, to be given early in the New Year. The other dramatic features consist entirely of "repeats" of tried favourites or of stage successes,

FUTURE FEATURES.

National (261 and 1,554 metres).

AUGUST 24TH.—Religious Service from Buckfast Abbey.
AUGUST 25TH.—American music.
AUGUST 26TH.—Canadian music.
AUGUST 27TH.—Promenade concert.
AUGUST 28TH.—Vaudeville programme.
AUGUST 30TH.—Mozart concert relayed from Salzburg.

London Regional

AUGUST 24TH.—Military Band concert.
AUGUST 25TH.—Promenade concert.
AUGUST 26TH.—"Beggar on Horseback," a play by George Kaufman and Marc Connelly.
AUGUST 27TH.—Vaudeville programme.
AUGUST 29TH.—"Prunes and Prisms," written and produced by John Watt.

Midland Regional.

AUGUST 28TH.—Anglo-American Songs and Duets, Old and New.

West Regional (Cardiff).

AUGUST 25TH.—Orchestral concert from Weston-super-Mare.
AUGUST 26TH.—A Welsh Interlude.

North Regional (Manchester).

AUGUST 25TH.—"Request" Orchestral concert.
AUGUST 30TH.—Northumbrian Folk Songs and Dances (from Newcastle).

Glasgow.

AUGUST 25TH.—Musical Comedy.
AUGUST 29TH.—Scottish Music, from Edinburgh.
AUGUST 30TH.—"Mary of Delight," a play by Naomi Jacob.

Belfast.

AUGUST 25TH.—An Irish programme.
AUGUST 29TH.—Instrumental concert from Portrush.

such as Galsworthy's "Strife," which can hardly fail to be effective at the microphone.

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"Brigade Exchange."

Two war plays will be given. The first, "Red Tabs," is an adaptation of the Canadian war story "Romance." The other is "Brigade Exchange," the German war sketch which was so successful at the microphone in the spring. "Brigade Exchange" will probably be broadcast on Armistice Day.

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"International Conversations."

Several new series of talks have been planned for the autumn. "International Conversations" will consist of exchanges between an Englishman and a foreigner, in which the latter will describe his country's view of England. These will include Russia, Turkey, Germany, France, Italy and America.

A second series will deal with "Science and Religion," and is bound to be provocative.

A third series consisting of twelve talks will give a comprehensive picture of Africa from all angles. Major Walter Elliot, M.P., will open this series.

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A Musical "First Night."

The people who complain that broadcasting empties the concert halls should have been dragged in a body to the Queen's Hall on Saturday evening, August 9th, and shown the fervent multitude who stood listening to the first Promenade Concert. It would have been impossible to find anywhere else in London so many people in such a comparatively small space.

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Why "Promenade"?

What struck me most about the standing audience was its youth. Upstairs in the circle and gallery were many elderly folk, but the floor of the house was mostly occupied by "promenaders" who must have been born in the present century.

By the way, why "Promenade" concerts? I saw no room to promenade either in the hall or at the buffet.

Amid the glittering spectacle of players, soloists, the conductor, the instruments and the palms, one object seemed to escape notice. It was the microphone.

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The Audition Ordeal.

Even the attainment of a place in the B.B.C.'s National Chorus apparently brings with it no permanent peace of mind. Already, I hear, half the members are to undergo a fresh audition during the next few weeks and the remainder will be re-heard at the end of the season.

Thereafter every member will have to submit to a fresh audition at the end of every second season.

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Probationers in Waiting.

What will probably increase the natural frightfulness of these auditions will be the thought that the Probationary National Chorus, to which I referred last week, will be lying in wait, ready to fill gaps as they occur.

The fact that failure to pass the tests involves no financial loss, all the singers being amateurs, will hardly lessen the pain of failure.

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Probationers in Other Departments?

There is something menacingly effective about the probation system which prompts one to ask whether it could be applied to other departments of the B.B.C., from the top downwards. If the Governors were told that the Probationary Governors had arrived, would they proceed to govern more wisely? Would an announcer grow happier and calmer if a probationer appeared in the background? Would the sight of a lurking understudy diminish a soprano's tendency to wobble?

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Instilling Confidence.

Possibly in each case the probationers would instil confidence; probably they would not. I think that the best friends of the National Chorus will hope that its members will forget all about those probationers.

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More Bach Cantatas.

The Bach Cantatas will be resumed on the last Sunday afternoon in August, after the summer holidays.

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Another Austrian Relay.

Herr Bruno Walter, one of the most distinguished of German musicians, will conduct the Mozart concert which is to be relayed to London from the Salzburg Festival on August 30th. The Vienna Philharmonic Orchestra will be heard in the "Haffner" Symphony and a Concerto for two pianos and orchestra in E flat.

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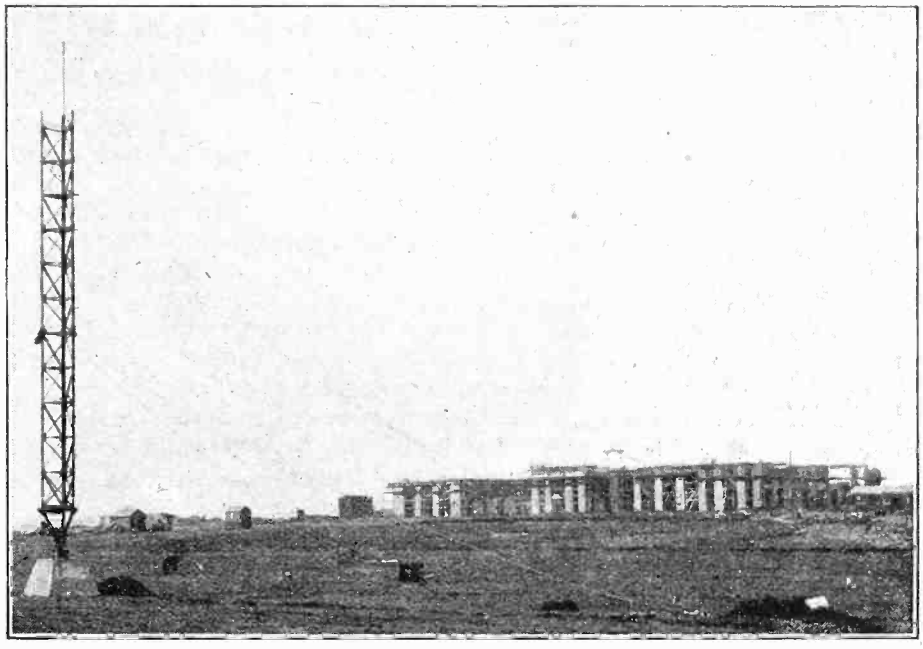
A Scottish Event.

There are comparatively few programmes which the B.B.C. can afford to repeat with any regularity, but, so far as Scottish listeners are concerned, there is always one at least which will receive a welcome as often as it is put on. This is a recital of "Songs of the Hebrides," given by their famous collectors and exponents, Mrs. Kennedy-Fraser, her daughter Patuffa, and her sister Margaret Kennedy. The three are to give one of these recitals in the Edinburgh studio on September 3rd, which will be broadcast from all Scottish stations.



NORTHERN REGIONAL. This photograph, taken at Pole Moor, Slaithwaite, a few days ago, shows the progress achieved in the construction of the Northern Regional broadcasting station. Our Special Correspondent indicates that preliminary transmission tests may start in October.

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Where B.B.C. Programmes are Popular.

During the present month no fewer than seven B.B.C. transmissions appear in the American programmes. The relays have included dance music, an orchestral concert from Manchester, and the Tidworth Tattoo. America usually "taps" the British programmes *via* 5SW at about 10 or 11 p.m. (G.M.T.).

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Canadian Night.

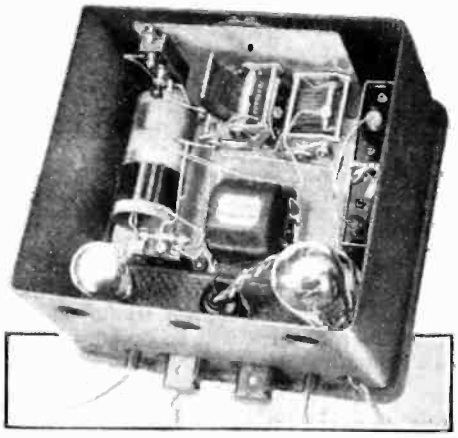
The folk music of Canada will provide a National programme on August 26th, in which the artistes are Frances Adaskin and Harry Adaskin, the latter a member of the Hart House String Quartet.

The National Museum of Canada has collected four thousand French and three thousand Indian melodies to form the backbone of the Dominion's folk music.

BROADCAST RECEIVERS REVIEWED

COSSOR Two-Valve Battery Receiver

WHEN the Regional scheme was first proposed, and, indeed, up to the time of its first practical application, many of us were inclined to be altogether too pessimistic regarding its effect on the performance of popular existing types of receivers. For instance, the opinion was freely expressed that simple detector-L.F. sets would automatically fall into disuse, being insufficiently selective for the new conditions. But we ignored the axiom that any receiver capable of separating a pair of twin transmitters at the extreme limit of its range (and few are unable to do so) could, by suitable control of H.F. input, be made to separate them at the shortest possible range—even at the gates of a Regional station. Consequently, simple apparatus can still be perfectly adequate, provided—and the proviso is important—that consistent reception of other stations is not required, or at any rate is not considered as vital. It will hardly be necessary to add that interference from high-power stations falls off rapidly with increase of distance, and that the choice of programmes afforded by a given set becomes more and more extended as the listener moves farther away from the wipe-out area.



Interior view; note H.T. connecting plug.

One is bound to admit that it is all to the good that these simple detector-L.F. sets have still a very considerable field of usefulness; they are bound to be cheaper, and are likely to be easier to operate and maintain than more ambitious outfits having one or more stages of H.F. amplification.

The Cossor two-valve battery model is typical, both with regard to its design and construction, of the simpler, but nevertheless effective, type of modern receiver. Its circuit arrangement comprises a grid detector with capacity-controlled reaction. The detector is shunted across the grid coil. As is shown in the accompanying diagram, the aerial system is semi-aperiodic for medium-wave reception, while on the long waves it becomes practically fully tuned. Alternative aerial sockets are provided, one of them being joined to the centre point of the medium-wave coil through a semi-variable condenser, which is brought into use when interference is experienced, or when the receiver is used with an aerial of unduly high capacity.

A pentode valve, which provides considerably more amplification than the usual triode, is used as an L.F. amplifier, and is coupled to the detector by a transformer. The loud speaker is directly connected.

Construction is on the chassis principle, and all apparatus is assembled on a plywood baseboard, which, after it is wired, is mounted in a neat metal container measuring some 10in. wide, 9in. deep, and 7in. high. The case is finished in "crackle" cellulose.

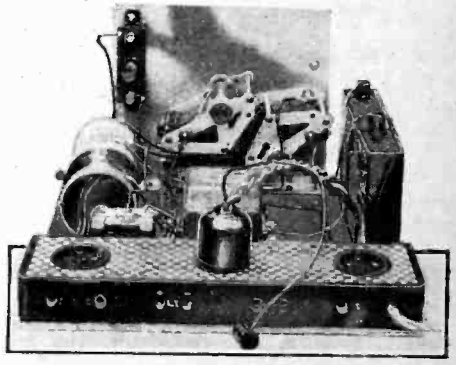
An Easily Installed Detector = Pentode Set Without Complications.

At the rear of the baseboard is mounted an insulated moulding carrying the valve sockets, and also plug sockets for external connections to aerial, earth, loud speaker, and L.T. battery; H.T. supply is fed through a multiple cable which is permanently attached mechanically, but of which the electrical continuity can be broken entirely by removing an internal plug on the terminal moulding. The grid bias battery is mounted inside the cabinet.

An ornamental escutcheon plate is fitted to the front of the receiver, and through it are passed the spindles for the control knobs.

The dual-range tuning and reaction coil assembly is wound in single-layer solenoid form on a paxolin former fitted with eyelet holes and tags for external connections. The reaction condenser, which is of commendably large capacity, is directly driven, but there is a suitable reduction gear for the tuning condenser.

Reverting to the circuit arrangement, it is noticed that the feed voltage for the pentode screening grid is the same as that applied to the detector anode (the pressure recommended is 90 volts). By operating the pentode in this way, its H.T. current consumption is considerably less than if its screen and plate were both supplied with the maximum available pressure, which in this case it is suggested should be 120 volts.



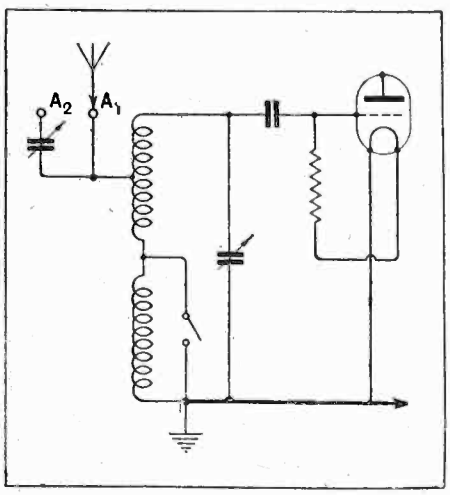
The chassis removed from its container.

There are three controls—tuning, reaction, and a combined filament-waveband switch. The reaction adjustment works particularly well on

Broadcast Receivers Reviewed.—

the long waves, but there is a slight overlap on the other band; tuning is but very slightly affected by variation of the feed-back capacity. As is to be expected, any change in the setting of the aerial series condenser has an appreciable effect on the main tuning control, but this is not objectionable in practice, as frequent alteration of this capacity is not likely to be made.

In the instructional pamphlet supplied, it is suggested that a bias of 9 volts should be applied to the pentode grid; this seems to be rather on the high side for the specimen actually tested, and a reduction to $7\frac{1}{2}$ volts had the effect of improving quality. With this setting the total anode and screen current for both valves amounted only to 10 milliamperes. Reproduction was distinctly pleasing, and volume was adequate.



Input and wave-range switching connections of the receiver.

The general performance of the receiver was found to be fully up to the standard that can reasonably be set for a single-control detector-pentode set, and all the circuit constants seem to be well chosen, with the result that selectivity and sensitivity are good enough to ensure a reasonable choice of programmes in all but the most difficult situations.

There is very little to go wrong, and, as the moving parts—variable condensers and switch—are well made, there is little reason why the set should give trouble as long as it is provided with adequate L.T., H.T., and grid bias voltages. Should a fault develop, the chassis is easily removable from the container for test and repair by slacking off the control knob grub screws and by removing the four screws which secure the baseboard to the case.

The receiver is made by A. C. Cossor, Ltd., Cossor House, Highbury Grove, London, N.5, and is sold at £5 10s., complete with a 210 H.F. detector and a 230 P.T. pentode output valve.

CORRESPONDENCE.

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

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

MAN-MADE STATIC.

Sir,—We were very interested in the recent correspondence in your columns regarding electrical interference with wireless reception.

On behalf of a large number of listeners in this town, we have been endeavouring for some time to obtain some satisfaction from the authorities concerned regarding the intense interference caused in Darlington by the electric trolley 'bus service. After considerable correspondence with the B.B.C., etc., we have received a letter from the Engineer-in-Chief of the General Post Office stating that the Postmaster-General has no statutory powers to compel tramway or similar undertakings to adopt remedial measures.

As far as we can ascertain, no steps have been taken successfully to reduce the trouble, which is so bad that a very large proportion of wireless listeners here are incapable of receiving any programme satisfactorily.

It seems to us a lamentable state of affairs that the public are deprived of a service such as broadcasting, in order to enjoy the doubtful service of the tramway system. Surely it could be possible to arrange for one to cause little or no interference with the other. Whilst the law remains as at present the wireless listener is likely to be the victim, and we suggest that strong representation should be made by every person affected to his member of parliament.

E. AND H. GLOVER.

Darlington.

PORTABLE OR FIXED SETS?

Sir,—In view of the fact that the majority of potential buyers of wireless apparatus for the coming season, or for that matter at any time, are more or less ignorant of what will suit them best and give lasting satisfaction, it surely behoves all manufacturers in their own interest to make once and for all a clear distinction between the portable and the fixed set (or frame aerial set with external speaker).

Most manufacturers and retailers, for some unknown and short-sighted reason, push portables in preference to fixed sets, even when they know they will not be used as portables. Surely this procedure will eventually injure the prestige of manufacturer, dealer, and radio in general. Which type of set is likely to create a fresh sale, when heard by friends of the owner, after say two months' use, a portable or a fixed set? The modern portable is certainly a marvel of science and ingenuity and, used as such with a car, is a very desirable thing to possess, but it still remains, from the point of view of results and upkeep cost, the worst value in the world. In the vast majority of cases people have only one set.

All manufacturers should emphasise the fact that for general use a fixed set will give infinitely more satisfaction, both in upkeep costs and what is, perhaps, more important in its ability to do more justice to the excellent quality transmissions now sent out by the B.B.C., especially since the recent adoption by them of the condenser microphone for regular use. The important gramophone companies have long ago relegated the portable gramophone to its proper place, to their great financial benefit and the satisfaction of their numerous clients.

Surely nothing but benefit for all concerned can result from enlightening the general public about portable wireless. It seems so futile to propagate inferior radio, when it can so easily be otherwise, at a time when the programmes and quality of transmissions are daily becoming better and better.

Wolverhampton. W. D. PEARSON.

LONG-WAVE STATIONS IN BRITAIN AND IRELAND.

Sir,—I strongly support your view that Britain should forthwith insist on being allocated a second long wavelength for broadcasting. I hope the Saorstat may get for their proposed central station a long wave also; I was seldom able to agree with them on any subject, but it is certain this country is missing sadly what the Irish temperament and outlook can bring to public life, and if they had a station easily audible over the whole of Ireland and in this country and would condescend to speak the language we both understand and of which they are able to make such excellent use, they would add im-

measurably to the influence of their culture in a world that needs it.

If Britain obtained an additional long-wave, probably the more remote districts of this island would be covered better by allowing the Midland National Station (5XX) to work on a medium wave, locating one of the long-wave transmitters farther north, *e.g* at Pole Moor, or better still, in Scotland, and the other one farther south than Daventry.

If Britain could not secure a second long wave—why she should not is difficult to understand, seeing that Paris and Holland have two apiece—experiments might be made to ascertain :

(1) Whether the present single long-wave transmitter could not be made to cover the whole country by increasing the power or altering the site, or both, or, if this proved impracticable,

(2) Whether two stations located as suggested in the preceding paragraph might not each use the same long wave (crystal controlled) as now used by 5XX, and each transmit the National programme.

In connection with the suggested increase of power, *Wireless World* readers will have observed in the issue of July 16th that Radio Paris and Tour Eiffel are increasing their power to 85 kW. and 24 kW. respectively; both are long-wave stations.

I do not understand Mr. J. A. Hall's alarm, consternation and anger at your excellent suggestion, nor his contempt for Savoy Hill. The B.B.C. manifests no self-satisfaction, and I believe feels none, though its achievements are far from being contemptible; on the contrary, the programmes bear evidence of careful compilation and their presentment thorough preparation, finish, dignity and, at times, even splendour. If they are listened to with attention the talks are of much interest, and, not least by the sick and convalescent, appreciated as welcome interludes between concerts. I speak from experience and with gratitude after three long and trying illnesses which B.B.C. programmes not only assisted me to endure, but materially accelerated recovery, besides adding to my store of general knowledge. It is not to the purpose to complain that B.B.C. programmes do not resemble those of other countries (save in the matter of the universal and often wearisome jazz of our American would-be masters); each country has its own culture, and its programmes should illustrate this, so that tuning in a foreign station should convey the atmosphere of its nationality, as, in fact, is usually the case. My only grumble at Savoy Hill is that the authorities occasionally seem to be afflicted with a Nordic-English-puritan-pacifist outlook instead of being robustly pro-British Commonwealth; that, however, is but a matter of personal taste.

I am somewhat surprised that at Bedford, with the outfit Mr. Hall describes, only long-wave foreign stations are receivable. I fear that recently he cannot have had time to peruse his *Wireless World* with attention and profit. He might, with great advantage and pleasure to himself, construct, say, one of the models of the "Foreign Listener's Four," after which his gloomy forebodings would assuredly depart.

Lest what I have written above should lead Mr. Hall and others to suppose that I am only a B.B.C. listener, I might observe that my own receiver (near London) has practically world-wide range on loud speaker. It is entirely of my own design and make, employs a *changeur de fréquence* (I.F. = 477 kh., *i.e.* $\lambda = 2\pi \times 100$m.); there are three S.G. I.F. stages, diode detector, with a stereophonic coupler preceding the 2nd L.F. (output) stage. Its total H.T. consumption is of the order of 24 mA. maximum, and on many European stations the volume control has to be set nearly at minimum to keep reproduction—which is of the highest quality—at less than overwhelming volume on three speakers, of which one is a M.C.

"SHENE ANGLORUM."

BROADCAST PROPAGANDA.

Sir,—While being in agreement with Mr. Munn that the B.B.C. programmes leave much to be desired, I do not think that the remedy lies in sponsored programmes.

If a manufacturer is willing to spend large sums of money on advertising *via* the ether, he would not be willing to confine the desirability of his product to a few casual remarks during the course of three hours' entertainment, as suggested by your correspondent, but would probably desire to make an announcement between each item. If Mr. Munn has ever spent an hour or two listening to the American S.W. stations he will realise what this means, and also that it is, in my experience, impossible to select any programme of a sponsored variety (apart from the advertising matter) which provides an entertainment equal to anything we have at present available from the B.B.C.

I think that a lot could be done towards improving the B.B.C. programmes by cutting down the talks by half, brightening up the Saturday evening programmes between 7 and 9, possibly by "variety," and making sure that there is at least always an alternative programme of different character.

The racing results might be left out of the "news," as they take up a lot of time, and are not of interest to more than a small percentage of the listeners; anyone who is really interested in these takes care to get an evening paper as soon as possible. If this was done I do not think the average owner of a receiving set would have much to complain about. G6RK.

Birmingham.

Sir,—Mr. Munn, in his interesting letter on broadcast propaganda, seems to imagine the broadcast programmes consist entirely of dance music, dowagers (what does a dowager sound like?) and drawing-room "entertainers," of which he evidently does not approve.

Ignoring for the moment (as Mr. Munn does) the symphony concerts, light classical concerts, military and brass band concerts, chamber music concerts, instrumental concerts, choral concerts, ballad concerts, organ recitals, plays, talks, prose readings, poetry readings, after-dinner speeches, running commentaries, which are broadcast from time to time, none of which seem to appeal at all to Mr. Munn, one cannot help wondering what sort of programmes *would* Mr. Munn like?

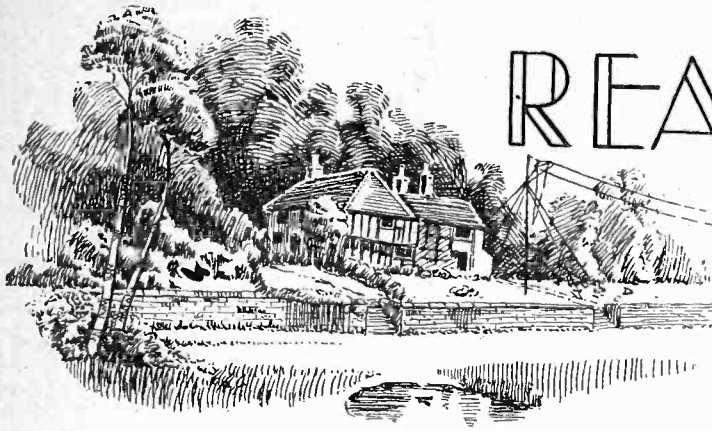
I, personally, have little fault to find with the programmes, except when they broadcast speeches, etc., without any alternative, which, in my opinion, they ought never, never, *never* to do. My grouse is that there is now no station from which I can be reasonably certain of receiving the National programme decently. During the summer it is rather the rule than otherwise for 5XX to be completely marred by atmospherics, especially after sunset (and especially during the "Prom" season!), while the Brookmans Park National is hopeless (even here, less than fifty miles from it) by reason of fading and distortion. Incidentally, the B.P. Regional also fades considerably, but does not distort. Alas, for good old 2LO, which always came in as steady as a rock and very nearly as strongly as B.P. Regional now does, and much more strongly than B.P. National! A. K. GORDON.

Crowborough.

Sir,—I have read with interest the views expressed with regard to broadcast propaganda in Mr. Munn's letter and your editorial. It is, I think, wholly undesirable, for the reasons you state, that the programmes of the B.B.C. stations should be interfered with in any way in the interests of advertising. If advertisers once obtain a hold on the programme matter of the B.B.C. there is no knowing to what evils their influence may lead. The dissatisfaction shown towards the B.B.C. results chiefly not from poor quality of the programmes but from the fact that individual taste can be satisfied to a small degree only, since there are so many different tastes for which the programme directors must cater. Whether a programme is poor in quality or not depends almost entirely upon the standard required by the individual critic.

If, however, advertisers must make use of broadcasting, why should they not erect a transmitting station of their own? The Press should be influential enough to solve the difficulty of wresting the monopoly from the B.B.C., and room could surely be found for it despite the crowded ether. This scheme would have several advantages. The public need not listen to the advertisers' programme unless they wished (or at least we hope the power would be restricted!), the programmes sent out would have to be good to command public attention, and the station would satisfy those who consider a mere alternative programme insufficient. G. A. BUSBY.

Newport, Essex.



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.

Casual Couplings.

My "1930 Everyman Four" fails to work at all until the screening cover is completely removed, and even in this condition gives quite weak signals from the local station. Tuning of all three circuits is quite sharp. The L.F. amplifier (and probably the detector, as the set works well with a pick-up) seems to be quite satisfactory, so I suppose the fault must lie in the "H.F." end of the receiver. Will you please suggest the most likely place to look for it? The usual tests have been made, and everything seems to be in order. L. F. B.

It would appear likely that there is no proper linkage between the various tuned circuits, and that you obtain weak signals from the local station only by virtue of stray direct magnetic couplings between the coils. An effect of this sort might well be caused by a faulty H.F. valve; you should accordingly test your valve carefully, together with its feed circuits. The substitution of another valve known to be in order would be helpful.

It would be wise to check the coupling connections between aerial and secondary circuits, and also the primary circuit of the H.F. transformer assembly; the secondary circuit of this component is almost certainly in order.

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Frame and Filter.

Some time ago you published (in the "Readers' Problems" pages) a diagram showing how a filter circuit could be interposed between a frame aerial and an H.F. amplifying valve. The arrangement as shown necessitated the use of a centre-tapped frame; if this is not an essential part of the scheme, will you please give me a circuit diagram showing the connections of an untapped frame to a capacity-coupled filter? H. M. S.

We should point out that the centre-tapped frame aerial circuit to which you refer was intended to be a help in eliminating locally generated interference and "vertical" pick-up, and that a tapped frame is by no means essential when an input filter is used.

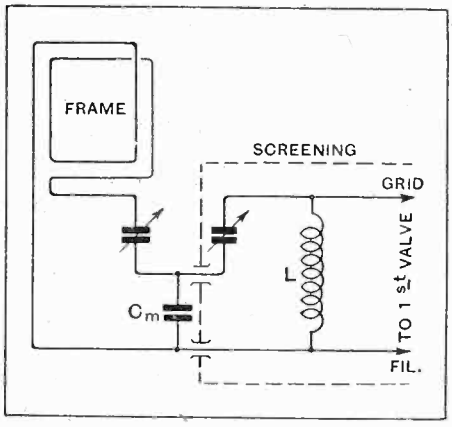

Fig. 1.—A frame aerial as part of a capacity-coupled filter.

We give in Fig. 1 the circuit diagram which you require; C_m is the coupling condenser, and L is the secondary inductance.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

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

(3.) 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.

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

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

(6.) Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.

(7.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.

Good Coils.

I have reason to believe that the coils used in my receiver (which has a single H.F. stage using a S.G. valve) are not as efficient as they might be. As I am thinking of modifying the set, will you please refer me to one of your back numbers in which the best possible coils suitable for use with a screen-grid valve were described? C. R. R.

This is rather a difficult question to answer helpfully, as with a modern receiver there is a distinct limit to the "goodness" of coils that can successfully be used.

Probably the best coils, from the point of view of high dynamic circuit resistance were those described for the "Record III" in our issues of September 4th and 11th, 1929, but, apart from their large size, they were intended for a highly specialised type of circuit, and it is most unlikely that they would yield satisfactory results in any other kind of set.

If you care to send us a brief description of your receiver, we will endeavour to suggest the most suitable types of windings.

o o o o

Long-wave Instability.

The H.F. stage of my receiver is coupled by a transformer, and works extremely well on the medium wave band, but is lacking in stability over the majority of the long-wave tuning scale. I have tried the experiment of removing primary turns, without any real success, and am inclined to abandon the transformer in favour of the tuned-grid type of intervalve coupling. Do you consider that this change would have the desired results? D. P.

It would be a mistake to make this change, as there is no inherent reason why a tuned grid intervalve coupling should afford greater freedom from self-oscillation on the long waveband. On the contrary, it is quite likely that the trouble will be accentuated because, all other things being equal, this form of coupling is rather more efficient on the long waves than on the medium band.

Potential Dividers.

Is there any real difference between a potentiometer and a "potential divider"? I have been reading a text book in which these two expressions are apparently used indifferently to designate the same piece of apparatus.
J. W. T.

These expressions, as generally employed, are synonymous, but the word "potentiometer" should, strictly speaking, be applied to an appliance for measuring potentials by the "balance" method. It is really incorrect to use it as an alternative name for a "potential divider"—although we all seem to prefer it to the more lengthy but more graphic and descriptive title.

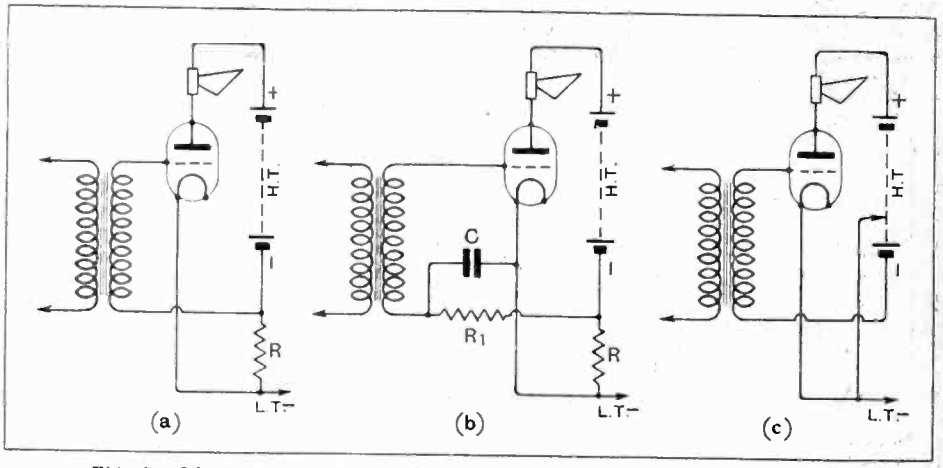

Fig. 2.—Illustrating methods of using a high-tension battery as a source of grid bias voltage.

Permanent Magnets.

Is the magnetic field of a reed-driven speaker unit likely to be retained for a greater length of time if the windings are directly connected (in the right sense, of course) in the anode circuit of the output valve than when a choke-condenser filter is provided. With the latter arrangement there is no steady D.C. current, and it seems to me that the magnets might quickly lose their strength. T. G. W.

We do not consider that this is a matter of any great importance. The comparatively small current flowing under normal operating conditions is most unlikely to have any great effect in assisting the retention of magnetism.

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Automatic Bias.

The voltage of my accumulator H.T. battery is rather greater than is necessary for reproduction of adequate volume for my needs; I believe that by sacrificing some of the excess voltage it is possible to use the battery for supplying grid bias for the output valve. Will you please show me how this may be done? R. L. L.

By inserting a resistance of suitable value between the negative terminal of the high-tension battery and the L.T. negative bus-bar of the valves in the receiver, grid bias for the output valve can readily be obtained, provided that its grid return lead is joined to H.T. negative. This method, in its simplest form, is illustrated in Fig. 2 (a), where the bias resistance is marked R.

Due to the fact that this resistance is common to the anode circuits of all valves in the receiver, it is probable that it will cause harmful interstage couplings, and so this simple circuit is hardly practicable. As a rule it will be necessary to add a decoupling resistance (R_1) of about 100,000 ohms, and a by-pass condenser (C) of about 2 mfds., as shown in Fig. 2 (b).

The need for using a bias resistance and decoupling devices is entirely obviated by the still simpler arrangement shown in Fig. 2 (c). The required number of cells at the negative end of the battery can be used for bias purposes if connection to the H.T. negative terminal of the receiver is made from a point on the battery that is positive (with respect to the negative end) by the required amount. Where an accumulator battery is used, this, again, is not altogether practical, as the end cells would not be discharged equally with the others.

A suitable value for the bias resistance shown in Fig. 2 (a and b) can easily be determined in the manner often explained in these pages.

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"Live" Loud Speaker Leads.

When the loud speaker leads of my set are brought in proximity to the aerial terminal a whistle is produced; otherwise it works satisfactorily enough, although I sometimes think that quality might be improved. Do you consider that the production of self-oscillation in this way is an indication that anything is wrong? D. R.

Effects of this kind show clearly that high-frequency currents are present in the output valve anode circuit, and consequently that H.F. and L.F. components have not been properly separated after the process of detection. Accordingly, you should fit some kind of "H.F. stopper." In its simplest form this may consist of a resistance of from 0.1 to 0.25 megohm connected directly in series with the grid of the first L.F. amplifying valve.

Interaction between input and output ends of a portable receiver is often caused in this way, and, to prevent it, a fairly large condenser is often shunted between detector and filament of the output valve; you might adopt this plan.

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L.F. Chokes in Parallel.

I am about to increase the power output of my eliminator by fitting a new rectifier, and am afraid that the current-carrying capacity of my present smoothing choke will be inadequate; also, its D.C. resistance will probably be unduly high. Do you recommend me to connect in parallel with this choke another of similar type, and with the same inductance value (30 henrys)? F. C. R.

By connecting two similar chokes in parallel, the resulting inductance may become less than that of either used separately, and therefore insufficient for adequate smoothing in your case.

In practice, matters will not be quite as bad as we have suggested, as the reduction of actual—as opposed to rated—inductance will be less than the figure given; this is because the current flowing will divide itself between the two chokes. But, in spite of this, we consider it unlikely that your proposed plan will yield satisfactory results.

FOREIGN BROADCAST GUIDE.

BERLIN-WITZLEBEN

(Germany).

Geographical Position: 52° 32′ N. 13° 25′ E.
Approximate air line from London: 580 miles.

Wavelength: 418 m. Frequency: 716 kc.
Power: 1.5 kW.

Time: *Central European Time.
** Coincides with B.S.T.*

Standard Daily Transmissions.

06.30 B.S.T. Physical exercises; 07.00 (Sun.) relay of concert from Hamburg; 08.15 breakfast concert; 08.50 (Sun.) sacred concert followed by carillon from Berlin Cathedral; 10.10, onwards, commercial reports and news broadcasts throughout day; 20.00 or 20.30 main evening programme; 22.20 news followed by dance music until 00.30 (except Tues. and Fri.).

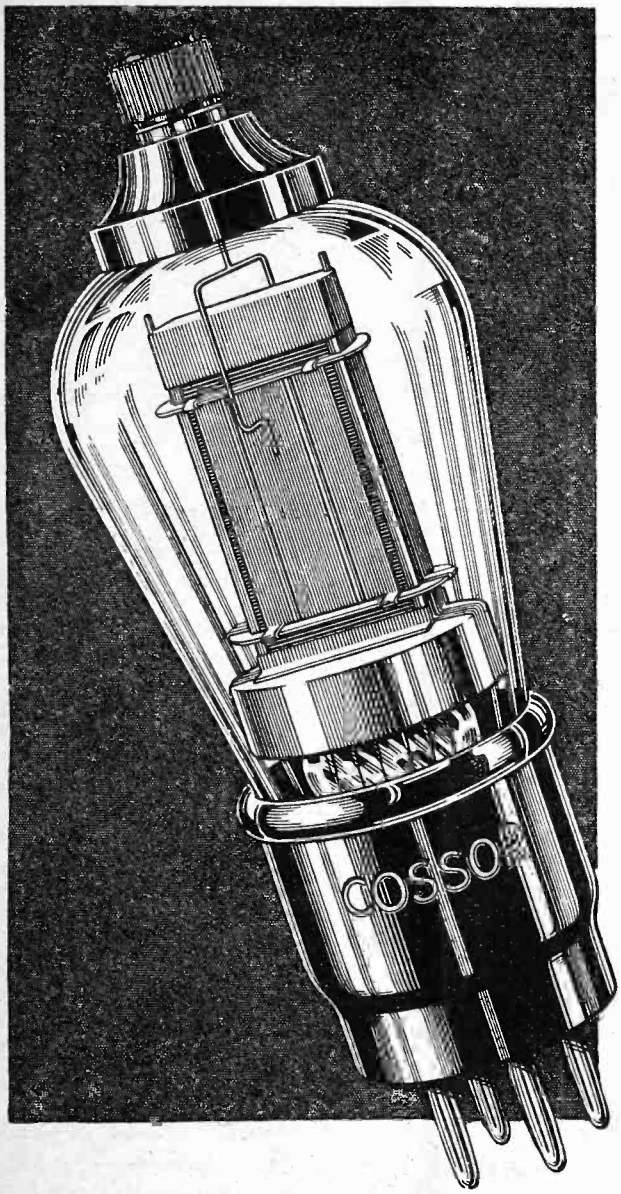
Closes down with the playing of the *Deutschlandslied* (Haydn's Hymn *Austria*).

Male announcers. Call: *Achtung! Achtung! Hier Berlin, Stettin und Magdeburg.*

Interval Signal: Metronome (4 beats per second) followed by abbreviated call: *Achtung! Berlin.* All announcements are made in the German language only.

When Koenigswusterhausen (1.635 m.) and the Zeesen short-wave transmitter (31.38 m.) take the programme the call includes their names as well as any other provincial stations to which the relay is being made.

Common wave relays: Berlin (E), Stettin, Magdeburg on 283 m. (1,058 kc.).



LOWEST inter-electrode CAPACITY ever attained

The actual amplification obtained from any Screened Grid Valve is largely governed by its inter-electrode capacity. Cossor research—during the past twelve months—has been focussed on this great problem. To-day we are able to announce that the new Cossor 215 S.G. has a lower inter-electrode capacity than any other Screened Grid Valve on the market. This capacity is of the order of ·001 micro-microfarads. Due to this—and also to many other features, including the new box-type screening grid and a method of shielding which is 100% efficient—the new Cossor 215 S.G. gives a degree of amplification with perfect stability and freedom from distortion which—a year ago—would have been considered utterly impossible. Use this new Valve in your Receiver and the all-round improvement in its performance will astonish you.

Cossor 215 S.G. 2 volts, ·15 amp. Impedance 300,000. Amplification Factor 330. Mutual Conductance 1·1 m.a./v. Normal working Anode Volts 120. Positive Voltage on Screen (approx.) 60. Price 20/-

A. C. Cossor Ltd., Highbury Grove, London N.5.

THE NEW COSSOR 215 S.G.

HIGHEST *ACTUAL* AMPLIFICATION

♡ 5682

Advertisements for "The Wireless World" are only accepted from firms we believe to be thoroughly reliable.

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NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is :

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue : 13 consecutive insertions 5% ; 26 consecutive, 10% ; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to **FIRST POST on THURSDAY MORNING** (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on **WEDNESDAY MORNING** at the Branch Offices, 19, Hertford Street, Coventry ; Guildhall Buildings, Navigation Street, Birmingham ; 260, Deansgate, Manchester ; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made ~~& Co.~~ payable to ILIFFE & SONS Ltd., and crossed ~~& Co.~~ Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box ooo, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. ooo, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes ; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged ; on transactions over £10 and under £50, the fee is 2/6 ; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

GECOPHONE 2-valve Mains Receiver, 200-260v. 50-100 cycles mains, used for demonstrations only, as new; £10.

EPOCH 22E M.C. Speaker, 6v. 0.3 amp., field, impedance, 1,000 ohms; £1/15.

ECKO V3 Mains Eliminator, 200-240v., output 120v. at 30 m.a., 3 taps, less valve; £2.

CALLERS, any day except Wednesdays.—McFarlane, 15, Rotherfield Rd., Enfield Wash, N. [1211

SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

Receivers for Sale.—Contd.

APPLEBY'S

19 19-1931?

SEASON 1930-31.—A comprehensive catalogue of new season's radio apparatus of convenient size for the pocket will shortly be issued; price 9d., post free; as this catalogue will be a pocket guide to modern radio material, it will be in wide demand; those desiring to secure a copy, would greatly assist us by kindly making application now, enclosing 9d. in stamps; a copy will then be forwarded as soon as issued, about the time of the exhibition; the 9d. may be deducted from any following order before the end of 1930, in excess of £1.

PLEASE Apply Early! Please send in your radio material for part exchange credit early—and avoid the rush; it will be a great season, good sets, good components, and fine workmanship.

APPLEBY'S, where radio part exchange began.—Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines). [0340

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

BERCLIF D.C.2 All Mains Receiver, 200 to 250 volts D.C.; price £14/10; with valves and royalties, suitable for M.C. speaker; particulars free; trade inquiries specially invited.—Simmonds Bros., 38, Rabone Lane, Smethwick. [8734

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere, and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

DEMONSTRATION Model 1930 Portable 4-valve S.G., listed 23 guineas, upright type, Celestion speaker, new valves and batteries, tip-top order; 16 guineas.—Richardson, Aughton, Ormskirk. [1226

F. W. SMURTHWAITE, A.M.I.R.E., specialist in high grade individually designed and manufactured radio apparatus; contractor to the B.B.C. and L.C.C. for hospital and institution installations; whatever your requirements, be they a simple 2-valve receiver or the most intricate design, may I suggest you get into touch with me?

MY Unbiased Advice is at your Disposal with Pleasure; I am always pleased to submit specifications and quotations, without obligation; a long list of instruments does not convey much, as it is impossible to give full details within the limits of small advertisements; the following are intended as examples, and are more or less standard lines which experience has shown to be particularly popular.

A.C. Three, the outstanding all mains 3-valve receiver, made up to scientific instrument standard with the finest components available; circuit consists of 1 S.G. H.F. valve, fully screened, with highly efficient dual wave coils, anode bend or power detector (to choice), transformer coupled to an A.C.-P1 output valve which works at maximum anode voltage with automatic grid bias, thus ensuring ample power output for a moving coil speaker; price £25. complete with valves and royalty; hear this set before deciding on any mains receiver.

SCREENED Grid Five, a unique receiver for battery valves; the H.T. can be supplied from either a mains unit or batteries as desired; 2 S.G. H.F. valves coupled by efficient dual wave tuned transformers, all assembled in beautifully made aluminium screening box, anode or power rectifier and a specially designed L.F. amplifier arranged to give the best possible quality, choke condenser output filter; this set has ample power to bring in any station whose signal is above the noise level; prices from £25. according to specification.

RADIO Gramophones.—I have a number, of extremely efficient designs, and am always willing to make up cabinet work to exactly match existing furniture; genuine period reproduction cabinets if desired.

HIGH Power Amplifiers, for dancing, public address, etc.; full details on application.

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DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more, we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms, from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5 'Phone: North 0623 (3 lines). [8751

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PHILIPSON'S Safety High Tension Supply Units for A.C. and D.C. Mains, 200-250 volts 40-60 cycles, also 230 volts 25 cycles.

10/- Down and Small Monthly Payment Secures the Finest H.T. Supply Available.

PHILIPSON'S Safety H.T. Units are Guaranteed for 12 Months Against All Defects.

ALL Models Sold on 7 Days' Approval to Ensure Complete Satisfaction.

PHILIPSON'S Safety H.T. Units are the Cheapest to Install and the Cheapest to Run; £1/17/6 to £6.

WRITE for Our Booklet, "Radio Power," which gives illustrations and full particulars.

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PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038 Bolton. [0318

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SAVAGE'S.—Reliable smoothing condensers, 1,500 volt D.C. test, 1 mfd., 2/-; 2 mfd., 3/-; 4 mfd., 5/3; 500 volt D.C. test, 1 mfd., 1/6; 2 mfd., 2/3; 4 mfd., 3/9.

SAVAGE'S.—Super smoothing and output chokes, many types available; write for list.

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CABINETS to Your Own Requirements; quotations by return.—Hammonds, 1, Stratford St., Nuneaton. [1234

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600 and 1,000 ohms Decoupling Resistances, specified for the largest and most important "Wireless World" receivers; 1/6 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1088

Coils, Transformers, Etc.—Contd.

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KILO-MAG Four Formers, slotted, ready for winding, 12/6 set; 1930 Everyman Four, 8/6 set, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1089

BAND-PASS Four Coils, complete, 70/-; Ideal Home receiver coils, 43/-; superhet. adaptor coils and base, 24/-; S.G.S.W. Three, 4 coils, 34/-; additional coils, 46/-.—Below.

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E.C. WIRELESS.—Regional One coils, 9/- pair; Band-Pass Four, 45/- set; first quality materials and construction to specification guaranteed.—28, Premier Place, High St. Putney, S.W.15. [1228

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AMPLIFIER Valve.—If you require power you cannot do better than one of these (or matched in pairs if required).

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COMPONENTS Lent on Hire.—Details from Alexander Black, Wireless Doctor, 55, Ebury St., S.W.1. Sloane 1655. [0329

FERRANTI Meters for Sale; particulars stamp.—Clarke, c/o 49, Leonard Rd., Hanley. [1215

RADIO HOUSE, HUDDERSFIELD, issues the Reliability Wireless Guide, which will be sent post free upon request by Messrs. J. H. Taylor and Co., 15, Macaulay St., Huddersfield. [7823

PART Exchange.—See our advertisement under Receivers for Sale.—Scientific Development Co., 57, Guildhall St., Preston. [0228

GOVERNMENT Surplus Mark II 2-valve Transmitters, 10/6; B.T.H. generators, H.T.950, 37/6; Mark III 2-valve sets, 17/6; Veeder counters, 1/-; Headphone cords, 6d.; hot wire ampmeters, 3/6; Rotax 8-way switchboards, 2/6; Amplion units, A.R.58, 7/6; 3-valve amplifiers, 17/6; plus carriage.—Camden Surplus Mart, 25, King St., Camden Town, N.W.1. [1224

PYE Mains Transformer, input 100, 200, 230, output 350 volts, 25/-; Varley pick-up, 12/-; 2 Mazda A.C. S.G. and valve holders, £1; also large number of chokes, transformers, valves; particulars on application.—Perkins, Brooklyn, Aberystwyth. [1222

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AIR Force 2-valve Transmitters, Mark II, contains transformer, choke, high voltage condensers, ammeter, multi-cables, and many other useful parts, made by G.E.C., new and unused, complete in carrying case, 10/-, carriage extra; Fultograph picture receivers, 30 only, £2/5 complete.—Modern Radio, 37, Lisle St., W.C.2. [1235

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SCOTT SESSIONS and Co., Great Britain's radio doctors; read advertisement under Miscellaneous column. [0263

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SCOTT SESSIONS and Co.—New sets constructed with your or our components, guaranteed finest workmanship; we specialise in "The Wireless World" circuits; remember, we have satisfied customers throughout the British Isles and in three Continents; if you so desire, we will design and construct high grade apparatus to suit your especial circumstances for quality, range and selectivity.—Tel.: Tudor 5326. Muswell Hill, London, N.10. [0262

ALEXANDER BLACK,

THE Original Wireless Doctor, will call (London and Home Counties) and cure your set.

CONSULTATIONS by Appointment without Obligation; sets installed, maintained and brought up to date; components and McMichael portable sets on hire; purity reproduction specialists
55, Ebury St., Victoria, S.W.1. Sloane 1655. [0277

EASY Payments.—We supply, by easy payments, components, accessories, and sets, any make; 10% down, balance spread over 11 months.—Send list of requirements to London Radio Supply Co., 11, Oat Lane, London, E.C.2. [0337

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BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition; see displayed advertisement on page 12. [0231

CELESTION Loud-speaker, perfect condition; cost £6, sell £2/10.—Bird, 112, Maidstone Rd., New Southgate, N.11. [1220

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EPOCH Moving Coil Speakers are Masterpieces, designed and produced by master engineers.

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EPOCH Moving Coil Speakers do Render Speech Perfectly and Music Correctly.

EPOCH Moving Coil Speakers Provide the Perfect Illusion of the Artist's Presence.

EPOCH Moving Coil Speakers Represent the Finest Intrinsic Value Ever Offered.

EPOCH Moving Coil Speakers are Guaranteed for a Year, but last for ever.

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EPOCH.—If you own the best get, only by Epoch can you confirm it.

EPOCH.—Away with the tin can and cracked banjo reproduction, and install an Epoch.

EPOCH.—Away with the drumminess, droniness, and huskiness of the average moving coil speakers.

EPOCH.—The clearest, sharpest, cleanest, reproduction—a marvel of accuracy and beauty.

EPOCH Moving Coil Speaker Models from £2/10 to £30.

EPOCH Moving Coil Speakers.—Models for every requirement and taste.

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EPOCH Permanent Magnet Moving Coil Speakers Require no Mains or Batteries.

EPOCH Permanent Magnet Speakers are more Sensitive than most Energised Moving Coil Speakers.

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EPOCH Super Cinema Speaker has Created the Biggest Sensation for Many Years.

EPOCH Super Cinema Model is many times as Sensitive as the so-called Supers.

EPOCH Super Cinema Speakers give Enormous Volume from a 1-watt Amplifier.

EPOCH Super Cinema Speakers are used on many 100-watt Amplifiers and never "rattle."

EPOCH Super Cinema Model is Standard on several Talkie Equipments.

EPOCH Super Cinema Model is already in use in over 200 Cinemas.

EPOCH Super Cinema are the only Moving Coil Speakers used in Large Theatres, unaided.

EPOCH Super Cinema Speakers provide alone the Upper as well as the Lower Register.

EPOCH.—Other Moving Coil Speakers require the help of exponential horns to provide depth.

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EPOCH Speakers are not Made of Tin or Aluminium Stampings, but are sound, solid, engineering jobs.

EPOCH Heartily Invite Comparison, on all counts, with any make, regardless of price or claims.

EPOCH.—Don't accept our quality claims without verification, but don't accept any other maker's either.

EPOCH.—Order one on 7 days' approval, and test with a switch-over; the only real test.

EPOCH Moving Coil Speakers may be heard in Our Demonstration Room Daily.

EPOCH.—Our demonstration room is in the heart of London.

EPOCH.—Its accessibility has been studied for the convenience of callers.

EPOCH.—If you cannot call, write for booklet W.S.3, and approval terms.

EPOCH RADIO MANUFACTURING Co., Ltd., Farringdon Av. (near Ludgate and Holborn Circus). 'Phone: Central 1971 [8903

NEW PUBLIC ADDRESS and Broadcasting MICROPHONES

The ideal instruments for addressing a large Outdoor or Indoor Audience through Loudspeaker (via Valve Amplifier or L.F. Stages of Wireless Set), for announcing Gramophone Records through leads of Pick-up, and for relaying Speech and Musical Entertainment to any distance.

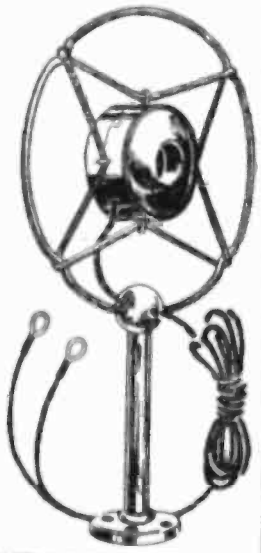
Powerful Loudspeaker Reproduction with Perfect Purity.

Hand Type.

Highly distance-sensitive, yet guaranteed entirely free from distortion or microphonic noises, absolutely silent background; far superior to ordinary Microphone Transmitters and obsolete Government surplus; for use with Valve Amplifier or Wireless Set, at Open-air Meetings, Sports Grounds, Garden Fetes; in Cinema, Theatre, or Dance Hall. Operates from 2-volt tapping of L.T. Accumulator, through Microphone Transformer. Current consumption one-tenth Ampere. Provided with detachable sound collector and a 9 ft. silk connecting cord; every metal part nickel-plated, black polished Erinoid handle, as illustration. **16/6**

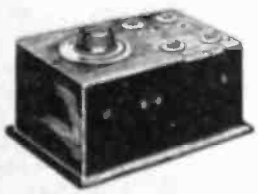
Pedestal Type.

Highly sensitive Microphone as above described, provided with detachable sound collector and a 9 ft. silk connecting cord, fixed by rubber-cord suspension in nickel-plated frame on pedestal 11 in. high; for mounting on Speaker's Platform, in Pulpit, on top of Camera Stand, or for suspension from ceiling, as illustration. **25/-**



The above Microphones are rendered **Directional** *by attaching the Sound Collector.*

MICROPHONE "COMPACTUM" COUPLING UNIT



For making Announcements by Microphone through Loudspeaker working from Valve Amplifier or Wireless Set, *without any further Accessories whatsoever.*

If a Valve Amplifier or Wireless Set is provided with connections for a Gramophone Pick-up, it is only necessary to insert the "COMPACTUM" Unit between ANY good Carbon Microphone and the Pick-up connections of the Amplifier (or Wireless Set) and you may broadcast announcements right away.

The "Compactum" Unit comprises a Microphone Transformer, a Volume Control, a Toggle Switch and a standard "Ever-Ready" battery of about 600 working hours. Spares of this battery can be obtained at any electrical stores in Great Britain.

Price complete, ready for use with any good Carbon Microphone. Includes 2 pairs of Plugs for the Microphone cord and for connections to Amplifier (or Wireless Set) **25/-**

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WANTED, adaptor (rectifier unit), 60 m.a., to permit use of D.C. eliminator on A.C mains.—Box 7157, c/o *The Wireless World.* [1212

"W.W." issues of January 1st and 8th, 1930.—Troutbeck, 10a, Newton Rd., W.2. [1214

WANTED for Cash, 3 or 4 all-electric receiver, must be cheap and in good condition; state where heard; South Lancs.—Box 7168, c/o *The Wireless World.* [1237

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WORKING Partner, with knowledge of the trade and small capital required, in old-established radio retail and manufacturing business; good scope for enlargement, with valuable work on hand.—Box 7171, c/o *The Wireless World.* [1240

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PRODUCTION, inspection, etc.; could take charge test room, quantitive measurement, 26 years; £300.—Box 7167, c/o *The Wireless World.* [1236

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SERVICE!—Experienced service man and demonstrator seek position, N.W. London preferred, portables, mains, gramophones, etc., indoor or outdoor (drive car).—43, Market St., Watford. [1207

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"TELEVISION To-day and To-morrow," the complete authorised book on transmission and reception (Baird Experimental). By S. A. Moseley and H. Barton Chapple. Fully illustrated, 7/6 net, from a bookseller, or Pitman's, Parker St., Kingsway, W.C.2. [1144

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