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

A CIRCUITOUS ROUTE.

CONGRATULATIONS to the B.B.C.! Although the B.B.C. has for some months past been following a circuitous route to reach the achievement of an Empire Broadcasting station—a route which has been almost strewn by the B.B.C. with self-imposed obstacles—yet they have got there at last. One might almost say "in spite of" the persistent egging on and pushing which they have experienced, and to which, we hope, we have contributed in no small measure ourselves.

The B.B.C. short-wave station is now in commission under the wing of the Marconi Company at Chelmsford, and the circumstances under which it has come into existence appear to be, as far as we can gather, very much along the lines of the suggestion we made some months back, that the B.B.C. should arrange for one of the commercial companies to undertake the erection and development of a short-wave broadcasting station which could be taken over by the B.B.C. when it had come up to the requirements of an agreed specification.

Exchange of Programmes with America.

Simultaneously with the news of the establishment of this station comes the announcement from Capt. Eckersley, who has just returned from a visit to the United States, that the B.B.C. hopes within the next three weeks to begin exchanging broadcast programmes nightly with America, the exchange to take place probably between Chelmsford and the Schenectady station on wavelengths of the order of 20 to 30 metres, and that, although previous relays from the United States have not been really successful, it was hoped that in future the broadcasting would be up to a very high standard.

Here, then, is another statement which, coming from the B.B.C. after their long series of pessimistic utterings on the subject of short-wave broadcasting possibilities, is indeed surprising. But let us forget our spirit of criticism now that we know the B.B.C. has come round to a reasonable point of view by however roundabout a route. If the B.B.C. will now continue in this new spirit and press on to the development of an Empire Broadcasting service (which will no doubt have to be regarded as purely experimental in the initial stages), then we, for our part, intend to forget their unfortunate past record of procrastination and pessimism.

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PROGRAMME ARRANGEMENTS.

ON matters of broad policy we consider that any journal or newspaper which represents the views of a section of the public is entitled to criticise the policy of the B.B.C. or any other national institution, but when it comes to petty criticism which savours of interference in what may be described as the "domestic" affairs of the B.B.C., we consider that the B.B.C. has every right to resent such interference.

Encouraging the Disaffected.

We have noticed that from time to time, and more frequently of late, any little disagreement between the B.B.C. programme organisers and individual performers seems to provoke the critical scrutiny of the Press.

If the B.B.C. is to be responsible for the programmes as a whole, at least a free hand in the choice of the material must be conceded them.

If the programme authorities find that they wish to discontinue to employ the services of any particular performer, or if they decide to withhold a talk which is offered to them because they consider that it may not be in the best interests of their listeners, surely the B.B.C. can be left to make decisions of this kind without the disaffected would-be broadcaster finding that the columns of the daily Press are open to him to state his grievance. Such publicity given to disappointed individuals in any other sphere in life not associated with the B.B.C. would look ridiculous, yet every instance of this kind, however commonplace, appears to achieve publicity if the B.B.C. can be dragged into it.

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ECONOMICAL GRAMOPHONE PICK-UP APPARATUS

Construction of Turntable Unit and Circuit Modifications Necessary in Typical Receivers.

By N. P. VINCER-MINTER.

IT is customary to consider that really first-class loud-speaker reproduction cannot be obtained for an expenditure of less than twenty or thirty guineas, with an additional five or ten guineas if one desires lthat one's apparatus be capable of giving first-class reproduction of gramophone music. Moreover, the figures just mentioned do not necessarily take into consideration the reception of stations other than the local. Now it cannot be denied that if one has in mind an installation of the "South Kensington" type, complete with moving-coil loud-speaker, a large number of valves of the L.S.5 type, and a practically unlimited supply of H.T., the figures quoted are not excessive, nor can it be doubted that it is possible to obtain the really superb results obtainable from the "South Kensington" installation for a less capital expenditure, the running costs being proportionately high and prohibitive to the ordinary man.

High Quality with Simple Apparatus.

From these considerations it would almost appear that good quality reproduction from a wireless receiver is completely outside the grasp of the average man of limited means. This is by no means actually the case, however, for it is probable that less than one per cent. of wireless listeners possess an "L.S.5 and moving coil" installation and yet, as is well known, a very large percentage of listeners obtain perfectly satisfactory results in the matter of quality. The reason is, of course, that although an expensive installation of the type mentioned is a valuable asset for those with the means to purchase and maintain it, it is no more necessary for obtaining really pleasing entertainment from the broadcast programme than is the £3,000 super de luxe car a *sine quâ non* of real motoring enjoyment.

The gramophone lover possessing a good instrument and a carefully selected repertoire of records who has hitherto looked upon good wireless reproduction as completely non-existent, or at any rate as a matter of hope only for the wealthy, will be agreeably surprised if he turns to page 562 of the October 27th, 1926, issue of *The Wireless World*, where he will find full constructional details of a simple, straightforward wireless loud-speaker set which can be constructed for two guineas and which is equally as inexpensive in its running costs. He will be still more agreeably surprised when he hears the wonderful quality obtainable from this set when used in conjunction with a diaphragm type of loud-speaker costing two to three guineas. He will find on investigation that there are a large number of loud-speakers capable of really excellent results obtainable within the price limits named. The various accessories he will need are equally inexpensive; his accumulator, for instance, need cost him only 4s. 6d. (for of course he will use 2-volt valves). As for upkeep costs, his accumulator will give him an evening's enjoyment daily for a fortnight, when it will require recharging at a cost of 6d., whilst, owing to the fact that his detector valve consumes scarcely any H.T. current at all, his dry H.T. battery, if of the proper type, will give him a full year's service before requiring renewal.

The circuit of this receiver is shown in Fig. 3, and again in Fig. 4 with certain small and inexpensive additions which will make it possible to use it at a somewhat greater distance from a station, and also render it more suitable for operating from an H.T. battery eliminator. These circuits are inserted in this article, however, mainly for the purpose of explaining the method of using a gramophone pick-up device, and those who intend constructing this set are advised to refer back to the original article. This article is mainly intended for the man who already possesses an "Economy Two," an "Everyman Four," an "All-Wave Four," a "Regional Three," or any well-designed modern set, and desires to avail himself of the vast store of additional enjoyment offered to him by the use of this gramophone pick-up device.

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Economical Gramophone Pick-up Apparatus.—

It is well before commencing any new endeavour to sit down and consider the cost, and the man who already possesses a wireless set has probably already done this and found it prohibitive. He finds that he wants a gramophone pick-up device costing anything from 27s. 6d. to £5, and in addition a gramophone, costing perhaps from £5 upwards. A total of ten guineas is much too excessive, and he probably gives up the idea in disgust. It is this man, among others, whom the writer especially desires to interest, by showing him that with a total expenditure of less than three pounds he can (provided he already has a wireless receiver capable of good loud-speaker reproduction) obtain results not surpassed by the most expensive gramophone it is possible to obtain.

A Good Motor Essential.

Now it is well known that the only part of the gramophone itself which enters into the question of electrical reproduction of gramophone records is the clockwork motor. The tone arm, the sound chamber or horn, and the sound box are entirely superfluous. It might be thought, therefore, that this part of the problem could be solved by the purchase of a cheap foreign gramophone having a cheap and nasty sound box, etc., and these unwanted parts of the instrument could be discarded. Unfortunately, however, those instruments which have a cheap and nasty sound box, etc., usually have also a motor which, even when new, only just manages to struggle through one side of a twelve-inch record, and which, after quite a short period of use, does the dying-duck trick before the end of the selection. If buying a gramophone with a good motor, on the other hand, one usually has to pay unnecessarily for a good cabinet, a good sound box, etc., so the whole instrument becomes expensive. Why not, however, buy a good motor and make your own cabinet and device for carrying the electrical pick-up? Nothing is easier. We can get an excellent double-spring motor, complete with turntable, brake, and all other small accessories, for 22s. 4d. In addition to this we must purchase a small amount of ordinary deal for making a rough cabinet and also some device for carrying the pick-up. It is this latter device which causes us to pause. Let it be said at once that unless the would-be constructor possesses a lathe he had far better purchase a tone arm straight away for the purpose of holding the pick-up device. This can be obtained from the makers of the motor used at a cost of 6s. 9d. Those possessing a lathe, however, will undoubtedly prefer to make their own device, partly because of their natural enthusiasm for constructional work (for nobody would go to the expense of purchasing a lathe if he did not take delight in using it) and partly because a suitable device can be made for less than a third of the cost of purchasing a tone arm.

We will now straightway consider the constructional details of the cabinet and tone arm. A careful study of Fig. 1 will reveal the nature of the "cabinet." It is plain, easy to construct, and perfectly suitable for its purpose. The motor and its accessories are mounted on a plain piece of deal 15in. × 15in. × ¼in. by means of the screws, nuts and bolts provided by the makers of the gramophone motor, the layout of the brake and speed regulator being in accordance with Fig. 1. It should be pointed out that the motor used, which as already mentioned costs but 22s. 4d. with turntable and all accessories, is all that is necessary, but those who prefer it may obtain a more massive article from the same makers for 37s. 6d. Do not forget that if using a different motor from the one

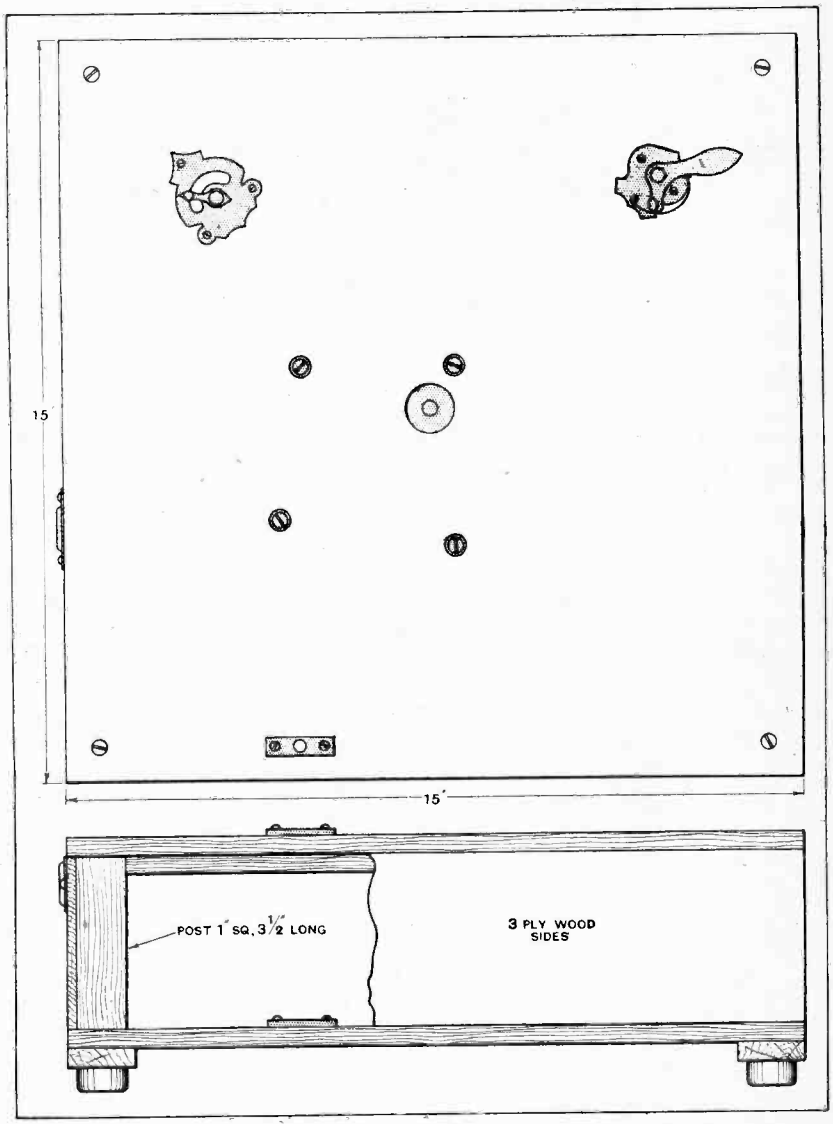

Fig. 1.—Constructional details of the cabinet.

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specified, or a different sized turntable, the layout of the "gadgets" will have to be modified accordingly. Do not forget the rubber washers supplied with the motor for keeping its top plate away from contact with the top platform of the cabinet. These are for the purpose of keeping the vibrations of the clockwork away from the record, and they must on no account be left out. The top platform is supported on the bottom platform (which is the same size as the top platform) by means of four stout wooden posts which are fixed by means of wood screws passing through the top and bottom platforms respectively. The sole purpose of the sides of the cabinet is to keep dust out of the motor, and so they consist merely of four pieces of three-ply wood screwed to the corner posts. Do not forget the hole for the key shaft which must penetrate through one side. Two wooden battens are attached to the underside of the bottom platform, and on these are mounted four rubber stops to act as "feet" for the cabinet and minimise vibration.

The main body of the tone arm consists of a length of 11-16in. diameter brass tubing cut to the dimensions given. At one end of this tube and at right angles to it is soldered a short piece of similar brass tubing. This is for the purpose of actually holding the pick-up device (which is, of course, fixed in the same manner as a gramophone sound box). Three saw cuts are made at one end of this tube as shown in Fig. 2. These saw cuts are spaced 120 degrees apart. This operation will enable the end of the tube to accommodate either an internal or an external fitting on the pick-up device, the ends of the tube being, for instance, bent slightly outwards in the former case.

A ½in. length of tube of an internal diameter that will just fit over the main tube is now soldered on at a distance of 3½in. from the other end of the tube. Through this passes the bolt which pivots the tube on the brass stirrup. This latter device consists merely of a piece of ⅜in. × ⅛in. brass, bent to the shape of a U. A steel rod is threaded into the well of this U, and it is this steel rod upon which the whole tone arm pivots. It passes through a small strip of brass or phosphor bronze attached to the top platform of the cabinet, and pivots in a recess in a similar strip screwed to the top of the bottom platform as shown in Fig. 2.

Adjustment of Needle Pressure.

It will be noticed that two brass weights are provided for insertion (by means of a brass tube of slightly smaller diameter) into either end of the main tube. Thus, if one weight is inserted into that end of the main tube which is remote from the pick-up device it will counterbalance the weight of the pick-up device. If now the other weight is inserted at the opposite end of the short tube to which the pick-up device is attached the effective weight of the pick-up device is increased. Needless to say, use of this latter weight by itself will make the weight on the record very heavy, and it must never be used alone. Since obviously, however, the leverage of the other weight can be altered by sliding it farther in or farther out of the main tube, a very fine adjustment of the effective weight bearing upon the record may be obtained, and it may be made more or it may be made less than the actual weight of the pick-up. In the case of a commercial pick-up device these weights are superfluous, as obviously the pick-up is made to have the same weight as any ordinary sound box, and no adjustment is necessary. If such adjustment of weight were necessary, of course it would be impossible to use a pick-up device on an ordinary gramophone, as there is no counterbalancing adjustment on an ordinary tone arm.

It was thought, however, that anybody possessing a lathe, and therefore having the necessary skill to make this tone arm, will also make his own pick-up device at some time or another, and since it is highly probable that when made he will find

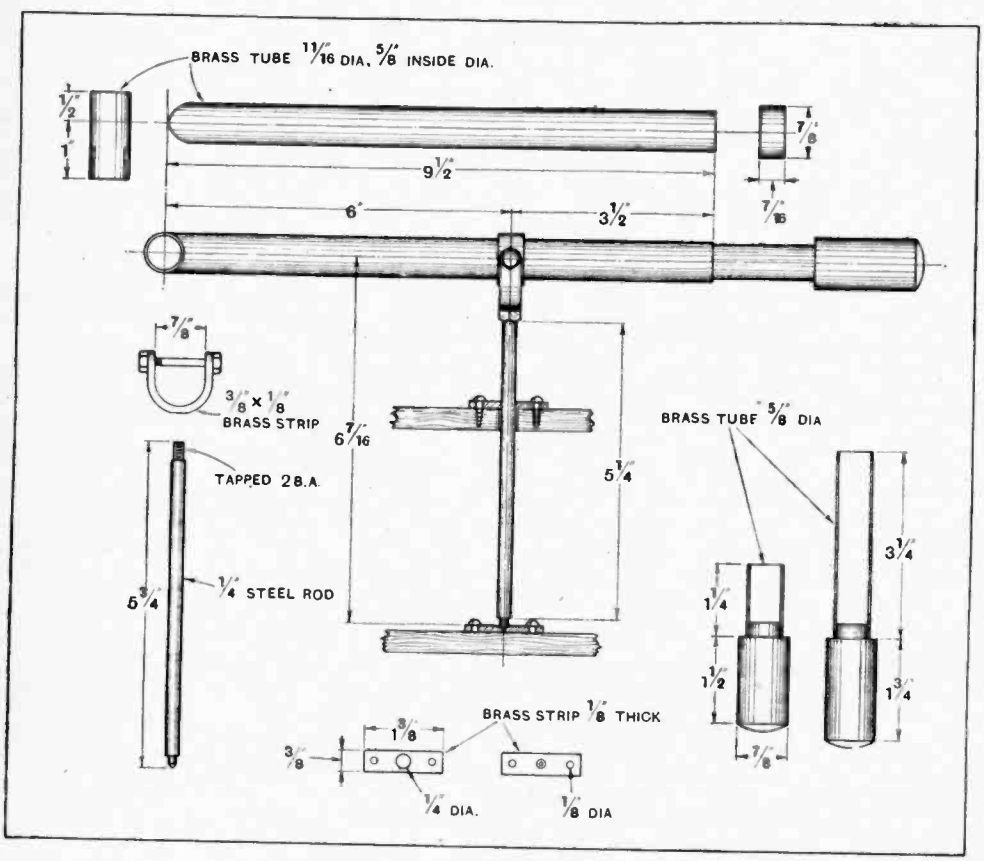

Fig. 2.—Dimensional details of the tone arm.

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his pick-up device either too heavy, thus causing undue wear on the record, or too light, thus causing imperfect reproduction among other things, these adjustable weights will be found invaluable. They are, of course, turned out of solid brass rod to the dimensions given, and soldered to their brass tube fittings.

So much for the constructional details of the "gramophone." We must now consider the question of its application to a typical wireless set. In the first place, we must purchase a gramophone pick-up. It has already been mentioned that these may be obtained at all prices between 27s. 6d. and £5. It might be thought that the 27s. 6d. article was not worth considering, as it would fall into the cheap and nasty class. The "Edison-Bell" pick-up device which sells at this price (it is shown being used in the photograph) will belie any such fears. With regard to adapting it to a receiver, we will take the "Economy Two," which has been mentioned previously in this article, as typical of a good local-station loud-speaker receiver, and see how we can attach the gramophone pick-up device. The circuit of this receiver is reproduced in Fig. 3, and on examination we find that it consists of an anode bend detector followed by a stage of resistance coupling, a power valve being used in the output stage. Such a receiver is capable of giving loud and clear results from the local station in spite of the fact (or perhaps we should say because of the fact) that it does not use a second L.F. stage.

Converting the Detector into an Amplifier.

Now, although we use only one L.F. stage with the instrument when it is reproducing the local station, it will be found that two valves, both operating as L.F. amplifiers, are necessary if adequate volume is to be obtained on the loud-speaker from a gramophone record. We must seek means, therefore, of causing the detector valve to act as an L.F. amplifier when the pick-up device is used. Fortunately this is quite easily done.

A moment's thought will make it clear to us that if we find that a certain value of negative bias must be applied to the grid of a valve to bring the mean grid potential down to the bottom bend of the anode-current grid-volts characteristic curve, and so cause it to act as a bottom bend rectifier (as it does in this receiver), then half that voltage will place the working point on the middle of the "straight" portion of the curve and so cause it to act as an amplifier. For instance, 3 volts negative on the grid will cause a D.E.5B to act as an efficient rectifier under certain conditions of H.T. voltage, etc., and 1½ volts will put it into the correct condition to act as an amplifier. All we have to do, then, is to remove the plug-in tuning coil, insert the pick-up in its place, and halve the grid bias on the detector valve by moving the wander-plug. Nothing could be easier. In the case of a receiver employing leaky-grid rectification, of course, it would be necessary to short-circuit the grid condenser by means of a switch and return the grid return lead to a suitable negative tapping on our ordinary L.F. grid bias battery.

Now the modified "Economy Two" diagram shown in Fig. 4 is fundamentally the same as the original, but it incorporates one or two additions which make for the more efficient working of the set. The most important of these is the insertion of the potentiometer. The function of this device is easily explained. It is known that there are now upon the market a number of high-impedance high-magnification factor valves, more especially in the 2-volt series, which rectify with 1½ volts negative on the grid. This voltage value is easily obtained by inserting the wander-plug in the first socket of the grid battery, thus using one cell only, one cell having, of course, an E.M.F. of 1½ volts. Now, obviously, if such valves will

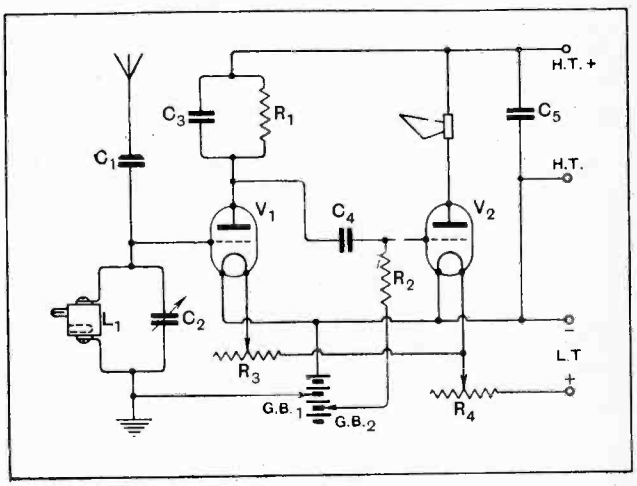

Fig. 3.—Theoretical circuit of the original "Economy Two" receiver.

rectify with 1½ volts negative on the grid, they will amplify with about ¾ of a volt on the grid. How are we going to get this voltage? We cannot split a cell; we must, therefore, use a potentiometer. Supposing in Fig. 4 we are using 2-volt valves, and we put the potentiometer slider fully over to negative and the detector valve grid bias wander-plug in the first socket of the grid battery, we shall obviously give the grid a 1½ volts negative bias, and it will be correct for rectifying. If now we put the potentiometer slider over to the positive side, we shall be giving the grid 1½ volts negative bias from the grid battery, and 2 volts positive bias from the filament battery. Were we using 6-volt valves, we should, of course, be giving it 6 volts positive bias from the filament battery. The resultant bias is ½ volt positive. If we put the slider to the half-way position the resultant bias would be ½ volt negative. If we put it slightly nearer to the negative side, we shall get ¾ volt negative, which is what we want.

When removing our coil in favour of the plug from the pick-up device, therefore, we must at the same time move the potentiometer slider to a point not quite half-way, reckoning, of course, from the negative end. There is one more important point to be discussed before leaving the question of the potentiometer. It will be noticed that every time the potentiometer slider is moved to effect a change of ¾ of a volt in the grid potential of the detector a similar change will be made in the grid potential of the output valve. Now, if this valve is a proper output valve, as it should be, it will have a normal bias of 20 volts negative derived, of course, from taking advantage of the full voltage of the grid battery. With

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a bias of 20 volts the change of ¾ volt will, however, be quite unimportant, and even if only a small power valve with a bias of 9 volts is used, this slight change in potential will be quite unnoticeable. It can be avoided altogether if desired by the employment of an entirely separate grid battery for the detector valve, as was done in the case of the "All Wave Four," for instance. In the writer's opinion, however, it is preferable in the interests of simplicity to avoid complicating matters by the introduction of yet another battery.

It will be noticed that in addition reaction has been incorporated into the receiver, and in order to accomplish this effectively it has been necessary to lower the value of the anode resistance to 0.25 megohm. The lowering of this resistance will also, of course, improve quality considerably. The plate current taken by the detector valve will, however, still be extremely small.

The introduction of reaction will enable the receiver to be used at a considerably greater distance from the local station than would be possible otherwise, and at the same time it will enable the set to be used in a flat where only a small indoor aerial can be erected. Reaction, if used in moderation, will definitely *not* mar quality, and will, in fact, improve the reproduction of the lower musical notes. In the interests of simplicity and constancy of operation, however, a two-way coil holder is not advised. It is recommended that the reaction coil be mounted in a single coil holder placed in a certain fixed relationship to the grid coil, so that a moderate and sufficient degree of reaction is given on the local station. The best position should, of course, be found by experiment, and then the single coil holder should be permanently screwed into position.

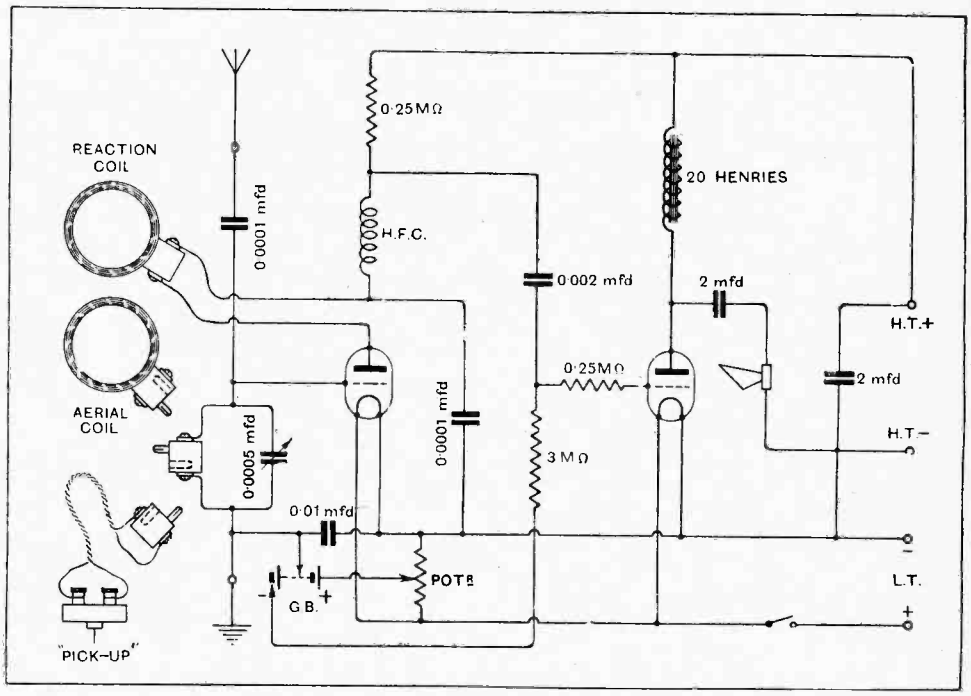

Fig. 4.—Modified form of the "Economy Two" circuit showing adaption for pick-up device.

Keeping H.F. out of the L.F. Amplifier.

The use of an H.F. choke in the plate circuit of the detector valve and the use of a resistance on the grid of the L.F. valve will serve the purpose of keeping all H.F. well away from the L.F. valve, where its presence will often cause mysterious faults of seemingly causeless bad quality and instability. On no account forget the 0.0001 mfd. fixed condenser running from the junction between reaction coil and H.F. choke to L.T.−, or not only will rectification efficiency be marred, but smooth reaction will be unobtainable. Finally, a choke filter output circuit is included. This is really a necessity if a proper power valve is used, as it should be, in the output stage. In addition, it will avoid a great deal of possible "motor boating" trouble if an H.T. battery eliminator is used. Be sure, however, to connect the loud-speaker between the 2 mfd. condenser and L.T.− as shown, and not from this condenser to H.T.+, thus leading the L.F. energy through the H.T. battery. If these instructions are followed, the likelihood of trouble when using a battery eliminator is considerably lessened.

Now those who possess a modern receiver employing an H.F. stage or stages will desire, in the interests of economy, to extinguish the H.F. valve filaments when using the gramophone pick-up. If a separate rheostat is provided for the H.F. valves nothing is easier, but cannot we devise some simple means of accomplishing this automatically as we thrust in the plug attached to the pick-up device? Yes, indeed, we can, but upon turning our attention to the "Everyman Four," for instance, to see exactly how this can be done, we see with dismay that the grid coil of the detector valve is immovable, it not being of the plug-in variety, and so on the surface it looks as if we can no longer use the plug-in system for the pick-up device. We can save the day, however, by attaching the pick-up device to a telephone plug and inserting a jack into the low potential end of the detector valve grid tuning circuit, as is shown in Fig. 5 (a). A careful study of the diagram will show us that on inserting the plug from the pick-up device not only is the filament of the H.F. valve extinguished, but the negative potential of the grid is halved by the automatic cutting out of the small single-cell dry battery $G.B._2$. Thus, supposing our detector valve is a D.E.5B requiring 3 volts for anode bend rectification purposes, 1½ volts of this will be provided by $G.B._2$, which will be in operation when the plug from the pick-up device is *not* inserted, and the remainder from a 1½-volt

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tapping from the normal grid battery, G.B.$_1$. Insertion of the pick-up plug cuts out G.B.$_2$, thus reducing the grid bias to 1½ volts and converting our D.E.5B from a rectifier into an amplifier.

This scheme possesses, however, one very grave disadvantage, and another which is less a matter of importance than of convenience. To take the smaller point first, it will be perceived that this scheme involves the use of yet another small separate battery, namely, G.B.$_2$. This is relatively unimportant, but still it is a nuisance, for instance, to the man who prefers to use a small 20-volt H.T. accumulator or one 20-volt dry battery for all his grid bias purposes rather than a motley collection of separate dry cells. The important point, however, is this: what is going to happen if we use, as in all probability we shall, one of the high-impedance high-magnification-factor valves which rectify at about 1½ volts and require ¾ volt bias when used as an amplifier? Not only do we require ¾ volt at G.B.$_2$, but we require, as it were, a half-cell tapping in G.B.$_1$ as well if this scheme is to be used. Is there then no solution? Fortunately, there is, and a very simple one, too, which will at the same time rid us of the superfluous and undesired G.B.$_2$.

The solution will at once be revealed by carefully studying Fig. 5 (b). Here we have a 20-volt grid bias battery serving our L.F. valve, or valves, *via* the wander-plug P$_2$. Across the first cell of it are connected by means of the wander-plug P$_1$ two 5-megohm resistances in series with each other. Now it will be obvious that if a 1½-volt cell is shunted across both of them in series, the difference of potential existing between the positive end of the grid battery (in other words, L.T. negative) and the junction between these two resistances will be half this value, namely, ¾ volt. Now, by connecting the jack as shown it will be noticed that normally when no plug is inserted in the jack the left-hand resistance is short-circuited, and in reality only the right-hand resistance is left shunting the whole of the 1½-volt cell. The junction between these two resistances will now be 1½ volts more negative than L.T.−, and the grid will have a negative bias of 1½ volts, which is in order for rectifying. Insertion of the plug from the gramophone pick-up device will first put the pick-up into circuit, secondly switch off the H.F. valve filament, and thirdly will remove the short circuit from the left-hand resistance, thus halving the negative bias on the grid to ¾ volt. The arrangement is, in fact, nothing more than a fixed potentiometer automatically operated by the jack. In practice it works very well. It is equally effective for use with a valve of the D.E.5B type which requires 3 volts when used as a rectifier and 1½ volts as an amplifier, although in this latter case the system is not absolutely indispensable as it is in the case of the other class of valve mentioned, and serves only the purpose of eliminating the annoying extra battery G.B.$_2$. In this case, of course, the wander-plug P$_1$ will be set at the second (3-volt) tapping from the positive end of the grid battery.

The resistance of the potentiometer is such that a negligible current is taken from the grid battery. Indeed, this current, a small fraction of a microampere, will, if anything, improve the standing life of the cells.

LIST OF PARTS FOR GRAMOPHONE SET.

1 Gramophone motor and accessories
(L. E. Jaccard, 19, Clerkenwell Road, E.C.1).
1 ft. of 11/16 in. brass tube.
6 ins. of 5/8 in. brass tube.
6 ins. of 7/8 in. brass rod.
6 ins. of ¼ in. steel rod.
4 rubber stops.
Scrap brass for constructing stirrup, etc.
Wood for cabinet.
Approximate cost 32/-.

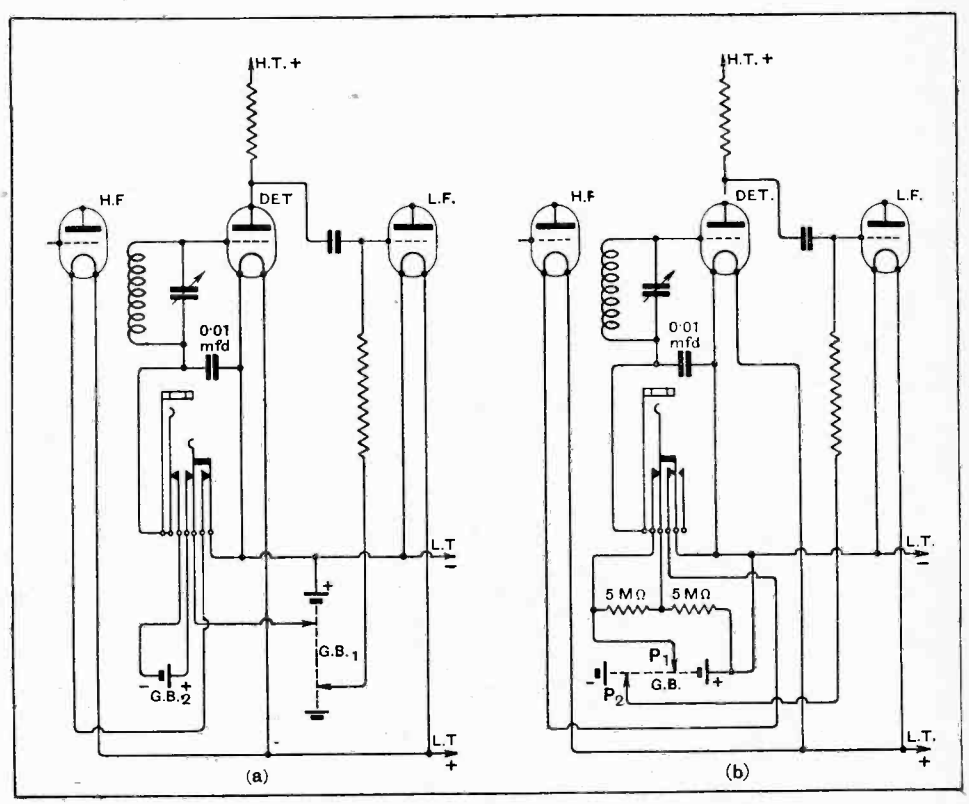

Fig. 5.—(a) Adapting an "H.F." receiver for a pick-up device; (b) The same circuit adapted for working without extra grid battery.

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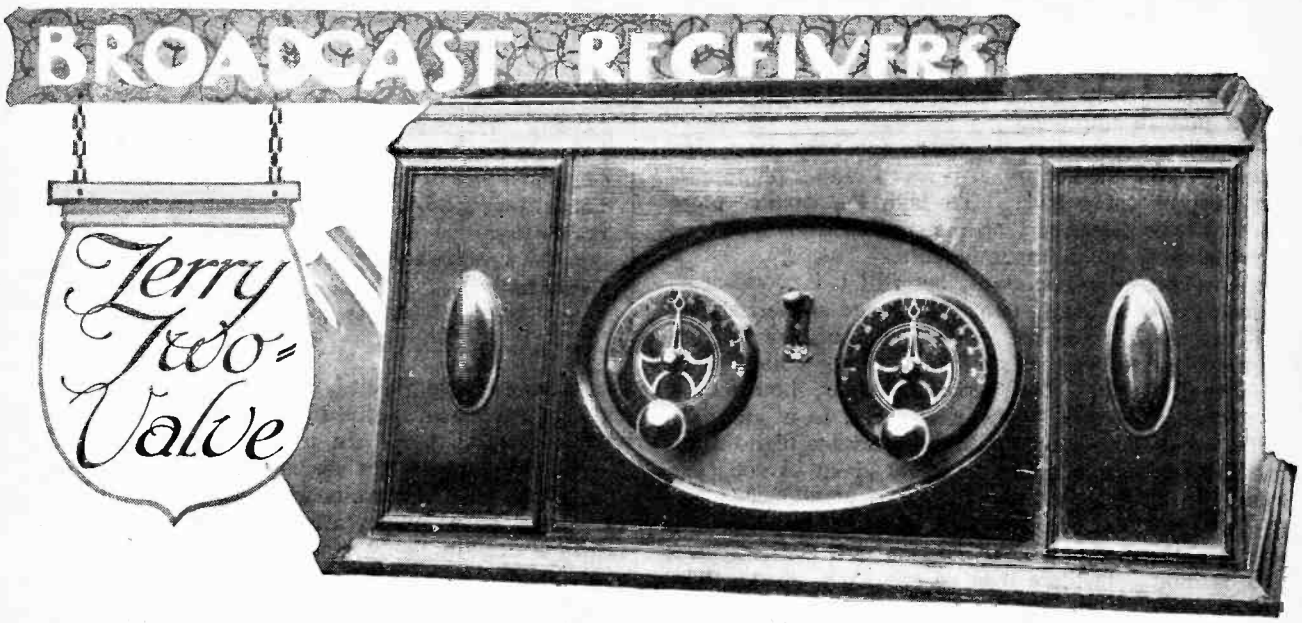
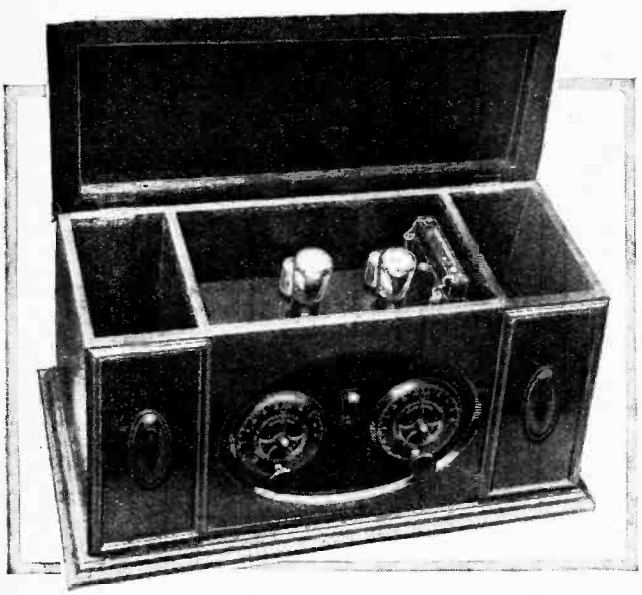


Self-contained Receiver of High-quality Construction and Finish.

TERRY springs are known the world over, and it is evident that the same painstaking methods which have ensured success in this branch of manufacture are being applied to the firm's recent efforts in the field of wireless receiver construction.

Two valves are employed, the first a reacting detector and the second a low-frequency amplifier with transformer coupling. A combination of capacity and magnetic reaction gives smooth control of regeneration over both wavelength ranges, the change-over from the normal broadcast range to Daventry being effected by a low-capacity switch on the front panel. When in the centre position this switch extinguishes the valve filaments.



Accessibility of interchangeable components is a noteworthy feature of the Terry Two-valve set. Note separate compartments for H.T. and L.T. batteries.

The tuning dials call for special comment. These are quite distinctive in appearance, the pointer being somewhat similar to the hand of a clock. The movement is extremely light in action, and there is no trace of backlash in the slow-motion device. We understand that these dials are available separately, the price being 7s. 6d.

An examination of the interior of the set revealed that only the best class of components has been used in the circuit. The quality of reproduction was excellent, and it was noted that a Marconiphone "Ideal" transformer has been used to couple the valves.

An excellent programme service was obtained in London from 2LO, 5GB, and 5XX, and no difficulty was experienced in separating the two low-wave stations at $3\frac{3}{4}$ miles from 2LO by judicious use of reaction. At greater distances from the local station the reception of foreign stations should be possible during broadcasting hours, but inside a radius of 5 miles it would be necessary to wait for the local station to close down before attempting long-distance reception.

Although 2-volt valves are normally recommended, other types may be used after substituting suitable fixed resistors. These are conveniently mounted on the valve panel, and can be seen behind the valves in one of the photographs. The grid battery is equally accessible, being fixed to the side of the valve compartment. Having mounted all interchangeable components in accessible positions the remainder of the circuit has been enclosed by a dust-proof cover.

The price of the receiver, complete with Mullard P.M. valves, Hart 2-volt, 40-amp. accumulator in glass case, and Ever Ready H.T. battery is £16 10s. The loudspeaker and royalty are charged as separate items. The set is made by Messrs. Herbert Terry and Sons, Ltd., Redditch.

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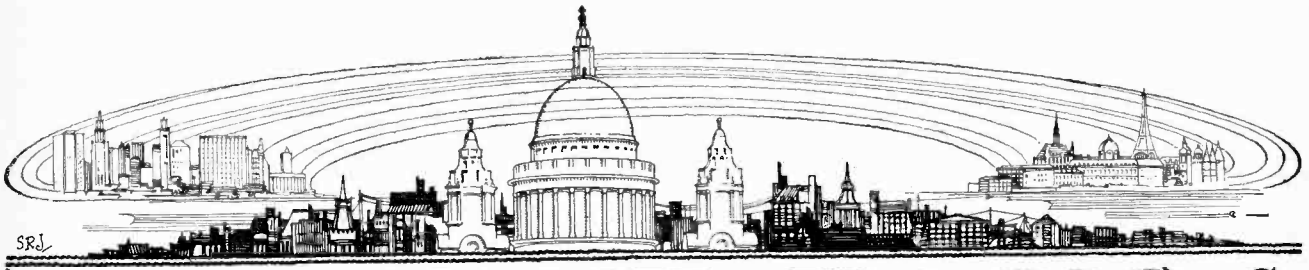

CURRENT TOPICS

Events of the Week in Brief Review.

NO OFFENCE MEANT.

"Let your friends listen," is the motto for National Wireless Week, which opens on November 13th. It is understood that the phrase is not intended to hurt the susceptibilities of the oscillating fraternity.

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BRISTOL RADIO WEEK.

Arrangements have been completed for a "radio week" to be held in Bristol from November 20th-26th. Special programmes will be broadcast from Bristol throughout the week.

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FIRST CATCH YOUR HARE!

Prizes have been offered by an American paper for the best suggestions for making use of burnt-out valves. The competitors' main difficulty, in these days of high-quality valves, will be to find a burnt-out specimen!

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P.O. WIRELESS EXPANSION IN AUSTRALIA.

Australia's growing use of wireless is reflected in the announcement that the Commonwealth Government is creating a separate branch of the Post Office to deal with wireless activities. A "chief inspector, wireless branch," has been appointed to control a staff which will be independent of the telegraph branch.

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FOUR DAYS MORE AT MANCHESTER.

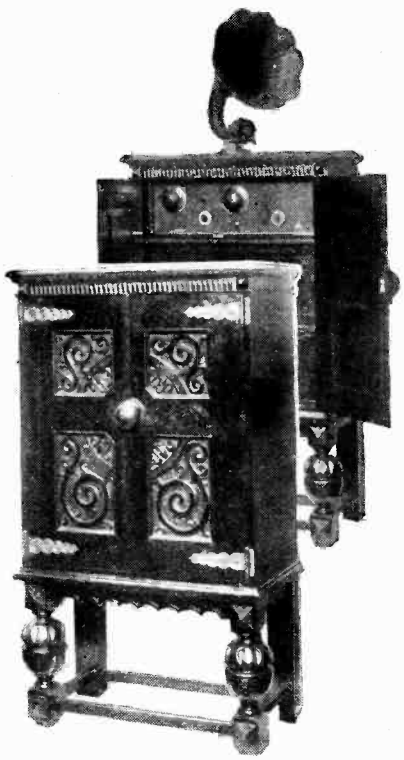
Amateurs from all parts of Northern England are still flocking to the Manchester Wireless Show, now being held in the City Exhibition Hall. Closing day is next Saturday, November 5th.

Capt. Ian Fraser, M.P., conducted the opening ceremony on Monday, October 24th, when he made the suggestion, which was immediately complied with, that blind persons in the Manchester district should be admitted free of charge. The exhibition has been organised by the *Manchester Evening Chronicle*, and in many respects resembles the recent show at Olympia, a number of prominent stand-holders at the London show having transferred their exhibits to Manchester.

Readers should make a point of visiting *The Wireless World* stand, No. 27, on which will be found a number of receivers recently described in this journal.

THE RINGER.

The excuse that he had won his crystal set at a game of "rings" and did not think a licence necessary was offered by a Clonsilla (Dublin) resident last week at the Lucan District Court. He was fined 5s. and ordered to take out a licence.



"EVERYMAN FOUR" IN A JACOBEAN SETTING. Two views of *The Wireless World* "Everyman Four," constructed by a Birmingham reader, Mr. H. F. Morton, and housed in a cabinet designed by his wife.

WIRELESS ON THE SABBATH.

The Clyde lighthouse keeper, Mr. Norman Shaw, who was recently dismissed from his post for refusing to take part in wireless tests from Toward Lighthouse on Sundays, has been refused unemployment benefit on appeal to the Deputy Umpire of the Ministry of Labour.

SOUTHPORT WIRELESS SHOW.

A wireless exhibition will be opened at Southport on Monday next, November 7th. Particulars will be found under "News from the Clubs."

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IS THIS A RECORD?

A London wireless enthusiast claims that while listening in on a small crystal set with an indoor aerial he received a long message from Australia by the afternoon post.—*Sunday Pictorial.*

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EXHIBITION IN LEEDS.

Enthusiasts in the Leeds district are looking forward with pleasure to the Leeds Wireless Exhibition, which will be held in the Fenton Street Drill Hall from Tuesday, November 15th, to Saturday, November 26th, under the auspices of the *Yorkshire Evening Post.*

Many prominent firms will be represented, and the B.B.C. will assist by showing their latest transmitting apparatus and by broadcasting music from the show.

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AMBITIOUS AIRSHIP WIRELESS.

An aircraft radio transmitter with a range of 2,500 miles has been designed for installation on the £1,000,000 dirigible now under construction for the U.S. Government at Akron, Ohio. The above-mentioned range has been decided upon to provide the airship with means of communication over a distance equal to half the cruising radius, which would enable it to be in constant touch with its base.

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CAPTAIN FRASER ON BRITISH WIRELESS TRADE.

Captain Ian Fraser, in his inaugural speech at the Manchester Wireless Exhibition, paid a tribute to the quality of British wireless products. He said:—

"I am driven to the irresistible conclusion that, although possibly the home market has contracted a little, British wireless manufacturers have enormously strengthened their hold upon it. This is due to the fact that we have concentrated upon maintaining the highest possible craftsmanship and technique. To have reduced the import of foreign apparatus by about half is something of which we can very well be proud."

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RELIGIOUS BROADCASTING IN NEW ZEALAND.

A broadcasting station intended solely for the dissemination of religious instruction and music is to be erected in New Zealand, according to present plans, by the Anglican Broadcasting Association. The estimated cost is £8,000, and the promoters hope to maintain the station by means of subscriptions.

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THE LISTENER'S PARADISE.

Has the wireless paradise been found? According to officers of the Royal Canadian Mounted Police it has. The delectable spot is said to be at Bernard Harbour, in the Canadian North-West Territories, for here in broad daylight one can pick up London, Dublin, Newcastle-on-Tyne, Bournemouth, Glasgow, Birmingham, Paris, Berlin, Madrid, and other European stations with perfect ease on the loud-speaker. Reception conditions are reported to be well-nigh perfect.

The Royal Canadian Mounted Police would be well advised to keep the information to themselves, otherwise this blessed Valhalla of the DX-er may become another Klondike.

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WIRELESS A HOSPITAL NECESSITY.

Is a wireless set part of the *necessary* equipment of a hospital? This question was discussed before the Chester-le-Street Joint Hospital Board last week, when the matron asked that the hospital set be brought up to date.

A member said that it was the business of the Board to get the patients well as early as possible, and if they could amuse them and keep them lively it was to the benefit of the hospital and the public.

The necessary expenditure was agreed to.

"W.W." SETS ON VIEW.

The set builder who meets with a constructional difficulty often wishes than an opportunity existed to inspect a completed receiver, which would make matters clear in a few moments Such an opportunity is offered by the array of recent Wireless World *sets which, owing to the success of the first display, are again on view for the benefit of the public at 116, Fleet Street, London, E.C.4.*

A cordial invitation is extended to readers to visit this miniature exhibition, which is open daily from 10 to 6.

NEWS FROM THE CLUBS.

Sale and Exchange.

This evening (Wednesday), the Tottenham Wireless Society will indulge in a "Sale and Exchange." Members are asked to bring along their surplus components.

Hon. Secretary, Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

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A Lecture in "Ham" Jargon.

A real "dyed in the wool" transmitter, Mr. J. Hum (5UM), gave an amusing talk at the last meeting of the Muswell Hill and District Radio Society. Mr. Hum, who demonstrated with his new one-valve transmitter, gave his remarks in the jargon so beloved of his tribe, and for the greater part of the time the audience were deciphering unfamiliar names given to familiar articles, such as "'cans" for headphones, etc.

The transmitter was not connected with the Society's aerial, but was put into an oscillating condition. Among interesting experiments was one in which a wavemeter lamp was caused to glow by being placed close to the inductance.

A number of new members have been enrolled at every recent meeting of the Society, among them being several ladies who have enthusiastically taken up wireless as a hobby. Full details of the Society, with particulars of membership, may be obtained on application to the Hon. Secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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Studying Acoustics with Loud-speakers.

Acoustics, a subject which has loomed large in the wireless world since the advent of broadcasting, was dealt with in a practical manner by Col. F. E. Wenger in his lecture before the Stoke-on-Trent Wireless and Experimental Society on October 5th. The lecturer demonstrated with the aid of a large number of loud-speakers of various types.

The lecture was well attended, and it was notable that many visitors were present.

Hon. Asst. Secretary, Mr. L. J. R. Taylor, Elm Tree House, Penkhull, Stoke-on-Trent.

Q.R.P. Transmitters.

A series of tests on 90 metres is to be carried out by the Q.R.P. Transmitters Society. At their meeting on October 20th, Mr. Guy (G2CS) opened a discussion on the Mesny circuit for short and ultra-short wave transmission.

Hon. Secretary, Mr. C. D. Abbott, 178, Evering Road, Clapton, E.5.

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Southport's Radio Exhibition.

On Monday next, November 7th, the 3rd Annual Radio Exhibition will be opened by the Southport and District Radio Society at the Temperance Institute, London Street.

The opening ceremony will be performed at 3 p.m. by Mr. Victor Smythe, of the Manchester B.B.C. station, and the Exhibition will be open on the following days from 10 a.m. till 10 p.m. Closing day: Saturday, November 12th.

Hon. Secretary, Mr. E. C. Wilson, "Lingmell," Kirklees Road, Birkdale, Lancs.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 2nd.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (Light refreshments at 5.30.) At the Institution, Surrey Place, W.C.2. Inaugural Address by the Chairman, Lt.-Col. A. G. Lee, O.B.E., M.C., B.Sc.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Business Meeting, followed by "Sale and Exchange."

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Demonstration and Lecture: "Optical Illusions," by Dr. Leonard Sessions, M.R.C.S., L.R.C.P.

THURSDAY, NOVEMBER 3rd.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Lecture: "Development of the Thermionic Valve," by Dr. J. A. Fleming, F.R.S.

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane, Stretford. Lecture: "Mains Units," by Mr. Bell, of E. K. Cole, Ltd.

FRIDAY, NOVEMBER 4th.

Leeds Radio Society.—At Leeds University. Lecture by Mr. A. H. Fisher.

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R.S.G.B. Convention at Nottingham.

Arrangements have been made for a "Radio Convention" to be held at the Elite, Nottingham, on November 26th, from 6 to 9 p.m. (supper, 2s. 6d.). The programme also includes a visit to transmitter 5NG during the afternoon. An invitation is extended to all members of the Incorporated Radio Society of Great Britain, and those wishing to attend are asked to communicate with Mr. W. H. R. Radford, The West Lea, Cropwell Butler, Notts, not later than November 9th.

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Institute of Wireless Technology.

"A Note on the Performance of Valve Detectors" will be the title of a paper by William B. Medlam, B.Sc., A.M.I.E.E., and U. A. Oschwald, B.A., to be presented at a meeting of the Institute of Wireless Technology at 7 p.m. on Tuesday, November 8th, at the Engineers' Club.

Information respecting the Institute and its activities may be obtained from the Hon. Secretary at 71, Kingsway, W.C.2.

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Valves in Short-wave Transmission.

An interesting talk on short-wave receiving apparatus was given by Mr. J. E. Nickless (2KT), President of the Ilford and District Radio Society, at the last meeting, describing his experiments over a period of two years, Mr. Nickless dealing with various kinds of valves that had been tried. Six-volt or power valves had up to now done the best work, but he had found that two-volt valves worked quite satisfactorily down to about 150 metres.

Hon. Secretary, Mr. H. O. Crisp, 2, Ramsay Road, E.7.

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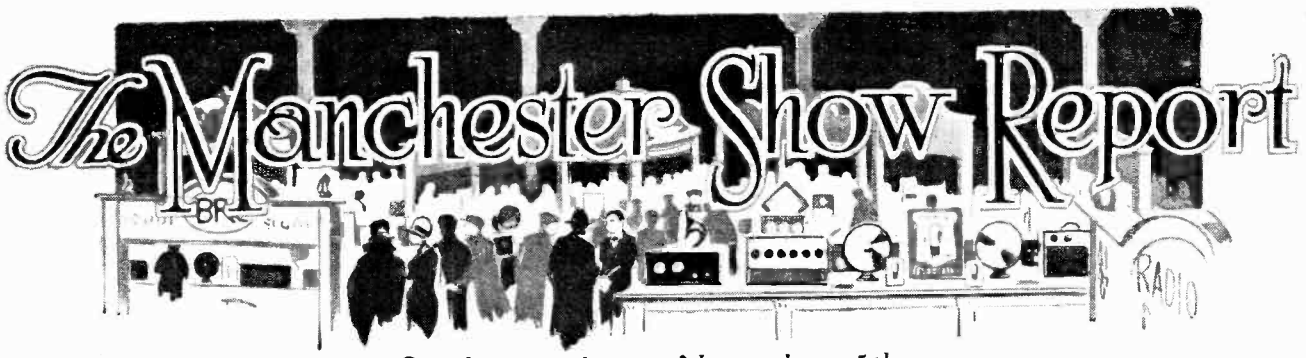


October 24th to November 5th.

New Apparatus to be Seen at the Stands.

Many of the components and sets to be seen at the stands were exhibited at the recent Olympia Show, and have consequently been referred to in detail in the pages of this journal. To avoid duplication of technical description, care has been taken to select only apparatus of new design, much of which is now being shown for the first time.

BAKELITE-SHROUDED TRANSFORMERS.

The range of Bowyer-Lowe L.F. transformers has been extended to include a multi-ratio instrument, giving "step-ups" of from 1.8 : 1 to 6 : 1. Low-frequency chokes, tapped at a point to include a third of the total number of turns from one end, thus giving a choice of three inductance values, are of similar appearance. All these components are mounted in well-finished black bakelite cases, with lugs for horizontal or vertical mounting.

The Bowyer-Lowe Co., Ltd. (*Stand* 2), *Radio Works, Letchworth, Herts.*

A SELF-CONTAINED MAINS RECEIVER.

A set which can be moved from room to room and attached to any electric lamp socket is certain to appeal to a large number of listeners. The Climax receiver includes several good points in design; it has one neutralised transformer-coupled H.F. stage, with an anode bend detector followed by resistance- and transformer-coupled L.F. amplifiers in the order given. The two condensers are fitted with "edgewise" dials mounted side by side. This arrangement gives almost all the advantages of single dial control, with the additional benefit of allowing the use of circuits of reasonably low decrement. Waveband change is by means of a switch, and there is another switch for the filaments, which are wired in series. Reaction is provided between plate and grid circuits of the H.F. valve. A Climax cone loud-speaker is mounted in the lid. A similar receiver is made to operate on batteries.

Climax Radio Electric, Ltd. (*Stand* 6), *Quill Works, London, S.W.*15.

ORPHEAN GRAMOPHONE ATTACHMENT.

The loud-speaker manufactured by this firm has already been reviewed in *The Wireless World* Olympia report; its electro-magnet movement, housed in a brown bakelite case with suitable supporting feet, is now supplied as a gramophone adaptor at the low price of 12s. 6d. A larger attachment is sold at 25s.; it has a large-sized moulded disc for adjusting the relative positions of pole-pieces and magnets.

London Radio Manufacturing Co., Ltd. (*Stand* 7), *Station Road, Merton Abbey, London, S.W.*19.

A BOWL LOUD-SPEAKER.

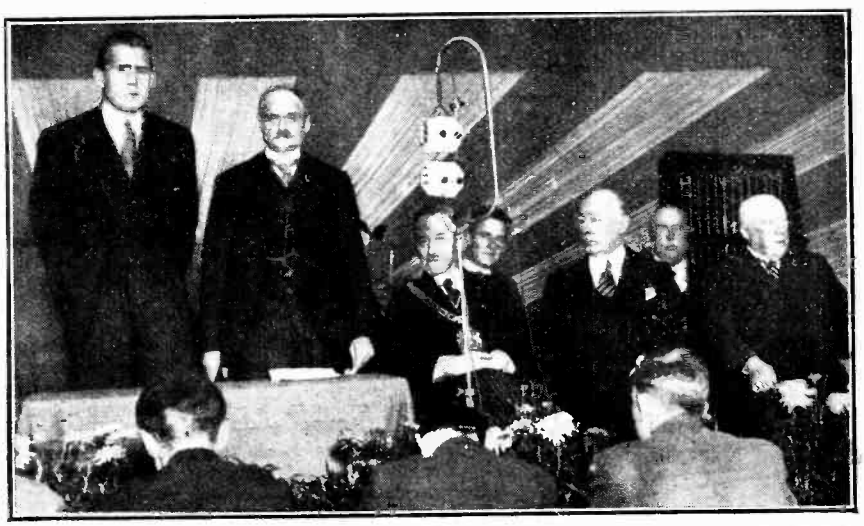
The "W.B." loud-speaker is of the free-edge double-cone type, with reed drive, and is mounted in an attractive bowl-shaped container, made of bakelite, coloured to imitate tortoiseshell. An ornamental grille of the same material covers the opening.

A similar instrument, enclosed in a perfectly plain, rectangular, wooden case, sells at a lower price and is particularly well adapted for inclusion in self-contained or portable receivers.

Whiteley, Boneham, and Co., Ltd. (*Stand* 8), *Nottingham Road, Mansfield, Notts.*

G.R. COMPONENTS.

Claude Lyons, Ltd., have for several years exclusively handled the products of the General Radio Company. The policy behind the General Radio design is not merely to meet the passing tastes of the home constructor. They have long specialised in the manufacture of testing equipments, such as modulated audio-frequency oscillators, wavemeters, capacity and inductance bridges, and valve-testing apparatus. Much of this gear, however, comes within the scope of amateur requirements, and several popular testing instruments will make considerable appeal to the experimenter. The broadcast and short-wave absorption wavemeters, Types 247 and 358, are well known, the latter accurately covering a wave range between 14 and 224 metres. Much interest is already being shown in even shorter wavelengths, and the need for a precision wavemeter is met by a new individually calibrated instrument having an optimum of 5 metres. Its coil is a single turn of ¼in. silver-plated



Captain Ian Fraser, M.P., delivering his address at the opening ceremony. On his left is Councillor Davy, Mayor-Elect of Manchester and the Mayor of Salford.

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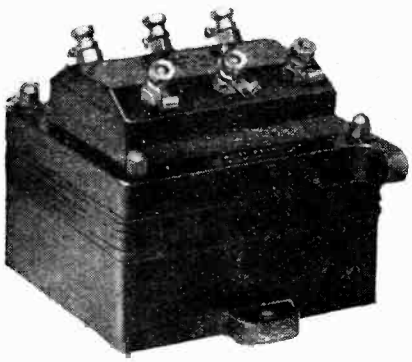
The Manchester Show Report.—

copper tubing, and a glance at the tuning condenser, with its double spacing, evidences a thorough understanding of the electrical requirements of condenser design. Each wavemeter is calibrated from a harmonic, piezo-electric oscillator. It sells at 70s.

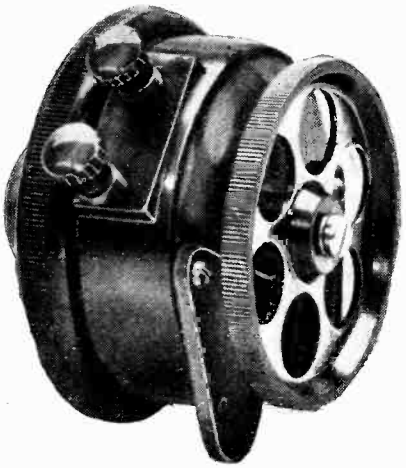
Another development of interest coming from the General Radio Laboratories is described as a double-impedance coupler. It is used in L.F. circuits in place of the usual transformer, and consists of two separate choke coils for use



The Bowyer-Lowe bakelite shrouded L.F. transformer with tapped windings.

in the anode and grid circuits, together with the coupling condenser, and is stated to give a practically uniform amplification between 60 and 10,000 cycles. Its principal merit is that the substitution of a choke for a high resistance in the grid circuit permits of the ready discharge of the coupling condenser, at the same time maintaining a high impedance at the input to the next valve. Simply explained, the reactance type of leak combines a high impedance to alternating current, with a low direct-current resistance, so that "blocking" of the coupling condenser is avoided.

The set of "G.R." transformers for use in the intermediate amplifier of a superheterodyne receiver was recently examined in operation, and, being the heart of a superheterodyne set, can be accepted with the assurance that the completed receiver will function correctly both as to range and quality. The peak of the intermediate wavelength is 10,000 metres.

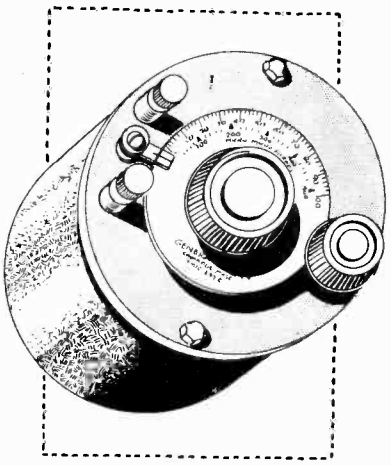


The Orphean gramophone attachment.

Another useful device among the range of low-priced measuring instruments is a geared, calibrated condenser giving a capacity change of 0.0005 mfd. between 15 and 95 divisions or a 100 scale. If used in the circuit of a simple valve oscillator, capacity measurements can be read off from the scale by connecting the condenser to be measured in parallel across its terminals and noting the difference in reading. For this purpose, therefore, the plates follow a straight-line capacity law, and the movement is protected in a black crystalline-finished case. Much space in a well-prepared catalogue is taken in referring to the many types of receiving and laboratory condensers.

Mention here of the rheostats and potentiometers will be appreciated by those wanting instruments of this class for use in conjunction with testing apparatus. The general build of the Type 214 potentiometer is very different from those usually supplied for constructing broadcast receiver apparatus. It is of larger diameter, has liberal current-carrying capacity, both in the wire and the rubbing contact, and has a smooth and noiseless action. The spindle is reversible for panel or baseboard mounting, and its price is 13s. 6d.

For use with valve oscillators and transmitting sets is a range of hot-wire ammeters and milliammeters with flush or raised mountings, or completely insu-



The inexpensive G.R. calibrated condenser on the stand of Claude Lyons, Ltd.

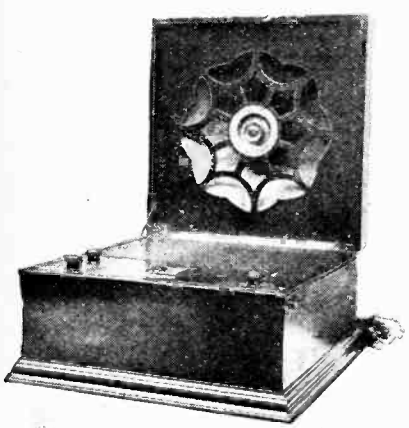
lated in a moulded case with baseboard terminals. Prices range between 32s. 6d. and 47s. 6d.

Claude Lyons, Ltd. (*Stand* 13), 76, *Old Hall Street, Liverpool.*

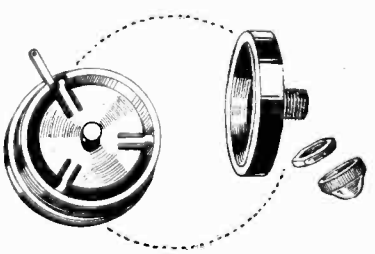
"TRUE SCALE" COUPLING.

Careful investigation shows that a number of manufacturers are replacing the usual grid leak in L.F. choke-coupled circuits by a choke of high inductance, the claim being made that, should a charge accumulate on the coupling condenser, it is immediately dissipated, owing to the comparatively low D.C. resistance of the choke; furthermore, it is possible to use a coupling condenser of somewhat higher value than usual and thus prevent a cut-off of the lower frequencies. Provided that the impedance of the grid choke is high as compared with that of the anode choke, and pro-

New design cone loud-speaker. Made by Whiteley, Boneham & Co., Ltd., with a bowl container of bakelite.



For connection to an electric light socket; the Climax self-contained receiver.



The Canotex Isodon of Claude Lyons, Ltd. A neutralising condenser for panel mounting with screw-on adjustment cover.

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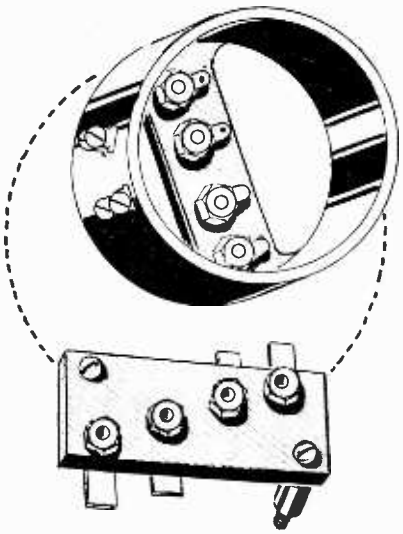
The Manchester Show Report.—

vided that it has a low self-capacity, there should be some gain in employing this method of coupling when powerful signals are being handled. The Formo



General Radio inductance former and mount.

Company, following the practice of H. P. Donle, an American engineer, have modified his dual-impedance coupling and arranged that the anode choke is tapped to produce a step-up by auto-coupling, the overall amplification of a stage being considerably in excess of the amplification factor of the valve. This method of L.F. amplification should interest the keen experimenter in search of unorthodox circuits. The prices of the tapped anode auto-choke and the grid choke are 12s. 6d. each.

SELF-SUPPORTING COILS.

A series of coils supported on thin celluloid formers are now on the market.

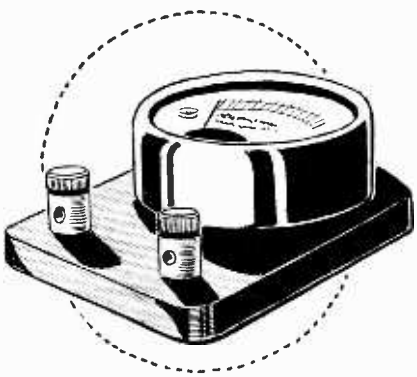
The G.R. H.F. choke coil.

The short-wave types are solenoid-wound, while the long-wave are bank-wound, and provision is made for interchangeability by a supporting bakelite strip on each coil with six contacts which register with six laminated springs on a standard base. To prevent straining the windings when changing coils, a small lever is provided which immediately releases the coil.—*The Formo Company* (*Stand* 15). *Crown Works, Cricklewood Lane, London, N.W.2.*

CARBORUNDUM CIRCUITS.

The Carborundum Co. has produced an interesting booklet entitled "Carborundum in Radio," giving data regarding the rectifying properties of this substance, and also a number of circuit diagrams—or, rather, practical wiring plans—showing the uses of their well-known permanent detector in crystal and valve-crystal receivers. The crystal set can be specially recommended; it is not far short of the mark to say that the circuit adopted, which includes a loosely coupled and separately tuned aerial circuit, with detector and telephones tapped across one half of the secondary coil, represents the most selective arrangement which is conveniently possible in a receiver not using valves.

Other sets and amplifiers employing the Carborundum resistances and resistance-capacity coupling units already reviewed in *The Wireless World* are shown. It may be added that these units



Hot wire aerial ammeter available with maximum scale readings of 100 milliamps. to 10 amps. (Claude Lyons, Ltd.).

include a 0.5 megohm anode resistance, a 0.002 mfd. condenser, and a 2 megohm leak.

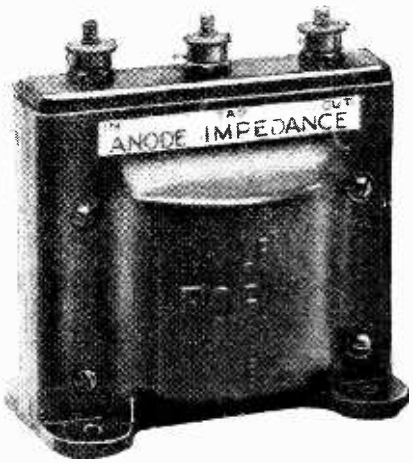
The Carborundum Co., Ltd. (*Stand* 16), *Trafford Park, Manchester.*

BAFFLE FOR MOVING COIL LOUD-SPEAKER.

The undoubted superiority of reproduction to be obtained from a moving coil loud-speaker has roused the envy of many listeners who have perhaps only been deterred from constructing one because of the ugliness of a plain baffle which would be an eyesore in a drawing-room. Messrs. Tutills have produced a highly artistic baffle in dark polished wood which stands on four legs and might well be taken for a fire-screen. The circular hole for the cone is surrounded by a wooden framework which carries a diaphanous silk curtain which further disguises the equipment. With a little ingenuity the pot-magnet could also be concealed, with the result that a home-constructed moving coil speaker need not be open to the objection already put forward.

TINOL WIRE STRIPPER.

This efficient and neat wire insulation remover, which should be found in every experimenter's workshop, consists of a strip of metal with a V-shaped cut made

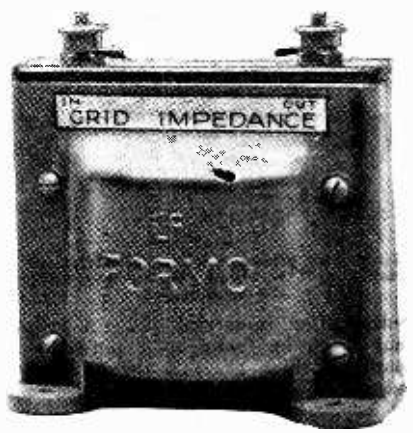


The Formo tapped L.F. inductance for choke coupling.

at each end; the metal is permanently bent round into the shape of a V, and when the jaws are pressed tightly together a small diamond-shaped space is left at the centre of the two over-lapping Vs which ensures that, while the insulation is effectively stripped, no damage is done to the conductor. This useful little tool sells at 6d.

COLVERN HIGH-FREQUENCY CHOKE.

This interesting and somewhat unorthodox choke has a multi-slot winding on a moulded bakelite former. There are actually three distinct windings for long, medium and short waves which can be brought into action at will by removing the choke, rotating it, and reinserting it again into its base. Such a simple means of providing for every wavelength will appeal to the amateur who employs Reinartz type reaction, choke-feed coupling after a H.F. valve, or a choke to prevent any H.F. components from entering the L.F. amplifier.



Formo grid circuit impedance for use in place of the grid leak in choke-coupled L.F. amplifiers.

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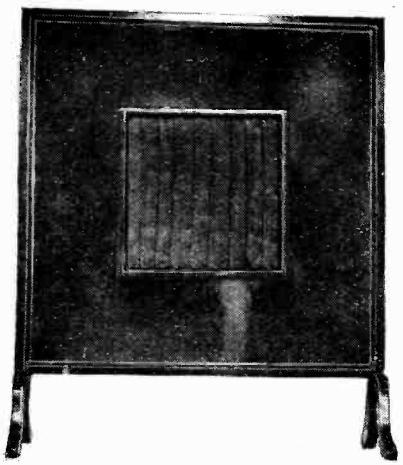
COLVERN GRID VALVE HOLDER.

This holder, a clean bakelite moulding, designed to take the S.625 type of valve, is split at a point about half-way across



Fire-screen form of loud-speaker baffle on the stand of Tutills, Ltd.

the moulding, so that the necessary metal-screening plate can be held rigidly when the two halves of the holders are clamped together. It possesses the important merit of permitting easy insertion of the valve without making use of flexible connections. The actual contact supporting pieces can be removed and remounted so that the brackets can be secured at right-angles to the panel.

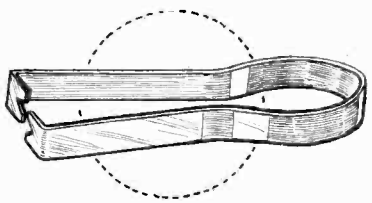
Tutills Limited (*Stand* 18), 7-9, *Swan Street, Manchester.*

BECOLLETTES.

Ebonite strip, tube and rod in odd lengths is now being put up by this company, in 1s. 6d. and 2s. 6d. packets. The amateur should find a large number of uses for these small pieces of ebonite, which are of the same guaranteed quality as the standard panels. Terminal strips, supports for valve holders, bushes for metal panels, and many other applications at once suggest themselves.

COIL FORMERS.

The Becol coil former, with provision for six tappings, will be found extremely useful for H.F. transformers in which



Tinol wire stripper, a simple device for removing insulation without damaging the conductor.

neutralisation is carried out. A refinement is to be found in a pin-and-slot mounting which prevents the accidental reversal of windings through inserting the former the wrong way round.

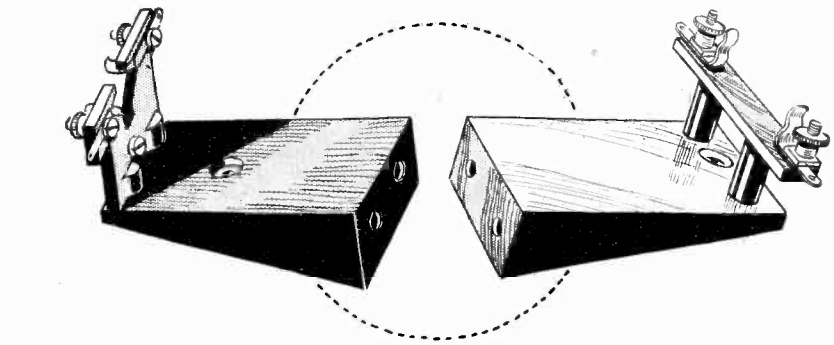
The British Ebonite Co., Ltd. (*Stand* 20), *Nightingale Road, Hanwell, London, W.7.*

BATTERY CABLE.

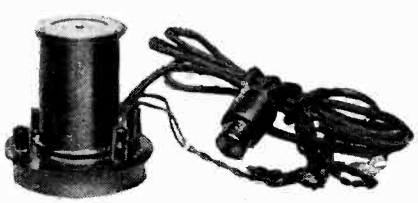
Of special interest to constructors is the "Goltone" Multiple conductor flexible radio cable. It is made up with from five to seven separate leads, each rubber-covered and braided in distinctive colourings. These strands are laid together, and braided overall. The price of the six-way cable is 1s. 1½d. a yard. The same firm also manufacture ready-made battery cables fitted with spade terminals and wander-plugs in assemblies having from four to seven separate conductors, as well as several varieties of twin twisted flexibles in various colours. Triple flex, with braided coverings in black, gold and red, is a really useful innovation, and should prove particularly helpful in making connection to H.T. batteries when two separate voltages are required.

A simple and inexpensive D.C. eliminator is also exhibited; it gives an output of approximately 15 milliamperes at 100 volts.

Ward and Goldstone, Ltd. (*Stand* 21), *Frederick Road, Pendleton, Manchester.*



Colvern screened valve holder.



Goltone D.C. battery eliminator.

REPROVOX GRAMOPHONE AMPLIFIER EQUIPMENT.

This company has paid a great deal of attention to the development of heavy-duty gramophone amplifiers for use in cinemas, dance-halls, etc. The small organs and orchestras which are to be found in public places of entertainment can, with advantage, be supplemented by a series of loud-speakers, and for this purpose the amplifier equipment under discussion can be employed, using a microphone at the input.

The self-contained pedestal cabinet for gramophone amplification can be obtained as a standard model, and is provided with Barraclough's own pick-up, which can be swung so as to be used alternatively with two turntables; this would appear to be an important development which will help to popularise the gramophone amplifier in cinemas, etc., where a delay in changing records on a single turntable would be a distinct handicap.

The L.F. amplifier is ambitious and designed for handling very large volume. The signals from the pick-up are supplied to an input transformer, and thence are amplified by seven valves which are choke-coupled by a system which avoids the use of grid leaks. There are actually four stages of choke-coupling, the first three stages employing one valve each and the last stage having no fewer than four L.S.5A valves in parallel. The L.T. and H.T. requirements are supplied by a Crypto motor generator giving two outputs. The design of eliminators for such large currents is a problem of no small magnitude, but great advance is being made with the use of Raytheon tubes.

Messrs. Barraclough have a comprehensive display of Burndept apparatus.

G. D. Barraclough (*Stand* 22), 16-18, *Moult Street, Cross Street, Manchester.*

The Goltone wave trap of Ward & Goldstone, Ltd.

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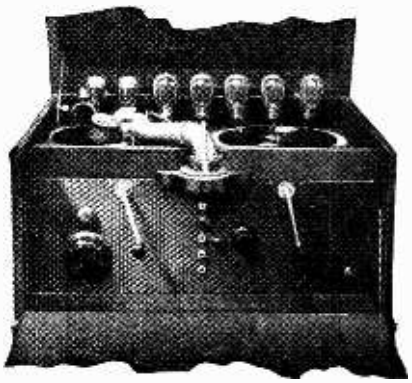
PHILIPS D.C. ELIMINATOR.

This instrument is arranged for connection to a lamp socket by means of a flexible lead and plug. It gives two



Barraclough's heavy duty gramophone amplifier. Note the two turntables.

high-tension voltage outputs, which are controlled by variation of tapped wire-wound series resistances. On a 220-volt supply, the highest voltage obtainable under normal conditions will be about 140, the output at 120 volts being 20 milliamperes. Due to the method of voltage reduction which is employed, two separate smoothing chokes are necessary: judging by the weight of the unit,

The Philips D.C. high tension battery eliminator.

these are of liberal design, while it is stated that condensers totalling 8 mfd. are used.

H.T. AND L.T. CHARGER.

This Philips appliance consists of a rectifying unit suitable for charging both L.T. or car batteries with from one to six cells at 1.3 amp., and H.T. batteries up to 120 volts; at this voltage the charging rate is 60 milliamperes, which is increased as the number of cells is reduced. A special valve (Type No. 1010) is used, together with a resistance lamp. The apparatus is contained in a perforated aluminium case, the switch for making the necessary circuit changes for operating the device with H.T. or L.T. batteries being included in a small external moulded case connected in the leads.

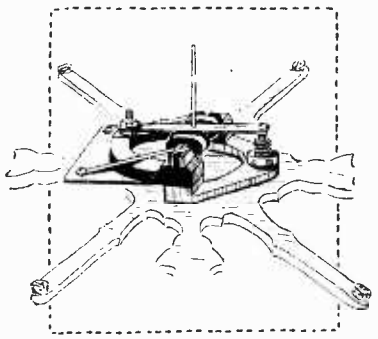
Another new production is a gas-filled lightning arrester for the protection of apparatus from atmospheric discharges. This piece of apparatus comprises two spaced electrodes enclosed in a sealed glass container; the space between them is normally non-conducting, but breaks down on the application of voltages in the order of hundreds. Arrangements of this kind have several advantages over protective spark gaps in air.

Philips Lamps, Ltd. (*Stand* 24), 2-3, *Lofthouse Court, King Street West, Manchester, and* 147, *Charing Cross Road, London, W.C.*2.

A Philips rectifier for charging both H.T. and L.T. accumulators from A.C. supply.

AMPLION PUBLIC ADDRESS SYSTEM.

The Amplion speech amplifier is primarily designed for operation in conjunction with a microphone or gramophone pick-up, although it may be connected to a radio receiver. A total of five valves are employed; that in the first stage is an L.S.5B, while L.S.5's are used in the remaining positions; the last pair are in parallel. Intervalve coupling is by a combination of choke and transformer, volume control being obtained by tapping off any desired proportion of the total L.F. potential developed across the choke in the anode



Details of the mounting of the M.P.A. loud-speaker drive unit. The cork pads are shown which support the edges of the cone.

circuit of the first valve by means of a stud switch.

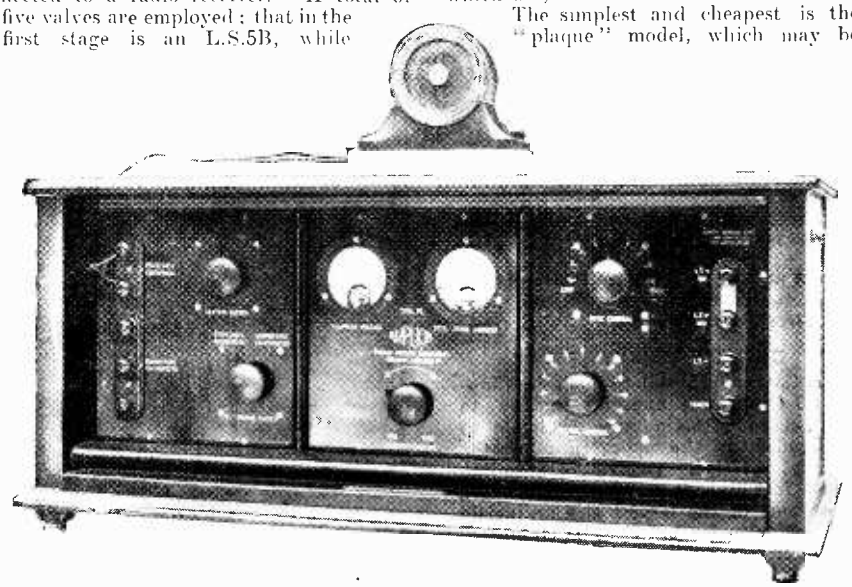
Two meters are fitted; the first shows the voltage across the valve filaments and the other normally indicates total anode current, but can be switched into the plate circuit of the output valves, thus acting as an overload indicator.

The instrument is designed to operate four large loud-speakers, giving a sufficient output to render speech audible to assemblies of as many as 4,000 persons in the open air. For still larger gatherings, an additional amplifier is available with sets of output valves in parallel for operating extra loud-speakers.

Graham-Amplion, Ltd. (*Stand* 28), 10, *Whitworth Street West, Manchester, and* 25-26, *Savile Row, London, W.*1.

M.P.A. LOUD-SPEAKERS.

These are made in three different types, which are, however, similar in essentials. The simplest and cheapest is the "plaque" model, which may be



The Amplion public address amplifier. It is fitted with a tone control device.

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stood on a shelf or table, or hung on a wall. The cone is mounted on a wooden board with its apex outwards; its edge is free except at four points, where it is

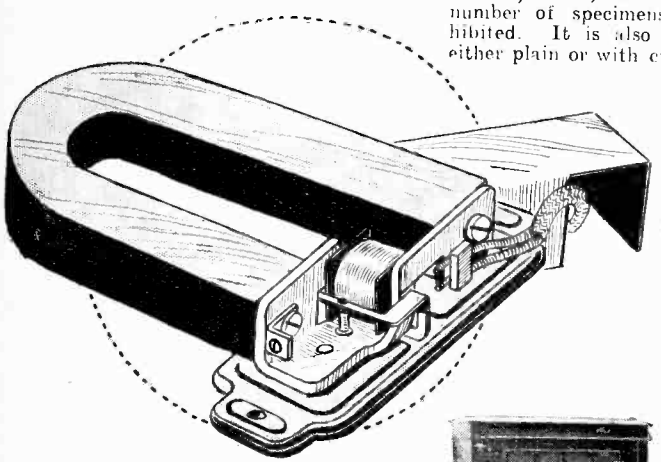
A handsome Caxton pedestal cabinet.

attached to thin flexible tongues of wood formed by making cuts in the supporting board to which the electro-magnetic drive unit is attached. The adjusting knob projects through the back.

The more expensive models are mounted with open grilles at back and front.

It is understood that these instruments are being demonstrated during the exhibition at 250, Deansgate, Manchester.

M.P.A. Wireless (*Stand* 29), 62, *Conduit Street, London, W.*1.



The Blue Spot differential loud-speaker unit with cover removed.

CAXTON CABINETS.

The Caxton pedestal cabinet, in Chippendale style, will appeal especially to those whose æsthetic sense is liable to be offended by the appearance of the ordinary wireless receiver. Standing about 3 feet high, it provides ample space for a panel of the largest size ordinarily used, and also for batteries or eliminator in a lower compartment. There is a drop front giving access to the apparatus. Workmanship and finish is of a high order.

Caxton Wood Turnery Co. (*Stand* 31), *Market Harborough.*

BALANCED ARMATURE LOUD-SPEAKING UNIT.

Differential loud-speaker movements have the important advantage over the more ordinary type in that the impedance of their windings at a given frequency is not sensibly changed by movement of the armature under the influence of signal currents. The "Blue Spot" instrument is made with an exceptionally large permanent magnet, between the four pole-pieces, on which is mounted the armature; its movement is transmitted to the cone with which it is intended to be used through a U-shaped metal stirrup carrying a threaded rod. A certain amount of damping is imposed by an extension of this stirrup, which is fixed to the frame, thus acting at the same time as a support. The unit sells at the low price of 18s. 6d.; it is used in the construction of a loud-speaker of interesting design, which is also exhibited. Its cone is supported at the edge by leather, and is also stiffened by a peripheral ring of balsa wood, a material of extreme lightness

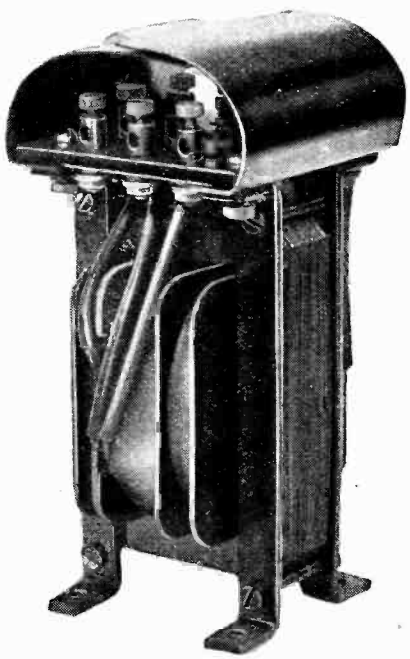
TROLITE.

This is a moulding material of considerable mechanical strength, with an extremely good appearance. It lends itself particularly well to the production of dials, knobs, switch parts, etc., a large number of specimens of which are exhibited. It is also supplied in panels, either plain or with cubed and wave-form surfaces, as well as in mahogany and walnut colourings.

F. A. Hughes and Co., Ltd. (*Stand* 32), 204-206, *Great Portland Street, London, W.*1.

A.N.P. FOUR-VALVE SET.

Those amateurs who have A.C. lighting mains should not fail to examine this constructor's set which is wired to take the new Cosmos indirectly-heated cathode valves, together with the A.N.P. coils, both of which components were described



Cosmos A.C. valve transformer.

in detail in *The Wireless World* of September 21st and September 28th, 1927. Owing to the large emission which is obtained from their specially constructed filaments, the mutual conductance of Cosmos Shortpath valves is very high, and a receiver containing these valves is likely to be more efficient than one con-

The several types of loud-speakers shown on the Celestion stand.

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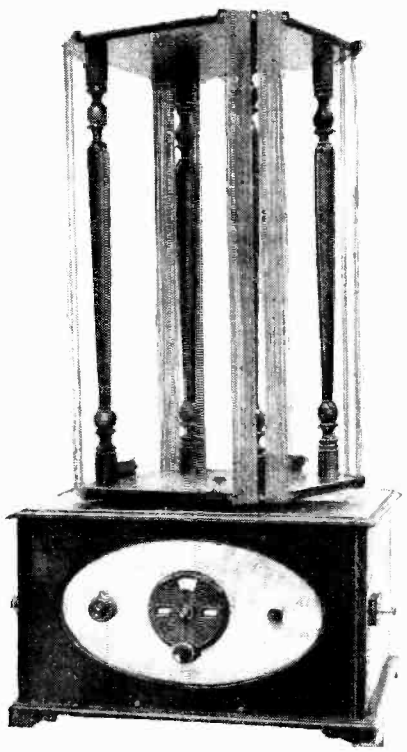
taining ordinary valves. The circuit used is one stage of H.F. employing the choke-feed method of coupling, neutralisation is

For the nursery—one of the many artistic forms of loud-speakers produced by Artandia.

effected by earthing the centre point of the tuned anode coil, and reaction is provided by capacity control from the detector plate circuit. So that a minimum reaction effect is always present, a small condenser of 0.00002 mfd. is connected between the grid and plate of the detector valve, which is of the leaky grid type. The two L.F. stages are resistance-capacity coupled, the necessary coupling



Peto Scott Sociable Three.

units being housed within the moulded bases of the valve holders, a refinement which makes for a considerable saving of space. Another feature which saves space is the fact that the A.N.P. coils used are astatically wound and can be set on the baseboard quite close to one another and with axes in the same plane without fear of interaction. Provision is made for short and long waves, and since loose coupling is employed selectivity should be of a high order.

The company supply suitable H.T. and L.T. eliminators for this set.

Metro-Vick Supplies, Ltd. (*Stands* 34 *and* 35). 14, *Long Millgate, Manchester, and Atlas Works, Trafford Park, Manchester.*

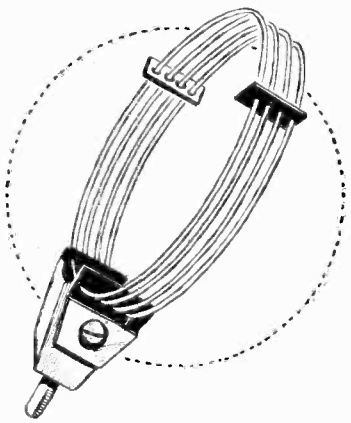
INEXPENSIVE VALVES.

The firm of Radions, Ltd., are producing a comprehensive range of valves with filaments rated at 2, 4, and 6 volts. These are priced at 7s. 6d., power or super-power valves being a shilling extra. The approximate stated characteristics of several of the more generally useful types are as follows:—Two-volt H.F. amplifier: filament current, 0.15 amp., impedance,

Valve crystal receiver with valveless amplifier.

28,000 ohms, amplification factor, 13.2. Power valve: filament current, 0.3 amp., impedance, 8,200 ohms, amplification factor, 5.3. The 4-volt H.F. valve has the same characteristics as the 2-volt type, but its filament consumes 0.1 amp., while the power valve passes 0.15 amp., and has an amplification factor of 7.5, with an impedance of 8,000 ohms. A 6-volt valve, with a filament consumption of 0.25 amp., has an amplification factor of 20 and an impedance of 27,000 ohms, while the figures applying to the super-power valve in the same class are, respectively, 0.34 amp., 4, and 3,000 ohms.

Radions, Ltd. (*Stands* 38 *and* 39), *Bollington, near Macclesfield.*



The new type Atlas short-wave coil.

THE NEW "EVERYMAN FOUR."

This screened grid valve set, as described in *The Wireless World*, is being shown on this stand. The copper screening box with lid can be obtained separately should constructors wish to build their own receiver.

The Peto-Scott Co., Ltd. (*Stand* 45), 77, *City Road, London, E.C.*1.

SHORT-WAVE COILS.

Realising the potentialities of short wave work, this company has designed a set of four coils suitable for wave-lengths between 15 and 100 metres. The mounting is arranged with the ordinary standard plug and socket screwed into a porcelain holder which as an insulation is very satisfactory, as its dielectric properties remain constant for a long period. Tinned copper wire of about 17 gauge is used, and the spacing is about a diameter and a half: the turns are

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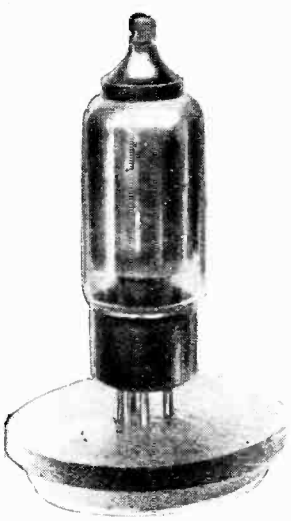
air-spaced and supported at four points by narrow strips of insulating material. With each set of coils a fully instructive pamphlet, giving a list of short-wave stations, is included; the circuit advised consists of an aperiodic aerial coil coupled to a tuned grid coil associated with which is a Reinartz reaction coil. The four coils retail at 10s.

Atlas A.C.12 Eliminator arranged for full wave rectification and provided with three H.T. tappings.

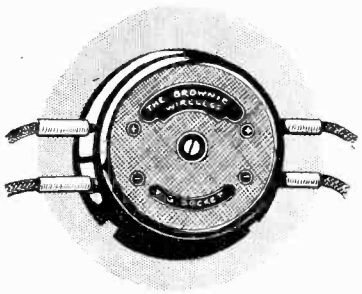
SELECTATUNER.

Probably the most popular type of set for receiving a number of stations on the loud-speaker is the four-valve set with one stage of high-frequency amplification. An example of this kind of receiver is to be found in the Atlas "Neutrofour," which contains a high-frequency transformer unit known as the "Selectatuner," which can be purchased separately. The fine-wire primary is centrally tapped for neutralisation, though it is wound laterally to the secondary,



The new Mullard screened grid valve.

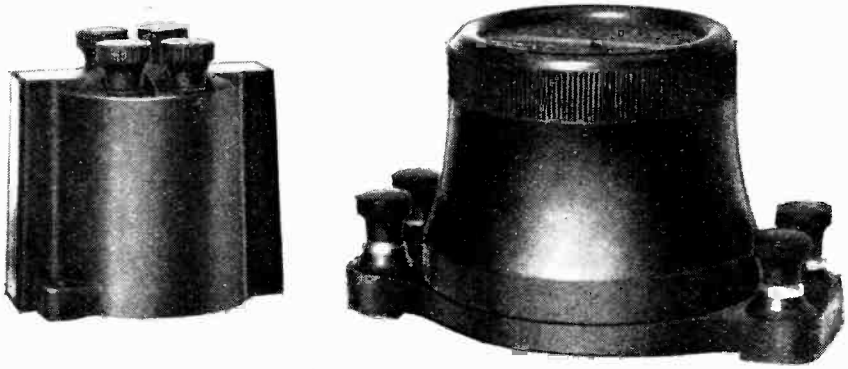
which consists of about 72 turns of twin wire wound on a Pirtoid tube of 3in. diameter. Variable magnetic reaction is introduced at the high-potential end of the transformer by means of



The Brownie tag socket for loud-speaker extensions.

a swinging coil which is panel-controlled. The transformer, which is wound for short waves, is provided with brackets to screw down to a baseboard, so that loading is necessary for long waves.

H. Clarke and Co. (Manchester), Ltd. (*Stand* 48), *Atlas Works, Eastnor Street, Old Trafford, Manchester.*



Brownie low-frequency transformers.

NEW CONSTRUCTOR'S SETS.

The Marconiphone Company has extended its range of sets of parts for home constructors by adding five new models. There are two D.C. mains sets, the first of which is a detector with two L.F. stages, and the second a similar arrangement with the addition of a neutralised tuned anode stage. Filaments are connected in series, while reaction is included in each case.

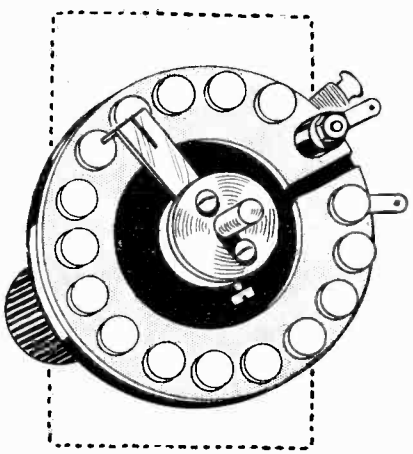
Most of our readers are aware that the Marconi K.H.1 valve, with indirectly heated cathode, which was introduced shortly before the Olympia Show, has infinitely better characteristics than even the best ordinary valve of its class; for an A.C. resistance of 30,000 ohms its stated voltage factor is 40. Advantage is taken of its properties in the K.2 four-valve receiver, for which parts are now supplied and which used three of these valves, with a K.L.1 in the output stage. All the energy consumed is supplied from A.C. mains, and the circuit arrangement comprises a neutralised tuned-anode H.F. amplifier, grid detector, and resistance- and transformer-coupled L.F. amplifiers in the order named. The filaments or, more correctly, the heating elements are fed with A.C., stepped down to a suitable voltage; a second winding on the same transformer feeds the filament of an H.T. rectifying valve, and a third supplies its anode current. A common H.T. voltage is applied to all the valves in the receiver proper.

Users of the Marconi screened valves are catered for with sets of parts for four- and five-valve receivers; the latter has two H.F. stages and is of special interest at the present time. Interchangeable astatic coils are used in grid and tuned anode circuits, and the aerial is directly coupled through alternative series condensers of 0.00005 and 0.0001 mfd. Each H.F. stage is shielded by means of a vertical metal screen. The detector operates on the bottom-bend principle, consequently a valve of comparatively low impedance (a D.E.L.610) is recommended by the makers for this position, as there is an L.F. transformer in its anode circuit. The succeeding L.F. amplifier is coupled to the output by means of a resistance.

The Marconiphone Co., Ltd. (*Stand* 49), 10, *Dolefield, Manchester, and* 210-212, *Tottenham Court Road, London, W.1.*

NEW SCREENED VALVES.

The Mullard screened grid valves are new exhibits of outstanding interest.



G.E.C. 1 megohm potentiometer specially suitable for volume control.

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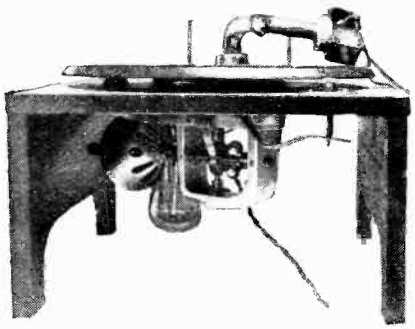
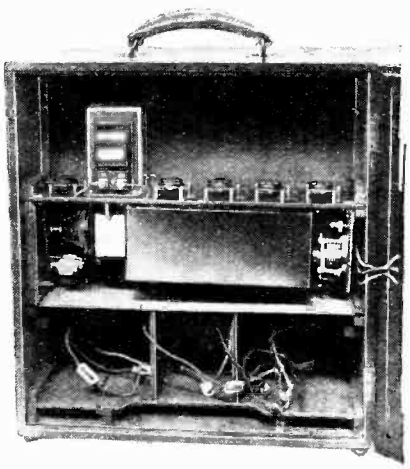
They are made with filaments having 2-, 4-, and 6-volt ratings, the first mentioned consuming 0.15 amp., and the others 0.075 amp. The amplification factor is given as 200, with an impedance of 250,000 ohms in the case of the 2-volt type; that of the others is given as



The new G.E.C. electrically driven gramophone pick-up equipment.

200,000 ohms. The valves are mounted on the usual four-pin base, in which what is normally the anode pin is connected to the screen. The plate is joined to a terminal carried on a bakelite moulding secured to the top of the bulb.

Fuller information regarding these new products is awaited with interest; unfortunately, due to the fact that the glass is almost completely obscured in the "gettering" process, it was not possible to obtain an accurate idea of the disposition of electrodes and screen; this latter, however, seems to be considerably larger than in other valves of similar type.



Igranic long-wave portable. It is operated by a single control.

A demonstration receiver, showing how easily existing apparatus may be modified for use with these valves, is on show. The set has one H.F. stage, coupled by means of a tuned anode circuit. It is noted with interest that a very small amount of screening—merely a vertical metal plate—is provided between grid and plate coils. It would thus appear that it is an easy matter to obtain stabilty when the new valves are used, but it is assumed that more complete isolation of the circuits would be necessary when a system of coupling giving a lighter aerial load is adopted; in the set under discussion the aerial is tapped direct to the centre point of the grid coil, so its damping effect is by no means negligible.

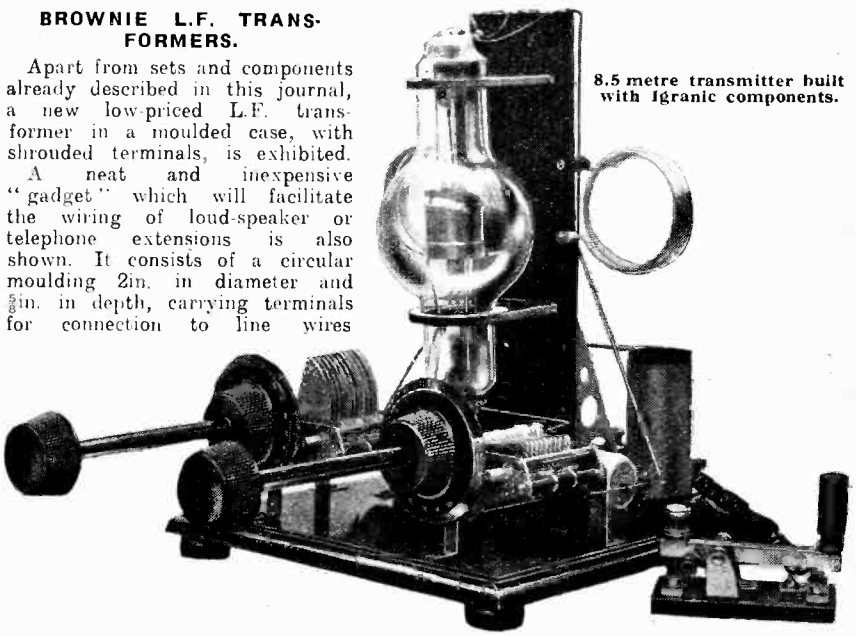
Mullard Wireless Service Co., Ltd. (*Stand* 51), *Mullard House, Denmark Street, London, W.C.2, and* 13, *Deansgate, Manchester.*

BROWNIE L.F. TRANSFORMERS.

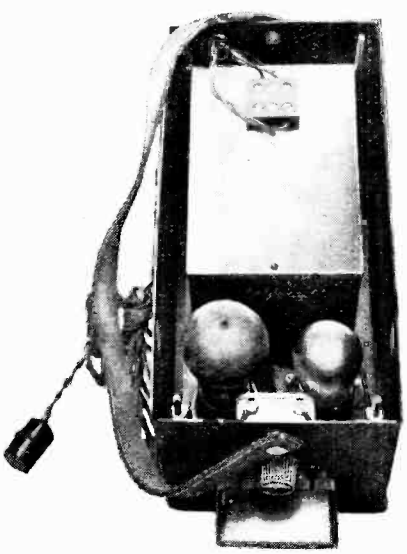
Apart from sets and components already described in this journal, a new low-priced L.F. transformer in a moulded case, with shrouded terminals, is exhibited.

A neat and inexpensive "gadget" which will facilitate the wiring of loud-speaker or telephone extensions is also shown. It consists of a circular moulding 2in. in diameter and $\frac{3}{8}$in. in depth, carrying terminals for connection to line wires (for which slots are provided) and two parallel-connected pairs of spring sockets for taking standard phone tags. The fitment may be secured to a wall or skirting board by means of a single screw, which is provided. Positive and negative sockets are marked.

Brownie Wireless Co. of Great Britain, Ltd. (*Stand* 52), *Nelson Street Works, Mornington Crescent, N.W.*1.



8.5 metre transmitter built with Igranic components.



The Cossor A.C. battery eliminator. A full wave glow discharge rectifier is used.

FOR USE WITH GRAMOPHONE PICK-UPS.

At the stand of the General Electric Company is a new electrically operated gramophone mechanism, less horn, and fitted with a special tone arm. Drive is obtained from an electric motor of the universal type for use with A.C. or D.C. supply. A novel feature is that the motor is started and stopped by the tone arm engaging upon levers mounted near the edge of the 12in. turntable. The price is 6 guineas.

General Electric Co., Ltd. (*Stand* 55), *Magnet House, Kingsway, London, W.C.2, and Magnet House, Victoria Bridge, Manchester.*

IGRANIC COIL WINDING.

Much interest is being shown in the automatic machine used for winding the Igranic triple section coils. At the Igranic stand also is an 8.5 metre transmitter which transmitting amateurs should not fail to inspect; while those listeners who have not yet witnessed the performance of a gramophone pick-up will appreciate the opportunity of examining the demonstration equipment in operation at the Igranic stand. The full range of Igranic components having recently been described in these pages, mention might only be made of the short wave receiving kit, which embodies an H.F. amplifier.

Igranic Electric Co., Ltd. (*Stand* 57), 149, *Queen Victoria Street, London, E.C.*

FERRANTI METERS.

Quality of reproduction cannot be assured without incorporating indicating instruments in the amplifying circuits.

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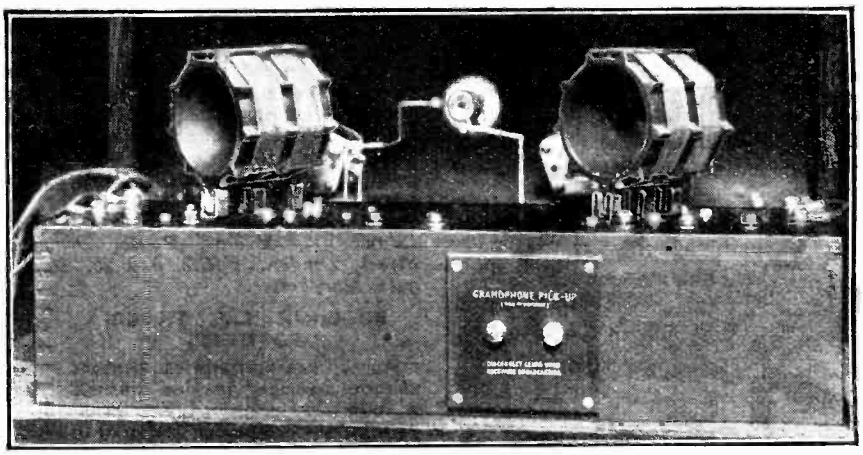
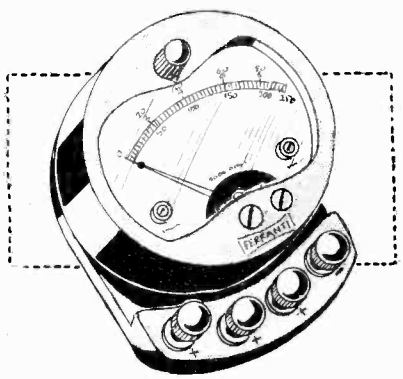
It is in this particular connection that the new Ferranti radio meters have been produced. At the low prices at which they are offered, in view of the high-grade construction, these meters will find their way into the majority of amateur receiving sets, having become available at a time when valve users are beginning to appreciate the importance of an indicator in an L.F. amplifier. Having been shown at Olympia, where they attracted much interest, they have already been described, but attention might be drawn to the combined scale instruments, Types 19 and 20, examined when visiting the stand. They are first-grade laboratory instruments selling at £2 7s. 6d. with scales reading to 7.5 and 150 volts and 15 or 30 milliamperes, and entirely meet the work-



Interior of the Dimic Four. Terminals are now provided for introducing a gramophone pick-up.



One of the new type multi-range Ferranti meters.

ing requirements as indicators of correct L.F. amplifier operation. Readers should apply for the circuit sheets showing the use of Ferranti meters in a typical receiver as well as an L.F. amplifier with gramophone pick-up.

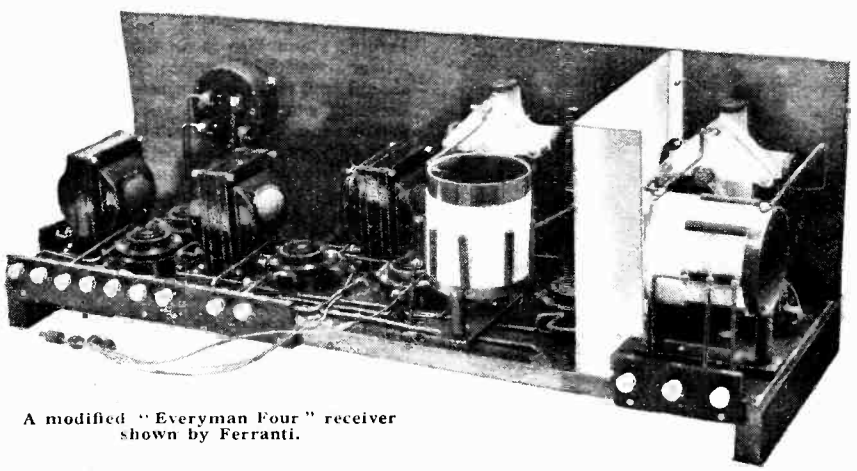
Ferranti, Ltd (*Stands* 59 *and* 60), *Hollinwood, Lancashire.*

"DIMIC" FRAME AERIAL.

Although at first one may be a little surprised to find a frame aerial built upon two metal loops, a careful inspection of the "Dimic" frame reveals that the supports form part of the frame aerial and are in circuit with the winding. A double aluminium alloy frame supports grooved ebonite cross bars carrying the long- and short-wave windings, wave change being effected by a two-position switch. Designed for use with McMichael superheterodyne equipment, this is one of the few frame aerials on the British market. The diameter is 23in.

It is interesting to observe among the receiving sets at the McMichael stand that a frame aerial model, which has become popular, makes use of a two-stage resistance-coupled high-frequency amplifier. By this means single dial tuning is obtained. Volume control is produced by adjustment of regeneration, and the two-range control is also the "on and off" switch. Probably the most favoured circuit among amateurs, where special H.F. transformer windings are not adopted, is a stabilised tuned anode arrangement in which the neutralising condenser adjustment appears on the front of the panel and is used to control regeneration. Such a circuit arrangement is embodied in the new type "Dimic Four," followed by valve detector and two L.F. stages with choke and transformer coupling, the L.F. equipment being specially made by Ferranti.

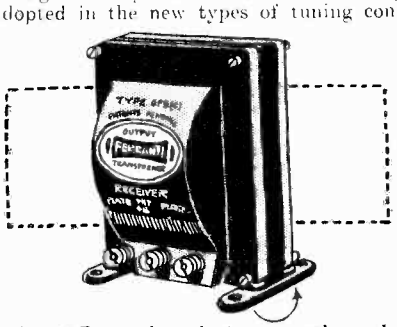
L. McMichael, Ltd. (*Stands* 61 *and* 62), *Hastings House, Norfolk Street, Strand, London, W.C.2.*



A modified "Everyman Four" receiver shown by Ferranti.

THUMB CONTROL LAMPLUGH CONDENSER.

Edgewise operated scales are being adopted in the new types of tuning con-



A new Ferranti product. Intervalve and output push-pull transformers. The mounting feet can be rotated or transferred to the top corners.

densers. Now shown for the first time are the Lamplugh single and two-sectioned condensers, which are attached to the instrument panel by means of two screws, and operated by the projecting milled edge of a metal segment mounted on the shaft. In the case of the dual condenser both sets of moving plates are in electrical contact with the common shaft.

Another newcomer to the range of Lamplugh products is the Neutrocon, a neutralising condenser built into a moulded case with long operating spindle, and designed for either baseboard or one hole panel mounting. Its range, stated to be 2.7 to 36 micro-microfarads, renders it suitable in any neutralised circuit, the change from maximum to minimum being produced by many rotations of the milled handle, thus giving critical adjustment.

S. A. Lamplugh, Ltd. (*Stand* 63), *King's Road, Tyseley, Birmingham.*

SLEEVING INSULATED WIRES, ETC.

Little attention is paid, as a rule, by the amateur in the selection of insulat-

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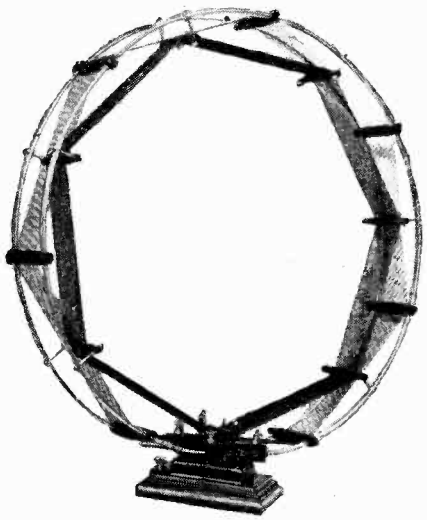
ing materials, while the use of sleeving has declined during the past few years. Even assuming the use of stiff wiring, coloured insulated sleeving is recommended and, now that leads from supply mains inter-weave with the wiring of a set, the need to guard against accidental short circuits is imperative. "Hivoltsit" coloured sleeving is well woven, of uniform diameter, and available in sizes

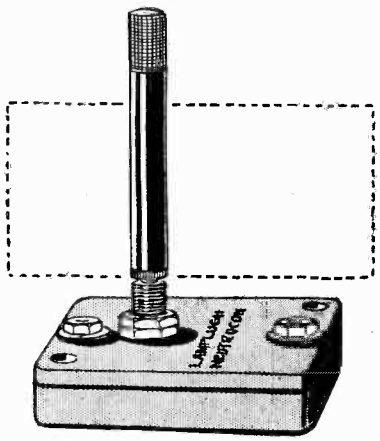


Dimic frame aerial.

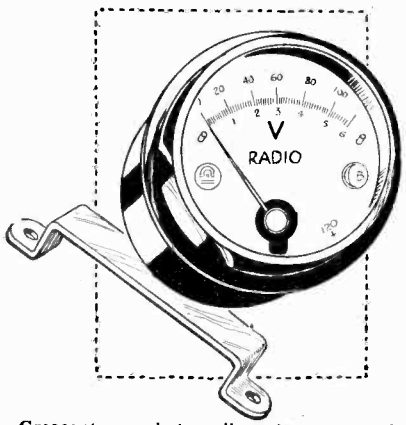
between 0.5 and 30 millimetres, internal diameter increasing by 0.5 millimetres. Considerable economy may be effected by purchasing the sleeving up to any required length instead of in the short strands as normally supplied.

"Kontact" coloured connecting wire may be preferred to the use of sleeving, and is obtainable in lengths as well as in boxes of four 5ft. coils in various colours at 1s. 6d. An important merit is that the insulation does not fray, and the covering has no tendency to corrode the tinned No. 18 wire, which would render soldering difficult.

Other interesting and useful products of the Standard Insulator Co., Ltd., are all types of battery cords, resin cored

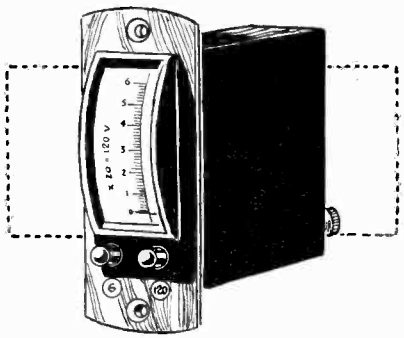


Lamplugh stabilising condenser.



Crescent moving coil voltmeter and mounting bracket shown by L. Holzman.

solder, india-rubber stops and feet, rubber headed tacks, rubber accumulator mats, canvas cord rubber strapping for the handles of home-made accumulator boxes, varnished insulating paper and cloth, and several forms of aerial wire. An interesting aerial wire consisting of a 7×7 weave of No. 38 S.W.G. is lead covered to prevent corrosion, and sells at the moderate price of 1s. 9d. for a 100ft. coil. Bakelised insulating tubes, now in such general demand, are available in the popular sizes, the 3in. × 3½in.



A new edgewise moving coil voltmeter (L. Holzman).

so often specified in the pages of this journal selling at 1s. Readers would be well advised to interest themselves in the bakelised panels, which are strong, work well, and retain their colour and bright surface.

Standard Insulator Co., Ltd. (*Stand* 64), *Winsley House, Wells Street, Oxford Street, London, W.*1.

CRESCENT MOVING COIL METERS.

For the correct operation of any valve receiving set a meter for indicating at least filament, anode and grid biasing potentials is essential. To meet the increasing demand an inexpensive range of testing meters is now marketed by Louis Holzman. For panel mounting an edgewise instrument is available with curved silvered scale, and, as a two-range voltmeter, is fitted with three terminals and two press buttons so that it can be permanently wired into the receiver circuit. Being of the moving coil type it has a uniform scale, and a full reading is obtained with a current of only 4.5 mA. The figure of merit may be expressed as about 225 ohms to the volt. It sells at 22s. 6d.

A 2in. circular type is also shown which is, again, a moving coil instrument, and represents good value, being offered with a single scale at 17s. 6d., and with a two-scale reading at 20s. Provision for flush or raised mounting is made by a reversible metal strap which is also useful for securing the meter to

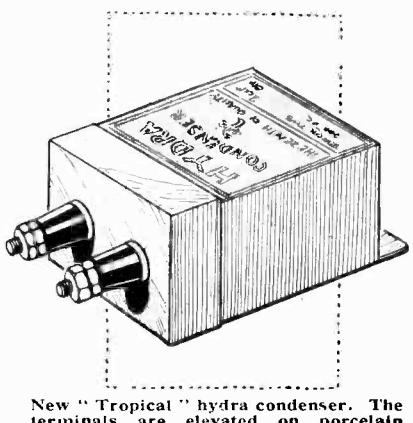
A multi-range moving coil meter (L. Holzman).

a baseboard, in the construction of a baseboard mounted testing set. A small wooden stand is exhibited for carrying meters of this type. This form of moving coil meter is supplied also in a small polished wooden case with sloping top, and by means of a single plug engaging on a row of holes is arranged to read 6, 60 or 600 mA. as well as 6 and 120 volts. By means of a chart this instrument can be used for measuring resistance, and its price is 45s.

Louis Holzman (*Stand* 67), 109, *Kingsway, London, W.C.*2.

ELECTROSTATIC PICK-UP.

Dubilier products include the new Torroidal H.F. transformers and the new type tuning condenser which were first shown at Olympia. In searching for new Dubilier products at their Manchester stand the new type gramophone pick-up might be mentioned, being un-



New "Tropical" hydra condenser. The terminals are elevated on porcelain insulators.

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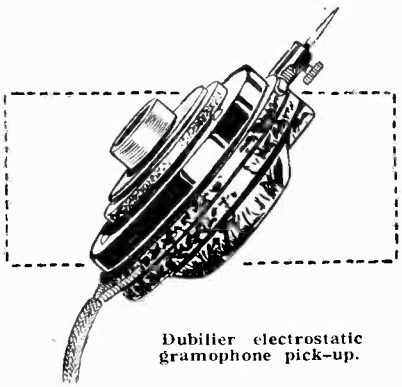
like any other, inasmuch as it operates by producing a change of capacity instead of being electro-magnetic. Movement of the needle causes a change in



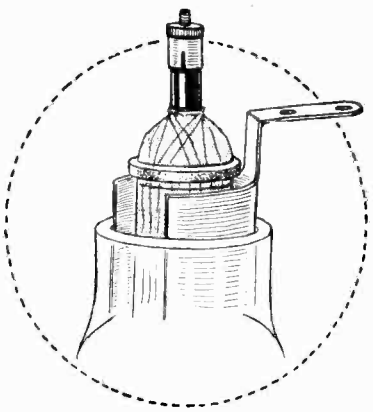
Dubilier electrostatic gramophone pick-up.

the spacing between two plates about 1½in. in diameter. It is used in the grid circuit in conjunction with a leak resistance to control the potential of the grid.

Dubilier Condenser Co. (1925), *Ltd.* (*Stands* 69 *and* 70), *Ducon Works, Victoria Road, North Acton, London,* W.3.

PARFAIT PANELS.

Difficulty in squaring the edges of panels is stimulating the demand for



The elements withdrawn from a cell of the Wet H.T. Battery Company, showing the arrangement of the terminals to ensure good contact and prevent corrosion.

finished panels cut to size. The Parfait range includes no less than 19 standard sizes, available in thicknesses $\frac{3}{16}$in. or ¼in., and in six different qualities—matt, semi-polished and highly polished black, hand polished black, and semi and highly polished mahogany. For a small extra charge panels are supplied with a genuine sand blast finish. Full details of standard sizes and scale of prices are given in a pamphlet.

H. B. Potter and Co., Ltd. (*Stand* 73), *Station Buildings, Rochdale.*

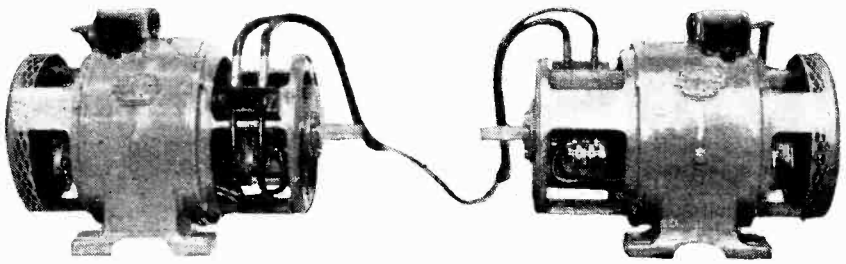
NEW ORMOND LOUD-SPEAKER.

As it is only the intention here to bring to the notice of readers new apparatus which has made its appearance since the Olympia Show, reference is made in connection with the Ormond exhibit to their new loud-speaker. It is a reed-driven

An inexpensive instrument cabinet by Walker Bros. and their "All-wood" loud-speaker horn.

cone enclosed in a well-finished rectangular cabinet measuring about 13in. × 13in. × 4½in. with a draped grille. A special feature claimed is that it is non-adjustable. The price is 3 guineas.

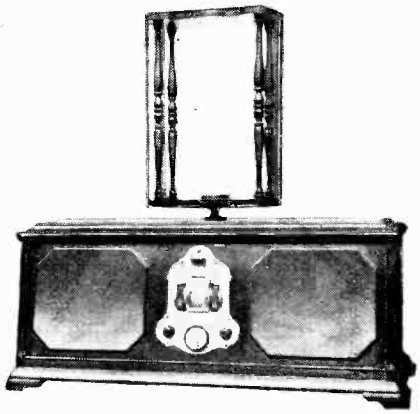
The Ormond Engineering Co., Ltd. (*Stand* 76), 199-205, *Pentonville Road, London, N.*1.



Battery charging machines shown by the Lancashire Dynamo and Electric Company. A constant voltage output is obtained and batteries on charge are parallel-connected.

TYPICAL AMERICAN RECEIVERS.

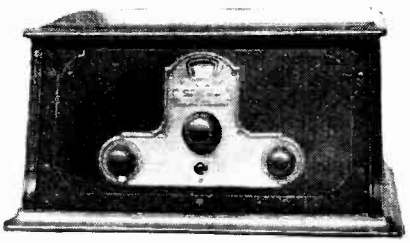
The Freed-Eisemann sets may be considered as representative of the products of the better-class American manufacturer. Of special interest is an



A long-range American receiver: the Freed-Eisemann 8-valve set with 5 H.F. stages.

eight-valve receiver with five "straight" neutralised H.F. stages, a detector, and two transformer-coupled L.F. amplifiers. Each H.F. valve, with its transformer, condenser, and other associated apparatus, is contained in an individual tinned copper screening case; the detector and L.F. amplifiers are contained in a separate compartment.

A removable frame is mounted on the top of the cabinet, while provision is made for the use of an open aerial. There is a simple dial tuning control, by means of which six separate circuits are adjusted simultaneously; it is observed that independent final adjustment is not considered necessary. The dial is of the "edgewise" type, and is illuminated by



Three H.F. amplifiers are included in the Freed-Eisemann 6-valve receiver.

a small lamp, which also serves as an indication as to whether the filaments are lighted.

A particularly attractive feature is the fitting of a two-range voltmeter: by operating a rotary switch it is possible to read the voltages of H.T., L.T., and grid-bias batteries. The set is priced at £87 10s., exclusive of royalties, valves and accessories.

Another set of interesting design is the Type N.R.9 six-valve receiver which has three high-frequency stages and is intended to operate on an open aerial, for which a variable coupling device is fitted. This also has a single dial tuning

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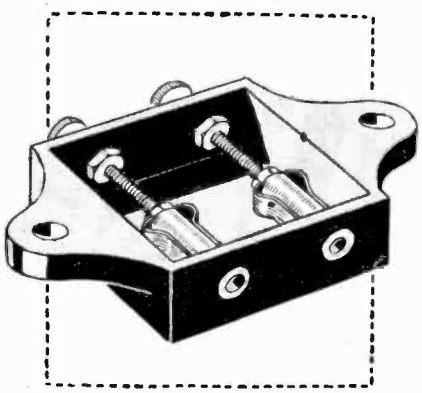
control, and the H.F. transformers, etc., are completely screened. Connection to the batteries, which are external, is made by means of a multi-way cable.

It will be almost needless to say that no attempt is made to cover a wider waveband than from about 200-600 metres as far as the eight-valve receiver is concerned, but the smaller set may be adapted for the reception of Daventry at a cost of £5 10s. in addition to its normal price of £28 (without royalties or accessories).

Richard Davies and Sons (*Stand* 78), *Victoria Works, Bilberry Street, Manchester.*

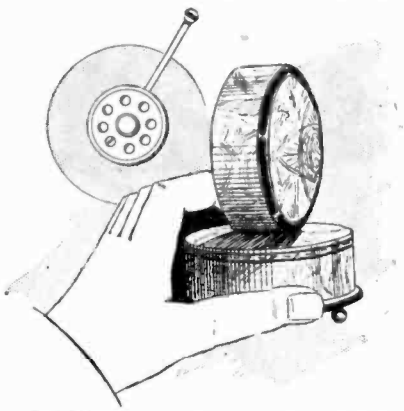
GRIPALL WIRING SOCKETS.

Ordinary electrical fittings are not always entirely satisfactory for use in



Back view of the Gripall wiring socket.

making extension "points" for connecting loud-speakers or telephones; the fitment made by J. Rigaut will remove the excuse for loose trailing wires, and is well adapted for its purpose. A small rectangular moulding of brown bakelite, with lugs drilled for fixing screws, carries two external terminals connected internally to spring sockets of ingenious design which are capable of accommodating any ordinary pin tags. Good contact is assured, as the pin passes between two metal balls which are mounted in holes drilled in the walls of a brass tube; these balls are pressed together by phosphor-

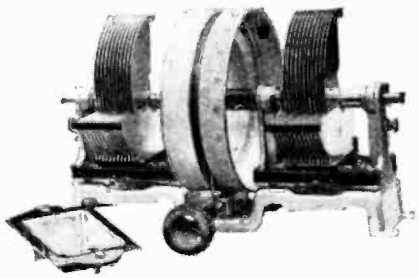


Miniature imitation mother-of-pearl loud-speaker shown by Bush House Radio.

One of the several cabinet designs shown by Bush House Radio.

bronze springs. The fitting sells at 1s. 6d., and measures about 1½in. square by ⅝in. in depth. The same firm exhibits several crystal sets of exceptionally neat design.

J. Rigaut (*Stand* 81), 108, *Euston Road, London, N.W.1.*



A new drum dial two-section condenser possessing many novel points of interest. The N.S.F. condenser shown by Runbaken.

ANSIL THREE-VALVE SET.

This receiver, the circuit of which conforms to well-tried practice, is retailed at the extremely moderate price of £8 12s. 6d. to include an attractive pedestal cabinet and all accessories.

The circuit employed is a regenerative detector followed by a resistance capacity-coupled stage which is again followed by a transformer. The principle of avoiding a grid leak and condens associated with the grid circuit of an output valve is to be commended, as any overloading gives less marked distortion, owing to the relatively lower D.C. resistance of the transformer secondary as compared with that of the usual grid leak. The value of the constants employed in the resistance-coupled stage is sufficiently low to allow of the use of ample regeneration, which is of the capacity-controlled magnetic type, a few turns of wire being wound laterally to the aerial tuning inductance. Solenoid winding on 3½in. formers is employed, and switching is arranged for a rapid change-over to long waves.

Experimenters wishing to build their own sets into an attractive cabinet would do well to examine the "Ansil" pedestal cabinet, which sells at the low figure of £2 9s. 6d.

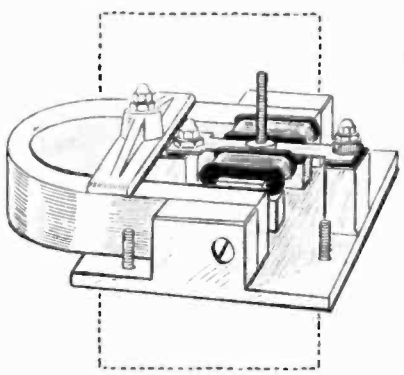
MINIATURE LOUD-SPEAKER.

Many attempts are being made by manufacturers so to design loud-speakers that by careful camouflaging they appear

The Runbaken vibrator A.C. battery charger.

as ornaments which are in keeping with other ornaments to be found in any ordinary living-room. The miniature loud-speaker under review has an ordinary metal diaphragm movement housed within a 3in. base, the diminutive horn is concealed within a double convex celluloid body, which is also 3in. in diameter. The whole loud-speaker has an imitation mother-of-pearl finish and provides little evidence of the presence of electrical equipment. The sound waves from the horn, which is about 2in. in diameter, impinge on to an inner reflecting surface and emerge through three slots in the opposite wall. For small inputs the quality of reproduction is quite pleasing.

Bush House Radio (*Stand* 86), 35, *Shudehill, Manchester.*



The Zampa loud-speaker unit. It is of liberal dimensions and assembled on a substantial aluminium casting.

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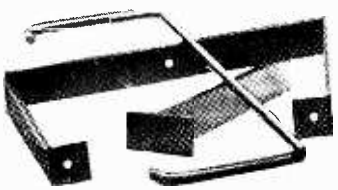
A NEW VARIABLE CONDENSER.

Although vertically-operated edgewise condenser dials are gaining favour it is perhaps clearness of indication of setting and not entirely convenience of operation that is appreciated. In the new N.S.F. condenser an edgewise indicator reveals the rotating drums on the condenser spindles which revolve by means of a separate operating knob, mounted beneath the indicator plate. By this means a reduction gearing can be obtained, and in this instance mechanical backlash is entirely avoided by a double-winding gear and catgut cord. The condensers, instead of taking their support from the panel, are mounted on a substantial aluminium pressing of complicated shape and designed to possess absolute stiffness. The condenser units are set up along insulating bars, the fixed plates being supported from their sides rather than between circular end pieces, as so generally adopted. The bearings are of die-cast aluminium and the central shaft, which is cut with a keyway along its length, can be completely withdrawn. The end of the spindle of the individual sections moreover is overhung at the rear end so that it becomes a simple matter to link sections together as required. Spring hard sheet brass has been used for the plates, and they are strengthened in a manner which prevents distortion. They are bonded together and soldered and then entirely silver-plated. A strip of gun-metal ensures electrical contact between spindle and bearing. A screening plate is supplied. A triple gang condenser with large diameter drums and indicator dial sells at 48s., and the price of the individual 0.0005 mfd. condenser is 12s. 6d.



Dionoid built-up battery. Note the metal strips for holding the components together.

An even cheaper model is also available, and is of the same general construction except that its bearings are supported on a ribbed D-shaped casting and possesses all the features already described.

Runbaken Magneto Co. (*Stand* 87), *Tipping Street, Ardwick, Manchester.*

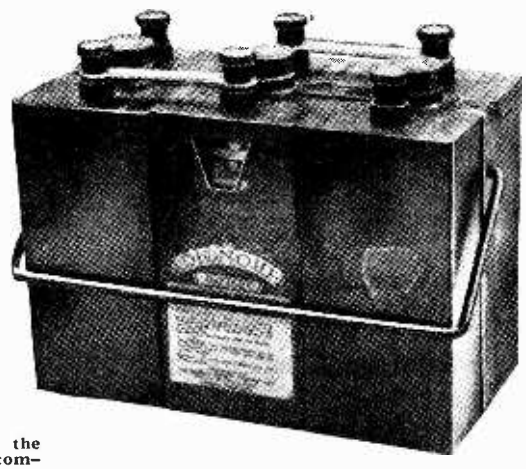
REED DRIVE LOUD-SPEAKER MOVEMENT.

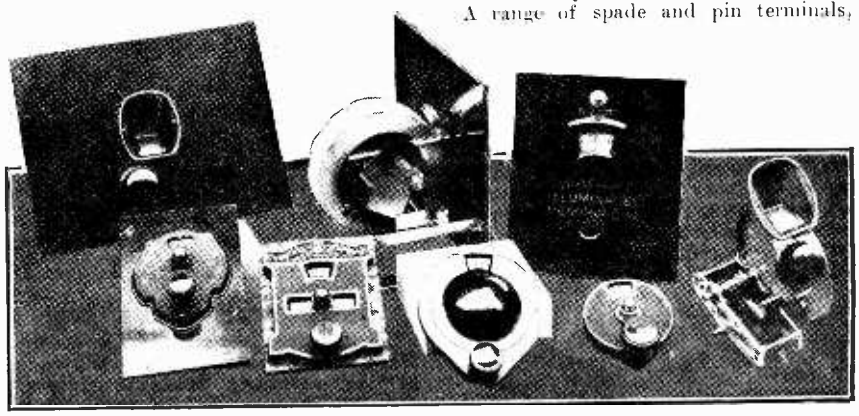
The "Zampa" unit is of exceptionally heavy and robust construction: it should be capable of operating cones of considerable size. The free end of the reed is mounted between two rubber rings, the pressure on which can be adjusted by turning a nut. The variable damping thus obtainable is of assistance in reducing resonance effects.

Mic Wireless Co. (*Stand* 91), *Market Street, Wellingborough.*

AMERICAN DRUM-CONTROL CONDENSERS.

The stand of Rothermel is attracting much attention by affording the public an opportunity of inspecting many products already known through the American journals. The vogue of drum control in America has been met by supplying drum-operating units for fitting to existing types of condensers. Both Remler and Silver Marshall controls are very similar, and it is stated that the former is designed to carry practically all types of condensers of either the single or three-hole mounting. Condensers can be mounted on either the right or left-hand side of the drum dial, which is adapted for either clockwise or anti-clockwise rotation. Neither of these dials are edgewise operated, and the scales are viewed through a recessed aperture illuminated, if required, by a small internally-enclosed pea lamp. In the case of the Remler, a full 15in. of tuning scale is obtained, divided into 200 divisions. The Silver Marshall sells at 15s. and the Remler at 25s.





Some of the many types of American geared dials shown by the Rothermel Corporation.

With the present interest in short-wave broadcasting the two short-wave tuning kits are receiving attention. The well-known "Aero" coils tune in conjunction with a 0.00014 mfd. condenser from 15 to 130 metres, and a 0.00025 mfd. reaction condenser is recommended. An extra tuning unit can be supplied for broadcast wavelengths up to 550 metres.

The Crossley "Merola" pick-up differs from others in that it is supplied complete with tone arm and pivoted support. It includes also flexible cord terminated so that it can be plugged directly into the detector valve socket; while included in the design is the volume control which is incorporated in the tone arm stand. The pick-up is of the differential type, the end of the armature being attached to the centre of the field magnet and surrounded by the coil.

Rothermel-Grebe and Rothermel-Crossley receiving sets, notably the "Bandbox" and the "Syncrophase Five," having been recently exhibited, have already been described in these pages.

Rothermel Radio Corporation of Great Britain, Ltd. (*Stand* 94), 24-26, *Maddox Street, Regent Street, London, W.*1.

GRIPSO GADGETS.

This firm exhibit a number of useful and ingenious small fitments likely to appeal to the home constructor. The terminals are designed to obviate the need for soldering: an eccentric hole is drilled in the shank for receiving a No. 16 connecting wire, which is passed through a nut which is "blind" at one end, except for a small hole of suitable diameter. When this is screwed home the wire is firmly gripped in position, the resulting joint being good electrically and extremely neat.

A range of spade and pin terminals, with sleeves of insulating material, are so designed that the attachment of a connecting wire is a very simple matter. The braided covering, as well as the actual conductor, is well secured, so it should be an easy matter to avoid the eyesore of frayed leads. Another simple and inexpensive device gives a good connection between two bare wires; it may be used for a "T" joint or as an attachment for a larger number of conductors.

L. H. Reid and Co. (*Stand* 97), 32, *Victoria Street, London, S.W.*1.

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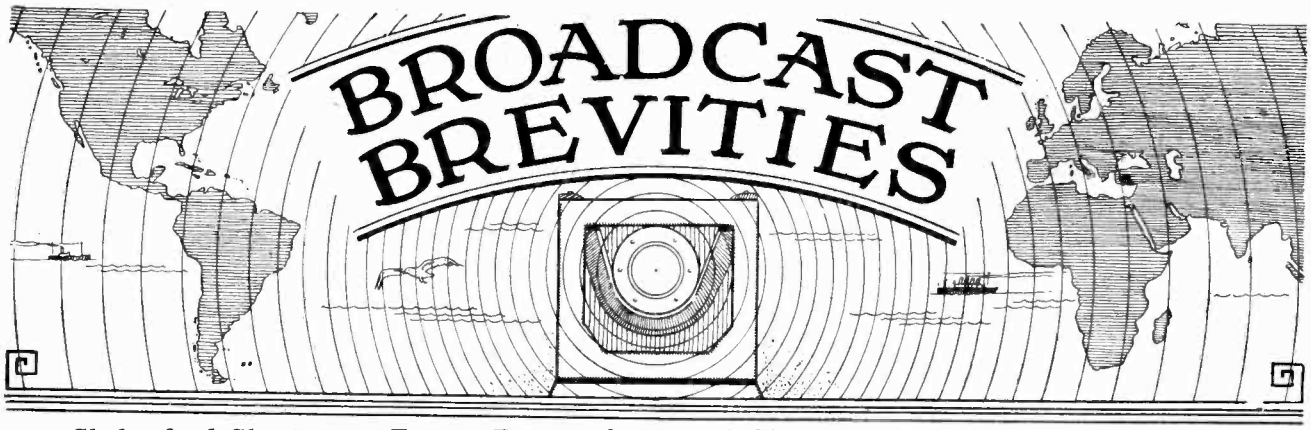

Chelmsford Short-wave Tests.—Future of 5XX.—A Change at Bournemouth.—Savoy Hill's Letter Bag.—Armistice Day Plans.—An Innovation.

Capt. Eckersley on Empire Broadcasting.

The most interesting side of Captain Eckersley's activities during his recent visit to America was that connected with short-wave broadcasting. His observations on the work of the Washington Conference are necessarily limited in view of the fact that the Conference is still sitting and that the ratification by the different governments of the many agreements arrived at cannot take place for at least twelve months.

But Empire broadcasting is the matter of the moment and in an interview after his return the Chief Engineer of the B.B.C. was able to supply me with some interesting facts concerning the arrangements which have been made for the interchange of short-wave programmes between this country and America. Definite schedules have now been prepared for tests between Chelmsford and Schenectady.

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Tests Primarily with America.

The transmissions from Chelmsford, which have already begun, are intended for any of the Colonies which may attempt to pick them up, but for the time being, at any rate, the tests will be conducted in close collaboration with the Radio Corporation of America, the chief engineer of which is Dr. Alfred N. Goldsmith. Capt. Eckersley points out that this co-operation with the United States is no new venture, the R.C.A. having co-operated with the B.B.C. for nearly four years, but it is felt that the time has now come when short-wave transmission, hitherto confined to the American side, should be carried out over here.

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Beam and "Spaced Aerial" Reception.

The transmitting arrangements at Chelmsford involving a 25 kilowatt transmitter (5SW) to work for the most part on a wavelength of 24 metres have already been described. Fading—the biggest obstacle—is being tackled at the receiving end, and the Marconi engineers at Chelmsford are assisting in the development of the "spaced aerial" system, whereby it is hoped a levelling out process in signal strength will be achieved. With this end in view, three separate receiving posts a mile apart have been erected at Chelmsford. I understand that a beam receiver is also in use. Whether the beam system would be definitely adopted for short-wave broadcasting is a subject upon which the Chief Engineer will not commit himself!

The success of these tests between Britain and U.S. will determine what

THE SHORT-WAVE SMILE. Captain P. P. Eckersley landing at Plymouth after his recent visit to America, during which arrangements were completed for Trans-atlantic short-wave broadcasting tests.

steps are to be taken in the near future towards the development of Empire broadcasting. Capt. Eckersley remains adamant upon the point that at present there is no "guarantee of service" either to or from America. I learn, however, that preliminary signals from 5SW have already been favourably reported by experimenters at sea.

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5XX to Continue Indefinitely.

Conflicting reports are reaching this country regarding the decisions at Washington. At present the delegates are divided into small committees, hence reports regarding "decisions" should be accepted with reserve. One thing, according to Capt. Eckersley, is fairly clear. In spite of discussions regarding the longer waveband (the appropriation of the 1050 to 1650 metre waveband for commercial purposes is mentioned), the Daventry long-wave station is likely to continue indefinitely on its present wavelength.

The value of the long-wave station for covering large tracts of country is being fully recognised by the B.B.C., and it is believed that representations at Washington have secured the 1600-metre wavelength "in perpetuity." This fact should give satisfaction to the multitude of British listeners to whom 5XX is the only reliable station.

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Bournemouth as a Relay Station.

The change in the status of the Bournemouth broadcasting station marks another step towards the development of the regional scheme. For some time the B.B.C. has been aware of a growing preference for London programmes in the Bournemouth district. Taking this into account and having regard to the greatly improved landlines, the B.B.C. has decided that the activities of Bournemouth shall be gradually reduced as from the end of the year.

The desirability of giving expression to local characteristics is not being lost sight of, and the artistic resources of Bournemouth will still be drawn upon directly from London.

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Savoy Hill's Letter Bag.

The science of telepathy, if there be one, still being in the amœba form, the Savoy Hill bag remains the surest criterion to the popularity of individual broadcast items.

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From a survey of letters received during the past few months it seems that the epilogue is one of the most important items from the listeners' point of view; in fact, a good deal more attention is paid to the Sunday programmes than to any others. Albert Sandler's broadcasts occupy a very high place in the correspondence. Rex Palmer, who generally broadcasts on a Sunday, has also been the subject of many letters.

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Are Talks More Popular

On the lighter side the correspondence shows special appreciation of Mabel Constanduros, A. J. Alan, and Tommy Handley. The promenade concerts and operatic broadcasts have both come in for a voluminous share of letters.

Whether the talks are becoming more popular or not I should not like to say, but there is certainly a large increase in the number of letters in which they are discussed.

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The Best Broadcast Play.

The broadcast play of the year has undoubtedly been the dramatised version of "Lord Jim," with "Trilby" as a good second.

One of the most popular features has been the "My Programme" series.

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Armistice Day Arrangements.

On Armistice Day there will be some appropriate deviations from the usual broadcast programme scheme. From 10.45 a.m. to 11.15 a.m. a service will be relayed through all stations from Canterbury Cathedral, and it will be during this service that the solemn two minutes occur. At 12.30 an organ recital will be transmitted from St. Mary-le-Bow. The afternoon programmes will follow the normal lines.

In the evening a special service will be transmitted from St. Martin-in-the-Fields, beginning at 7.15, and conducted by the Rev. H. R. L. Sheppard. Bands of the Brigade of Guards will attend and will sound the "Last Post."

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5GB and 2LO: An Innovation.

There will be no dance music on Armistice Night, but a brief interlude of wartime memories will be provided by the "Roosters" early in the evening. At 8 p.m. all stations except 5XX will receive the National Symphony programme from the Queen's Hall. Incidentally, this will be the first occasion on which 5GB and 2LO have been linked together, the alternative programme being provided by 5XX.

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The Advisory Committees.

The resignation of the Musical Advisory Committee of the Manchester broadcasting station on the grounds that individual opinion is of greater value than that of a committee, may serve to remind people of the existence of such committees.

Nearly all the B.B.C. stations are advised on matters musical and literary by committees composed of prominent local personalities not officially connected with the Corporation. This reflection must give us pause before impugning the B.B.C. on all questions of programme selection. The layman *is* consulted, though the extent to which his suggestions are adopted remains open to conjecture.

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What Morse Sounds Like.

Do not be alarmed, broadcast listener, if you occasionally hear a noise such as that described in a letter which was quoted in the *Evening Standard* last week. The writer, who resides at Chadwell Heath, Essex, considered that he had heard an SOS speech message from the ill-fated *Principessa Mafalda*, wrecked off the coast of Brazil.

"My friend," said the writer, Mr. Stroud, "said there was no mistake its being an SOS signal. I had plugged in on a wavelength of 300 metres with the object of getting some of the German stations, when about 9.30 we heard noises on the instrument which at first appeared to sound like the drone of an aeroplane engine. Soon the noises became intermittent and resembled a motor bicycle engine.

"The sounds began to get clearer, and my friend, who is fully acquainted with the Morse code, having been in the Air Service, said there was no doubt it was an SOS signal."

FUTURE FEATURES.

London and Daventry (5XX).

Nov. 6TH.—Religious service from the Studio.
Nov. 7TH.—Farewell recital by Jelly D'Aranyi.
Nov. 8TH.—Popular orchestral concert.
Nov. 9TH.—Speeches from the Guildhall at the Lord Mayor's Banquet.
Nov. 10TH.—Ballad Concert.
Nov. 11TH.—Armistice Day Service from St. Martin-in-the Fields. Armistice Day National Concert, relayed from the Queen's Hall.
Nov. 12TH.—West Ham v. Cardiff City—running commentary on second half of the Association Football Match. Variety programme.

Daventry (5GB) experimental.

Nov. 6TH.—Czecho-Slovakian programme.
Nov. 7TH.—Military Band Concert.
Nov. 8TH.—First broadcast performance of "The Seal Woman," a Celtic opera in two acts by Margaret Kennedy-Fraser and Granville Bantock.
Nov. 9TH.—Light French music.
Nov. 10TH.—Hallé Concert. "Israel in Egypt," a sacred oratorio, relayed from the Free Trade Hall, Manchester.
Nov. 11TH.—Orchestral Concert.
Nov. 12TH.— Popular Concert.

Manchester.

Nov. 12TH.—"This, That and the Other," a new revue in 12 scenes and two interruptions.

Glasgow.

Nov. 7TH.—"I Pagliacci," an opera in two acts by Leoncavallo.

Aberdeen.

Nov. 12TH.—Songs and Stories of the Celt.

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It Happened in London Last Week.

The wireless dealer had gone to some trouble to install a moving coil loud-speaker in his doorway. On the day when, according to announcements, the speaker was to come into operation, a collection of earnest folk gathered to listen. But our friend had omitted to glance at his *Radio Times*, so he received a shock when the lunch-time announcer blandly remarked that a programme of gramophone records would follow. So the moving coil loud-speaker was called upon to reproduce gramophone records, and the earnest crowd melted away.

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Don't Miss This.

I see that a Yorkshireman has disguised a loud-speaker as a microphone. No, I cannot tell you why he has done this thing.

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An Alarming Precedent.

He has, at any rate, created an awkward precedent. Perhaps at any moment we may discover that in future all L.T. accumulators are to look like H.T. batteries. Maybe a prominent firm of transformer manufacturers will now decide to produce a transformer disguised as a resistance-couping unit? Perhaps . . . no, no.

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Farewell Transmission from PCJJ.

In response to a large number of requests it has been decided that PCJJ, the famous short-wave station at Eindhoven, will remain in operation for a few more days prior to its removal to Hilversum. A series of farewell broadcasts is being given from the station this week, beginning each evening at 6 o'clock.

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From the People's Palace.

The next National Symphony Concert from the People's Palace, Mile End Road, will take place on November 18, with Sir Landon Ronald conducting and Solomon as solo pianist. Popular dances from Edward German's "Henry VIII" and Pianoforte Concerto No. 2 in C Minor (Rachmaninoff) will be included in the programme, besides the Overture to Nicolai's "The Merry Wives of Windsor," the Tchaikovsky Symphony No. 5 and the Suite, "L'Arlesienne," by Bizet-Ronald.

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How the "Palace" Originated.

The People's Palace owes its origin in part to the popularity of a novel by Sir Walter Besant, entitled "All Sorts and Conditions of Men," in which the writer pointed out the sore need of the inhabitants of East London for social improvement, and set forth an imaginary picture of a "palace of delight" wherein these needs might be partly satisfied.

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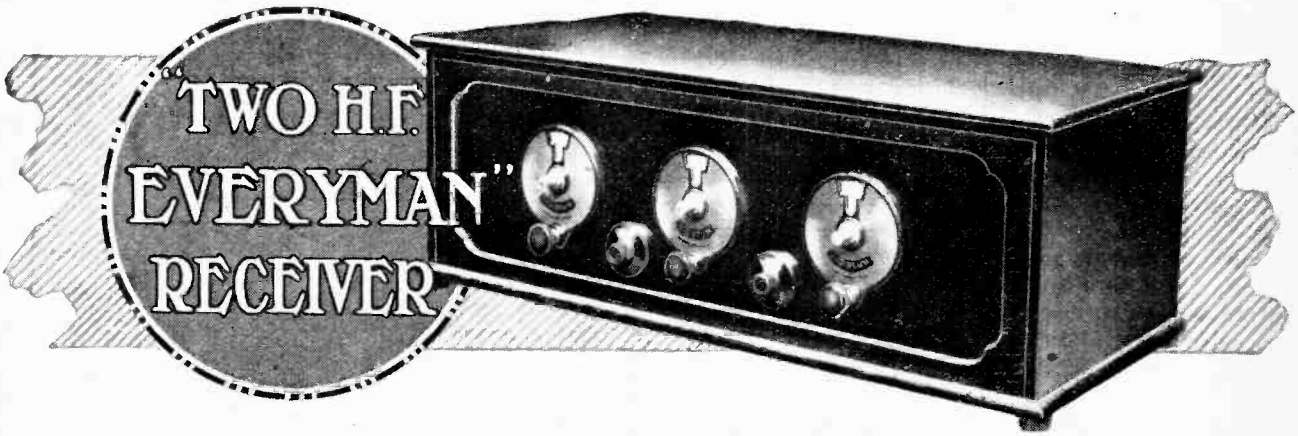

Further Constructional Details and Tuning Instructions.

By W. JAMES.

(*Concluded from page 568 of last issue.*)

THE copper box has to have a number of holes drilled in it for the various connecting wires which join components in one section to the next section or to the battery strip, but the position of these is best marked after the set has been completely assembled, for then the right position for the holes can more easily be found. It should be noted that although the bottom edge of the copper box will rest against the front panel, that the side of the copper box will not, because its construction is such that there is a lip along the bottom edge. It is therefore necessary to place a packing piece between the panel and the box having a thickness at least equal to that of the copper; otherwise the side of the box will be distorted by being pulled towards the panel. Cardboard not more than $\frac{1}{10}$th of an inch in thickness may be used, and it is better, in fact, to use for packing a material which is rather thicker than the copper itself to facilitate the putting on and the removal of the lid. The front lip of the lid is not really required, however, and may be removed without affecting the working of the set. With the lip removed, the user will find it easier to put the lid on or take it off when the instrument is fitted in a cabinet.

Drilling the Panel.

The panel has to be drilled as indicated in Fig. 6, which shows the position of the three tuning condensers, the balancing condenser and the filament rheostat. When this has been drilled and the baseboard fitted, the screening box can be put in position, and the holes which have to be made in the box for the spindles and fixing screws of the various condensers can be marked. Particular attention should be given to the balancing condenser, for the spindle must not touch the copper box, and it is therefore necessary to drill a clearance hole in the box for the spindle of this condenser.

One side of the filament rheostat makes contact with the copper box, as does the end plate of the two tuning

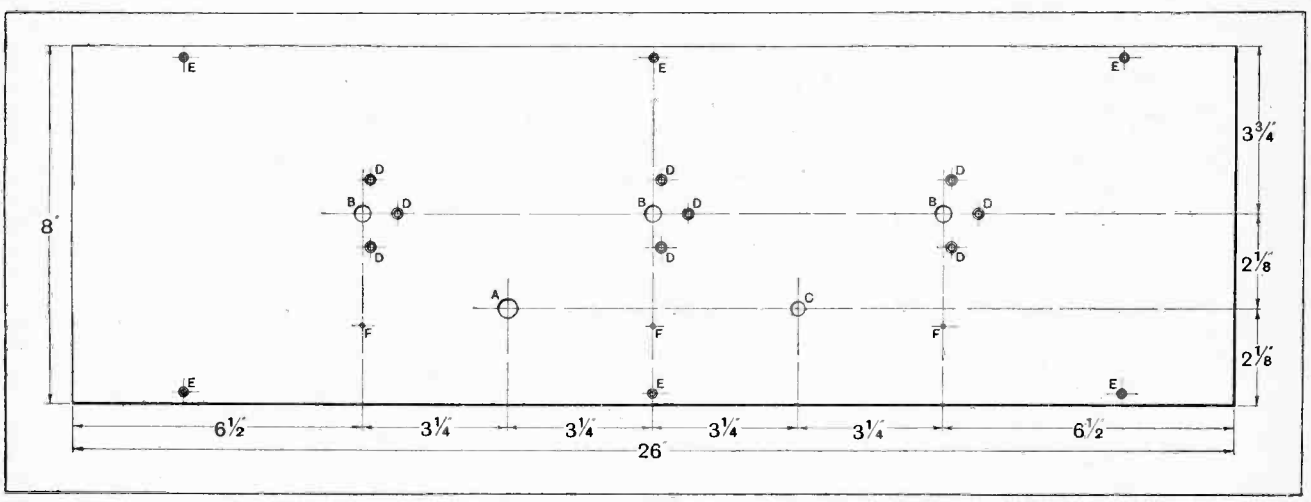

Fig. 6.—Drilling details of the front panel. A, 7/16 in. diameter for balancing condenser; B, 3/8 in. diameter for tuning condenser; C, 5/16 in. diameter for volume control rheostat; D, 5/32 in. diameter for condenser fixing screws, countersunk for 4 B.A.; E, 1/8 in. diameter for baseboard fixing screws, countersunk for No. 4 wood screws; F, 3/32 in. diameter for dial stops.

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"Two H.F. Everyman" Receiver.

condensers; the box itself is earthed and connected to – L.T.

The position of the box on the baseboard is given in Fig. 9, and it is secured to the baseboard by wood screws.

Details of the terminal strips are given in Fig. 7; these are of ebonite, and the longer one carries a Bulgin filament switch in addition to terminals.

Two pieces of wood 8½in. by 6½in. by ⅜in. are used to carry the parts included within the screen. The baseboard for the H.F. stage comes first, and on it is mounted a valve holder, H.F. transformer base, high-frequency choke coil, coupling condenser C_5 of .001 mfd., and by-pass condenser C_8 of .2 mfd. This baseboard, with the parts mounted on it, fits in the left-hand half of the screen when looking at the front of the set. In the right-hand part fits the detector baseboard with valve holder V_3 for the detector, a coil base, Gambrell balancing condenser NC_2, coupling condensing C_6 of .001 mfd., by-pass condenser C_9 of .2 mfd., high-frequency choke, $H.F._2$, and a T.C.C. fixed condenser C_7 of .0003 mfd. of the series parallel type with grid leak R_2 of 1 megohm. The remainder of the parts are arranged as in Fig. 9.

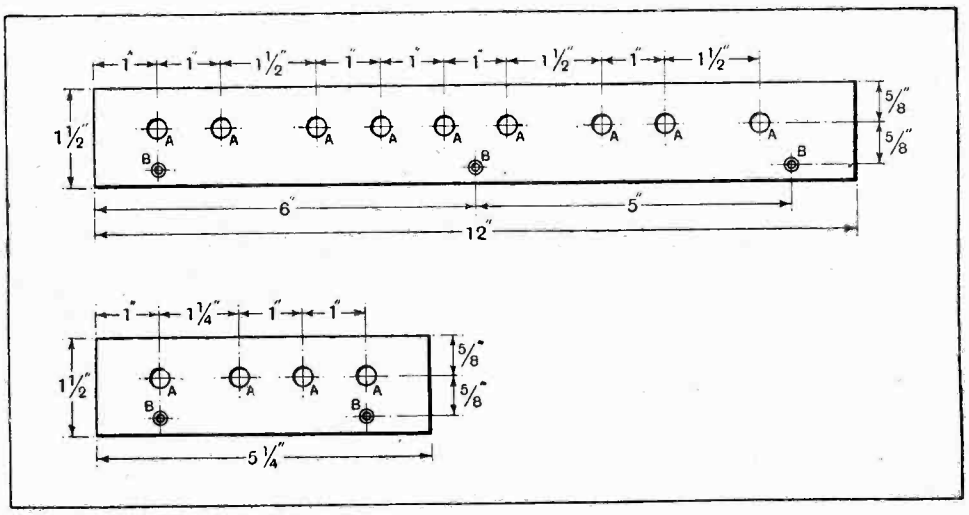

Fig. 7.—Details of aerial and battery terminal strips. When Belling and Lee terminals are used, A is 5/16 in. diameter; B is 1/8 in. diameter c'sk for fixing screws.

Fixed condenser C_1 is of .0001 mfd., and is included in the aerial circuit; L_1 is the aerial-grid coil base, and V_1 the valve-holder for the first H.F. valve.

At the other end of the baseboard are the two transformers, the two by-pass condensers, and the output valve V_4. Readers who do not wish to include an output transformer T_2 may leave it out without affecting the results provided their loud-speaker will carry the last valve's anode current without harm.

Wiring.

Having arranged the parts of the receiver, the wiring can be commenced. It is better to begin by taking the two baseboards from the screening box and putting on as many of the wires as can be managed. Fig. 10 shows the connections of the parts on the two baseboards, and when these have been partially wired they should be put back in the box and the wiring completed in accordance with Fig. 11. It should be noted that the screen is earthed and connected to negative L.T., and that the various wires marked with similar letters should be connected. Wire C, for instance, after leaving the rheostat R_1, is joined to wire C in Fig. 10, which runs to the filament of valve holder V_2 and one side of fixed condenser C_8. Notice also that the two tuning condensers C_3 and C_4, as well as the rheostat R_1, rely for one of their connections upon

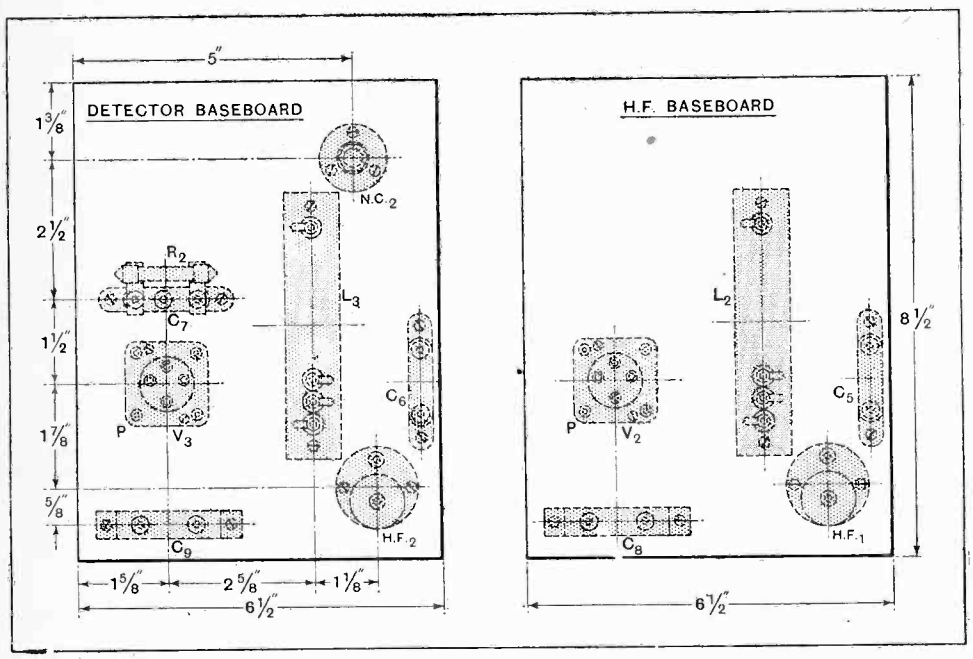

Fig. 8.—Arrangement of parts on the baseboards which fit inside the screen. The baseboards are of 3/8 in. wood. C_5 and C_8, .001 mfd.; C_7, .0003 mfd., series parallel type; C_8 and C_9, .2 mfd.; R_2, 1 megohm grid leak; NC_2 Gambrell balancing condenser; $H.F._1$ and $H.F._2$, high frequency chokes; L_2 and L_3, bases for H.F. transformers.

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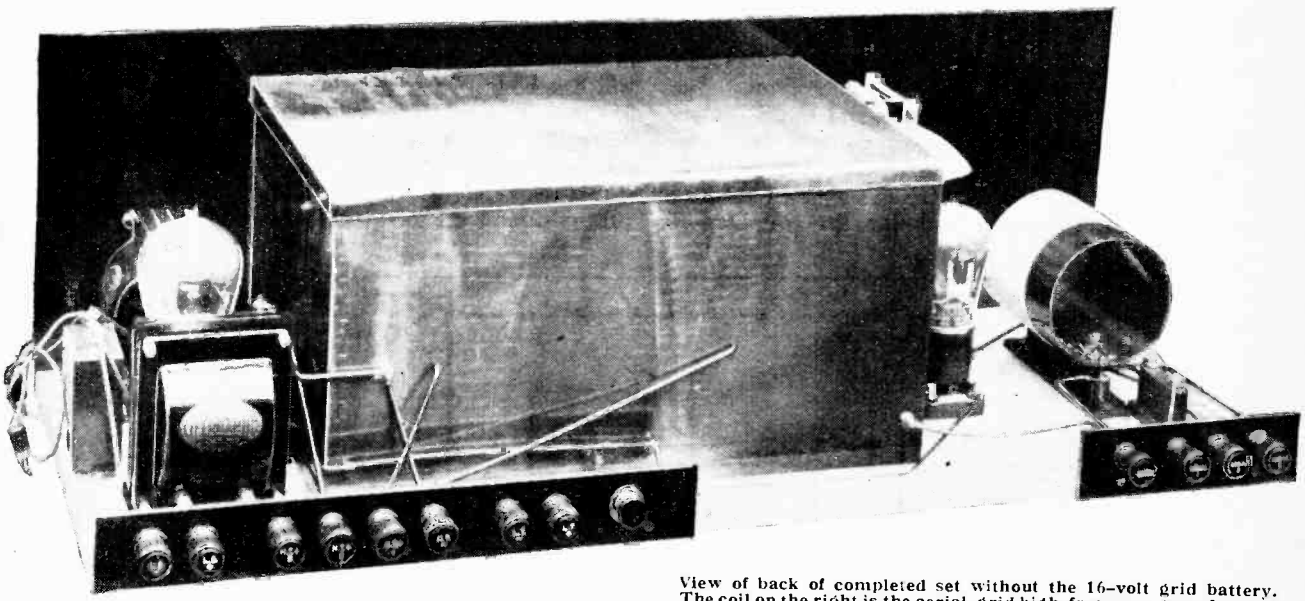
the contact made between them and the screen. Balancing condenser NC_1 is, of course, insulated from the screen and therefore has two wires passing from it. The wire which leaves the filament rheostat must come from its insulated terminal.

battery when it is mounted on the end of the cabinet. This battery can be fastened to the cabinet by a pair of small brackets so arranged that it is above the components.

The high-frequency transformers were described in the first part of this article, and it will be remembered that



View of back of completed set without the 16-volt grid battery. The coil on the right is the aerial-grid high-frequency transformer. On the left can be seen the intervalve and output transformers. Note the two wires connected to the screen and the two H.T. wires leaving holes in the screen to the terminal strip.

All wires which pass through the screen must be very carefully insulated with Systoflex or similar tubing, and many of the other wires should also be covered to protect them.

The flexible wires provided for connecting the grid battery should be made of sufficient length to reach the

one of the long-wave coils is provided with a resistance for the purpose of preventing spurious oscillations. The resistance may have a value of about 2,000 ohms and be wound with any convenient size of resistance wire. A value of 500 ohms has been found satisfactory in some instances, but for safety it is advisable to use one of

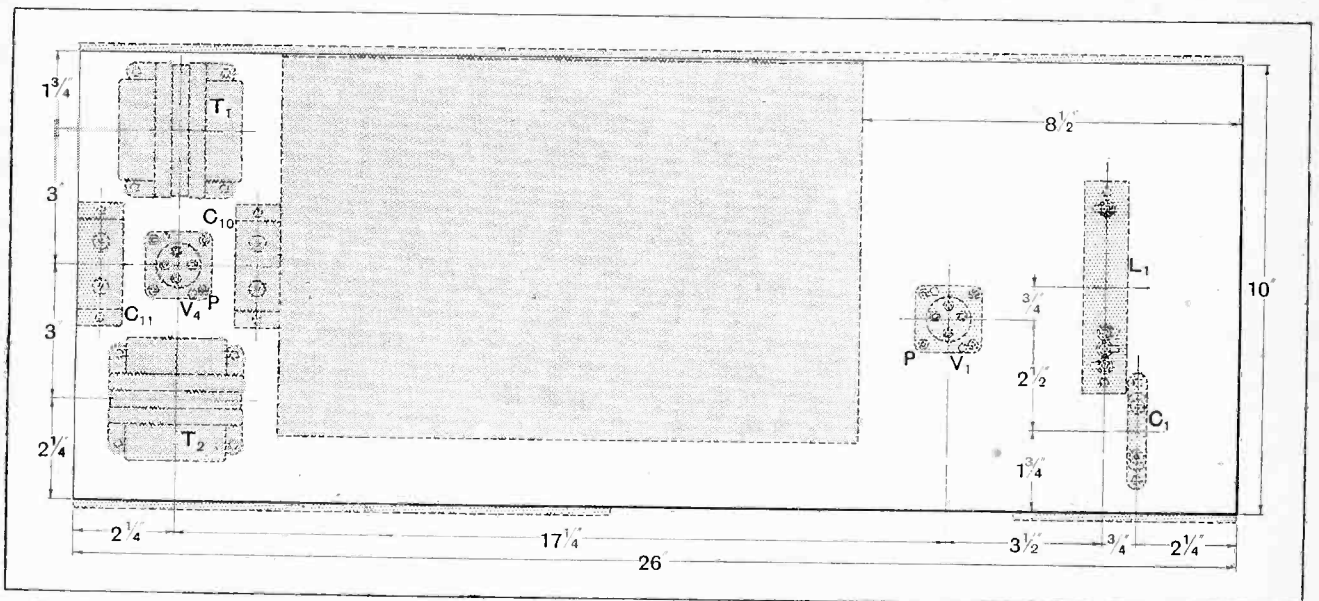


Fig. 9.—Plan view of the baseboard showing the aerial end, the screen, and the output circuit. The parts which fit inside the screen are shown in Fig. 8. Note that the back of the screen does not rest against the panel because of the lip on its lower edge. A packing piece is used between the components and the screen.

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about 2,000 ohms. If fine wire is used the resistance will be a very small thing which can easily be fitted inside the coil by means of a clip bolted to the former with a countersunk-headed type of screw and nuts. This coil should be marked, and always be placed next to the detector.

The valves which the writer has used in this receiver are the Cossor 6-volt H.F. in the two high-frequency stages, a Cossor 6-volt R.C. in the detector stage, and a power valve in the output position. The high-frequency transformers were designed to suit valves having an A.C. resistance of 15,000 to 20,000 ohms, and the amplification and selectivity was balanced under these conditions. It has to be noted that the filament rheostat R_1 is in the – L.T. circuit, and that the grid bias of the two H.F. valves is equal to the drop in voltage over this resistance. Therefore, when the volume control is adjusted, we alter the grid bias as well as the filament current, which provides a more effective control than when the filament current is varied.

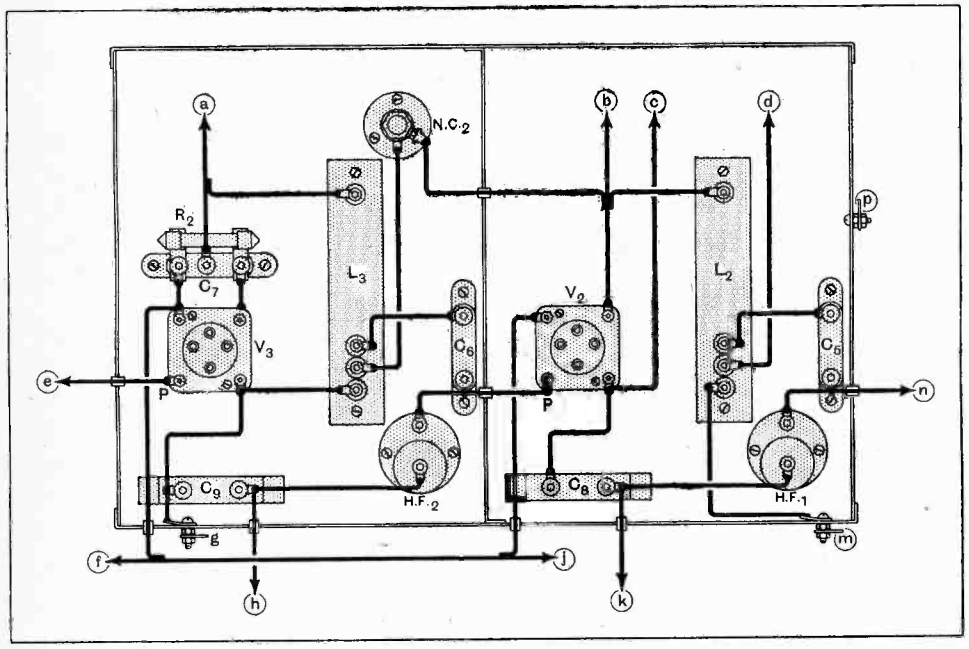

Fig. 10.—Wiring of the second H.F. and detector stages. Much of this can be done on the bench and then, when the two stages are put in the screening box, it is an easy matter to connect the few remaining wires. The wires that are lettered connect to wires having a similar letter in Fig. 11.

With the receiver connected to the aerial and its batteries, tune in the local station and then disconnect the filament circuit of the first valve by taking a wire from one of the filament terminals of the valve holder. Then adjust the balancing condenser on the panel for weakest signals and make a note of the setting of its dial. Now restore the first valve and remove one of the filament wires of the second. Then adjust the second balancing condenser NC_2 by passing a screwdriver through a hole in the lid of the screening box to the handle of the balancing condenser (which should have a small slot in it), and turning it until a minimum of sound is heard. If now this valve is restored and the balancing has been carefully done, the set will be found perfectly stable over its whole tuning range. To adjust the balancing condensers is quite easy provided the work is done in two stages, as described.

Naturally the voltage applied to the anodes of the valves will affect the amplification and the selectivity. With the two H.F. valves mentioned an H.T. voltage of 100 to 120 is most suitable, while the voltage applied to the detector should be varied in order to find that which is best. Normally this voltage will be of from 100 to 120. To the last valve apply from 120 to 160 volts—preferably the latter voltage if the loud-speaker to be used with the set is a good one and is capable of dealing with strong signals. It will then be necessary to use the full voltage of the grid bias battery on the last stage. A power valve used under these conditions will, of course, take rather a heavy anode current, and unless the battery is a big one it may be better to use an ordinary power valve in the last stage.

When tuning the receiver it will soon be noticed that the right-hand condenser control is not at all critical as compared with the other two. This is a great help when searching for stations, but for the best results it is important to tune each stage very carefully, for then the set will have its maximum selectivity. If the stages are distuned a little the response curve of the high-frequency amplifier will be much broader. This is not desirable, for the set is so sensitive that slight distuning would probably result in interference.

The user will soon find that the working selectivity of the set depends to some extent on the setting of the volume control, for by weakening the signals it is much easier to separate distant interfering stations, or a weak distant station from a relatively powerful near-by one.

The set will have maximum selectivity when the aerial is connected to terminal A_1, but with the aerial connected to this terminal it will be found that stations working on wavelengths of above about 400 metres are relatively weak. They can be made stronger by connecting the aerial to terminal A_2 or to A_3, but this reduces the selectivity. The user will soon find to which terminal his aerial should be connected for the best all-round results. So much depends on the construction of the aerial and its position that it is not possible to say which aerial connection will be found most suitable.

With a set of this description it is important that a

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good earth be used. If the earth is a poor one, or should the earth wire be lengthy, then a certain amount of instability may be experienced. The remedy is, of course, to improve the earth, and the set will work quite well provided the earth is a reasonable one.

When changing the short-wave for the long-wave coils it should not be necessary to touch either of the balancing condensers to secure stability. The long-wave coils are so designed that the circuit is very stable. It was found very necessary to do this because it is easy to spoil the quality of long wavelength signals by using circuits that are too sharply tuned. Three tuned circuits of very low resistance would cause bad quality. Here, then, is another reason why the leaky grid method of rectification was used, for this broadens the tuning of the last stage.

There is one small point which should be mentioned and that is the Ferranti intervalve transformer used has a built-in by-pass condenser across its primary winding. A reader who uses a different make of transformer will, therefore, have to provide an extra fixed condenser of .0005 mfd. This can conveniently be connected between the anode of the detector valve and its filament. The transformer used must be one having a primary of large inductance.

The writer has obtained really excellent results with this receiver. In the first place, the quality of the reproduction is very good, and ample volume can be obtained in spite of the fact that only one low-frequency stage is used. Secondly, the set is very selective, although being easy to tune. This is partly because of the metal shielding, but mainly because of the design of the coils. The set is very easily made, and looks attractive. It is a worthy companion of the "Everyman Four."

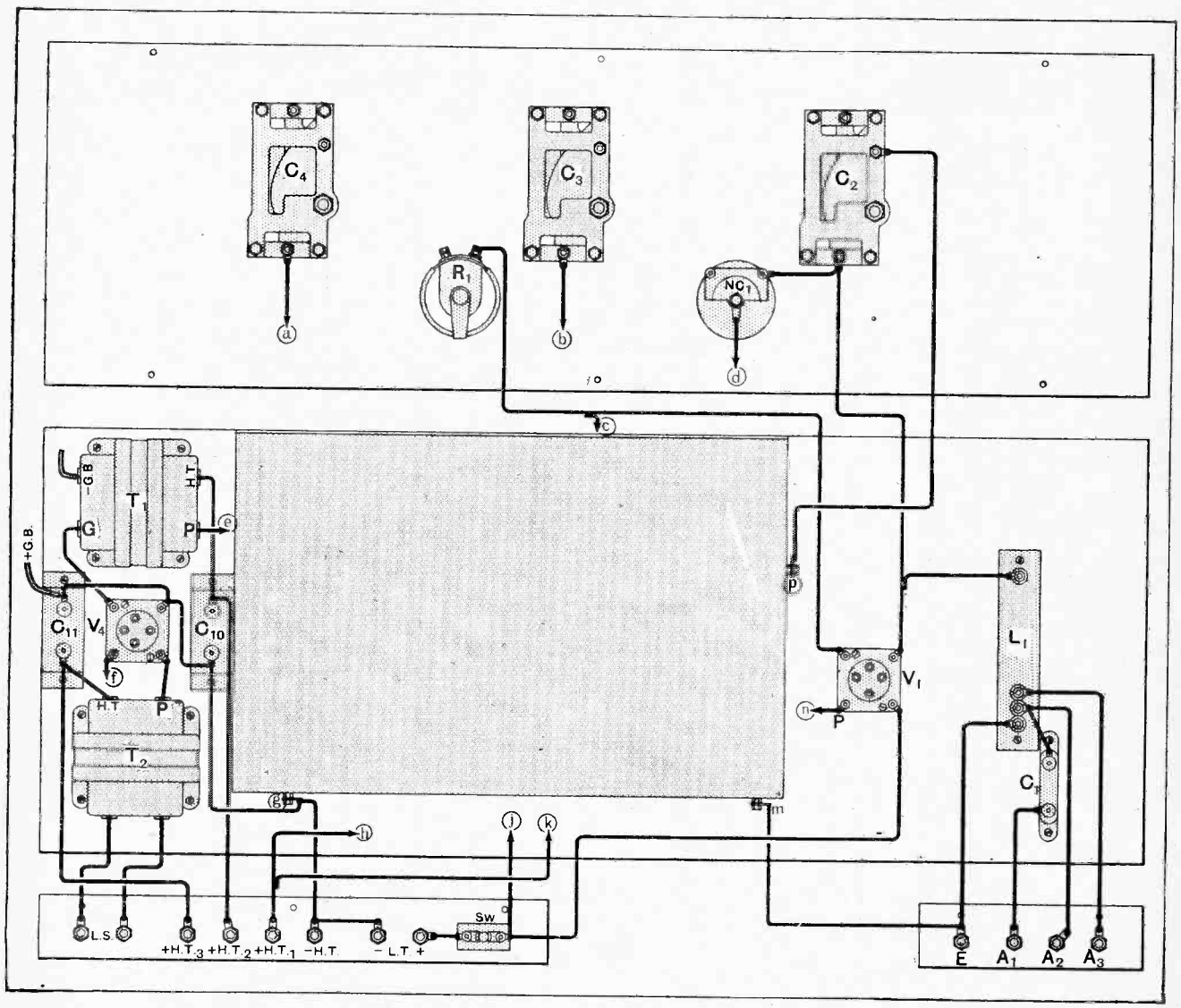

Fig. 11.—Remainder of wiring diagram. Note that this drawing has been simplified. The tuning condensers, C_2, C_4, and R_1 and NC_1 are inside the screen, and the wiring connecting them with apparatus outside the screen passes through holes.

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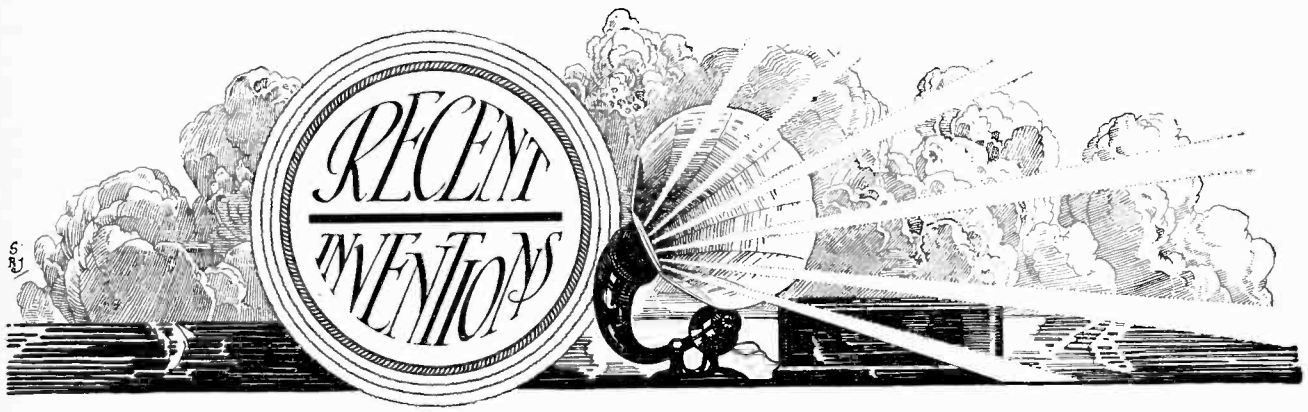
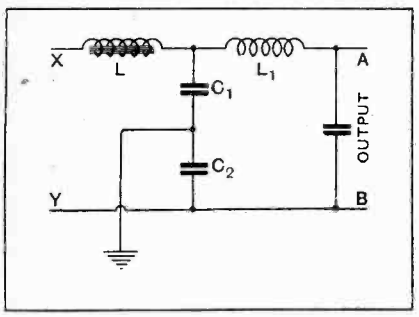


The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

Filter Circuits.
(No. 271,032.)

Convention date (U.S.A.): May 17th, 1926.

The ordinary smoothing-units used in connection with wireless receivers fed directly from the house-mains are not usually designed to block out any radio frequencies that may be picked up directly by the mains and thus find their way into the set. The present arrangement comprises a high-frequency rejector circuit for this purpose. It is intended to be connected at X, Y to the output of



H.T. filter circuit with R.F. filter to prevent pick-up from mains. (No. 271,032.)

the usual low-frequency smoothing-unit, the points A, B being taken to the appropriate terminals on the receiving set. The elements comprise an iron-cored choke L and an air choke L_1. A pair of condensers C_1, C_2 are bridged across the mains at the junction of the two chokes, the centre point being earthed as shown. Patent issued to Dubilier Condenser Co.

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Piezo Electric Control.
(No. 274,660.)

Application date: August 18th, 1926.

One usual method of stabilising the frequency output of a transmitter is to couple the master-oscillator to successive stages of amplification. It follows that, if the piezo crystal or other master control gets out of order, the whole system is temporarily paralysed. In order to overcome this defect, the first valve, V, comprising a piezo crystal-oscillator P in its grid circuit, is coupled to a valve stage V_1 capable of generating independent oscillations. This stage is, however, partly neutralised through a tapping T and condenser C, so that when the crystal oscillator is supplying energy only those oscillations corresponding to the predetermined frequency are passed through for further amplification. Should the crystal break down, the neutralising means can be readjusted to the point at which the valve V_1 becomes self-oscillating, and transmission can be maintained through the oscillator V_1 and modulator M, even though accurate synchronisation is temporarily lost. Patent issued to C. W. Goyder.

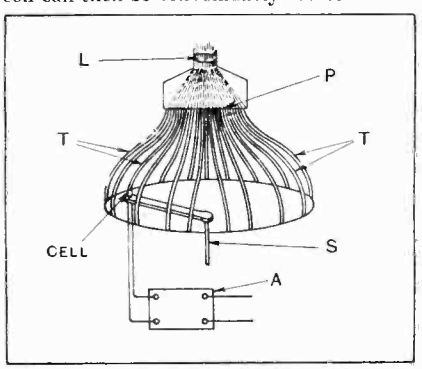
o o o o

Transmitting Pictures.
(No. 276,084.)

Application date: May 21st, 1926.

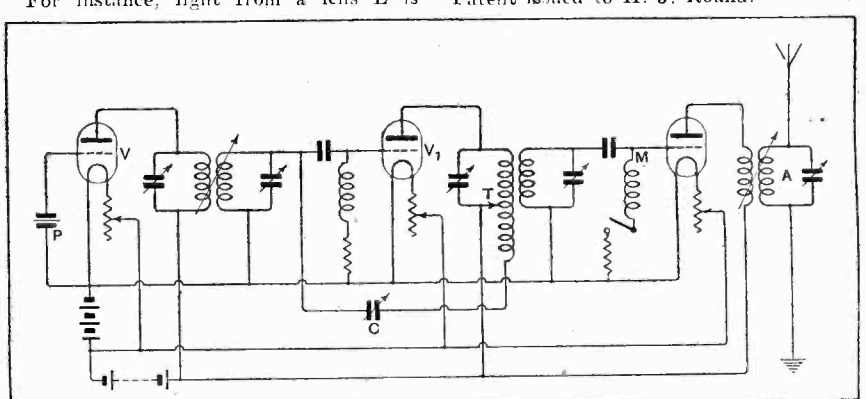
When a ray of light is passed longitudinally through a rod of quartz or glass, or through a tube of silver polished on the inside, the ray does not spread laterally, even if the glass or other rod is bent out of the straight. In other words, the arrangement acts as a light "tube" or conduit. Advantage is taken of this fact to distribute the various elements constituting the transmitted image or picture in a form convenient for reproduction.

For instance, light from a lens L is focussed upon a transparent picture P, which is backed by a bundle of "light tubes." The other ends of the tubes are spread out so that they lie along the circumference of a circle. A photo-electric cell can then be conveniently rotated about



Optical system of picture transmitter. (No. 276,084.)

a shaft S at a speed of from 8 to 10 revolutions per second so as to pick up the corresponding light and shade elements in rapid succession. The varying output from the cell is then fed through an amplifier A to the usual modulator. A similar device is used at the receiving end to build up the complete picture from a circular grouping of transmitted elements. Patent issued to H. J. Round.



Transmitting circuit for self-generated or crystal-controlled oscillations. (No. 274,660.)

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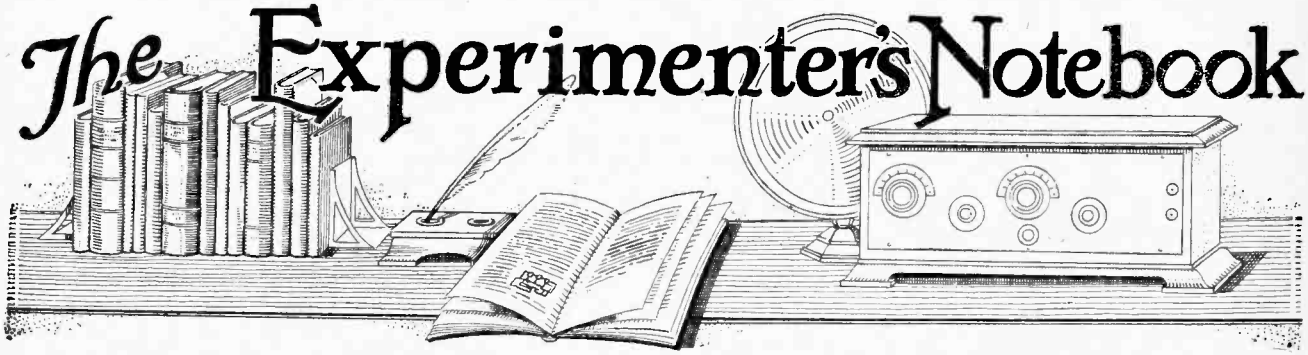
The Experimenter's Notebook



Reaction in Receiving Circuits.

By "EMPIRICIST."

THE improvement of the sensitivity and selectivity of a radio receiving circuit by means of variable reaction was one of the earliest of the many miracles performed by the thermionic valve, and remains at the same time one of the simplest and most powerful means for achieving these two highly desirable characteristics. Public-spirited individuals may decry the use of reaction as promoting the oscillation nuisance; precisely minded people may attack it from another angle and preach the merits of distributing the selectivity of a receiver between a number of bluntly tuned circuits; nevertheless, one feels that reaction will never lose its popularity in the amateur and home constructor's world, and, in consequence, accepting the principle that it will be used, it becomes of the greatest interest and importance to see that it is used rightly.

Ease of Control.

We must start then by enquiring what are the desirable features in any means for applying the reaction principle in a radio receiving circuit. We may accept as an axiom that the adjustment of the reaction-control must be, in a sense, critical; we require to bring a tuned circuit of a receiver into a state where it is very nearly but not quite oscillating, and the adjustment of the retroactive coupling must be capable of being effected with a very great degree of nicety. At the same time, we must have simplicity of operation, and a certain type of critical adjustment, where every tuning control interacts with every other and the capacity of the operator's hands with all, is too terrible to be contemplated with equanimity; it is this type of reaction circuit which is essentially responsible for the greater part of the "oscillation nuisance."

Considering, then, the desirable feature of simplicity in control it is perhaps right to place first in the order of necessary characteristics that of freedom from hand capacity effects. In these days this trouble is far less nuisance than heretofore, owing to the improvements in present-day condensers and the greater care which is usually exercised in the laying out of a set. One still finds to this day, however, that high-frequency currents are allowed to pass unscathed through low-frequency circuits, and, in the case of receivers employing head telephones, this necessarily results in very dire troubles when the hand of the operator is brought near the tuning circuits. In the very large majority of cases a by-pass condenser across the low-frequency circuit is an essential, though admittedly, when a capacity reaction circuit with an audio-frequency stage is used, this item may often be dispensed with. Whatever be the cause, at any rate hand capacity must be eliminated before any reaction circuit can be made to work properly.

It is difficult to choose which of many highly desirable characteristics comes next in order of importance; possibly the absence of "back-lash" must be given pride of place. By "back-lash" we mean an overlapping of the positions of the reaction control where oscillations start and stop, respectively, on increasing and decreasing the feed-back. This results in a receiver being in a state of relative insensitivity or else actually oscillating; usually a click accompanies the onset of oscillations, and no satisfactory operation on the threshold of reaction can be obtained. The cure for troubles of this character lies as a general rule in making the valve operate on the right part of its characteristic, and an adjustment of the H.T. value will not infrequently produce a marked improvement. At the same time, a valve which is working under slightly unsatisfactory conditions as regards its characteristic will respond frequently to an alteration of the circuit or components in use, and give a far more even and controllable threshold.

Effect of Reaction on Tuning.

Interdependence of adjustments is, of course, a thing to be most carefully avoided. Some forms of reaction control, notably those employing moving coils, have a tendency towards altering the tuning when the reaction setting is altered. This may be made small if a proper choice of components is made, a point which will be considered again, in connection with the various individual circuits of which it is proposed to treat.

Lastly, it is highly desirable that the position of the reaction control should remain as nearly as possible the same over the tuning range of the receiver. Sometimes this is very far from being the case, and, very often, reaction is far more vigorous on the shorter wavelengths than on the longer. In the case of magnetic reaction this is quite often due to the use of too large a reaction coil, this effect being similar to that which was considered

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The Experimenter's Notebook.—

In a previous article on the subject of low-power oscillators. With modern valves and circuits of average good quality it will be found possible to use small reaction coils, so that even in a simple magnetic reaction circuit the effect need not be really troublesome.

The methods of applying reaction are almost numberless, and it is quite impossible to make any attempt to deal with them exhaustively; a few representative circuits only will therefore be considered.

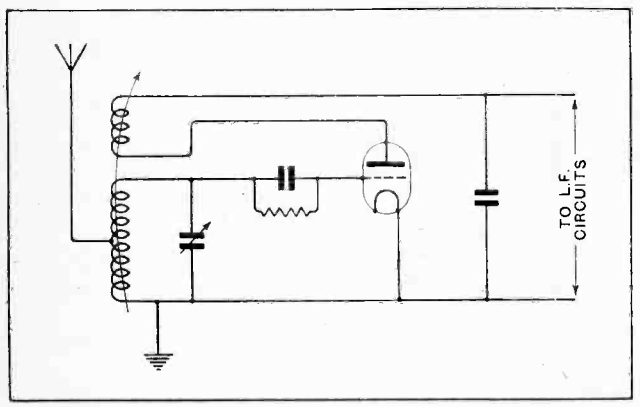

Fig. 1.—Normal magnetic reaction circuit with plate current flowing through reaction coil.

In Fig. 1 we have an ordinary magnetic reaction arrangement in which a coil is included in the plate circuit of the valve and variably coupled to the grid circuit, the latter being an oscillatory circuit, and in the example given, being connected to the aerial in the well-known "aperiodic" manner. A condenser and leak are employed for the purposes of rectification, and in this way it is possible to use the valve on the straight part of its plate current characteristic.

A Small Reaction Coil Desirable.

Normally, this arrangement is quite satisfactory provided that certain precautions are observed. In the first place, there is no advantage to be gained by increasing the L/C ratio of the circuit very greatly, and there is the disadvantage if this is done that the grid current will cause very heavy damping during positive half cycles and the arrangement will become somewhat liable to "back-lash." If a good valve is used having a magnification factor of, say, 16 and a resistance of 20,000 ohms the size of the reaction coil may be reduced to something materially smaller in inductance than the tuned circuit coil, and, as a result, the distuning effect on moving the coil will be negligibly small.

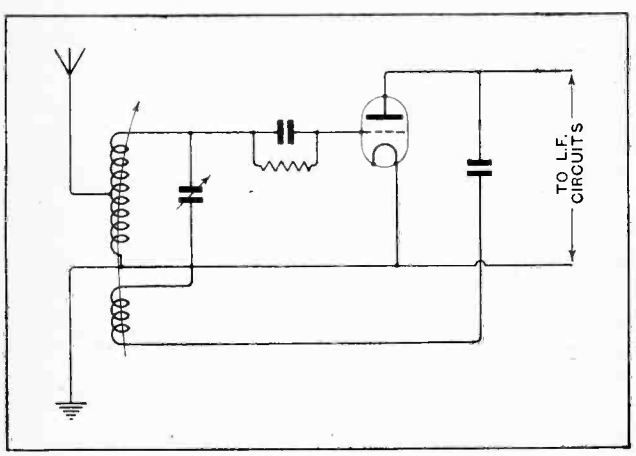

Fig. 1(a).—Variant of the circuit of Fig. 1, in which only the high-frequency component of the plate current passes through the reaction coil.

Parallel Feed.

A variation of this arrangement which has certain conveniences is shown in Fig. 1 (a). Here the plate is connected to the reaction coil through a fixed condenser, the coil being connected to L.T.– instead of to the H.T. battery. This arrangement is satisfactory if any low-frequency transformer of ordinary impedance is used, though, should the transformer already have a condenser embodied in it, it is perhaps preferable to use the normal arrangement of Fig. 1.

The sense of the reaction winding, it need hardly be stated, must be opposite to that of the tuning winding; in other words, currents passing respectively from grid to battery through the tuning coil, and from plate to battery through the reaction coil, must produce opposite electromagnetic fields. This can easily be achieved, in the case of plug-in coils, without any particular thought, if it is remembered to connect "plug to grid" and "socket to plate" (or *vice versa*).

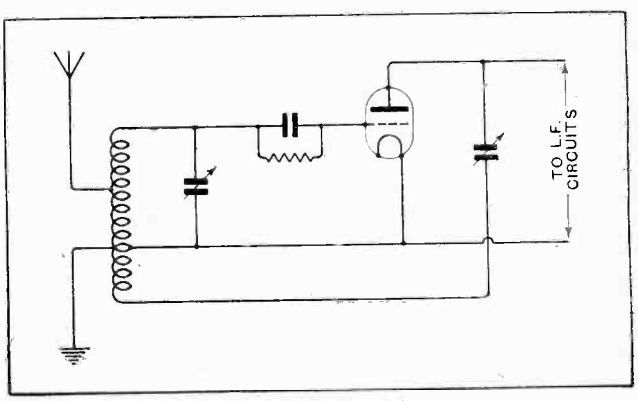

Fig. 2.—Reinartz circuit in which control is effected by a variable condenser.

The circuit of Fig. 1 (a) develops naturally into the Reinartz reaction circuit shown in Fig. 2 if we consider the reaction coil as fixed in relation to the aerial coil and the condenser connecting it to the plate as variable. The two coils may now be replaced by a single tapped coil, should it be considered desirable, the sense of the reaction winding being grid if the tapping be connected to filament. The control of reaction in this manner is possibly the most satisfactory of any, but it must be regarded as somewhat luxurious in view of the necessity for an extra variable condenser. It will be found that no appreciable distuning of the circuit takes place when the reaction control is altered, though, as both terminals of the variable condenser are "live" high-frequency points, there is a slight tendency in the direction of hand capacity effects.

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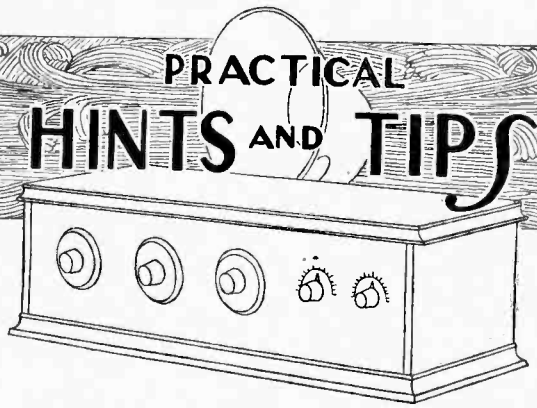
PRACTICAL HINTS AND TIPS



Aids to Better Reception.

Simple Circuit Theory.

TESTING ANODE RESISTORS.

THE practice of using extremely high anode coupling resistances (in the order of megohms) seems to be on the decline, but values of from 0.25 to 0.5 megohm are frequently advocated. Wire-wound elements of these values are obtainable, and, considering the difficulties in manufacture, their cost may be considered as reasonable; where expense is not of first importance, it is recommended that they should be used. However, a number of improved resistors of the grid-leak type, some of which are of a metallic nature, are capable of carrying a reasonable current without undue change in ohmic value, and they may be used with satisfactory results, provided that they are not expected to carry an excessive current.

A resistor of 250,000 ohms, with the usual applied voltage of 120, will pass a current of something less than half a milliampere; this, under working conditions, will be reduced very considerably, due to the fact that the valve resistance is in series with the circuit. It is not a difficult matter for those who are in possession of, or who can obtain access to, a sensitive measuring instrument, reading, say, up to 1 milliampere, to test the suitability of any type of resistor for carrying currents of this order; the important point is that an increase of current should not result in any serious change of value. To make a test, the resistance, meter, and an H.T. battery of known voltage (which may conveniently be 60), are connected in series. The scale reading should be carefully noted, and then voltage should be increased to double the original figure; if everything is in order, the current, as indicated, will also be doubled. In other words, current should increase in proportion to increase of applied voltage. Any considerable divergence will suggest that the particular type of resistor under test is unsuitable for use as an intervalve coupling.

It may be noted that when there is uncertainty as to whether a resistor will carry the desired current, it is a good plan to connect two in parallel; each must have twice the ohmic resistance of the value required.

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HOLES IN SHEET METAL.

DIFFICULTY is sometimes experienced in drilling holes in sheet metal used for interstage screening, especially if the material is thin. As a rule it will be found easier to punch the hole; provided a soft metal such as copper or aluminium is used there is no need for any special tool as a rod of steel or even brass with one end filed square will serve quite well. It is essential, however, that the sheet in which the hole is to be made should be rested on the end grain of a piece of hard wood or similar material

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MEASURING INSTRUMENTS.

A COMPARATIVELY simple four-valve receiver may easily have over a hundred connecting points, a fault in any one of which will result in either complete failure to receive signals, or, at the best, in the production of weak or more or less distorted results. Added to this there are possibilities of mechanical breakdowns, particularly in components such as variable condensers and rheostats, internal open- or short-circuits in transformers, etc., and finally the chances of failure in various accessories, under which heading may be included valves, loudspeakers, and, perhaps most important of all, three or more separate batteries, one at least of which usually comprises a very large number of separate cells, each with their outer connections.

When these facts are taken into consideration it is not strange that the newcomer to the wireless art is overcome by a feeling of absolute helplessness, either when a newly-constructed set fails to function, or when a fault develops after a period of satisfactory service. He lacks the more or less instinctive knowledge of where to look for the trouble which has been acquired by the professional or expert amateur after years of experience, and too often inclines towards a consideration of the receiver as a whole instead of taking a single detail at a time and tracing the fault by a process of elimination. His difficulties are accentuated by the fact that he is, as often as not, unable to take advantage of the experience of others, simply because he cannot give a lucid and adequate description of the symptoms; indeed, had he sufficient knowledge to do so, it is more than probable that this knowledge would enable him to locate the fault without outside help.

All this sounds very dismal, but it may serve to stress the need for a clearly-defined plan of campaign, and, most important of all, for measuring instruments and the ability to use them. One may point the moral by comparing the wireless receiver and the motor car; the latter, even in its cheapest form, is generally equipped with ammeter, oil gauge, speedometer, and petrol gauge. The quality, convenience, and number of

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these devices is, of course, largely a matter of price. One can hardly imagine a motorist without any means of ascertaining if an involuntary stoppage is due to an empty petrol tank, but it is probably true to say that the majority of wireless users are in the analogous position of having no definite means of knowing if their batteries are delivering the necessary voltage. Every owner of a receiver should have at least a voltmeter capable of measuring the output of L.T., H.T., and grid batteries; also, if possible, a milliammeter with a range suitable for reading the anode currents taken by each of the valves in the set.

The most obvious method of using a voltmeter is to connect it across the terminals of each battery; this procedure is all very well in its way, but readings are apt to be misleading unless the set is switched on, so that the condition of the batteries may be checked while they are actually delivering current; this is specially important in the case of the L.T. accumulator, which will almost invariably show full voltage on an "open-circuit" test. There are other and even more helpful uses to which measuring instruments may be put; these are best described with the assistance of a diagram, and the reader is referred to Fig. 1, which shows the circuit of the popular "Everyman Four" receiver, with the addition of a grid potentiometer. Various points at which tests should be made are indicated by lettering.

In the first place, it is useful to know if the correct voltage actually exists across the filaments of each individual valve; this may be checked by applying the voltmeter across the points a a, b b_1 c c, d d. The H.T. voltage reaching the anode of V_1 may be checked by testing between *e* and the H.T. negative terminal, as may that on V_4, by moving the testing lead to point h (with loud-speaker terminals short-circuited). As far as V_2 and V_3 are concerned, it will generally be impossible to make accurate tests of voltage actually on the anode, due to the high resistances in circuit, so the test should be made between the negative terminal and points f and g. This, at any rate, will indicate continuity in the terminal connections and internal wiring.

The bias batteries should, of course, be checked periodically as an unsuspected fall in voltage will, at the best, result in a waste of current from the H.T. battery. Referring to the circuit diagram, the actual voltage on the grid of V_1 (the H.F. amplifier) may be measured by testing between it and L.T. −, but in the case of the detector, V_2, an inaccurate reading may be obtained, due to the presence in circuit of a proportion of the potentiometer winding, which may have a resistance comparable with that of the meter. It is quite impossible to obtain a direct reading of the grid voltage of V_3 with ordinary instruments, due to the high resistance of the grid leak, and the same applies more or less to V_4, as the transformer secondary also has a high resistance.

The best of valves are apt to lose their emission after a while, and the easiest and most certain way of making reasonably sure of their condition is to take a reading of the anode current; this should not be very much less than that shown in the manufacturers' published curves under the working conditions obtaining in the receiver under test. Referring to V_1, the meter may be inserted at the point X_1, or, if more convenient, between the H.T. terminal supplying this valve and the battery. The detector, V_2, usually has an extremely high resistance in its anode circuit, with the result that current may be less than the ordinary meter can measure if connected at X_4; in this case the resistance should be removed, and the instrument connected in its place at X_2. The positions for testing the first and second L.F. amplifiers are shown at X_3 (or X_5) and X_6; for the latter test, the meter may be in series with the loud-speaker windings.

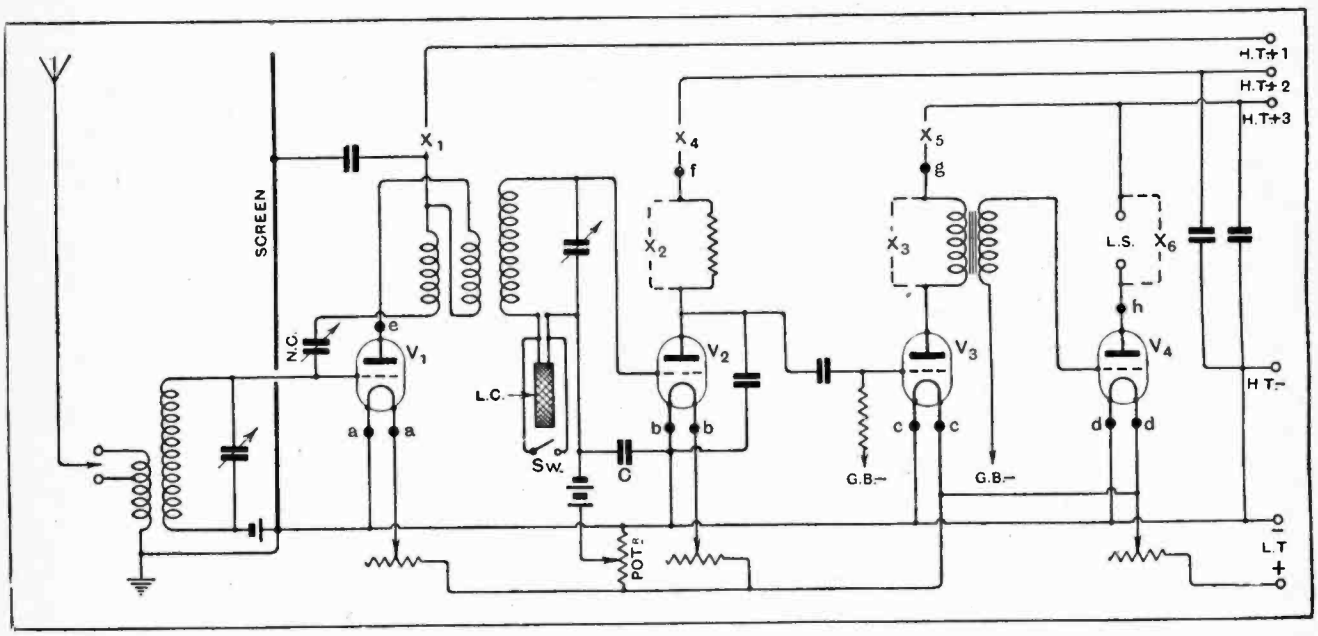

Fig. 1.—Showing how measuring instruments may be applied to the "Everyman Four."

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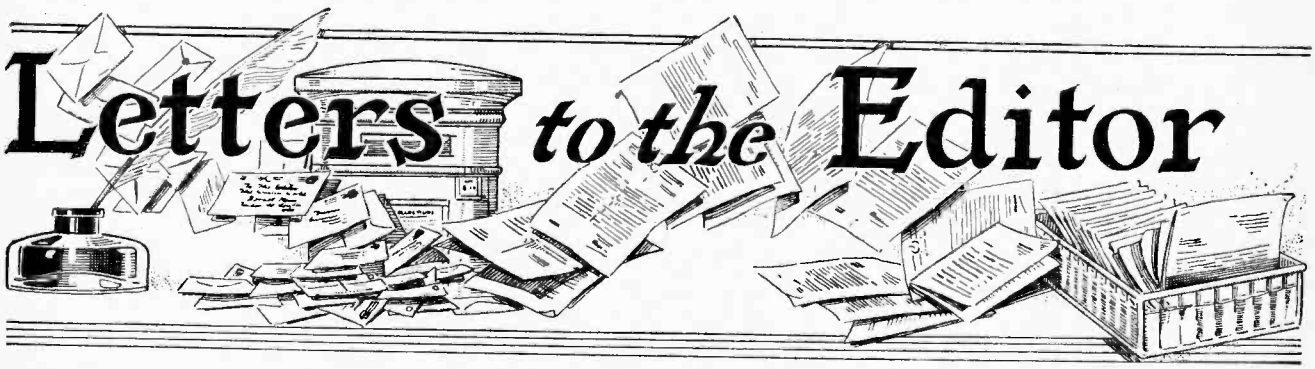

The Editor does not hold himself responsible for the opinions of his correspondents.

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.

EMPIRE BROADCASTING.

The following letter, received by Mr. Gerald Marcuse, is indicative of the enthusiasm for Empire broadcasting in the colonies, and also of the success which is attending Mr. Marcuse's efforts :—

[COPY.]
46, Railway Terrace,
Mt. Lawley,
Western Australia.
26/9/27.

Mr. Gerald Marcuse (2NM).

Dear Sir,—I have much pleasure in writing to let you know that on three occasions I have had the pleasure of hearing your broadcasting from London.

The first was on your test night. The second was on your opening night, and again this morning, which was the best of all. I say this morning because it was 1.30 when I received it, that is Perth, West Australian time, which is two hours behind Sydney time.

One of the items played on the 11/9/27 was so perfect that I thought it was Mr. Coxon, 6AG, who is living near my place, and he plays the same piece on his gramophone when he is broadcasting, that is, the "Triumphal March."

This morning I put the alarm clock to wake me at 1.30 a.m., and after waiting for five minutes after tuning in I heard your carrier wave, and two or three minutes I heard you calling, and then a band record, a fox trot, and announcements calling different countries and persons, and then I heard the church bell striking, and following which the church service was heard better than if I was there in England sitting in the church, as I am hard of hearing.

First, choir singing.
Hymn 627.
Anthem, "The Lord is my Shepherd."
Prayer (I never missed one word).
Hymn 641.
Scripture lesson from St. Luke.

The sermon was from St. Luke's Gospel, 10th chapter, the preacher said the 7th verse, and then corrected himself and said the 10th verse, the sermon finishing at 3.10 a.m., Perth time.

The choir chanting and 2NM closing down at 3.34 a.m., Perth time.

Wishing you every success.

I am,
Yours sincerely,
(Signed) A. TOSTEVIN.

P.S.—My set is a three-valve Reinartz from 20 to 2,000 metres. I use it for our local station 6WF on 1,250 metres.

THE REGIONAL SCHEME AND 5XX.

Sir,—With reference to Mr. D. R. White's letter in your issue of October 19th, I should like to point out that there is one point (and a strong point, too) in favour of a 1,600-metre transmission that Mr. White has forgotten. This transmission is a godsend to us who live near the coast. It is impossible in Grimsby to tune in any broadcasting station except 5XX without interference from Morse stations on 600 metres. Even Hull at times is quite blotted out.

For this reason I hope the B.B.C. will not discontinue the 1,600-metre transmission. If they do, I am afraid many listeners here will not renew their licences, as the transmissions on other wavelengths are useless.

A. E. GOOD.

Grimsby.

Sir,—I was surprised to read in your correspondence columns a letter which suggests the total abolition of 5XX. Surely your correspondent can have no knowledge of the conditions obtaining in south-east coast towns, and probably in other districts. In Eastbourne, for instance, 5XX provides the only British programme, there is no alternative, and to close Daventry would deprive thousands of listeners of their broadcast entertainment. Until such time as the authorities concerned are able to control the commercial working of spark stations the question of closing 5XX ought not to be considered.

W. STEVENSON, JUN.

Eastbourne,
October 19th, 1927.

Sir,—We who live on the South Coast have been forced, in the interests of shipping, to consider 5XX our only source of wireless entertainment. Lately 5XX has been seriously interfered with by Morse, the worst offender being a machine transmitter. On the longer wavelengths there can be no question of life saving, so think listeners have a right to enter a strong protest.

BM/BLDN.

October 16th, 1927.

Sir,—I must say I fully concur with A. H. B.'s letter on "Morse on the South Coast," also finding it useless to listen in to anything on the medium waves.

I had hopes that when 5GB came into being to be able to listen to this station, but in this district the reception is so weak as to be impossible to anyone except the multi-valve enthusiast, the result being that, except for the dial twisting fan, the listener who regards his set as a musical instrument has got only one alternative, 5XX.

It is a great pity that something cannot be done, now that the first excitement and wonder of broadcasting has worn off. I hear continually of people reverting to the gramophone, as there, at least, no Morse is to be found.

G. A. VINER.

Southsea,
October 12th, 1927.

MORSE INTERFERENCE.

Sir,—Your correspondent, Mr. T. B. Wilson, has, if nothing else, done a useful service in keeping open a question which,

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I venture to suggest, is of paramount importance both to the listening-in public and shipping interests at the present time, and which was so timely raised in your Editorial of October 12th.

Apart from this, however, Mr. Wilson has made certain statements the accuracy of which may, with advantage, be challenged. First, then, I would take exception to the view that technically spark or I.C.W. transmissions are essentially necessary for a reliable emergency service in the future.

The fact is that the highest receiving efficiencies are obtained when the transmitter emits a *steady* and continuous wave, and there is no technical reason that I know of why a vessel should not be able to emit a standard wavelength on sufficient power for the purpose of a safety call. It is merely a case of the ship being provided with a thoroughly competent wireless staff capable of checking daily their wavemeters by standard calibration signals and applying the same to the transmitter. It is solely a matter of routine, the procedure being similar to that of the captain, who checks his bearings, compass course, etc., periodically.

Your suggestion as to the use of a combination of tuning notes such as I foresee could be controlled by, *e.g.*, standard tuning forks, certainly may have much to be recommended to secure additional safety during, perhaps, a transitional stage before such time when by experience it might be found they could be dispensed with.

Secondly, Mr. Wilson near the end of his letter makes a most dangerous assertion. He says, "As the law stands practically the whole of the British mercantile marine are compelled to fit the apparatus (Auto-Alarm), and those not compelled will do so on grounds of economy." I challenge Mr. Wilson to prove that the law makes such compulsion. As I read it, the law requires that a continuous watch be kept on every ship at sea for a distress signal.

Until recently this condition was satisfied by the provision of two men (usually boy apprentices) who after an hour or so of practice could detect aurally the Morse SOS. The wireless official is called in the event of the receipt of such signal, and on his training and skill everything else depends.

Now, sir, I suggest that the shipowner, far from being compelled to install the present Auto-Alarm, will be well advised to leave it entirely alone. As he already carries seamen apprentices the continuous watch is not expensive to him, and in any case he must have a certificated wireless officer on board to deal with the situation, sometimes very difficult, when the distress signal has to be sent or is received.

The cost of the Auto-Alarm as manufactured by one of the largest wireless companies in this country I do not know. It is not sold, however, I understand, by the actual manufacturing company, but by a subsidiary company whose shares are largely held by the former and the price is £250. There are approximately 4,000 vessels in the British mercantile marine, and if we are to accept the statement quoted above of your correspondent the sum which may eventually be involved will approximate to £1,000,000. I do not think that even Mr. Wilson will suggest that a quarter of this sum has been expended in developing the present instrument.

Apart from this, however, having both studied the mechanism and published literature of the device and from many years of practical experience of wireless and other delicate telegraphic apparatus, I am confident that the Auto-Alarm will require frequent expert mechanical and electrical attention quite outside the scope of a ship's navigating officer or even the average certificated wireless officer, whose training is usually unfortunately conspicuously deficient of all skilled mechanical work.

This attention will prove additionally expensive to the shipowner when coupled with various renewals charged at, perhaps, an even more extravagant basis than the original instrument.

Thirdly, it appears that we are still to preserve 600-metre spark sets on ships, even if only for the sole purpose of distress signals, with less power than heretofore, on the ground that it is most suitable for the particular Auto-Alarm instrument now approved by the Board of Trade. The wireless part of the apparatus, we are told, tunes flatly between 585 and 615 metres, *i.e.*, between 513 k.c. and 487 k.c., which gives us enough separation for nearly five broadcast stations.

This being the case it is conceivable that the receiving instrument on a ship when required to operate with the minimum of interference and as rapidly as possible in reply to or as a result of a distress signal may be badly jammed by one or more of the future high-power broadcast stations.

Finally, when the shipowners have installed all their Auto-Alarms—if they do—it will be extremely difficult to compel any further change in the transmitting apparatus however desirable and necessary such change might be.

This letter is already too long, but I trust, sir, that the matters raised will awaken your readers to an appreciation of the importance of this subject, and that they will require from the Government a clear statement of the provisions proposed at the International Conference at Washington before this country is committed for a number of years to a course which may prove to be disastrous to the progress of broadcasting and other vital wireless services. MAURICE CHILD.

London, N.W.2.
October 20th, 1927.

TELEVISION IN 1925.

Sir,—Col. M. J. C. Dennis is quite correct in pointing out that the word "normally" was omitted from the translation of Dr. Dauvillier's statement in the *Comtes Rendus*. This was a clerical error, as in my notes of the translation the word "normally" is included. The fact that the original French was quoted in full should satisfy Col. Dennis's query.

Dr. Dauvillier's statement seems to have been misunderstood by Col. Dennis in that, where the word "normally" is used in the translation, the meaning implied is more accurately described by the word "usual."

Dr. Dauvillier's obvious meaning is, that while shadowgraphs or objects illuminated from within could be transmitted, no object illuminated in the usual way, *i.e.*, from an external source, could be sent by his apparatus. The question of normal or abnormal lighting was not raised.

For the information of Col. Dennis regarding television under normal lighting conditions, I would point out that prior to Mr. Baird's discovery of the application of infra red invisible rays to television, he had already reduced the studio lighting to little over that necessary for ordinary photography, and most of the demonstrations of about a year ago were given under such lighting conditions. O. G. HUTCHINSON,
Joint Managing Director,
For Baird Television Development Co., Ltd.

London, W.C.2,
October 20th, 1927.

B.B.C. RECEPTION IN SCOTLAND.

Sir,—Mr. Thos. C. Horne's letter in to-day's issue addressed to you from Hawick is very surprising. He complains bitterly of the poor reception in his locality. During the month of September I spent a fortnight at Melrose, about ten miles from Hawick, and was surprised at the wonderful way in which stations came in on a two-valve set at the foot of the Eildon Hills.

In daylight Glasgow, Aberdeen, Edinburgh, Newcastle, Daventry, Radio Paris, Motala, and Hilversum were received with unfailing regularity on the phones. After dark the dials were crowded with stations, Glasgow, Daventry, and some of the Germans being quite audible on the loud-speaker. Radio Toulouse, Spanish stations, and Moscow were heard many times.

There was nothing very remarkable about the set; 0.06 ampere valves were used with capacity reaction and a good P.O. aerial. Loud-speaker reception was quite normal on a three-valve and a four-valve set, which were heard in neighbouring houses.

Aberdeen was not so loud as would have been expected judging from experience on Tyneside, while Dundee was only heard once. The aerial was situated about 300ft. above Ordnance datum. Possibly Hawick is particularly badly screened by its neighbouring hills. GEORGE M. MEYER.

Gateshead.
October 19th, 1927.

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READERS' PROBLEMS ANSWERED

Queries should be concisely worded, written on one side of the paper, and headed "Information Department." Only one question (which should deal with a specific point) can be answered. A stamped addressed envelope must be enclosed for reply. Letters which do not comply strictly with these rules, cannot receive attention or acknowledgement.

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

Correct Position of a Potentiometer.

I notice that, in the reply given to "A. W. F." in your September 7th issue, you advise that critical adjustment of detector valve grid bias be obtained by shunting a potentiometer across the filament battery in addition to the use of the small grid battery. Why shunt it across the filament battery and not across the grid battery? D. A. R.

The average potentiometer of the wire-wound type has a resistance of 400 ohms, and, if shunted across a 6-volt accumulator, a current of 10 milliamperes will be continuously drawn from the accumulator by the windings of the instrument. Now such a current is a negligible drain on an L.T. accumulator, but this would not be so in the case of a small grid battery of the dry cell type, and we should speedily exhaust the grid battery. A moment's consideration will reveal to you that, since exactly the same results can be achieved by shunting a potentiometer across the filament battery without the disadvantage of actually taking current from the grid battery.

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An Unwise Step.

I propose to use in the first L.F. stage of my "Everyman Four" receiver a 70,000-ohm valve with a magnification factor of 35 in order to obtain increased amplification. I shall be glad if you can tell me if there are any pitfalls to avoid? F. D. H.

We do not on any account advise you to adopt your proposal, as you would probably get both forms of distortion, namely, frequency distortion and amplitude distortion. Frequency distortion would come about owing to the fact that 70,000 ohms is far too high an A.C. resistance for a valve preceding a transformer, and a loss of the lower musical frequencies would result. In addition to this, the input to the first L.F. valve of the "Everyman Four" is by no means small, and since a 70,000-ohm valve has not a very large permissible grid swing, amplitude distortion would probably result, due to overloading of this valve.

Quite apart from these considerations, any extra amplification in the L.F. stages of this receiver should be totally unnecessary, and if you think that the volume obtained from your loud-speaker is not sufficient we should advise you to carefully examine your set, as in our opinion there must be some serious defect in it. Not only should the whole receiver be examined for defects in the H.F. transformer, the soldered connections, etc., but the valves should also be carefully tested. We presume, of course, that you already have tested the voltages of your batteries.

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A Simple H.T. Battery Eliminator

I wish to build a simple half-wave rectifier and smoothing unit for the purpose of supplying H.T. from my A.C. mains to the last valve only in my set. This valve is a super power valve. I have already a U5 valve, which is of the full-wave type, and should be glad if you could give me a circuit for using this valve in a half-wave eliminator, as I am not at all sure of the connections. P. R. G. J.

We give below a circuit diagram showing a suitable A.C. eliminator, which should meet your needs. Any full-wave valve can be used for half-wave rectification by simply joining together the two anodes as shown in Fig. 1. The output obtainable will, of course, be greater than if an ordinary half-wave valve were used. You do not mention the H.T. voltage value you require, but this will be determined by that section of the secondary which supplies the anode.

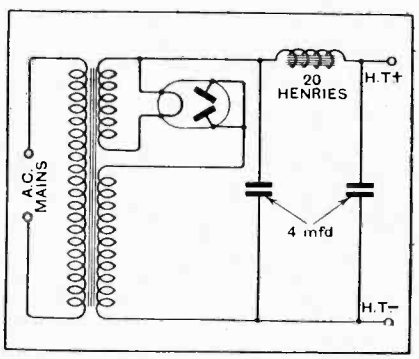

Fig. 1. Half-wave rectifier using full-wave rectifying valve.

Instability of H.F. Circuits.

I am experiencing difficulty in stabilising the H.F. circuit of a 4-valve receiver incorporating the "Regional" type of H.F. transformer. I have included a high-frequency choke in the anode circuit of the detector valve, as I was led to understand that this might cure the trouble. However, although a slight improvement is noticeable, I am still unable to obtain stability. Can you suggest how I can overcome this difficulty? J. D. S.

The failure to stabilise an H.F. circuit may be due to a number of causes, the most common being short-circuited turns in either the primary or neutralising windings on the H.F. transformer, high-resistance contact between the transformer pins and sockets on the base, or faulty neutralising condenser. Should high-frequency oscillations find their way into the L.F. portion of the receiver, this trouble will arise, but incorporating an H.F. choke in the anode circuit of the detector valve should preclude this possibility. The components concerned should be carefully examined for any of the faults mentioned above, special attention being given to the neutralising condenser. Certain types have a rather high minimum capacity, but in most cases this can be reduced by stripping off a few of the plates.

High-resistance contact between pins and sockets can usually be traced to either dirty pins or sockets; alternatively, if the split type of pin is used, this may require "splaying out" before a good contact will result. A careful examination of the H.F. transformer will enable any short-circuited turns to be located.

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Choosing a Detector Valve.

I am building a detector and two L.F. receiver, but do not know whether I should choose an "H.F." or an "L.F." valve for the detector position, and should value your opinion. I use transformers in both stages V. S. R.

It will be appreciated that the terms "H.F." and "L.F.," as used by manufacturers to distinguish their different types of valves, are purely arbitrary, and

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in the case of a resistance-coupled amplifier, it may be necessary to use a so-called H.F. valve in the first L.F. stage, whilst many receivers whose H.F. couplings have been designed for valves of moderate A.C. resistance will require a so-called L.F. valve in the H.F. stages. Speaking generally, an H.F. valve is one having a higher A.C. resistance than an L.F. valve in the same class. Now, even in the best of L.F. transformers the A.C. resistance of the valve preceding it should not exceed 30,000 ohms at the outside, if good quality from the point of view of faithful reproduction of the lower musical notes is to be a consideration.

In addition to this, although you do not mention it in your letter, your detector valve is probably going to perform the function of regeneration, and on the whole a valve of medium A.C. resistance gives smoother reaction effects than a high A.C. resistance valve. When choosing your detector valve, therefore, you should ignore the H.F. and L.F. markings of the valve, and choose one having an A.C. resistance between about 15,000 and 30,000 ohms, and you will, of course, naturally choose a valve which gives you the highest amplification factor for a given A.C. resistance. In general, this will mean that you will choose the "L.F." valve of any given series. This rule applies irrespective of whether you are going to use 2-, 3- or 4-volt valves.

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Converting a Crystal Receiver.

I have an efficient crystal receiver giving excellent results on telephone, and now desire to reconstruct this so that a two-valve L.F. amplifier can be used. I should be obliged if you could supply me with the necessary circuit arrangement of a really good amplifier giving the maximum amplification compatible with good quality.

D. P. E.

Your best course would be to reconstruct your crystal set on the lines indicated in the circuit diagram Fig. 2, using two good transformers for the purpose. The aerial should be tapped in to the coil about one-third from the earth end, and the crystal connected across about one-quarter of the coil. The transformer T_1 should have a high primary secondary ratio, and an 8 : 1 ratio is to be recommended. A 20,000 to 30,000 ohm. valve, with the highest amplification factor obtainable with this resistance, should occupy the position V_1, and this followed by a low-ratio transformer (T_2) having a high primary inductance. In the position V_2 a good power valve is recommended; that is to say, one having an A.C. resistance in the order of 4,000 ohms. with an amplification factor of 3.5 to 4.

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Increasing Signal Strength in a Crystal Set.

I have a crystal receiver, but find that although signals are clear, they are not of sufficient strength for comfort, and I propose to add a single valve amplifier, but before doing so would ask if there is any better method of overcoming my difficulty?

N. C. R.

In the first place, we should advise that you made sure that it was not possible to improve your aerial and earth system, as much can be done in this manner to improve signal strength. Having made sure on this point, you should turn your attention to the crystal set and see if it is not possible to improve signal strength by *not* connecting the aerial and earth system across the whole of the tuned circuit; that is to say, the aerial should be tapped well down the tuning coil towards the earth end, this giving the effect of a periodic aerial coupling with only a comparatively few turns of the tuning coil in the aerial and earth circuit. You should also make sure that your receiver is not of the old-fashioned type, in which the crystal and phones are shunted across the whole of the tuned circuit, and if it is so, alterations should be made and the crystal tapped down so that the crystal and telephones are shunted across only a portion of the tuned circuit, thus reducing the damping, and permitting a bigger H.F. voltage to be built up across the tuned circuit. Even though in this case the whole of the voltage developed across the tuned circuit will no longer be applied to the crystal, the actual voltage developed across the tuning coil may be so much enhanced that the voltage applied across the crystal may be greater than when it received the full voltage developed across the coil. If after all it is necessary to bring a valve into action, we think that you would be far better advised to build a two-valve receiver such as the "Economy Two" described in our issue of October 27th, 1926; such an arrangement will in reality give you far more satisfactory results than a crystal followed by an L.F. amplifier, as the inconstancy of the crystal will have been got rid of. It is necessary also, if using an amplifier after a crystal, to purchase a transformer, whereas in the case of the "Economy Two" a cheap resistance coupling unit is used. The quality obtainable from the "Economy Two" would be in no way less than with a crystal and transformer-coupled amplifier.

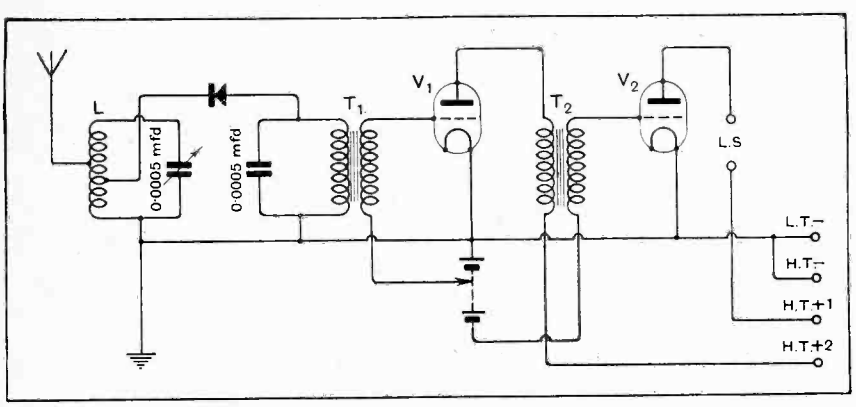

Fig. 2. Two-valve and crystal receiver for working a loud-speaker.

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Using Commercial R.C. Units.

I am building the "All-Wave Four" receiver, but wish to make use of commercially made R.C. units in place of the separate anode resistance, grid condensers and leaks in the original receiver, but am not sure of the way in which to connect my commercial units up in place of the components used in the original receiver.

L. A. C.

The substitution of commercial units is quite a simple matter. Your unit will have four terminals. One terminal will be marked "A" or "P," indicating the word "anode" or "plate." This connects to the plate of the valve in place of the high potential end of the anode resistance used in the original receiver. Another terminal will be marked H.T.+, and of course this is substituted for the low potential end of the anode resistance. The terminal of your unit marked "G" will connect to the grid of the succeeding valve in place of the high potential end of the grid leak, the terminal marked "G.B." connecting to the grid battery in place of the low potential end of this grid leak. The 0.002 mfd. coupling condensers in the original receiver will, of course, be no longer required, but the 0.0001 mfd. fixed condenser shunting from the plate of the detector valve to L.T.− and the stabilising resistance between the high potential end of the grid leak and the actual valve grid will still be required, as these devices are not usually included in commercially made R.C. units.

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Using Rigid Valve-holders in a Modern Set.

I am building a modern four-valve receiver, but do not wish to purchase new valve holders, as I have a number of good quality rigid type in my possession. Is it possible in any way to take precautions against vibration effects without going to the expense of buying new valve holders?

R. A. S

We advise you to use your solid valve holders and to mount them on a strip of sponge rubber, using flexible electrical connections to the valve holder. This was done in the case of a four-valve receiver described on page 519 of our April 27th issue, and proved highly successful. If you will refer to this issue you will see exactly how this was done.

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

THE SUPER-HETERODYNE.

THE super-heterodyne principle of reception stands out from all other types of circuit as a system of remarkable ingenuity, and probably it would be no exaggeration to say that it holds first place for originality amongst all the multitude of receiving circuits which have come to light since the valve was developed. After first the principle of the super-heterodyne was disclosed receivers of that type were in vogue for a considerable time in America, and the enthusiasm also spread to this country; but after a while the popularity of the super-heterodyne died down, and it is, perhaps, of interest to consider some of the causes which contributed to the lapse of enthusiasm.

Early Objections to the Superhet.

First probably amongst the objections to it was the fact that more valves were required, and the cost of running, in the days of bright emitter valves, had to be taken into consideration; also components were numerous, thereby adding considerably to the initial cost. Secondly, the super-heterodyne receivers put out were for the most part unsatisfactory in performance, particularly as regards quality, and the general-purpose valves available then were by no means ideal for performing under the variety of conditions required in this type of circuit. Thirdly, the super-heterodyne came into marked prominence at a time when broadcasting stations were by no means numerous and special selectivity was quite unnecessary in a receiver, and, since this may be regarded as the outstanding feature of the circuit, it seems quite natural that the impression soon got about that a super-heterodyne was not worth the extra expense the number of valves and current consumption involved.

But let us review the position to-day. Valves are very much cheaper than they were. The same remark applies to components. The consumption of current by valve filaments has gone down to a fraction of what it was in the days of the bright emitter; and the need for selectivity has increased enormously. To-day, unless one is content with one or, at most, two programmes, selectivity is essential, and probably only a super-heterodyne can tackle the problem of separating all the broadcasting transmissions of Europe which do not actually overlap one another in their frequency bands. The only alternative is to consider a neutrodyne type of receiver with a number of tuned H.F. stages, when immediately you are up against the problem of tuning each stage independently or compromising with still more stages of flatter tuning.

We have never lost faith in the super-heterodyne receiver, although our readers will have noticed that we have not dealt with it to any great extent in constructional articles. For some time past we have had frequent applications for the design of a super-heterodyne, but we felt that it was necessary to make sure that when we did put one out it should be a receiver which did full justice to the advantages inherent in the circuit principle.

The Wireless World "Super Seven."

In this issue we introduce to our readers a design for a super-heterodyne which we are satisfied will come up to expectations. Amongst its principal merits are that it enjoys a background of silence, whereas with super-heterodynes generally it is so common for the background to be heard almost above the signal strength. By background, of course, is meant the noise originating in the receiver itself and not picked up by the collector. The quality leaves little to be desired, and this without impairing the outstanding advantage of selectivity.

It is always interesting to handle a receiver employing a principle with which we may not be familiar. Many of our readers, no doubt, have never used a super-heterodyne, and the Wireless World "Super Seven" will undoubtedly be appreciated, especially as the details of construction have been simplified until the work involved in the actual making of this receiver requires very little ingenuity beyond that necessary to build receivers of the more usual types.

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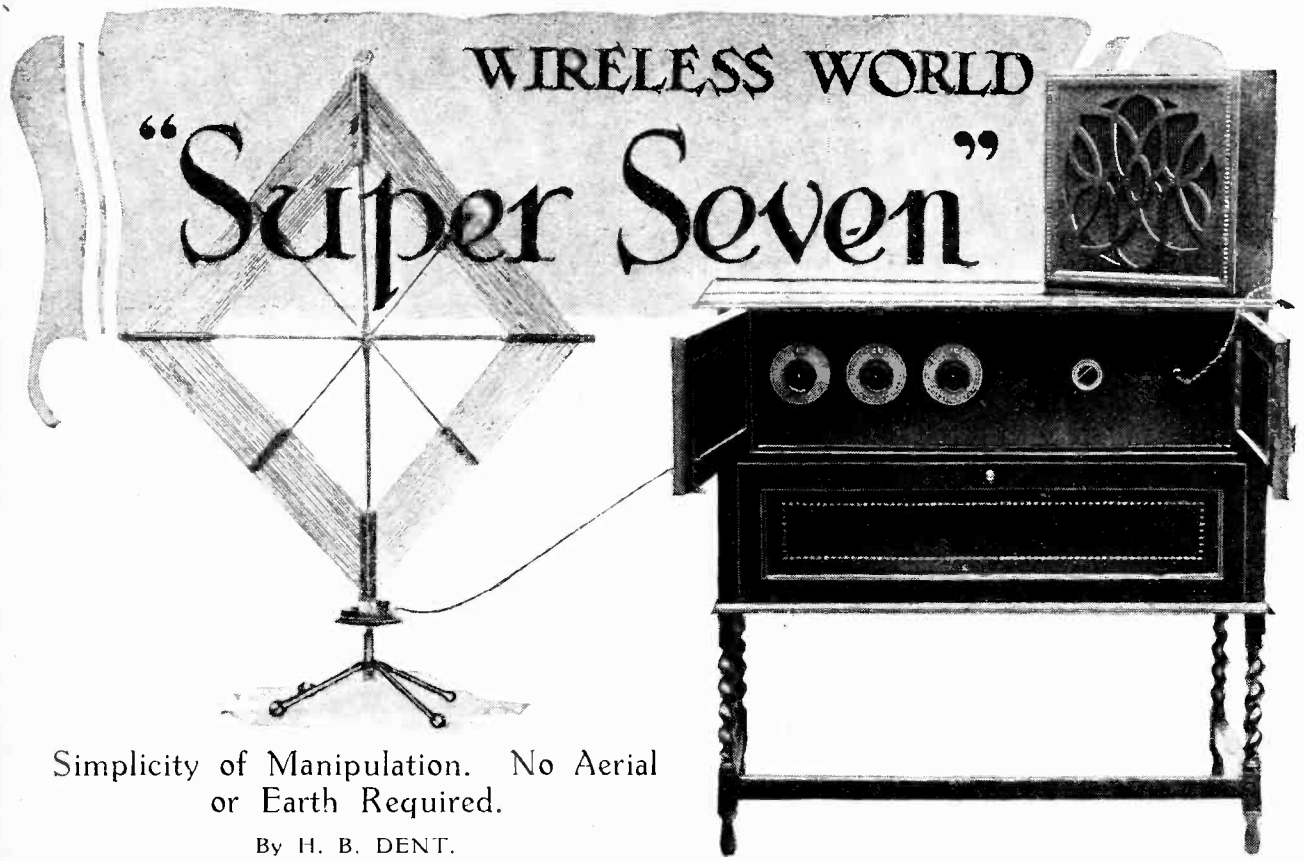
WIRELESS WORLD "Super Seven"



Simplicity of Manipulation. No Aerial or Earth Required.

By H. B. DENT.

THERE is a common belief that an outside elevated aerial is a necessary adjunct to a wireless receiver when it is desired to receive signals transmitted from a distant station, and under certain conditions this is true. A short inside aerial and a receiver incorporating a number of high-frequency amplifying valves will enable the distant broadcast stations to be heard, but this necessitates the employment of receiving apparatus fitted with many complicated tuning controls. A wire suspended across a room or running parallel with a picture rail but spaced well away from the wall does not enhance the appearance of a room, or please the eye of the commander-in-chief, and it is for this reason that many are debarred the pleasure of listening to home or distant broadcast. The elevated wire could, of course, be replaced by a frame aerial, either built into the receiver or as a separate component, but this still further complicates the tuning for the reason that all controls become very much more critical than would otherwise be the case.

To achieve any worth-while results when a frame aerial is employed the receiver should incorporate at least three stages of high-frequency amplification, and as an aperiodic amplifier is little better than a passenger it becomes necessary to tune each stage if a reasonable amplification per valve is desired. Improvements in the design of receiving circuits and valves will lead eventually to the efficient "ganging" of tuned circuits, but at the present time this can be achieved only by the addition of sundry compensating devices, which must be adjusted at different settings of the main control. When the receiver is in close proximity to a broadcast station and it is desired to receive distant signals, very high selectivity is demanded, and this can be achieved only by cascading a number of sharply tuned circuits, all of which must be adjusted for any change of wavelength. The supersonic heterodyne method of reception provides an easy way out of these difficulties, and a really efficient receiver embodying three stages of high-frequency amplification, but having two essential controls only, can be designed. To appreciate this, the fundamental principles of supersonic heterodyne reception must be understood, and a space will be devoted, therefore, to a brief explanation of this subject.

Supersonic Heterodyne Reception.

The outstanding difference between this method of reception and the arrangement generally known as a "straight" circuit is that in the former high-frequency amplification is carried out on a long wavelength, whereas in the latter this takes place on the signal wavelength. To make this quite clear, in a superheterodyne the H.F. amplifier is adjusted to a definite wavelength, and all signals, irrespective of their individual wavelengths, are amplified at this fixed wavelength. The H.F. amplifier is usually adjusted to about 6,000 or 8,000 metres; however, in some cases it may be advantageous to go as high as 10,000 metres. The long-wave amplifier can be constructed so that each stage is sharply tuned, but as this functions on a fixed wavelength it will not be necessary to incorporate variable tuning controls. A further advantage is that a stable amplifier for one wavelength only is considerably

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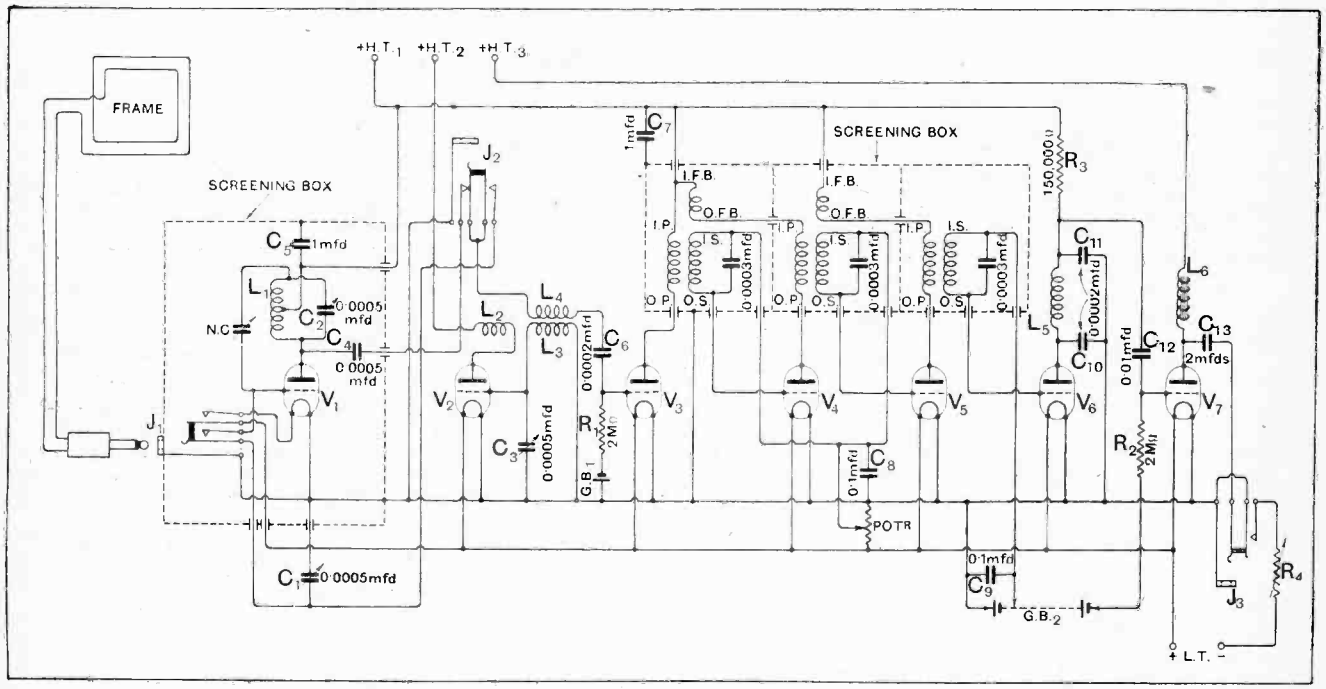


Fig. 1.—The circuit diagram. Screening boxes are indicated by the dotted lines.

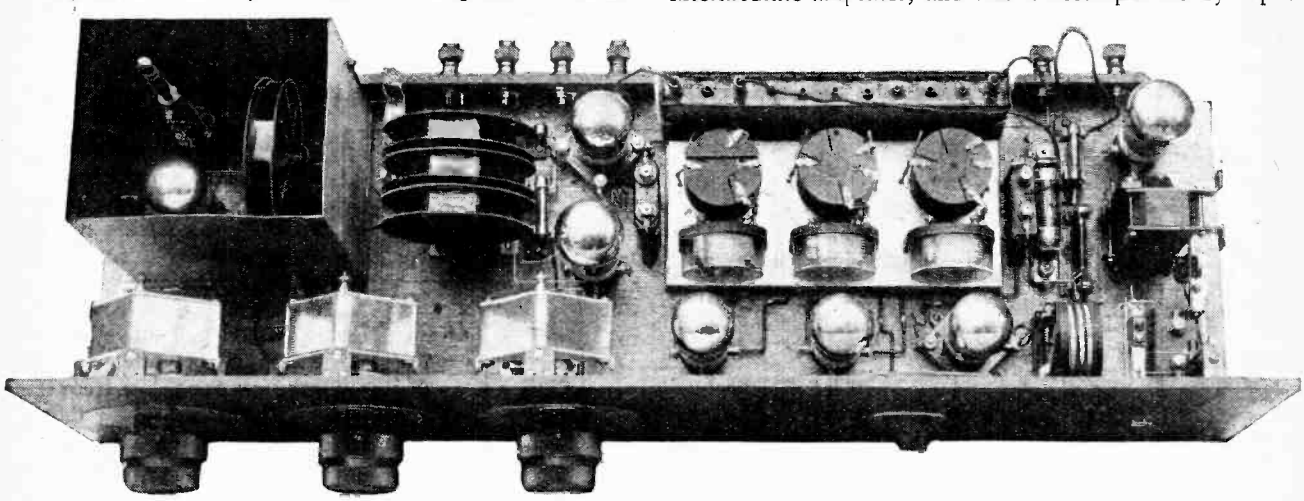
easier to build than one required to cover a band of wavelengths and to be continuously variable, and stable, over the whole tuning range.

The sensitivity and, incidentally, the selectivity can be improved by the addition of a high-frequency amplifying valve before the signal is converted to a long wavelength, and as this will result in two separate H.F. amplifiers, each functioning on entirely different wavelengths, suitable nomenclature must be adopted when referring to the various circuits comprising a superheterodyne receiver. In the present case the short-wave amplifier will be called the signal-frequency amplifier, and the other the intermediate frequency amplifier.

We have seen that one of the conditions pertaining to the supersonic heterodyne method of reception is that all signals must be converted to a long wave, and the method by which this is achieved will now be considered. This will be more easily followed if signals are considered in respect of their frequencies rather than of wavelength, and the following formula shows the relationship between frequency and wavelength :

$$\text{Frequency} = \frac{\text{Rate of Propagation}}{\text{Wavelength.}}$$

The rate of propagation, or velocity, of wireless waves is the same as that of light, namely, 186,000 miles, or 300,000,000 metres, per second. It will be seen, therefore, that as the wavelength is shortened the frequency increases, and *vice versa*. Before the received signal can be amplified it must be converted to the frequency of the intermediate amplifier, and this is accomplished by super-



A general plan view of the receiver with the screening box covers removed.

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LIST OF PARTS.
7-VALVE SET (H.B.D.).

1 Ebonite panel, 30in. × 9in. × ¼in.
1 Wooden baseboard, 30in. × 9in. × ¾in.
1 Baseboard mounting Lorostat, one-way, 6 ohms (A. W. Stapleton).
5 "Triumph" valve holders type V138 (A. H. Clackson).
2 "Benjamin" valve holders (Benjamin Elec., Ltd.).
3 "Utility" variable condensers, with micro dials, 0.0005 mfd. (Wilkins & Wright).
2 "Igranic Pacent" jacks, No. P66 (Igranic).
1 Neutrovernia (Gambrell).
2 Mansbridge type fixed condensers, 1 mfd. (Dubilier).
2 Mansbridge type fixed condensers, 0.1 mfd. (Dubilier).
1 Mansbridge type fixed condenser, 2 mfd. (Dubilier).
1 "Freshman" fixed condenser and base, 0.0005 mfd. (Igranic).
3 "Freshman" fixed condensers and base, 0.0002 mfd. (Igranic).
3 Air dielectric fixed condensers, 0.0003 mfd. (Ormond).
2 Grid leaks, "Dumetohm," 2 meg., and holders (Dubilier).
1 Anode resistance, 150,000 ohms, and holder (Dubilier).
2 "Igranic Pacent" universal plugs, No. P40 (Igranic).
1 Centre-tapped coil "B" and holder (Gambrell).
1 Coil, B1 (Gambrell).
1 Coil, B (Gambrell).
1 Coil, A (Gambrell).
1 "T" Cell, 1½ volt (Siemens).
1 Grid bias battery, 15 volts (Siemens).
6 Terminals (Igranic).
3 "Springmore" wander plugs (Igranic).
1 L.F. choke, 32 henries (Pye).
3 Coil mounts, "Wearite" (Wright & Weaire).
1 "Igranic Pacent" potentiometer, porcelain type, 400 ohms (Igranic).
8 ins. ebonite rod, 2in. diameter.
1 pr. "Cameo" aluminium panel brackets, 6in. × 4in. (Carrington).
2 ozs. No. 40 S.W.G. D.S.C. wire.
8 ozs. No. 32 S.W.G. D.S.C. wire, green covered.
8 ozs. No. 32 S.W.G. D.S.C. wire, white covered.
2 ozs. No. 24 S.W.G. D.S.C. wire.
4½ sq. ft. copper sheet.
½ lb. No. 18 S.W.G. bare copper wire.
4 yds. Sistoflex (Spicers).

Approximate cost £11 (without cabinet).

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 instrument. 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.

imposing on the incoming oscillations a second set of oscillations generated in the receiver. This will result in the formation of an E.M.F. having a frequency equal to the difference between the frequencies of the two forces acting on the circuit, and this beat frequency is passed to the long-wave amplifier. If we assume that this amplifier is tuned to have a fundamental frequency of 50,000 cycles (6,000 metres wavelength) and the incoming signal 1,000,000 cycles (300 metres), then the local oscillator must generate either 1,050,000 cycles or 950,000 cycles per second to produce the required difference of 50,000 cycles. From this we see that every signal can be received at two distinct settings of the local oscillator, and the use to which this can be put will be dealt with later when we come to the question of tuning adjustments.

Number of Valves Required.

The high-frequency amplification is carried out on a fixed wavelength so that as many stages as practical considerations will allow can be employed without adding to the complicity of tuning; however, in practice two or three stages will be found sufficient. Under normal conditions of reception and when three efficient stages of high-frequency amplification are used, one low-frequency amplifier will suffice to give loud-speaker results from practically all the worth-while stations, even though a frame aerial is employed to pick up the initial signal impulse.

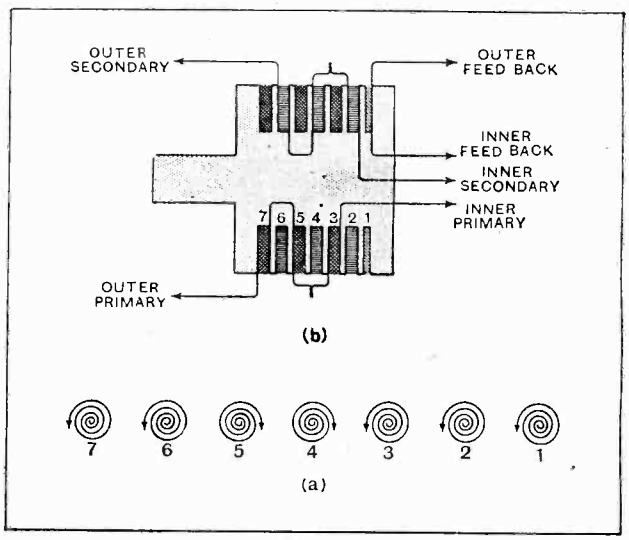

Fig. 3.—Winding details of I.F. transformer; (a) shows the direction of windings in each groove; (b) the method of interconnecting the sections.

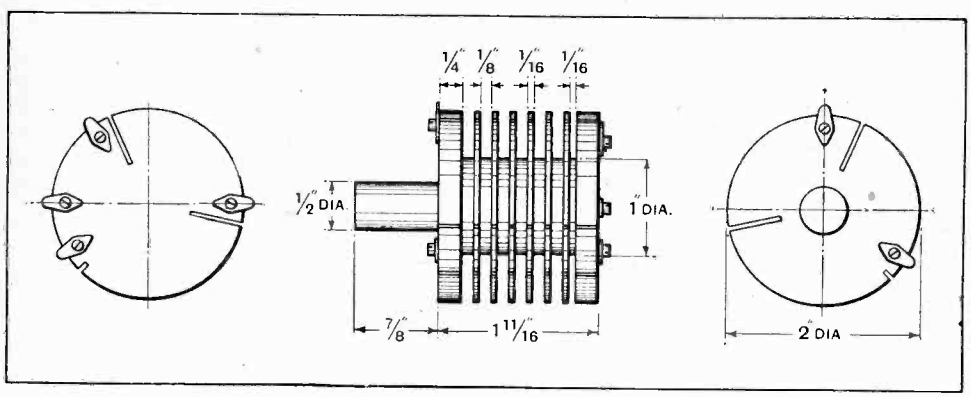

Fig. 2.—Dimensional drawings of special long-wave transformer bobbin.

Stabilised I.F. Amplifier.

The supersonic heterodyne receiver described in this article incorporates a high-frequency valve functioning at signal frequency, a local oscillator, a detector, two stages of long-wave amplification, a second detector, and one stage of low-frequency amplification. With the exception of the intermediate amplifier, all components in the receiver can be obtained ready made, and it is only

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due to the absence of suitable I.F. transformers that the construction of these must be undertaken by the reader. If reference is made to the circuit diagram, Fig. 1, it will be seen that the intermediate amplifier is stabilised by feeding back a small amount of energy from one stage to the preceding stage, and the amount fed back will, of course, depend on the type of valves used in the I.F. amplifier. In all but two of the supersonic heterodyne receivers which the writer has examined, the required stability is obtained by applying a positive bias to the grids of the valves, with the result that the high-tension current is considerably increased. The heavy drain thus imposed on the H.T. battery has, in the past, rendered this type of receiver very unpopular, but when an economical I.F. amplifier is used the total H.T. current consumed will be found comparable with that taken by any other type of set incorporating a similar number of valves.

The stabilisation of the I.F. amplifier is not absolute, but adjusted so that when the grids of the valves are at zero potential the amplifier is hovering between stability and instability, and it is therefore highly sensitive to very weak signals. The potentiometer is provided to give just that extra control necessary when receiving strong signals. To obtain the maximum amplification and selectivity from this portion of the receiver it is essential that each H.F. stage should be tuned to the same wavelength, and experiments have proved that this can be accomplished without resort to variable controls. However, the transformers should be carefully constructed and matched condensers must be used. The mica type of condenser does not lend itself to quantity production of matched capacities, and it is for this reason that the air dielectric condenser is recommended.

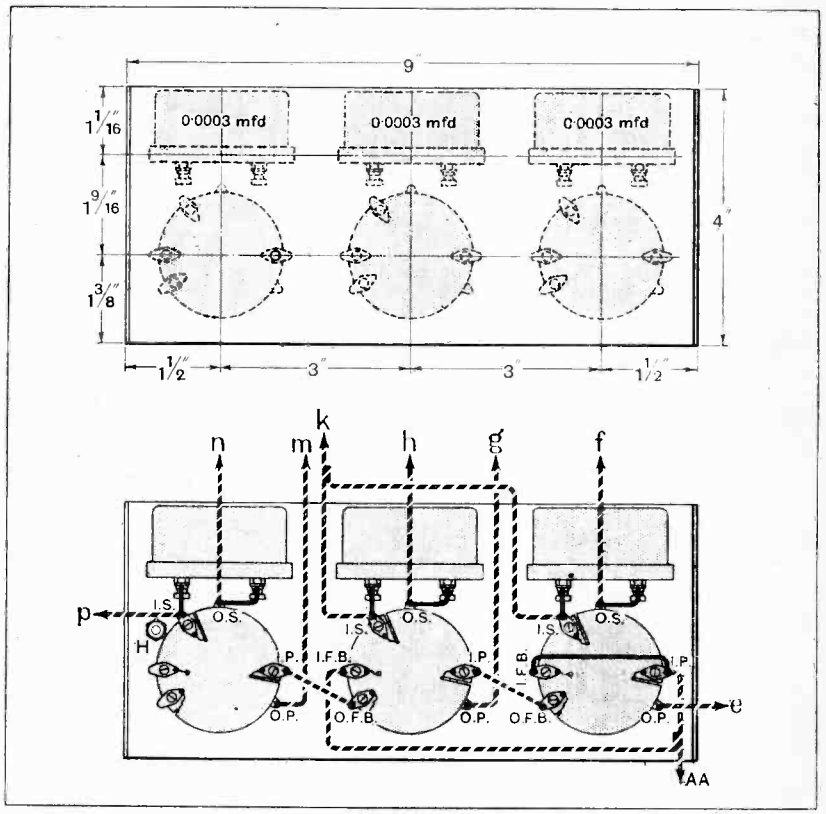
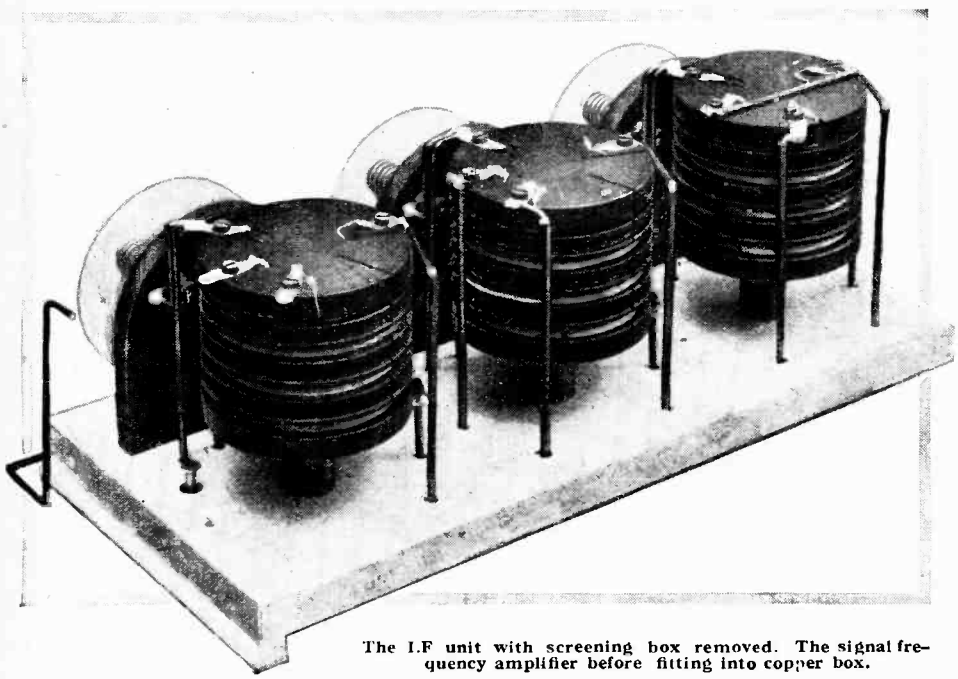


Fig. 4.—Wiring plan of I.F. unit.



The I.F unit with screening box removed. The signal frequency amplifier before fitting into copper box.

The formers carrying the transformer windings, Fig. 2, are turned out of solid ebonite rod, 2in. in diameter, and the width and depth of the grooves must be identical in all three cases, as any slight discrepancy between these individual formers will result in the inductances varying between wide limits. The ¼in. annular grooves should be wound with 300 turns of No. 32 D.S.C. wire and alternative sections connected in series. The method of winding has been carefully planned to facilitate this, and the reader is advised to adhere strictly to the following instructions. By again referring to Fig. 2,

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it will be seen that two narrow slots have been cut longitudinally through the former, and these reach to ⅛in. below the bottom of each groove. The slots should be cut with a fretsaw and great care must be taken not to break the dividing partitions. To guard against the possibility of the partitions becoming displaced during winding, it is recommended that spacing pieces of wood, or other suitable material, should be inserted in the grooves either side of the one being wound.

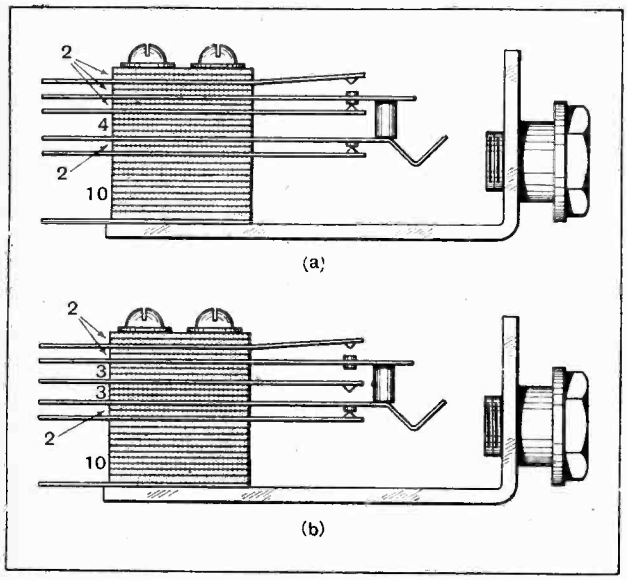

Fig. 5.—(a) The Igranic P66 jack before alteration. (b) After making the necessary modification.

The direction of the windings in the seven grooves is shown in Fig. 3 (a), and the method adopted of interconnecting the various sections can be seen from Fig. 3 (b). No. 3 should be wound first, and packing pieces must, therefore, be placed in grooves 1, 2, and 4; however, before inserting the packing in grooves 1 and 2 the commencement of the wire must be laid in its respective longitudinal slot and bedded well down below the bottom of sections 1 and 2. Having inserted the distance pieces in grooves 1 and 2, wind 300 turns of No. 32 S.W.G. D.S.C. green-coloured wire in the No. 3 and finish off by tying the last turn with cotton to a few of the neighbouring turns. Now remove the packing from No. 2 groove and wind this in the same manner as No. 3, only in this case use the white-coloured wire. The packing pieces in No. 1 groove can now be removed, and this wound with 60 turns of No. 26 S.W.G. D.S.C. wire. It is important to see that the direction of the winding is the same in these three sections. The next groove to be wound is No. 4, but before inserting the packing pieces in No. 5 groove the commencement of the wire must be laid in its respective longitudinal slot, leaving about six inches protruding beyond the end of the former to facilitate joining to the commencement of the last secondary section. The direction of the winding in No. 4 groove must be opposite to that in Nos. 1, 2, and 3; this is very important and must not be overlooked. The white-coloured wire should be used, as this winding forms a portion of the transformer secondary and is therefore the same as No. 2. The remaining grooves will be completed in rotation, viz., 5, 6, and 7; the green wire being employed for sections 5 and 7 and the white for No. 6. The direction of the winding in No. 5 should be the same as that in No. 4, but those in 6 and 7 must follow the same direction as 1, 2, and 3. Three transformers will be required, and the instructions given above should be carefully followed in all cases. An examination of the circuit diagram will show that two of the transformers only need to be provided with a feed back winding, but it is thought that standardisation of construction will considerably simplify the work.

Screening.

The intermediate transformers and their condensers are mounted on a small sub-panel made from hard wood covered with a sheet of copper and battens are fixed to the underside, thus enabling the various wires to be brought out to their respective connections. A copper box, provided with two dividing partitions, totally encloses the unit, so that each tuned circuit is individually and completely screened. A general idea of the completed unit, with the screening box removed, can be obtained from the illustration. and the wiring plan is shown in Fig. 4.

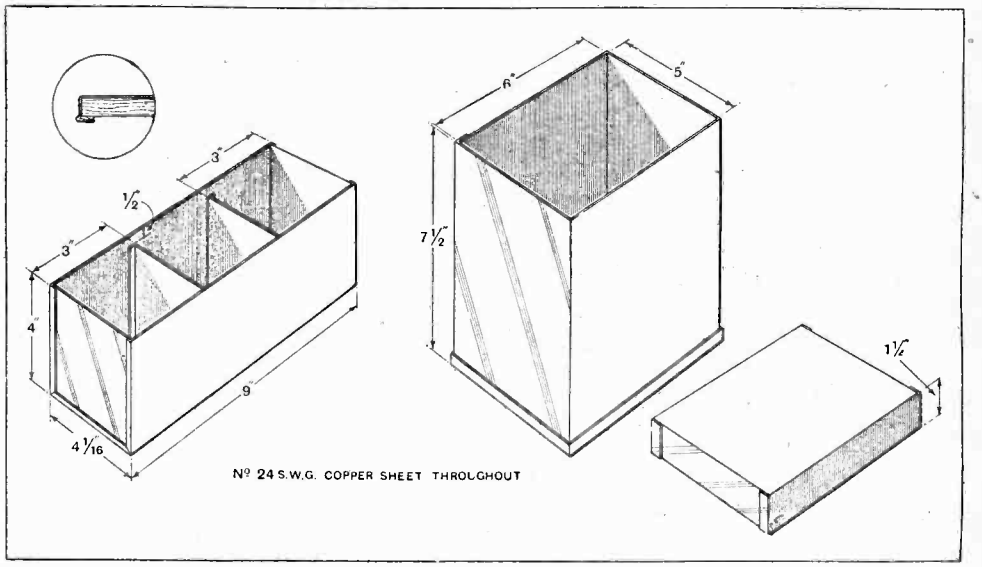

Fig. 6.—Details of the two copper screening boxes and metal covering on I.F. sub-panel.

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The single-valve signal-frequency amplifier is constructed as a separate unit, and, similar to the I.F. amplifier, is completely screened in a copper box. The importance of screening in receivers embodying high-frequency amplification must not be overlooked, especially in cases where a high amplification per stage is obtained, or when two or more stages are cascaded. The necessity for complete screening is, perhaps, more essential with a frame aerial receiver than with any other type, for the reason that the input circuit is very lightly damped. The signal frequency amplifier is constructed as a separate unit, and all the component parts are assembled on a small wooden base which, when completed, is lowered into the copper box, and the whole held in position by two wood screws passing through to the baseboard. A neutralised tuned anode circuit is employed in conjunction with a medium voltage amplification valve, and commercial components can therefore be used, thus obviating the necessity for special constructional work. The only point of interest about this portion of the receiver is the provision of jack switching to enable this unit to be switched in or out of circuit as the occasion demands. Generally speaking, switching in H.F. circuits is not to be encouraged, but if this is necessary to simplify tuning and it can be accomplished with the minimum of losses, its inclusion is justified. Without some means of switching out the signal frequency amplifier there would be three essential, and critical, tuning controls, and this would render the initial tuning-in of stations a tedious process, whereas with two controls tuning is reduced to quite a simple matter.

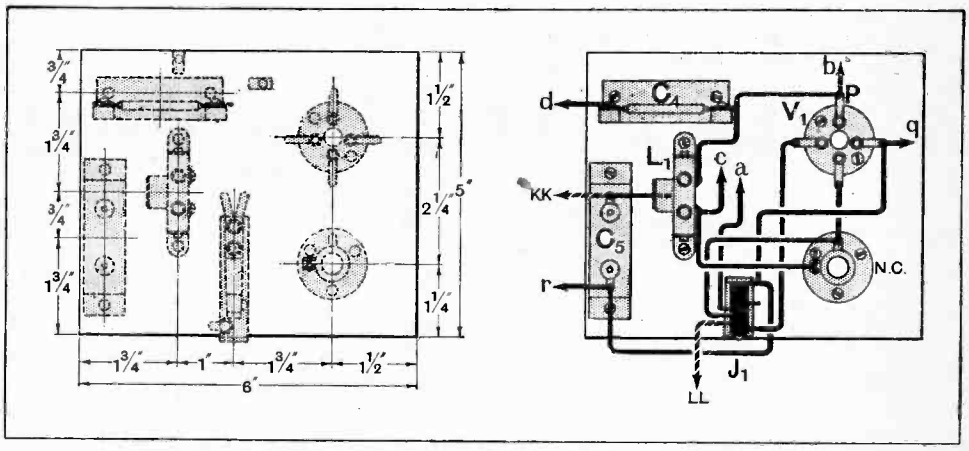
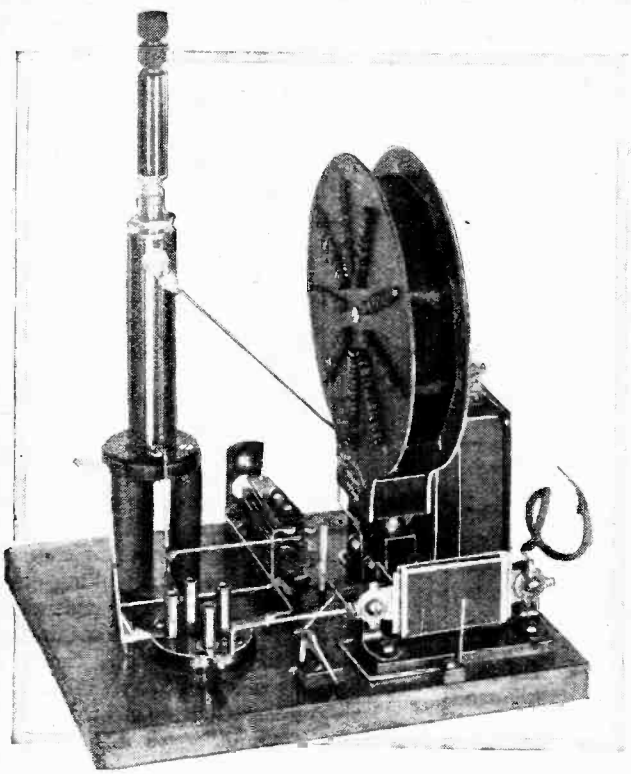


Fig. 7.—Wiring plan of signal-frequency amplifier.



The signal-frequency amplifier unit removed from the screening box.

Alternative Frame Positions.

With the frame aerial lead plugged into the second jack, the signal frequency amplifier is out of action, but on changing the plug to the first jack (in copper box) the amplifier is brought into circuit. The switching has been planned to simplify the tuning, and this can be accomplished only when the variable condensers tune their respective circuits under all conditions. Unfortunately, the switching of the first valve cannot be carried out with a commercial pattern jack, but, by the exercise of a little care, a standard jack can be altered to comply with the requirements. An Igranic No. P66 jack was therefore obtained and modified in the manner shown in Fig. 5; (a) shows the standard vehicle and (b) the modification.

The above conditions will hold good only with the tuned anode method of H.F. amplification, and transformer coupling cannot be employed, even though this possesses certain advantages over the former. A careful examination of this portion of the circuit will show that, unless certain precautions are taken, the H.T. + 1 tapping will be short-circuited to H.T. negative during the initial travel of the plug when inserted in the second jack, and to overcome this a blocking condenser, with a capacity of 0.0005 mfd., is connected between the anode of the H.F. valve and the second jack. This provides a path of low resistance for the high-frequency oscillations, but effectively blocks off the D.C. component.

The neutralising condenser should be mounted on supports so that the ebonite spindle protrudes through the screening cover. This enables the condenser to be adjusted without upsetting the balance due to the effect of hand capacity.

(To be concluded.)

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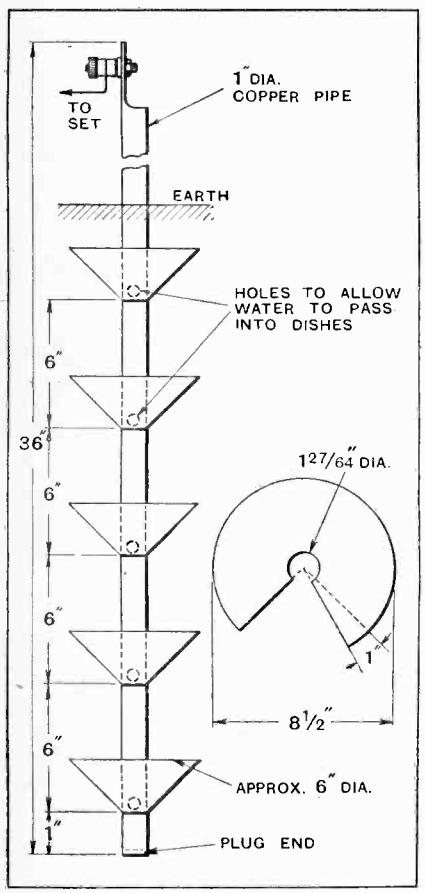
READERS' NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

AN EFFICIENT EARTH TUBE.

Probably fifty per cent. of amateur wireless sets would be improved with a better connection. Very often a good deal of care is spent on the aerial and anything is considered good enough for an earth. This appears to be particularly the case where the garden space is restricted and a plate cannot be sunk, the usual earth being a spike, very often of iron, driven into the ground.



Copper earth tube.

The earth tube shown was designed to overcome this difficulty where the owner had only a small patch of soil available, the surrounding ground being paved, but with soil underneath joining the exposed portion. Its features are that it penetrates a good depth of soil, exposes a large surface area of metal to the damp ground, and can be kept thoroughly damp adjacent to the exposed surface.

Primarily, it consists of a copper tube plugged at the bottom end with conical dishes or saucers like inverted lamp shades soldered at intervals (brazing is better, of course). The tube has a hole drilled or cut to communicate with each dish, and the end is left open at the top.

A hole requires to be dug in the earth 18in. square by about 2ft. 6in. deep. The tube is placed in position and earth rammed around it and in the dishes with a bent rod. It will be seen that when water is poured in at the top it fills the tube and oozes through the holes into each dish. If watered persistently it will keep the outer as well as the inner surface of the dishes damp through capillary action. The construction and development of the conical dishes is quite clear from the illustrations.

The device has effected a considerable improvement in results, and can be recommended to readers who are restricted for space.—J. W. M.

VALVES FOR IDEAS.

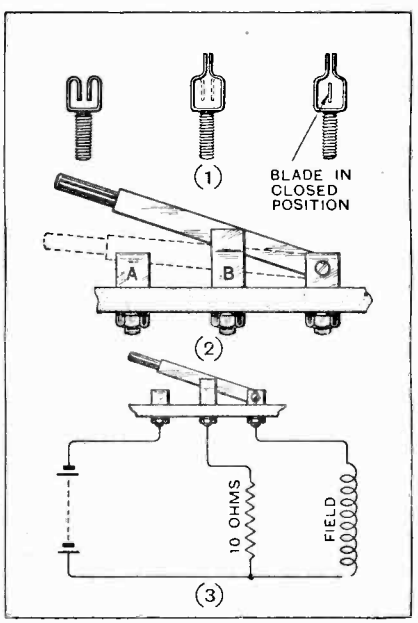
Readers are invited to submit brief details, with rough sketches where necessary, of devices of experimental interest for inclusion in this section. A dull-emitter receiving valve will be despatched to every reader whose idea is accepted for publication.

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

FIELD SWITCH.

The following description of a field switch will probably be found useful to readers possessing Rice Kellogg pattern loud-speakers, in order to prevent breakdown of field windings due to high induced voltages on breaking the circuit.

An ordinary single-pole knife switch is needed and one extra contact, this being bent as in diagram (1) and arranged as in diagram (2). The knife blade must make contact with contact B before breaking contact with contact A. The resistance of about 10 ohms is momentarily across the battery, but the time of contact is so small as to be negligible.



Field switch of coil-driven loud-speaker magnets.

Using this switch connected as in diagram (3), no spark can be detected when breaking a field taking 3 amps. at 6 volts. H. J.

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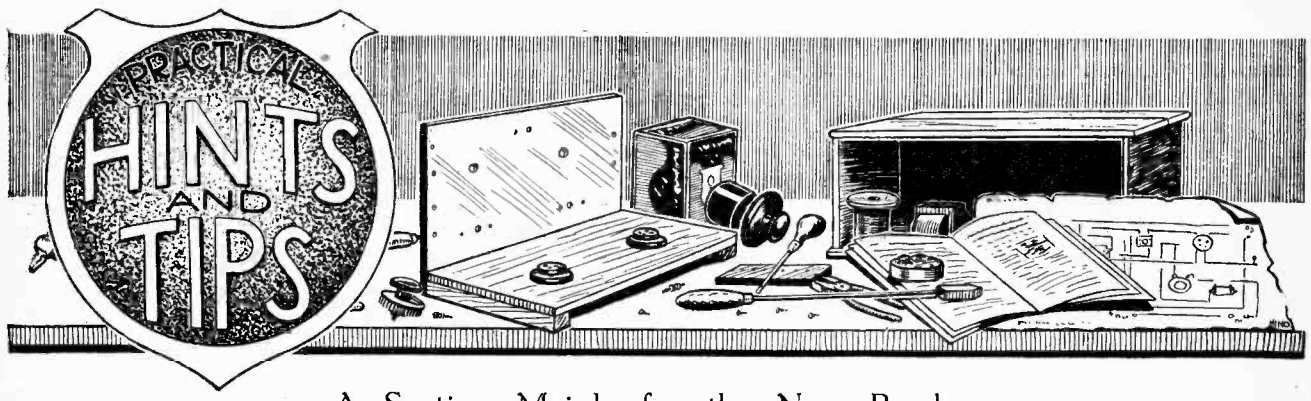

A Section Mainly for the New Reader.

WIRING A RECEIVER.

IN a recent paragraph in these columns it was stated that a theoretical diagram should not be followed blindly when wiring a set; two examples were shown where, for the sake of simplicity in conventional drawings, actual connections are not exactly as the diagrams would seem to indicate. This has perturbed several correspondents, who seem to doubt if they are correct in habitually ignoring practical wiring plans. Let it be stated emphatically that their method of procedure is unquestionably right, if they are sufficiently acquainted with the general principles of layout and wiring; by adopting it they gain a greater knowledge of their receivers than would result from too great a reliance on simplified aids to construction. Those who take the trouble of mastering theoretical diagrams will be able to alter their sets in order to keep them in line with future developments, and will also be in a better position to trace any trouble which may arise.

It is hoped that the foregoing will serve to dispel any impression that the paragraph in question implied that it is unwise to work from theoretical diagrams; the difficulties as regards the connections of components likely to arise as a result of doing so are few and far between, and it will be found that essential information on puzzling points is always given in constructional articles.

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SIMPLIFYING THE D.C. HIGH-TENSION ELIMINATOR.

THE design and construction of any kind of H.T. eliminator is greatly simplified if we decide to restrict ourselves to a single output voltage. As a matter of fact, there was, even in the past, a tendency to over-estimate the advantages of a separate anode supply for each valve, although admittedly this was sometimes made necessary by the fact that the H.F. part of the set was unstable when a sufficient voltage for good amplification was applied. Nowadays, however, with the general adoption of easily operated neutralising systems, it is quite usual to apply voltages of well over 100 to high-frequency amplifiers, and the increasing popularity of anode bend detection renders unnecessary a lower voltage for the rectifier. Indeed, a grid circuit detector valve works quite well with 120 volts, particularly if it is of the high-impedance type with a transformer primary of high inductance in its anode circuit. Even if we are using a general-purpose valve as a detector in this manner, there is still no real need to reduce the applied voltage artificially, as the same effect will be obtained by resistance-coupling it to the L.F. amplifier.

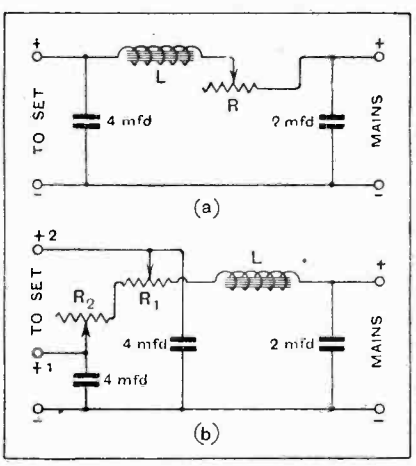

Fig. 1.—(a) A single-voltage eliminator for D.C. mains. (b) A similar arrangement, with series resistance for a second output voltage.

Sets depending for their sensitivity almost entirely on critical control of reaction are exceptions to the rule, as they require a fairly close adjustment of anode voltage for best operation; however, except for short-wave work such arrangements are less popular than formerly, and in any case they are not the most likely to give the best possible result on mains supply.

It may be said that the output valve should be supplied with a greater voltage than the others; this is perfectly true, and here we come to the one real disadvantage of the single-voltage eliminator. It must be remembered, however, that the average power or super-power valve is rated by the manufacturers at some 120 volts maximum, and that only a small number of listeners are likely to use a valve of still greater power-handling capacity, or alternatively to risk a reduction in the life of an ordinary valve by over-running it. As far as the average amateur is concerned, very good results can be obtained with a common voltage of about 120.

Assuming that we decide to satisfy ourselves with this arrangement, the simple eliminator shown in Fig. 1 (a) is likely to give satisfactory results, provided that the supply mains are free from serious ripple. It will be seen that a tapped series resistance R is used for reducing voltage; the value of this will depend very largely on the current consumed by the set, and may easily be calculated. As a critical adjustment is not necessary, all we require to have is a rough idea of this, which can be obtained from the manufacturer's published curves.

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Taking a typical 1-v-2 set, such as the "Everyman Four," as an example, with 120 volts on each anode, it may be assumed that the H.F. amplifier will consume 2 milliamperes with $1\frac{1}{2}$ volts negative grid bias. The detector, if operating on the anode bend principle, with resistance coupling, will pass a current so small that it may safely be ignored. The first L.F. amplifier, which will probably be of the same type as the H.F. valve, accounts for another 2 milliamperes, while the output valve, of the ordinary power type, will require perhaps 6 milliamperes with 9 volts grid bias. This gives a total consumption of 10 milliamperes. Now, assuming the mains voltage to be 220, and the voltage required 120, the necessary value of resistance in ohms is obtained by dividing the "voltage to be dropped" by the "current to be passed." ("Volts to be dropped" is, of course, the difference between the mains voltage and that required at the output terminals.) The answer must be multiplied by 1,000 if the current is in milliamperes. In the case under discussion the figures are $\frac{100 \times 1{,}000}{10} = 10{,}000$. Thus a resistance of 10,000 ohms will be required; this should be wire-wound, and may have a few tappings near one of its ends for fine adjustment. It must be remembered that the iron-cored smoothing choke L may have a D.C. resistance of several hundred ohms; this may be compensated for by making a corresponding reduction of R.

The inductance of the choke may be from 30 to 50 henries; the larger the better, provided that it will carry the required current without saturation.

When using a series resistance in an eliminator it must be realised that a reduction in load (or current consumption), such as would result if one valve of the receiver quoted as an example were switched out of circuit, will give rise to an increase in voltage. It is, therefore, a good plan, particularly if valve switching is included, to use a voltage-reducing resistance of a considerably higher maximum value than that ordinarily necessary; commercial tapped resistances of 20,000 ohms would be quite suitable.

When a second (and lower) output voltage is absolutely necessary, another series resistance R_2 may be connected as shown in Fig. 1 (b). If fine adjustment is required, this should be of the continuously variable type.

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USING A GRAMOPHONE PICK-UP.

THERE seems to be a widespread impression that gramophone pick-up devices can be used only with elaborate receivers having a super-power valve, or even several such valves in parallel, in the output stage. This is quite incorrect, though obviously such a set will give a better performance as a gramophone reproducer, in the same way as it is a better wireless receiver than the unpretentious outfit with an ordinary power valve and some 100 volts of high tension.

The majority of pick-ups on the market are reasonably sensitive, and few require more than two stages of low-frequency amplification for loud-speaker reproduction of good volume. This being so, there is very little difficulty in adapting even the popular detector-L.F. two-valve set; all that need be done is to rearrange the detector valve circuit so that a suitable negative bias may be applied to the grid; at the same time, the grid condenser must be short-circuited, and the output from the pick-up applied either direct or through a transformer, between grid and filament.

The necessary modifications to a typical simple circuit of the type under consideration are shown in Fig. 2; the usual reaction coil, connected between detector anode and L.F. transformer primary, is omitted for the sake of simplicity as its presence does not affect results. It will be seen that the pick-up leads are connected to a coil plug which is inserted into the socket which normally accommodates the aerial coil. The grid leak must be connected across its condenser, and a short-circuiting switch is added. The connections of the common bias battery should be carefully noted; instead of joining its positive end to the L.T. bus bar, this connection should be made to the second negative tapping in order that the plug terminating the grid return lead may be inserted into a positive or negative socket, depending on whether the first valve is to be operated as detector or L.F. amplifier. An optional by-pass condenser of from some 0.1 mfd. upwards is shown at C.

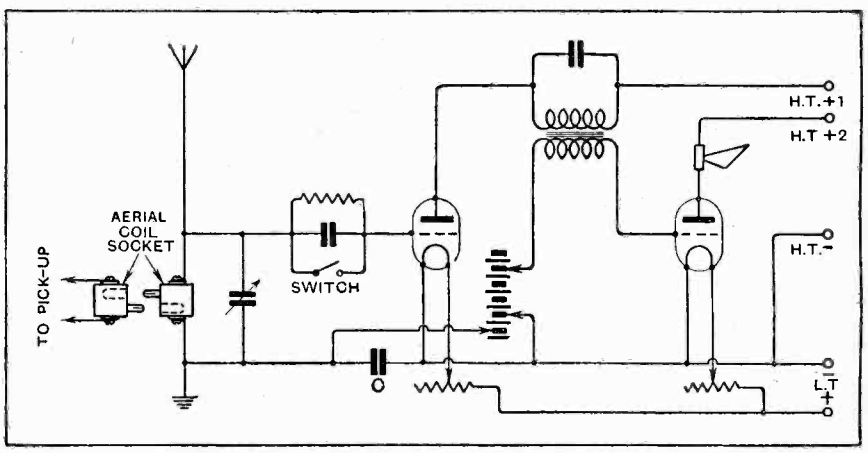

Fig. 2.—Adapting a detector-L.F. receiver for gramophone reproduction.

The problem of alternative radio or gramophone reproduction is still further simplified when the detector valve of the receiver functions as an anode bend rectifier; in this case all that is necessary is provision for altering bias; generally speaking, the negative voltage required for amplification is half that normally applied for rectification.

If potentiometer control of the detector valve is included, the slider must be moved towards the positive end of the winding: the indicating dial may be marked at the two positions. Where control is by means of a tapped battery it may be found convenient to include a switch for changing over.

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A PLEA FOR CHOKE-COUPLING.

High Amplification at Low Frequencies.

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

THERE is a generally accepted notion that the degree of amplification obtained by choke-coupling is inferior to that obtained when transformer-coupling is in use, but that the quality is considerably better. If the same valves are used for the two forms of coupling, this statement is undeniably true, but it is of little practical use for those attacking the problem of the quantitative design of an amplifier. Let us attempt the comparison of the two on a slightly more scientific basis.

The improvement in quality assigned to choke-coupling is based on the increased amplification of low notes as compared with transformers, so that we have ready to hand a suitable basis of comparison. We will compare the overall amplification produced by the two methods when the circuit constants are so adjusted that the low notes are amplified to the same extent by either.

The actual amplification produced by a stage of choke-coupling is given by the well-known formula:

$$A = \mu \times \frac{2\pi fL}{\sqrt{(2\pi fL)^2 + R_o^2}},$$

in which f = frequency, L = inductance of choke, and μ and R_o are the amplification factor and impedance respectively of the valve preceding the choke. In the case of the transformer, the formula is exactly the same, except that the ratio of the transformer appears as a multiplier in the right-hand side, so that in this case

$$A = \mu S \times \frac{2\pi fL}{\sqrt{(2\pi fL)^2 + R_o^2}},$$

where S is the ratio of the transformer, and L is the inductance of the primary winding.

Amplification at Low Frequencies.

It appears at first sight that a transformer gives roughly S times the amplification of a choke, and that the accepted opinion as to relative amplification needs no correction. But if we are to stick to our original proposition—that we are going to compare the two on the basis of equal low-note amplification—we must take a few more factors into consideration.

There is no need to remind readers that a valve of fairly low impedance must precede a transformer if low notes are to be reproduced properly, and it is a characteristic of low-impedance valves that their amplification factor is low also. But when a choke is employed we have at least the possibility of a much higher inductance than can be obtained in a transformer primary, so that there will be no objection on the score of quality to the use before it of a valve of much higher impedance which will have a correspondingly higher amplification factor. The question then arises whether the extra amplification obtainable in this way will compensate for sacrificing the step-up of the transformer; whether, in fact, we can so increase the "μ" of formula (1) that it becomes greater than the "$\mu \times S$" of formula (2) without at the same time incurring any loss in the strength of the low notes.

Obviously, this depends not only on the peculiarities of chokes and transformers, but also upon the characteristics of the valves available. Fig. 1 is a curve showing very roughly the connection between amplification factor and impedance, and is based on the makers' figures for the most efficient valves at present on the market. It will be noticed that it is extended to include valves of a higher "μ" than the highest now made; it is fair to assume, however, that if such valves were obtainable, their characteristics would be represented approximately by the curve, and that if such valves were required the valve makers would produce them.

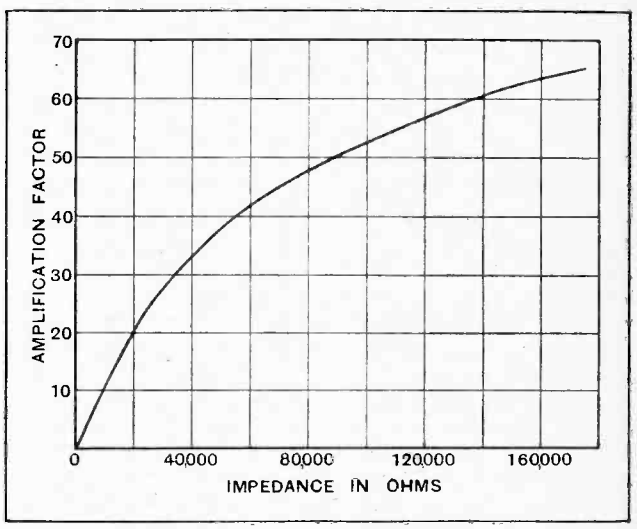

Fig. 1.—Curve showing relation between amplification factor and choke impedance.

Turning now to the characteristics of chokes and transformers, there are only two points that need interest us for our present purpose. The first is that the inductance of a choke (or of a transformer winding) is approximately proportional to the square of the number of turns comprising it, other things being equal; so that in a transformer of ratio 3 : 1 the secondary would have about nine times the inductance of the primary. Secondly, it must always be remembered that neither a choke nor a transformer can have its inductance increased indefinitely by increasing the number of turns of wire, because the self-capacity of the windings then increases to such an extent that the high notes begin to weaken. We may take it for granted that in a first-class L.F. transformer the maximum practicable number of turns has already been

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A Plea for Choke-Coupling.

wound on. We will therefore base our more detailed consideration of the subject on a hypothetical transformer of primary inductance 30 henries, and of ratio 4 : 1. This is at least as good a transformer as can at present be made.

A Comparison.

Let us assume that our requirements as to quality are satisfied by the use of a valve of 7,000 ohms impedance before this transformer; then our low notes will be rendered exactly as well by a 30-henry choke following a 7,000-ohm valve, by a 300-henry choke following a 70,000-ohm valve, or by any other combination in which the inductance of the choke and the impedance of the valve stand in the same ratio to one another as in our original example. That this is so can be seen from either formula (1) or formula (2). These formulæ further inform us that, so long as we stick to this relation between inductance and valve impedance the actual amplification obtained on *all* frequencies will be the same fraction of the " μ " of the valve used, so that we can take the value of " μ " in each case, multiplied by the ratio of the transformer, if we are using one, as the measure of the actual amplification obtained.

Since the actual number of turns in our transformer does not affect our argument, we will take the comfortable round number of 5,000 for the primary turns, which means, with a ratio of 4 : 1, that the secondary will have 20,000 turns, making a total of 25,000 turns all told. Since our transformer is, by hypothesis, the best possible, 25,000 turns must be taken as the maximum practicable number, whether for transformer or choke, and we must make up our minds to do the best we can with these windings as they stand.

If 5,000 turns of wire on any given core provide an inductance of 30 henries, then the total turns, five times as many, will give us an inductance twenty-five times as great, namely, 750 henries, which is the inductance of primary and secondary joined in series. This permits us to precede the transformer, used as a choke, by a valve of impedance 175,000 ohms, and this combination will amplify low notes in exactly the same proportion to others as the original transformer used as such with its 7,000-ohm valve, so that, apart from any alterations of stray capacity effects which may vary the amplification of the very high notes, our quality will be unchanged by this change of circuit.

Now let us compare the overall amplification obtained in the two cases. Using the transformer as such, with a 7,000-ohm valve, of amplification factor 7 (from Fig. 1), the overall amplification of the stage will be proportional to 7×4, or 28. Using it as a choke, with a valve of 175,000 ohms, which would, if it existed, have an amplification factor of 65, the overall amplification would be proportional to 65, so that *without loss of quality* we have increased signals to more than double their previous volume by converting our transformer into a choke and making a compensating change of valve.

In practice, some sort of compromise would have to be made, for there is at present no valve of so high an amplification factor as suggested, and, further, the working impedance of such a valve would be quite sufficiently far above the maker's rating, derived from static curves, to throw our calculations very seriously out. Nevertheless, we might quite safely use a valve of 80,000-ohms impedance, which gives us a " μ " of 50, and so secure very nearly double the amplification of the corresponding transformer circuit.

As an alternative, we might choose our valve for the choke arrangement so as to give us the same amplification as we had with the transformer (which would, in our case, mean a valve with a " μ " of 28, and therefore an impedance of about 30,000 ohms), in which circumstances we should gain a very considerable extra amplification of low notes, obtaining then quality somewhere near the best standard of resistance-coupling, without any necessity for the high plate-voltages which this method is inclined to demand.

Summary.

In conclusion, it is fair to say that a properly designed choke amplifier combines in many respects the advantages of the two rival methods, while the statement so often made that it only succeeds in combining the disadvantages of both is quite obviously based on experiments made with an incorrectly designed amplifier.

Nothing in this note is to be taken as an encouragement to use small chokes of low inductance in conjunction with high-impedance valves. A good choke is as large, as heavy, *and as expensive* as a first-class transformer.

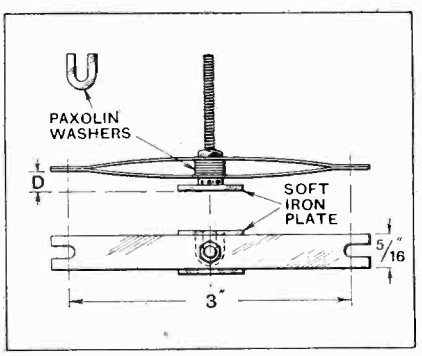
ADJUSTABLE LOUD-SPEAKER MOVEMENT.

A Reader's Suggestion.

No doubt many readers have from time to time experimented with diaphragm-type loud-speaker movements in an endeavour to modify them for driving a cone diaphragm. The accompanying diagram shows an effective way of doing this.

The diaphragm is removed, and its place taken by a soft-iron plate of a size corresponding to the pole pieces of the magnet. A long screw is soldered to the surface of the iron plate for the purpose of attaching the apex of the cone and also for clamping to the suspension. The latter consists of two thin strips of spring material between which are inserted a number of paxolin washers. It will be at once apparent that the distance D can be varied by inserting a suitable number of washers, and that the air gap between the soft-iron armature and pole pieces can be adjusted to suit the volume required from the loud-speaker.

W. R. C.



Adjustable suspension of moving-iron loud-speaker movement.

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NEW USES FOR VALVES.

Now Employed in Power Stations to Control A.C. and D.C. Generators.

By A. DINSDALE.

THERMIONIC valves, primarily developed for use in radio communication, are daily finding new applications in widely different spheres of electrical engineering, and in other branches of science. The two latest applications come from America, where the General Electric Company have devised means of controlling A.C. power-station operation by means of valves; and Professor Nicholas Minorsky, of the Moore School of Electrical Engineering at the University of Pennsylvania, has developed a method of amplifying direct current which can be applied to the regulation of D.C. generators in power stations.

Before an additional generator can be switched into circuit in an A.C. power station it must be started up and the speed so adjusted that the generated output is in synchronism with the current already flowing in the line to which it is to be connected. This is a comparatively simple matter when the incoming generator is situated in the same building as the generators already supplying the line, but when the incoming machine is to reinforce the power fed to the line by generators some miles distant the problem is more difficult.

At the present time, throughout the United States, isolated power plants are consolidating their resources in great central organisations, just as it is proposed to do in this country. With such consolidations and the attendant economies in operation it is possible to tie-in a great number of generating plants, and this pooling of generated power allows a great area to be served from a single system.

The old method of synchronising a group of generating stations was by means of potential transformers and synchroscopes, a method which was effective but expensive; and the latest application of the valve has been developed to meet the new conditions. The "vacuum-tube synchroscope," as the new device is called, gives a direct and immediate indication as to whether incoming machines are running too fast or too slow, and shows the difference in speed without any time lag.

Tapping High-voltage Power Lines.

The first installation of this new type of equipment was made by the G.E.C. at the Menands sub-station of the Adirondack Power and Light Corporation, near Albany, N.Y., and it gives the usual "fast," "slow," and "synchronism" indications without the use of instrument potential transformers.

Potential from the high-voltage power lines to be synchronised is obtained from a capacity transformer, and is amplified by means of valve amplifiers until sufficient power is obtained to operate a synchroscope.

Expensive oil-filled transformer bushings of standard type (see Fig. 1), oil circuit breakers, or other apparatus can be replaced by a modified bushing when a capacity transformer is substituted for a potential transformer.

The potential obtained from the capacity transformer,

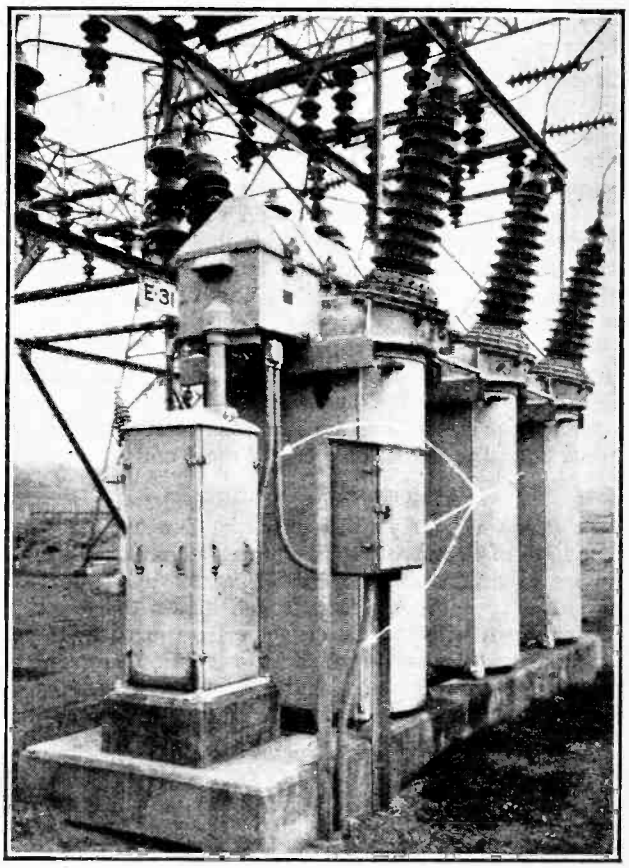

Fig. 1.—Synchroscope installation attached to a high-voltage outdoor sub-station. Arrows indicate leads from capacity transformer to synchroscope unit.

which is in phase with the line-to-neutral voltage of the system, is impressed on the grid-filament of a valve and amplified. This valve, it is stated, should not be more than 50 ft. from the transformer, and is built into a weatherproof housing for outdoor mounting. The arrangement is shown in Fig. 1. One such amplifier is required for each bus-bar and line to be synchronised, and it requires a five-wire multi-conductor cable with 500-volt insulation to connect it with the sub-station where the high-power amplifiers are installed.

The station equipment consists of a valve and control unit, a motor-generator set, and the synchroscope. The valve and control unit consists of two 50-watt amplifying valves and their associated equipment. Fig. 2 gives a front view of the unit, together with the synchroscope on a swinging bracket on the right, and a back view of the panel, showing the valves, transformers, etc.

A Compact Unit.

This amplifying panel, which measures 76in. × 22in., amplifies the energy received from the low-power outdoor amplifier until it is sufficiently powerful to operate the synchroscope. It will supply any number of synchronising points at one sub-station, proper switching being provided to take care of a number of circuits where this is necessary.

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New Uses for Valves.—

The panel can be placed in any convenient position in the station, and on it are also the controls for the motor-generator unit.

This unit consists of a driving motor, a filament alternator, a grid bias generator, and high-voltage, double-commutator generator. The driving motor requires approximately 1kW., and operates from the station battery, or, with a different type of motor, from A.C. The filament generator supplies filament current for all the valves, while the bias generator supplies grid bias voltage for the valves and excitation current for the high-voltage generator. This latter supplies direct current at 500 volts for the plate of the outdoor amplifying valve, and 1,000 volts for the indoor amplifier.

The insertion of the synchronising plug starts the motor-generator set, which lights the valve filaments and supplies all necessary power. Where several lines have to be synchronised the connections are alternately transferred to the indoor amplifier so that only one of these units is required.

Amplifying Direct Current.

Professor Minorsky's discovery of a new use for valves is perhaps of more far-reaching scientific value. Up to the present valves have usually been operated under alternating current conditions, but it is well known that a steady direct current will flow through a valve when its filament is heated and a positive potential is applied to its plate. It is by controlling the magnitude of this steady direct current by means of a minute alternating voltage applied to the grid of the valve that we obtain, in the output circuit of the valve, a greatly amplified replica of the original input voltage variations. This output is an alternating current.

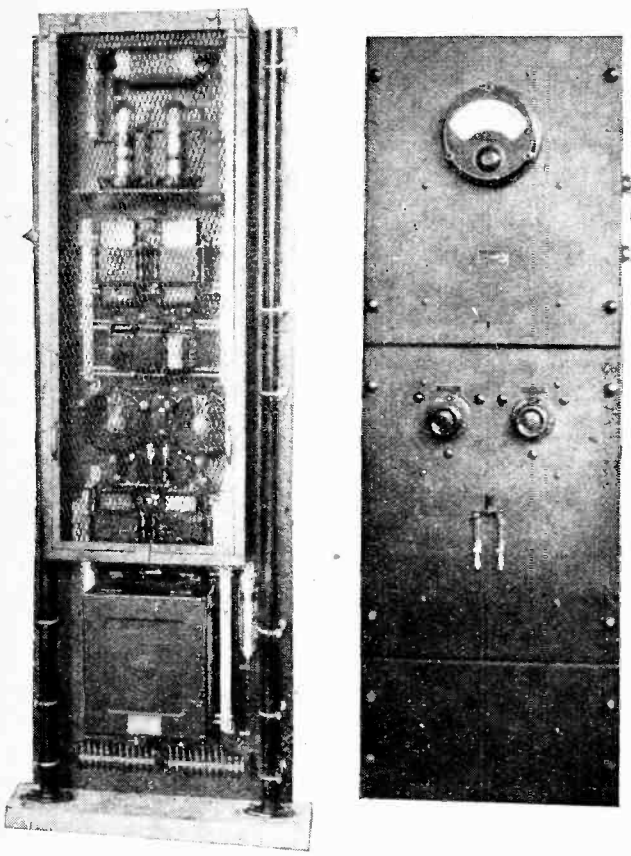

Fig. 2.—Indoor amplifier of vacuum-tube synchroscope.

The common application of this phenomenon to the needs of radio communication has tended to make us lose sight of the valve's potentialities in the direction of direct current work, but in a recent paper[1] Professor Minorsky describes a method of arranging a series of valves

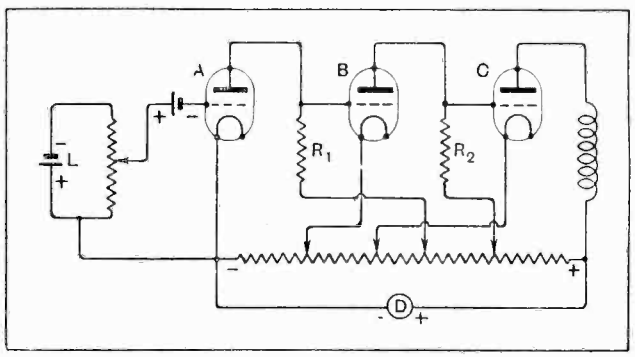

Fig. 3.—This series of valves, all supplied with H.T. from the potentiometer across the dynamo, will deliver a large D.C. in the anode circuit of the last valve, C, in response to a small signal initiated by the subsidiary circuit, L, and applied to the grid of the first valve, A.

whereby he obtains in the output of the last stage a large direct current in response to a small signal impressed upon the input circuit.

In this new arrangement, which acts as a direct current amplifier, the output of one valve communicates with the grid of the next, all valves being supplied with adjusted D.C. plate potentials from points along a potentiometer, as shown in Fig. 3. When the characteristics of the valves and associated circuits are suitably related to each other (for the details of which the original paper should be consulted) the final valve of the series possesses a peculiar kind of instability by virtue of which a small change of the grid potential of the first valve causes the plate current through the last valve to alternate between a high value and a value which is virtually zero.

Professor Minorsky calls this action a "contact effect," thus emphasising the similarity between it and the action of any contact device, such as a switch. By applying to the grid of the first valve a small additional voltage, in the right direction, a relatively large current can be "switched on," or caused to flow in the plate circuit of the last valve, just as if an ordinary contact switch had been closed.

By virtue of the fact that electronic changes occurring within a valve take place instantaneously, and without inertia, the combination acts as an instantaneous switch, or relay. Thus the same quick-acting relay principle which has already contributed to the successful applica-

[1] "Phenomenon of Direct-Current Self-Excitation in Vacuum Tubes and its Applications," by Nicholas Minorsky. *Journal of the Franklin Institute* (Philadelphia), Vol. 203, pages 181-209 (February, 1927)

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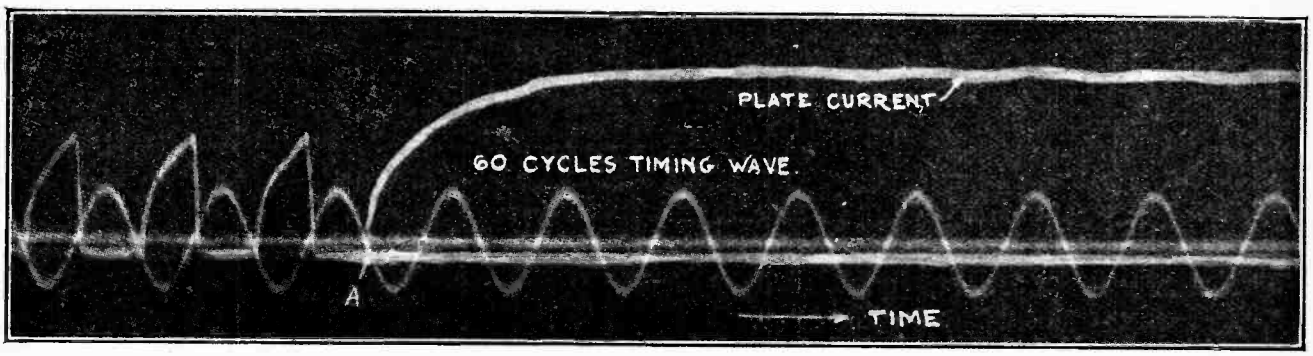

An oscillograph record made by the series of valves arranged by Professor Minorsky to operate as a direct current relay. The regular sine curve is the 60 cycles timing wave. The curve marked "plate current" indicates how quickly the valve relay closed, permitting the plate current to rise, after the starting signal was given to the first valve of the series. The time of this starting signal is indicated at A.

tion of thermionic valves to certain alternating current problems can now be applied to direct current technique.

To close an ordinary switch or relay requires both time and energy, but this new electronic device does the job much more rapidly and with the consumption of very much less power.

One practical application of the principle which has already been made is in connection with the voltage regulation of direct current dynamos. The standard method of doing this requires some form of voltage-operated relay which will open or close a circuit leading to an auxiliary winding on the field coils of the machine. If the voltage of the machine drops below a certain value, the voltage-operated relay closes and switches on a current through the additional field winding, thus strengthening the magnetic field and causing the machine to generate a higher voltage. Once the proper voltage has been restored, or is exceeded, the relay opens and weakens the field again.

The relays so far used for this purpose have been mechanical, being operated by some electromagnetic effect of the altered voltage. Although reasonably satisfactory, they suffer from a definite time lag, and they consume an appreciable amount of power. They also possess mechanical contact points which burn out in time, and require frequent adjustment.

Professor Minorsky has applied his new D.C. amplifier to this class of work, and reports that it operates excellently. It uses very little power, has no lag due to inertia, and does away with troublesome contact points, for the electrons within the valves constitute the "contacts."

Thus we have two more examples of the utility in other branches of science of apparatus originally developed for wireless work.

BOOKS AND CATALOGUES RECEIVED.

Electric Rectifiers and Valves, by Prof. Dr.-Ing. A. Güntherschulze, translated and revised by Norman A. de Bruyne, B.A. Pp. 212, with 94 illustrations and diagrams. Published by Chapman and Hall, Ltd., London. Price 15s. net.

The B.B.C. Handbook, 1928, with foreword by the Earl of Clarendon, Chairman of the Board of Governors; introduction by Sir J. C. W. Reith, Director-General; and articles on programmes, engineering, international broadcasting, publicity, sidelights and the wireless trade. Pp. 380, profusely illustrated. Published by the British Broadcasting Corporation. Price 2s.

Experimental Radio, a collection of eighty-five laboratory tests and experiments, with notes on different types of receiver and on the apparatus and accessories used, by Prof. R. R. Ramsey, Indiana University, U.S.A. (Second edition, revised.) Published by the author and sold by the University Book Store, Bloomington, Indiana.

Redfern's Rubber Works, Ltd., Hyde, Cheshire. The book of Redfern's "Ebonart" radio panels, ebonite, rubber and "Fernolie" radio accessories.

Selby and Co., 6, Hauberk Road, Lavender Sweep, London, S.W.11. Price list of Igranic condensers, Sterling Baby loud-speakers, and other standard wireless lines available by post, c.o.d. if desired.

A. F. Bulgin and Co., 10, Cursitor Street, Chancery Lane, London, E.C.4. List 116, relating to foreign-made "Competa" radio products. List 117, dealing with British-made "Deckorem" radio products, including jacks and switches, remote control units, panel illuminators, chokes, etc., etc. List of "Aermonic" radio requisites.

W. G. Pye and Co., Granta Works, Cambridge. 16-page art catalogue dealing with the range of Pye valve receivers. Leaflets dealing with Pye portable receivers and components.

The Camden Engineering Co., Ltd., Bayham Place, Camden Town, London, N.W.1. 12-page pamphlet dealing with "Centroid" variable condensers, screened coils, etc.

Pelham's, Ltd., 5, Banner Street, London, E.C.1. Leaflet describing the "Pelham Five," with particulars of the "Axuel" Timepiece Three, a receiver automatically switching on and off at chosen times.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. Leaflet O.V.72, indicating reduced price of K.L.1 type valve. Leaflet O.V.90, describing K.H.1 H.F. and L.F. amplifying and detector valve with indirectly heated cathode.

Star Engineering, King Street, Didsbury, Manchester. Price list of "Webson" moving coil loud-speaker parts.

S. G. Brown, Ltd., Western Avenue, North Acton, W.2. Leaflet describing the "Brown" electrical gramophone pick-up.

Enterprise Manufacturing Co., Ltd., Electric House, Grape Street, Shaftesbury Avenue, London, W.C.2. List No. 93, dealing with the "Emaco" range of wireless cabinets.

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ECONOMICAL GRAMOPHONE PICK-UP APPARATUS.

Messrs. L. E. Jaccard, 19-23, Clerkenwell Road, London, E.C.1, point out that the price of the gramophone motor used in the apparatus described in the above article should be 32s. 4d., and not 22s. 4d. as stated on page 593 of the November 2nd issue.

A double-spring motor of another type is, however, available at the lower price mentioned.

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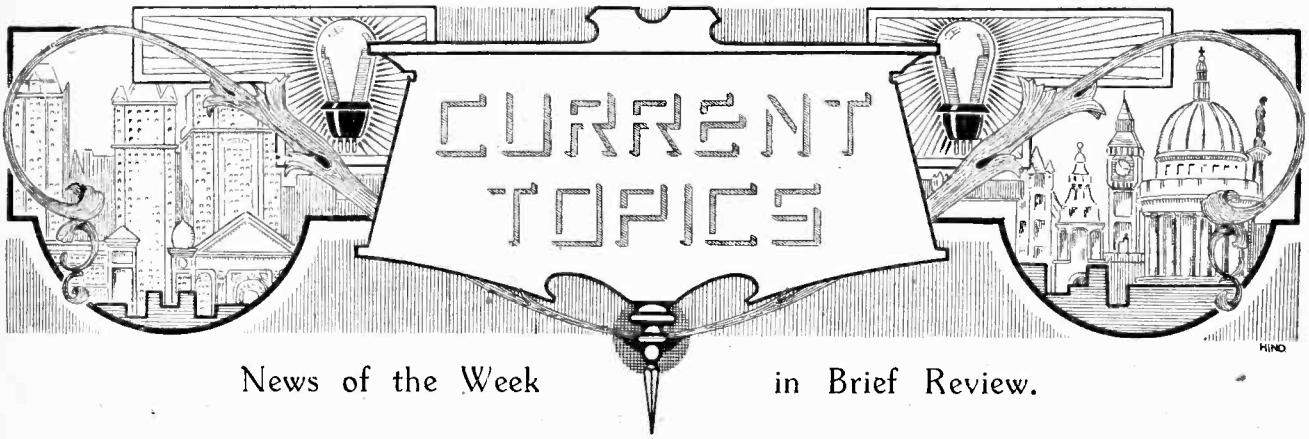

News of the Week in Brief Review.

LET YOUR FRIENDS LISTEN.

National Wireless Week will be ushered in on Sunday next, November 13th, when the B.B.C. will open a series of special programmes.

The motto for the week is: "Let your Friends Listen."

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BIG TRANSATLANTIC TALK.

Seventy-five people participated in a telephony talk between New York and London in the early hours of November 1st. The demonstration of the Transatlantic service was made in connection with the visit to New York of the delegates to the Washington International Conference. Each conversation was necessarily brief, but every word was heard clearly on both sides of the Atlantic.

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HOSPITAL WIRELESS SCHEME COMPLETED.

The final hospital in the list of those equipped with wireless through the "Daily News" fund is the Woolwich War Memorial Hospital, Shooters Hill, which was opened on Wednesday last by H.R.H. The Duke of York. The installation was handed over on behalf of the Fund by Mr. B. F. Crosfield.

Since the fund was inaugurated by the late Mr. J. Hugh Jones, then managing editor of the "Daily News," 15,766 beds have been supplied with listening points.

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GALE UPSETS WIRELESS.

During the gale at the beginning of last week several wireless stations were put temporarily out of action, including the Daventry and Liverpool stations of the B.B.C. The beam service to Australia and India was also affected owing to damaged land-lines.

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TWO ASPECTS OF WIRELESS.

The relationship between wireless and the Press was referred to in a speech by Lord Burnham at Edinburgh on Wednesday last. Broadcasting and newspapers, he said, would in all probability stimulate and prosper one another, not by mutual aid or mutual confidence, but by playing upon human weakness; or, to put it in a more favourable light, by quickening human intelligence.

BETTER THAN CIGARETTE CARDS.

A well-known firm of cigarette manufacturers is offering a wireless valve for every 150 coupons collected from cigarette packets.

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ANY PIRATES IN POLAND?

According to the Ministry of Posts and Telegraphs in Poland, there are now more than 95,000 registered listeners in that country.

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WIRELESS SHOW AT LEEDS

The Leeds Wireless Exhibition will open on Tuesday next, November 15th, at the Fenton Street Drill Hall, under the auspices of "The Yorkshire Evening Post."

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SEA WAVES AND WIRELESS WAVES.

That the variations in the wavelength of WCGU, Coney Island, U.S.A., are due to the rise and fall of the tides is the explanation given by Mr. R. W. Daniels, chief engineer of the station. According to the *Telegraph and Telephone Age* tests with a laboratory oscillator showed that the wavelength fluctuated between 210 and 211.6 metres in accordance with the rise and fall of the tides. It should be mentioned that the station aerial is 75ft. from the breakers.

This experience suggests that many of the European broadcasting stations may be nearer the sea than we had imagined, judging from their wavelength vagaries!

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BLIND LISTENERS.

The total number of free receiving licences issued to the blind now exceeds 9,000.

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NEW BROADCASTING STATION?

"A microphone is to be placed in the local church so that inmates of the Medway Poor Law Institution might hear the services *by wireless*."—Daily Paper. The italics are ours.

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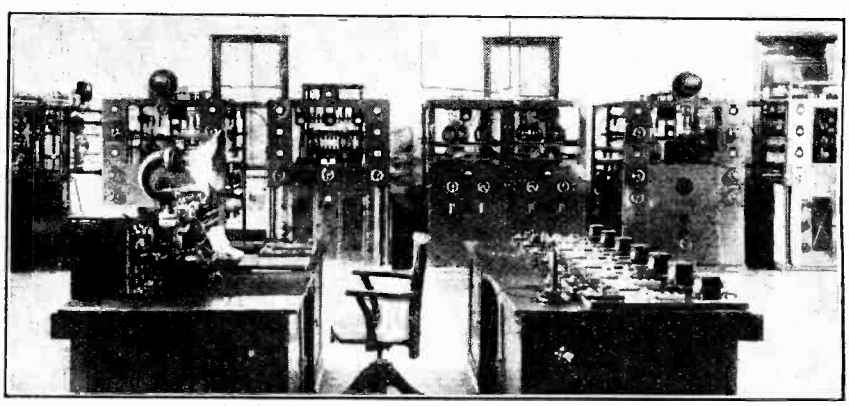
WIRELESS WEATHER REPORTS.

The growth in the use of wireless weather reports receives mention in the report of the Meteorological section of the Air Ministry for 1926-27. In the twelve months under review 4,714 reports were received from thirty-two North Atlantic liners. The number of British observing ships regularly making weather reports to all ships along all the trade routes has more than doubled.

"The practical application of the work at sea," says the report, "is steadily



BROADCASTING FROM SYDNEY. A view of the transmitting room at the Pennant Hills wireless station from which the programmes of 2 FC were transmitted on short waves on September 5th and October 30th. The control table is in the foreground while in the background can be seen the transmitting panels. Marconi valves are used throughout.

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being organised with the voluntary co-operation of marine observers, and the support of many of the marine superintendents of the great steamship lines, with a view not only to aiding navigation, but ultimately to aid aerial navigation overseas. In home waters evidence of the value to shipping of the British Weather Shipping Bulletin has continued to come in, and during the year the appreciation of sailors was especially evident."

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"W.W." IN PATENT SPECIFICATION.

It is interesting to note that *The Wireless World* is mentioned no fewer than three times in Patent Specification No. 276,584, accepted on September 1st, 1927, and now published. The patentee, Herr Rudolf Alban Clausnitzer, of Lubeck, Germany, describing improvements in super-regenerative circuits, refers the reader to the first attempt to use a multi-back-coupling as outlined by Edwin H. Armstrong in *The Wireless World* of November 18th, and he refers to the same article twice subsequently in the same specification.

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"W.W." SETS EXHIBITION.

The exhibition of *Wireless World* sets at 116, Fleet Street, E.C.4, closed on Saturday last after a successful "run" extending over several weeks.

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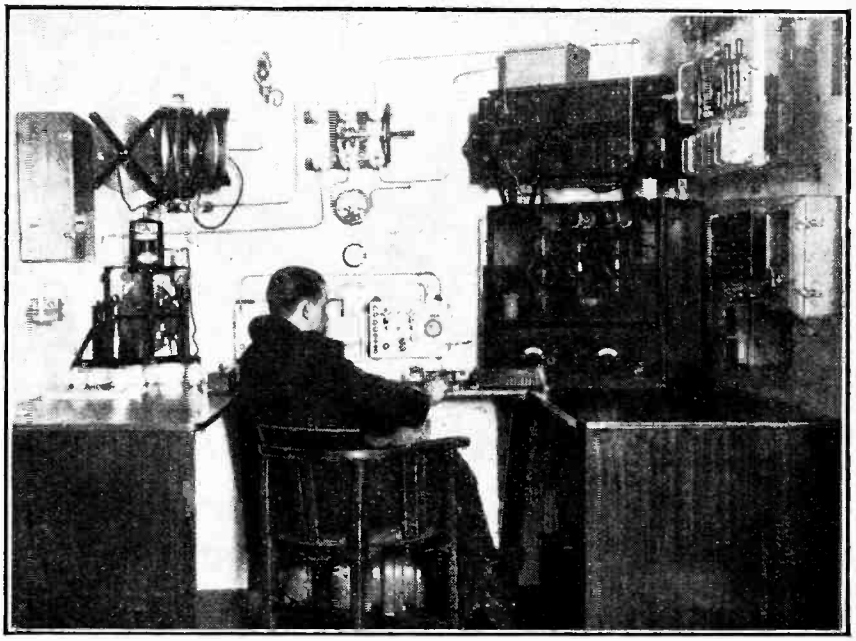
A CORRECTION.

We regret that, through an oversight, an error occurred in printing the address of Messrs. Metro-Vick Supplies, Ltd., in the description on page 607 of our last issue of the Cosmos A.N.P. coils on view at the Manchester Wireless Exhibition. The company's Manchester addresses are at 14, Long Millgate, and Trafford Park.



SHIP'S SET AT MANCHESTER EXHIBITION. The Cunard exhibit at the Manchester Wireless Show, showing a complete ship installation manufactured by Siemens Bros. and Co., Ltd., Woolwich. The main transmitter is of the quenched spark type and is rated at 0·5 kilowatt. A separate c.w. transmitter is included for long distance work.

OFFICIAL WIRELESS TO ISLE OF MAN ?

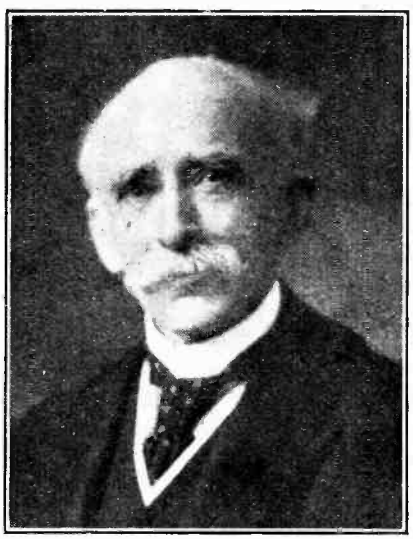
The cost of instituting an official wireless service between England and the Isle of Man is being considered.

DR. FLEMING ON "THE VALVE."

AN historic evening in the annals of the Golders Green and Hendon Radio Society occurred on Thursday last, November 3rd, when Prof. J. A. Fleming, F.R.S., the famous inventor of the thermionic valve, lectured in person to a large audience comprising, in addition to members, representatives of the Hendon District Council and members of other societies.

Dr. Fleming's lecture, which was illustrated with lantern slides, covered the entire history of the thermionic valve and the early experiments which led up to its invention by himself in 1904. In his prefatory remarks, the lecturer reminded his audience that the thermionic valve occupied a place in electrical progress comparable in importance to that of the induction coil and the incandescent lamp. The evolution of the thermionic valve could be said to begin with the discovery of the Edison effect, which show that an emission of some sort occurred when a carbon filament was made incandescent. Dr. Fleming traced his researches from the time when he considered that this emission might consist of carbon molecules until that historic evening in October, 1904, when the two-electrode valve was first tried and showed sensitivity to electro-magnetic waves.

How near Dr. Fleming came to the realisation of the importance of a third electrode can be seen by the fact that soon after this event he was experimenting with a piece of rubbed sealing wax with the object of diverting the electron stream between the filament and the plate! "It was unfortunate," remarked Dr. Fleming, "that it did not occur to me at the time to place the third element inside the bulb!"



Dr. J. A. Fleming, F.R.S., who lectured on the history of the thermionic valve at last week's meeting of the Golders Green and Hendon Radio Society.

Dr. De Forest's introduction of the grid was next described, and Prof. Fleming then dealt with experiments conducted to improve the emissivity of the filament, concluding with a tribute to the new four-electrode screened valve.

Captain Round, who was present at the meeting, gave some interesting reminiscences in connection with his first introduction to the thermionic valve in New York in 1905. He had been experimenting with valves ever since!

Before and after Dr. Fleming's lecture incidental music was provided by means of special amplifiers and moving coil loud-speakers, constructed by Mr. W. J. Turberville-Crewe, the Society's founder. High tension batteries at over 500 volts were lent by the Edison Swan Electric Co., Ltd., who also exhibited a case of valves of historic interest. It is interesting to recall that Prof. Fleming was technical advisor to the Edison Swan Co. in 1906.

Amongst other exhibits were a case of valves of all dates and types lent by the Osram Valve Co. But the exhibit of greatest interest was the original two-electrode valve constructed by Prof. Fleming twenty-three years ago.

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NOTES & TRANSMITTERS QUERIES

General Notes.

Mr. J. W. J. Tyrrell (2BLX), 15, Boundary Rd., Ramsgate, asks us to state that he is willing to stand by and report by card to transmitters who wish to make tests on modulation, etc., on wavelengths between 45 and 200 metres any evening after 11 p.m. and on Sundays up to 2 p.m., 6 to 7 p.m., and after 10 p.m.

Mr. L. N. Blackburne-Maze (BRS 74), 66, Acacia Rd., St. John's Wood, N.W.8, is also willing to listen for transmissions on the 5-metre band from 2030 to 0800 G.M.T.

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Identification of Experimental Stations.

We have several times in the past drawn attention to the difficulty of locating stations heard, owing to the somewhat perfunctory way in which their call-signs are announced, and therefore fully agree with a correspondent in Newark, who writes: "May I offer the suggestion that the call-signs of experimental stations be announced more frequently and also more distinctly when *telephony* is being employed, as there is no knowing how far their signals may carry on the short waves?"

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Short-Wave Reception.

One or two of our readers have commented on the unusual difficulty in picking up distant signals on 20 to 35 metres during the first fortnight of October, and we shall be glad to learn if this phenomenon has been experienced by other listeners. One correspondent, writing on October 13th, says he had been unable to hear either 2XAD or 2XAF at their usual strength for about a fortnight, though KDKA, on 26 metres, was about normal.

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A station which is attracting some considerable attention at the present time is NU 2XAA, at Houlton Main, U.S.A., which works on wavelengths of 22 to 23 metres, and is often clearly heard.

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Holland and Java Communication.

A correspondent at Bexley Heath states that on Wednesday, October 19th, he picked up PCLL and Bandoeng PK1 at 1400 G.M.T., apparently working duplex on a wavelength of about 18 metres.

He is, however, uncertain whether these stations were actually working on duplex telephony, and suggests as a possible alternative that PCLL's transmitting aerial may pick up and re-transmit signals from PK1 which are received on PCLL's receiving aerial, or possibly that the Dutch station may receive PK1 on a loud-speaker within the range of their transmitting microphone and thus unintentionally relay PK1's transmissions. It will be interesting to know if other listeners have noticed this peculiarity.

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Sydney, 2FC.

We have been inundated with reports from listeners who have heard the short-wave transmissions from Sydney, 2FC, either in the early morning between 6 and 7, when experimental tests are being carried out, or between 6 and 7 p.m., when the station transmits specially for England. The general opinion seems to be that there is very little fading, but that atmospherics are troublesome. A listener writing from Sidcup states that he heard the programme on Sunday, October 16th, from 6.15 p.m. until 7.10 p.m., using the two-valve "Empire Short-Wave Set," described in our issue of June 29th; and another, in Southwold, Suffolk, reports having received this station on 28.5 metres at the same time, the strength being R3-R4 on a single-valve receiver.

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New Call-signs and Stations Identified.

2AV E. Thomas, 81, Hoel Fedw., Morriston, Swansea. (Change of address.)

5CB Capt. K. E. Hartridge, 52, Westbourne Terr., W.2, transmits on 46 and 150 metres. (Change of address.)

6GC J. G. Carlson, 28, Johnson St., South Shields, transmits on 8 metres and will welcome co-operation with other experimenters using this wavelength.

CLI A. E. Livesey, Stourton Hall, Horncastle, Lincs, transmits on 8 and 45 metres. This station will not be working until next March. Mr. Livesey's present address is: 15, Rue d'Orleans, Pau B.P., France.

6 PN Mr. Frederick Holden, of 5, Frinton Rd. Stamford Hill, London, N.15, advises us that he has relinquished the call-sign 6 BJ, but that he will be pleased to receive reports on station 6 PN at the above address. 6 PN is situated at Finchley, London, and is crystal-controlled at a wavelength of 44.75 metres. Usual operating times: 19.00–22.00 G.M.T. on Tuesdays and Thursdays.

2APW A. D. Narraway, The School House, Moreton, Nr. Oswestry. (Change of address.)

2AXA Ivor A. G. Cole, 174, Broomwood Rd., Clapham Common, S.W.

2 AXK H. A. Shea, Hayden House, Essex Rd. Romford. (Change of address.)

2 AYB R. W. Hobbs, 78, Cranbrook Rise, "Beehive," Ilford.

2BCM A. L. Clare, 13, Macmillan St., Rochdale, Lancs.

2 BPJ T. A. Whitelev, 13, Haslam St., Rochdale.

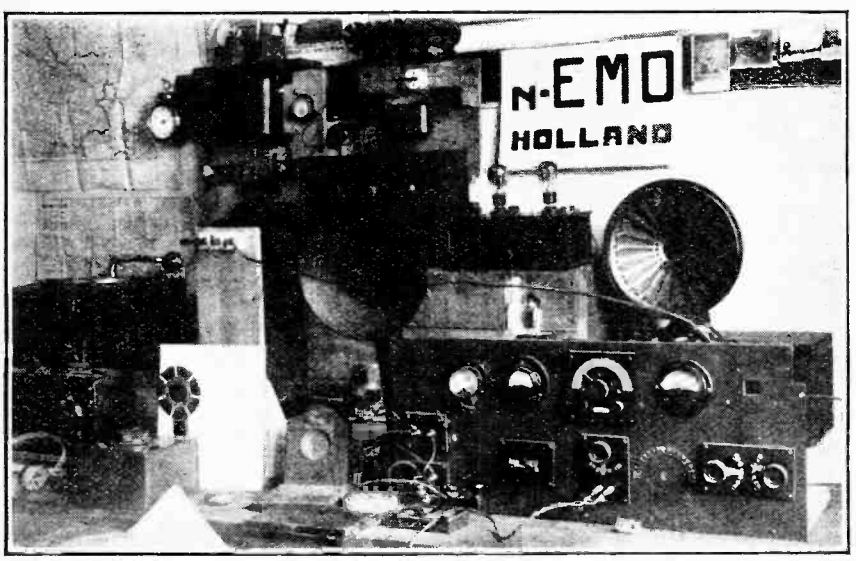
NU 9BZI R. W. Theilke, Ackley, Iowa, U.S.A.

FE A1ES Corpl. W. E. Corbett } No. 1 Wireless Coy.,
FE A1WT Sergt. N. A. Norcross } Egypt Signals, Polygon, Cairo, transmit on 20–45 metres with an input of about 100 watts, usually working 0001–0200 and 0330–0430 G.M.T.

GW 19C G. R. S. Pennefather, 3, Adelaide Terr., Summerhill, Cork.

OC OBK Rev. G. H. Horan, Observatoire de Ksara, Said Nail, Beyrouth, State of Grand Lebanon. Transmits on 35-metre waveband.

XEF 8TA Mr. Archdeacon, S.Y. "Esperanto," St. Cloud.



A DUTCH TRANSMITTING STATION. EN EMO, at Hillburg, near Amsterdam. This station is working on telephony every Sunday between 12.10 and 13.10 on 43.47 metres and the operator will welcome reports.

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THE PROBLEM OF SELECTIVITY.

Showing its Intimate Connection with the Problem of Good Quality Reproduction.

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

IN these days of many powerful broadcast stations comparatively close together in wavelength, the problem of selectivity of tuning in a receiver has become extremely important, and it is the purpose of this article to show as simply as possible on what factors selectivity of tuning depends and how it is connected with the problem of good quality of reproduction.

It is really necessary, in order to understand the problems involved, first to consider the case of a simple-tuned circuit consisting of a coil of inductance L, and a variable condenser C, the total effective resistance of the circuit being "lumped" and represented by R, as shown in the diagram Fig. 1.

If a voltage E, at a definite frequency, is induced in the circuit by some means—by an aerial coupled to the coil picking up from a broadcast station, for example—a current, which may be denoted by *i*, will flow in the circuit, and the value of this current, for a given value of E, will depend on the setting of the tuning condenser C.

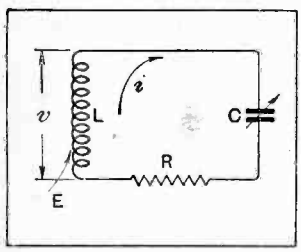

Fig 1.—A simple tuned circuit with inductance L, capacity C, and resistance R. The induced voltage E produces a current *i*, which in turn produces a voltage *v* across the inductance.

The effect of the current *i* flowing through the coil L is to set up a voltage (*v* in Fig. 1) across the coil, and it is this voltage which is applied to the crystal or valve, as the case may be, in every wireless receiver.

If the current *i* or the voltage *v* is plotted against the value of condenser C, a curve of the shape shown in Fig. 2 will result. This curve is usually called a resonance curve. In the case illustrated in Fig. 2 the resonance curve has a sharp peak value when C has a value of 300 micro-microfarads, which corresponds to the capacity required to tune the circuit to the incoming inducing frequency. In Table I actual values of the voltage across the coil are given, as a percentage of the voltage at resonance with 10 ohms circuit resistance, for various values of the tuning condenser.

This table has been prepared for a circuit consisting of an inductance of 200 microhenries, a resonant capacity of 300 micro-microfarads (tuning to about 450 metres), and three values of circuit resistance. The results are given in the form of three resonance curves in Fig. 3, which show the relative voltages obtained across the coil for the three values of circuit resistance when there is a fixed inducing voltage E. It will be seen that the value of R fixes the maximum voltage across the coil when tuned, but that there is hardly any difference in the voltage for other values of capacity, except in the *immediate* neighbourhood of the resonant capacity.

This means that while a good low-resistance circuit will give a large peak value of voltage at resonance, it will not do anything towards reducing the voltage across the coil at points far removed from resonance.

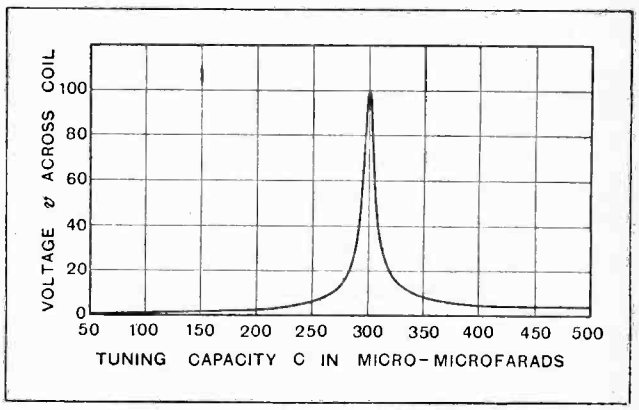

Fig. 2.—A resonance curve showing the relation between tuning capacity C and the voltage *v* across the coil. The voltage scale is arbitrary.

For capacities greater than the resonant capacity the circuit behaves chiefly as an inductance to the current *i* circulating in it, and for an infinite capacity it would behave as a practically pure inductance to this current. The impedance of the coil at any frequencies likely to be used will be very many times the value of R in practice, so that there will be a definite limiting value to the voltage across the coil which depends, for a fixed inducing voltage E, on the value of L, the inductance of the coil. Thus, the greater the value of L, the larger is this limiting voltage at any given frequency. In the circuits considered in Table I and Fig. 3, this voltage is 1.22 per cent. of the maximum voltage obtained with the 10 ohm circuit.

TABLE I.

C. mmfd.	Percentage Volts across Coil. R=10 ohms.	R=20 ohms.	R=30 ohms.
50	0.245	0.245	0.245
100	0.613	0.613	0.613
150	1.25	1.25	1.25
200	2.56	2.55	2.53
250	6.1	6.05	5.97
270	10.9	10.7	10.4
280	16.7	16.0	15.1
290	33.6	29	24.4
295	58	41	30.2
298	89.5	48.5	32.9
300	100	50	33.3
302	89.5	48.5	32.9
305	61	42	30.6
310	35.9	30.5	25.2
320	19.3	18.3	16.9
330	13.3	12.9	12.4
350	8.6	8.5	8.4
400	4.9	4.9	4.9
450	3.68	3.68	3.68
500	3.08	3.08	3.08
∞	1.22	1.22	1.22

TABLE II.

C. mmfd.	Percentage Volts across Coil. R=10 ohms.	R=20 ohms.	R=30 ohms.
50	0.245	0.49	0.735
100	0.613	1.226	1.839
150	1.25	2.5	3.75
200	2.56	5.1	7.59
250	6.1	12.1	17.9
270	10.9	21.4	31.2
280	16.7	32	45.3
290	33.6	58	73.2
295	58	82	90.6
298	89.5	97	98.7
300	100	100	100
302	89.5	97	98.7
305	61	84	91.8
310	35.9	61	75.6
320	19.3	36.6	50.7
330	13.3	25.8	37.2
350	8.6	17	25.2
400	4.9	9.8	14.7
450	3.68	7.36	11.04
500	3.08	6.16	9.24
∞	1.22	2.44	3.66

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The Problem of Selectivity.—

An important point arises here, which perhaps is best explained with the aid of Table II and Fig. 4, which show the variation of voltage in the three circuits with tuning capacity when the *resonant* voltage is the same in each case. This means that the value of the inducing voltage E will be twice in the 20-ohm circuit and three times in the 30-ohm circuit its value in the case of the 10-ohm circuit.

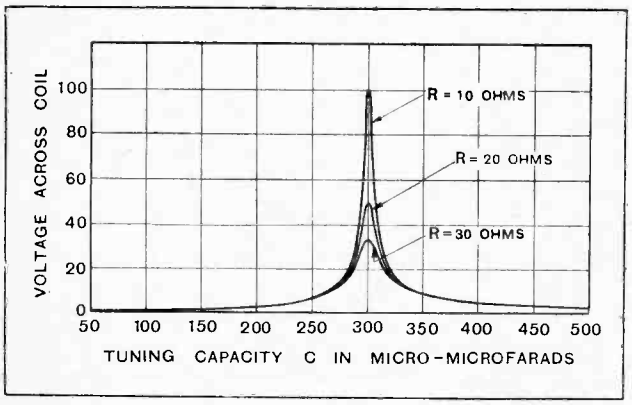

Fig. 3.—Showing three resonance curves for three different circuit resistances, for a fixed inducing voltage E. The voltage scale is arbitrary.

So far, we have been considering a single inducing frequency which corresponds to an unmodulated carrier wave. The actual output from a broadcast station, however, does not consist of a single frequency, but may be regarded as a narrow band of frequencies, the width of the band being 20 kilocycles. Just as one frequency may be tuned by one valve of capacity C, so a band of frequencies will correspond to a "band" of capacity values—in the case of the example selected in this article the 20-kilocycle width is represented by the capacity range 295 to 305 micro-microfarads approximately.

The band width of 20 kilocycles (or 10 kilocycles each side of the carrier frequency) corresponds to a modulation of the carrier wave for all frequencies up to 10,000 cycles —the carrier frequency plus 50 cycles representing a modulation of 50 cycles, and so on.

Turning again to Fig. 4 and Table II, we see that while each circuit gives 100 per cent. voltage at the carrier frequency (*i.e.*, a modulation of zero frequency) at a modulation of 10,000 cycles (corresponding to 295 micro-microfarads capacity), the 10-ohm circuit gives 58 per cent., the 20-ohm 82 per cent., and the 30-ohm circuit 90 per cent. of the maximum voltage. This means that for uniform modulation from 0-10,000 cycles at the transmitting station there is much more uniform reception with the 30-ohm circuit than with the 10-ohm circuit; in fact, if the resistance is reduced below this value the distortion (in future called frequency distortion) introduced by the extra peakiness of the resonance curve will be distinctly noticeable in the reproduction, especially when a good amplifier and loud-speaker are being used.

When it is remembered that the rectified current from a detector (valve or crystal) varies very nearly as the *square* of the applied voltage, it will be seen that even the 10-ohm circuit is going to introduce a certain amount of cut-off of the higher modulation frequencies which may be noticeable.

Thus, the rectified current at resonance being taken as 100 in each case, the Table III shows the relative rectified currents for the three circuits at modulations of 2,000 cycles (corresponding to 299 micro-microfarads), 4,000 cycles (corresponding to 298 micro-microfarads), and 10,000 cycles (corresponding to 295 micro-microfarads).

TABLE III.

Tuning Capacity C in micro-microfarads.	Corresponding Modulating Frequency.	Percentage rectified current.		
		R=10 ohms.	R=20 ohms.	R=30 ohms.
300	0	100	100	100
299	2,000	94	98.5	99.5
298	4,000	80	94	97.5
295	10,000	58.6	67	82

It should be noted that Table III represents the output from only a single tuned circuit and rectifier. If two or more tuned circuits are used, then the frequency distortion will be much worse, since the effect is cumulative; thus using two similar circuits (*e.g.*, in an H.F. amplifier) the "overall" resonance curve when they are both exactly in tune will be the curve for a single circuit with the ordinates squared, while for three circuits the ordinates would be cubed, and so on. It is easy to see that by using several comparatively high resistance circuits all in tune it is possible to obtain an extremely "peaky" overall resonance curve. The conclusion we are forced to, then, is that to avoid frequency distortion as far as possible in the tuned circuits it is necessary either to use comparatively high resistance circuits, and few of them—which means poor selectivity, as will be shown—or that we must introduce a counter distortion further on in the receiver to enable us to make full use of low-resistance circuits to their full extent.

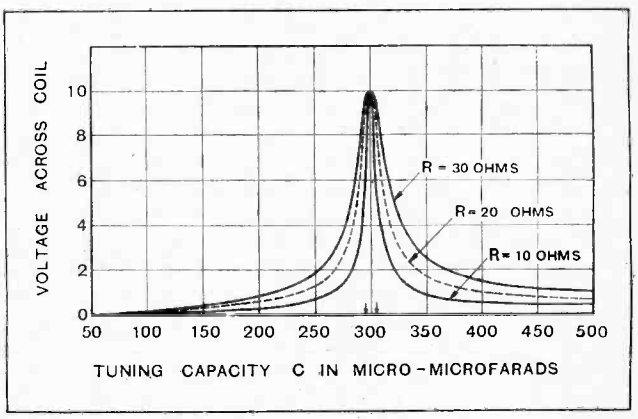

Fig. 4.—Three resonance curves for three circuit resistances, with same peak voltage in each case. The arrows at 295 and 305 micro-microfarads represent the width of the speech band. The voltage scale is arbitrary.

This latter solution is not so difficult as may be imagined, and is one that is very strongly advised by the writer when a long-range selective receiver is required.

What has to be done is to make a low-frequency amplifier which amplifies the higher audio-frequencies much more than the lower and so counteracts the increased output of lower frequencies from the detector.

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The Problem of Selectivity.—

In Fig. 5 the full-line curve A represents the output voltage from the detector over the audio range of frequencies. The dotted curve B shows what the amplifier characteristics should be to give a uniform output to the loud-speaker, as shown in curve C. Of course, the problem of good-quality output is usually not quite so simple as this, because in order to obtain a uniform *sound* output from the loud-speaker at all frequencies, it is not always (or even usually) necessary to feed it with uniform power from the amplifier. However, this latter point is rather by the way in the present article, the main point being that it is quite possible to correct for frequency distortion in the tuned circuits (within reason) by suitable design of the L.F. amplifier. This is becoming more and more important as the design of loud-speakers improves, and, as we have already a fairly good type in the coil-driven cone which will deal with quite a large proportion of audio-frequencies from 0-10,000, the more attention that is paid to this solution the better. Table III shows that the amplifier, following even a single 10-ohm circuit and rectifier, should amplify just three times as much at 10,000 cycles as it does at very low frequencies, while for two such circuits this ratio would have to be $3^2 : 1$, or 9 : 1, which will need rather careful design.

Effect of Circuit Resistance on Selectivity.

Turning again to Fig. 4, let us consider the effect of circuit resistance on selectivity alone. It has been said before that each broadcast station requires a band 20 kilocycles wide (on the normal system of transmission), so that the next possible station below in wavelength to the one giving the resonance curves illustrated will be at 20 kilocycles higher in frequency, corresponding to about 290 micro-microfarads tuning capacity. This is the least separation possible without interference.

Table II shows that at 290 micro-microfarads the *voltage* across the coil is 33.6 per cent. of the maximum value for the 10-ohm circuit, so that if two stations are transmitting simultaneously, are separated by 20 kilocycles in frequency, and induce equal voltages E in the circuit when the latter is tuned to each in turn, when tuned to either station there is an unwanted *voltage* due to the other station of one-third the value of the "wanted" voltage.

The rectified currents due to these two voltages will have the ratio of 9 : 1 (*i.e.*, $3^2 : 1$), but even so, the interference will be quite appreciable.

Considering now the 20-ohm circuit, this voltage ratio (from Table II) is 58 per cent., or a rectified *current* ratio of about 3 : 1, while the 30-ohm circuit gives a current ratio of less than 2 : 1, thus showing conclusively that a single high-resistance circuit is no good at all for selectivity.

Two 10-ohm circuits will give a current ratio of 81 : 1 *when both are correctly tuned*, which is reasonably selective for most purposes except when close up to the local station. In the latter case the voltage induced by the local station (at resonance) may be, say, 10 times at least that for the station adjacent in wavelength (also at resonance). In this case, when the receiver is tuned to the weaker station, with one 10-ohm circuit the voltage ratio will be 100 for the required station to 336 for the local station, showing that the local station will swamp the other; two circuits give a voltage ratio of 100 to about 110 for the local station, the local still louder than the other; while with three circuits the ratio will be 100 : 38, or a current ratio of 100 : 19, which is still only passably selective, since the local station will still be giving a quite good background. If any one circuit is slightly off tune the current ratio is, of course, seriously reduced and selectivity suffers badly.

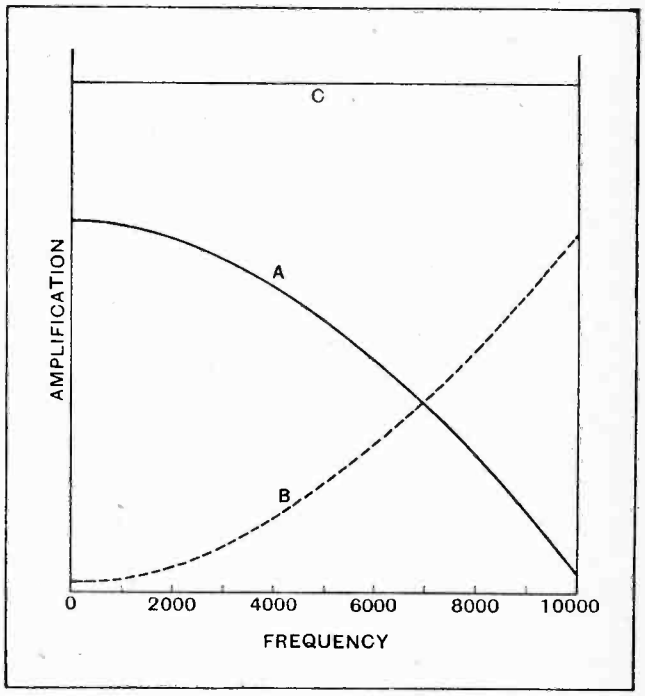

Fig. 5.—Curve A shows frequency-response curve for tuned circuits; curve B shows frequency-amplification curve required by amplifier to give a uniform overall frequency response (curve C).

By reducing circuit resistance better selectivity may be obtained, but it would appear, from what has already been shown, that good selectivity involves frequency distortion, and that in order to take advantage of low-resistance circuits to obtain distant stations it is absolutely necessary to correct for this frequency distortion in the L.F. amplifier.

Limitations of the Loud-speaker.

The reason why this has not received general attention is chiefly due to two things, viz., the average loud-speaker, until recently, has practically no output on the very low or the very high audio-frequencies, and in quite a lot of cases not above about 4,000 cycles, so that one need not worry about these frequencies if the speaker will not put them out anyway, and, secondly, the average ear is very accommodating towards distortion of speech and music—especially music—and there may be various types of distortion present in the loud-speaker and the result still be pleasing to the average ear.

However, it is possible to obtain more perfect results than have previously been considered satisfactory, and it is hoped that this article will have pointed out one line of attack on this problem.

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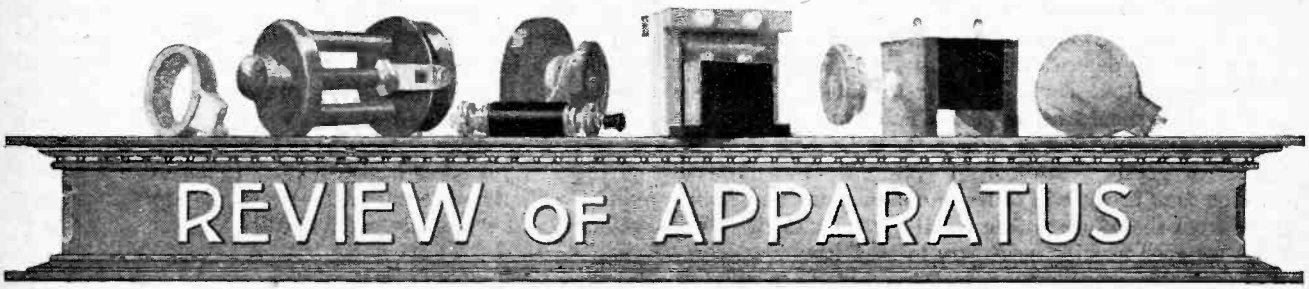


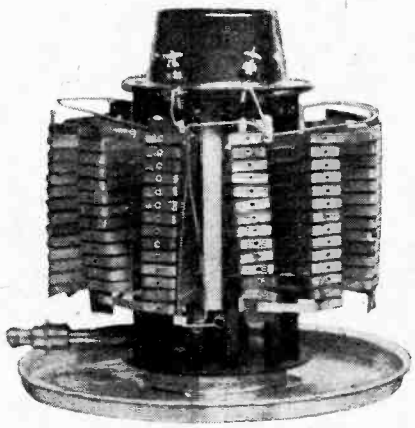
Latest Products of the Manufacturers.

GAS RING BATTERY SUBSTITUTE.

An entirely new method of deriving filament heating current is presented in the "Thermattaix," a thermojunction device designed principally for operating from a gas supply. Comprising a large number of junctions connected in series-parallel, the model tested was found to deliver a current of 0.45 amperes at 2.5 volts. Heat is supplied from a vertical row of jets, around which the thermo-junctions are assembled, asbestos sheets being used to diffuse the heat and to assist in maintaining the output constant. A few seconds elapse after lighting the gas before the full output is developed, and in the 2-volt model, after a period of about a minute, the potential rises to nearly 4 volts on open circuit. One must be careful, therefore, when using the apparatus

A new device for supplying filament heating current, the Thermattaix gas operated thermojunction.

with 2-volt valves to apply the current through a filament rheostat. There is no objection to floating a 2-volt accumulator across the output, though care must be taken to break the accumulator circuit before turning off the gas supply. It might be thought that a device of this kind would possess poor efficiency. It was found with some surprise that the "Thermattaix" consumed only a small quantity of gas, and that many hours' running could be obtained with the consumption of one therm. The manufacturers state that three hours' running is obtained at the cost of 1d., but actually, if the price of gas is 1s. a therm (200 cubic feet), the cost of running may be found to be even less. Provision is made



Interior of the Thermattaix showing the assembly of the thermojunctions.

for attaching a ventilating flue and for permanent use this would seem desirable. This device appears to be foolproof, and is brought into operation merely by lighting up the gas; the output is, of course, entirely free from fluctuation. Attention is drawn in a descriptive pamphlet to the fact that when in use the "Thermattaix" serves to some extent for heating the room. The instrument is well finished, the 140 metal strips composing the units being enclosed under a crystallite finished metal cover, and a voltmeter is fitted. Electric or petrol operated models are also available, rated to give on load 2, 4 or 6-volt outputs. Further information can be obtained from Attaix, Ltd., 106, High Street, Southampton.

For the Soudan Government. Short-wave set built by Radio Instruments Ltd. for the reception of time signals.

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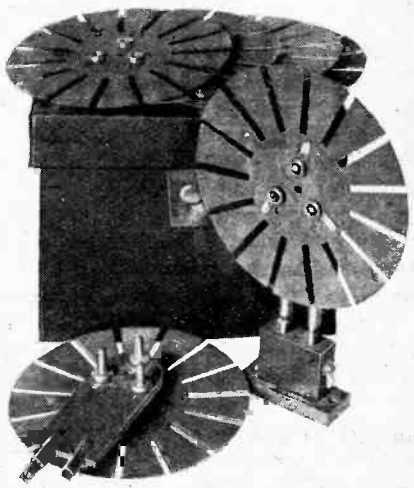
COIL FORMERS.

The amateur will find the range of Nile coil formers designed by the Associated Battery Co., 101, West Nile Street, Glasgow, useful for the construction of all types of radio-frequency inductances.



An inexpensive set of coil formers.

The formers, arranged for the winding of basket coils, are clean stampings in a hard, smoothed surface fibre, and are 4¼in. in diameter. Provision is made for terminating the winding on brass sockets fitted with soldering tags, three sockets being provided for making a tapped winding.

The outfit includes a set of six formers and a pair of mounts. The plugs project on both sides of the mounting pieces, so that a pair of formers can be arranged as an H.F. intervalve coupling using separate formers for primary and secondary.

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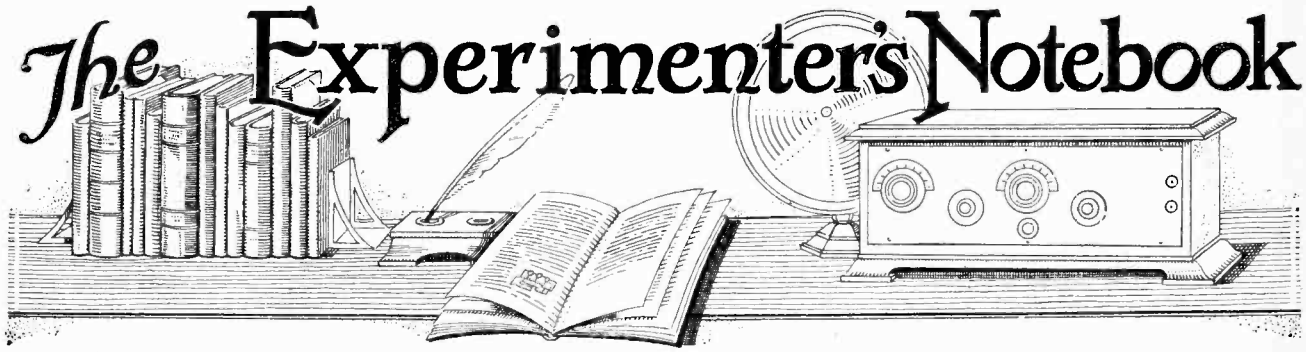
The Experimenter's Notebook



Reaction in Receiving Circuits.

By "EMPIRICIST."

(*Continued from page 624 of the previous issue.*)

THE Reinartz reaction circuit described in the previous issue may be regarded as intermediate in character between magnetic reaction and true capacitative reaction, though the distinction is difficult to draw. In both a simple magnetic reaction circuit and a Reinartz circuit the operation of the device is essentially dependent upon a flow of relatively large current through a path of low impedance, and, in consequence, the operation of the circuit is largely independent of the nature of the alternative path in the plate circuit through which the low-frequency currents flow. If the impedance of this branch of the circuit is reasonably high for high-frequency currents, no appreciable fraction of the latter will flow through it.

We come next to a class of circuit in which there is a plate circuit path for high-frequency currents having an impedance comparable, at any rate, with the impedance of the path through which the reaction current is fed back to the grid circuit; typical of this class is the circuit illustrated in Fig. 3, which while not of very much general interest has certain special characteristics which make it of use in particular cases.

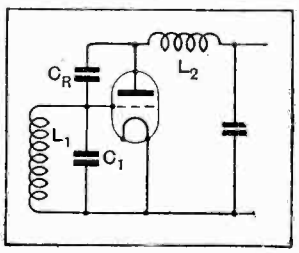


Fig. 3.—Reaction effects are obtained in this circuit if L_2 is made the easier path for H.F. currents.

It will be noted that the circuit L_1 C_1, connected to the grid, is coupled by means of a reaction condenser C_R to an inductance L_2 situated in the plate circuit, the latter being completed through an audio-frequency path provided with the usual by-pass condenser for high-frequency currents. In this circuit the value of L_2 is deliberately chosen so that it is the easiest path for the high-frequency component in the plate circuit and thus determines the phase and amplitude of voltage across it. Due to this voltage, a small current will be fed through the condenser C_R back into the circuit L_1 C_1, and the phase relationship will be right for the generation of oscillations or the production of variable reaction. This circuit is useful when the aerial is tuned by variation of L_1, and in this case control of reaction may be effected by varying the inductance of L_2. If, however, C_1 is varied it will be found that a very great increase of reaction effect is obtained at the shorter wavelengths and, in fact, there is a tendency in this direction in any case with variometers of ordinary construction.

The Hartley circuit of Fig. 4 is a common example of a similar principle of applying reaction. In the embodiment shown in the figure, the inductance L_1 is centre-tapped and the reaction condenser C_R is connected to the remote end of L_1 and to the plate of the valve. In the plate circuit is an impedance X which may be regarded as the resultant impedance of all the high-frequency and low-frequency branches in this circuit.

Principle of the Hartley Circuit.

If X is constructed in the form of a radio-frequency choke of really high impedance, then C_R may represent the path of easiest flow for the high-frequency plate current. In general, however, the impedance of X is comparable with that of the C_R branch and exercises a modifying influence on the properties of the circuit. As a rule, X partakes of the nature of a very small capacity, comparable with that of the valve; in this case regeneration is produced by increasing C_R, with a greater or less distuning effect, according to the magnitude of the equivalent capacity of X as compared with the tuning condenser C_1. It has been found possible, however, to obtain excellent results when X is a resistance of the order of that used in a resistance-capacity amplifier, and this appears to favour smooth working, particularly on short wavelengths.

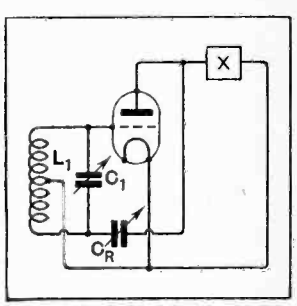


Fig. 4.—The Hartley circuit with centre-tapped coil.

If the inductance L_1 is not centre-tapped, but so arranged that the tapping is brought nearer to the end of the coil which is connected to the reaction condenser, the impedance of the reaction path will decrease, and in order to obtain a satisfactory result it will be necessary to increase the capacity of C_R. The operation of the circuit then approximates very closely to the Reinartz arrangement, the only difference being that the condenser

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The Experimenter's Notebook.—

C_1 is shunted across both the grid and the reaction coil instead of only across the grid coil as in the Reinartz arrangement.

We come next to the consideration of the use of the reaction principle in cases where there is more than one tuned high-frequency circuit. Fig. 5 shows a tuned aerial circuit with a loose coupled secondary, reaction being applied to the latter.

This is not a very easy circuit to tune, though it is indubitably selective when properly adjusted. The difficulty of operation is bound up with the properties of coupled circuits. When the aerial circuit L_1 C_1 is tuned to resonance with L_2 C_2 it will be found that damping is thrown into the latter circuit from the former and more reaction can be applied. When L_1 C_1 is thrown out of tune after the reaction is adjusted the set will oscillate, and as a result the various adjustments are highly interdependent and difficult to manage. If the tuning difficulties are overcome, however, remarkable results can be achieved, as, by the use of coupled circuits, it is possible to obtain a flat-topped resonance curve which enables a great degree of selectivity to be obtained while retaining the essential side waves.

A more usual case to be considered is where one or

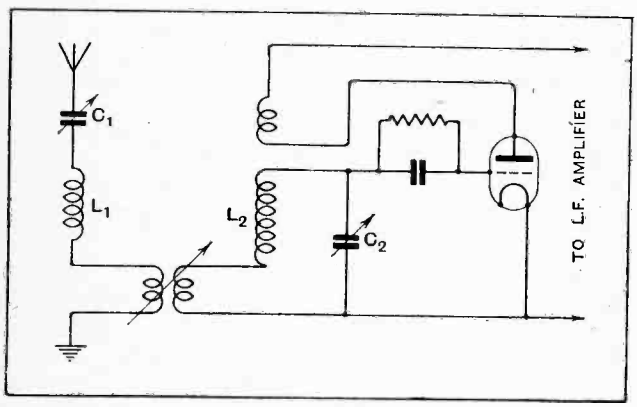

Fig. 5. Loose-coupled tuner with reaction applied to secondary. The tuning of L_1C_1 upsets the reaction conditions of L_2C_2.

more stages of high-frequency amplification are employed, and it may perhaps be assumed from the outset that such stages are neutralised, both in order to simplify the consideration of the problem and also to emphasise once more what has already been dealt with in previous articles, that it is hopeless to make use of reaction so long as there is any appreciable coupling between the circuits of the amplifier.

The function which reaction can best fulfil in the case of a tuned amplifier is the removal of the load due to the plate circuit of the preceding valve. If this can be satisfactorily accomplished a very great increase in magnification results, and it is possible to use for the amplifying valve one which has not necessarily a high amplification factor, but which has a high mutual conductance. In this case, if the application of reaction can be made smooth enough it does not pay to employ a high-frequency transformer, as a tuned anode circuit is just as effective.

In Fig. 6 an amplifier is illustrated which has a stage of tuned anode high-frequency amplification. It will be noted that the grid circuit L_1 C_1 is neutralised in relation to L_2 C_2, the tuned anode circuit by an ordinary neutrodyne coupling L_3 C_3. The operation of this circuit has been previously described, and is doubtless familiar to many readers. It will be found that, as the correct adjustment of C_3 is approached, the circuit L_2 C_2 will tolerate more reaction coupling from the detector valve, but ultimately a point is reached where the movement of the condenser C_3 in either direction will throw the set into oscillation. This is the point where

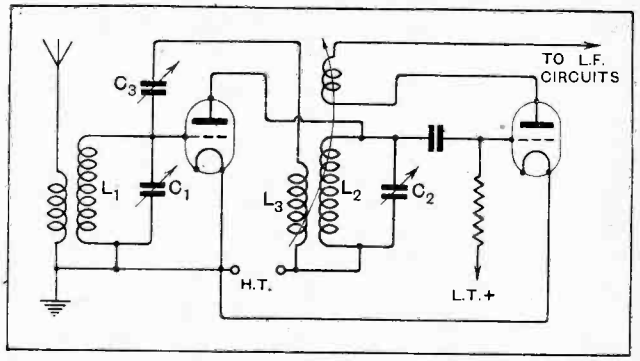

Fig. 6. Reaction applied to the tuned anode circuit of a H.F. amplifier. If neutralisation is perfect the arrangement works with greater efficiency than a transformer amplifier.

the maximum amplification is obtained, and it will be found in general that a higher degree of amplification is obtainable with such circuit than with a corresponding one in which a transformer intervalve coupling is employed. Moreover, it is a matter of indifference what the nature of the first valve is, *i.e.*, whether it is high- or low-impedance valve, since, by means of reaction, we can remove the damping effect of this valve and gain in consequence a great deal of amplification. Mathematical analysis shows that if we apply reaction until a certain loss of side tones results, it is the slope of the plate current-grid voltage characteristic of the H.F. valve and not its magnification which determines the performance of the circuit.

The above points correspond to theoretical conditions, however, and it is pertinent to consider whether these can be adequately realised in practice. First, there is nearly always some residual coupling between the plate and grid circuits which cannot be neutralised out, and, according to the measure of this, so the benefit of using a tuned anode will be greater or less. In a transformer arrangement, the neutralising is less critical and the residual coupling is not likely to be so great; in consequence, unless extreme care is exercised, the fullest advantages of the tuned anode may not be obtained.

Secondly, it is clear that we are dependent for the efficient performance of this circuit on the power to reduce the damping of L_2 C_2 due to the high-frequency valve by applying reaction to it from the detector. As far as the actual "sledge hammer" aspect of this problem is concerned, it is, of course, possible to do so; we can quite easily make L_2 C_2 oscillate, but it is a moot point whether we can make an adjustment of the reaction coupling of such a critical character that the utmost

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The Experimenter's Notebook.—

amplification is obtained. The point is bound up with the curvature of both the high-frequency and detector valve characteristics; if these were ideally straight there is no doubt that this method of regeneration would be completely successful, however low the impedance of the high-frequency valve. On a basis of general experience the writer believes that with a valve having an impedance of the order of 17,000 to 25,000 ohms the tuned anode arrangement gives a better amplification than a transformer, and that this is about the best type of high-frequency valve to use.

The application of reaction to amplifiers comprising more than one stage of high-frequency amplification calls for no special comment. Standard practice tends towards the use of reaction in the last tuned circuit of the chain, and there are no special conditions to be considered except the necessity for increasing the care with regard to neutralisation. This is particularly important in relation to the question of coupling between remote circuits, which was dealt with in a previous article.

The extent to which in general a reaction device can be made to take the place of a low-loss coil is a problem well worthy of consideration, but one which is too far-reaching to be dealt with in the present article. The writer believes that this is a question of degree, and dependent upon the efficiency of the valves employed, the losses which require counteracting, and the amplitude of the received signals. In respect of the first limitation we are undoubtedly in a far better position than we were a few years ago, owing to the improvement in the quality of valves. In respect of the second, experiments carried out with an ordinary valve detector, with reaction applied in the aerial circuit, indicated that a quite amazing amount of resistance could be tolerated, if compensated for by the reaction adjustment. As regards the last factor, there would appear always to be a likelihood of distortion of strong signals in a reaction circuit when very great amplitudes are attained, but, on the other hand, such amplitudes need not be considered, as in the case of strong signals it would not be necessary to use so much reaction. Summing up, it would seem that reaction is by no means supplanted as a result of the "low-loss" era, and that the technique of applying it in a receiving circuit to the best advantage has not been developed to the fullest possible extent.

NEWS FROM THE CLUBS.

Holloway Wireless Club.

A wireless club is to be formed by the Holloway Literary Institute, Hilldrop Road, Camden Road, N.7, meeting on Monday evenings at 7.30 under the direction of Capt. Jack Frost, formerly of the B.B.C. The club is intended for advanced workers as well as beginners, and facilities will be available for the testing of members' sets. The membership fee from November to Easter will be 4s. The first meeting, to be held on Monday next, November 14th, will be open to members of the public free of charge, and those desiring to enrol are asked to communicate their intention to the head of the Institute not later than Thursday, November 10th.

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Wembley Club's Hospital Scheme.

The Wembley Wireless Society is actively engaged in equipping the New Hospital with wireless apparatus. The scheme was recently initiated by the chairman, and provisional sanction was obtained to start the scheme forthwith, as it was necessary to install the wiring before the flooring of the wards was finally fixed. To ensure a thoroughly reliable installation, a strong technical sub-committee was formed with Mr. H. W. Gregory, resident engineer of the North Metropolitan Electric Power Supply Co., as chairman.

The Society is undertaking to finance the scheme among its own members and their personal friends, but as a large sum will be required it is thought that many who are not members may wish to contribute. Any donation, however small, will be gladly welcomed by the wife of the Society's president, Mrs. Cecil Chapman, Woodcock House, Woodcock Hill Lane, Kenton, Middlesex.

The Society has a few vacancies for new members, and application can be made at any of the usual weekly Friday meetings held in the Park Lane School.

All communications should be addressed to the Hon. Treasurer, Mr. H. E. Comben, B.Sc., 24, Park Lane, Wembley.

o o o o

Concealed Loud-speaker Demonstration.

A fascinating loud-speaker demonstration, the instruments being concealed behind a screen, was conducted at the last meeting of the Croydon Wireless and Physical Society by Mr. F. W. Smurthwaite, A.M.I.R.E. Loud-speakers of all modern makes were demonstrated, the members present recording their opinions of each as it was heard from its place of concealment. The voting produced some rather surprising results.

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

o o o o

Loud-speakers Dissected.

Dr. Hodgson, a keen experimenter in loud-speaker design, gave an absorbing talk on the subject at the last meeting of the Radio Experimental Society of Manchester. Beginning with a brief survey of the elements of sound, the lecturer traced the development of the loud-speaker from the earphone. Stress was laid on the fact that not only must the horn and diaphragm be correctly designed, but that the sound chamber was equally important. Concerning the horn, Dr. Hodgson discussed the problem of its natural note and the necessity of fixing the rim to something solid. He described his experiments with the cone type speaker, giving hints on the best way of constructing cones, movements, stands, suspensions, moving-coils and baffle-boards, and the winding of pot magnets, permanent magnets not being recommended. The baffle-board, it was pointed out, was an important factor in the reproduction of the higher notes, as these have a greater tendency to escape round the edge of the cone due to the suction of the air. Thus the cone speaker, which normally had a tendency to reproduce the lower notes better than the horn type, was made a really good all-scale reproducer by the addition of the baffle-board.

Hon. Secretary, Mr. J. Levy, 19, Lansdowne Road, West Didsbury, Manchester.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 9th.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Demonstration of the Society's transmitter, by Mr. F. Dyer (G6IY).

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. Annual General Meeting.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Lecture by Messrs. Cossor, Ltd.

FRIDAY, NOVEMBER 11th.

Radio Society of Great Britain.—Lecture: "The Development of the Broadcast Receiving Valve," by Mr. F. E. Henderson (of the G.E.C.).

Leeds Radio Society.—At Leeds University. Lantern Lecture by a Representative of the Edison Swan Electric Co. Ltd.

Radio Experimental Society of Manchester.—Lecture by Mr. R. M. Kay, B.Sc.(Tech.).

Wembley Wireless Society.—Demonstration of an "Everyman" Set by Mr. N. P. Vincer-Minter (of the Wireless World).

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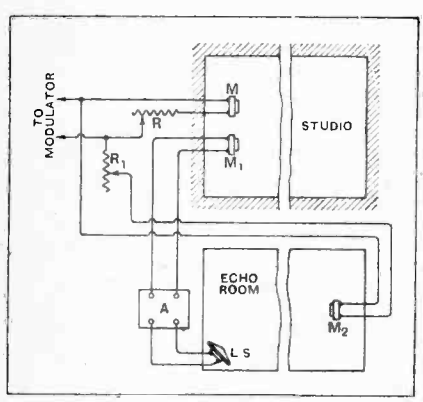
The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 26, Southampton Buildings, London, W.C.2, price 1s. each.

Improving Broadcast Transmission. (No. 276,052.)

Application date: May 13th, 1926.

According to this invention, auxiliary "echo" effects are deliberately introduced at the broadcasting studio in order to enhance the tonal qualities of the transmitted item as reproduced in a loud-speaker. With this object in view, the original sounds as picked up by the microphone in the broadcasting studio are mixed with reverberations produced in a separate room.

As shown in the diagram, a second microphone M_1 is placed near the main microphone M in the studio, which ordinarily feeds the received sounds directly to the modulator. The second microphone is connected through an amplifier to a loud-speaker LS located in an "echo," which, unlike the studio, is free from draping. A third microphone, M_2, is placed in the same room so as to receive the minimum possible direct sound from the loud-speaker, although it picks up the echoes or reverberations. The output from the microphone M_2 is then fed to the modulator circuit in parallel with that from the first



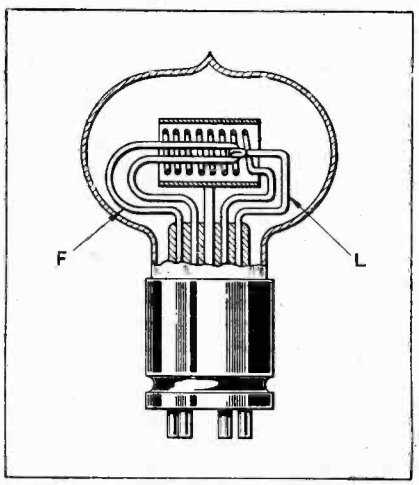
Arrangement for producing artificial echo effects. (No. 276,052.)

microphone M, the relative strengths of the two superimposed currents being regulated by means of rheostats R, R_1. Patent issued to H. J. Round.

Alternating Current Filaments. (No. 271,025.)

Convention date (U.S.A.): May 17th, 1926.

The problem of using alternating current for heating valve filaments is neces-



Filament construction for A.C. supply. (No. 271,025.)

sarily bound up, on the one hand, with unequal electron emission owing to the fluctuating character of the supply, and on the other with impedance variations created by the changing magnetic flux. The present invention aims at removing both difficulties by using a thick filament bent back on itself, so that the two parallel portions lie closely together.

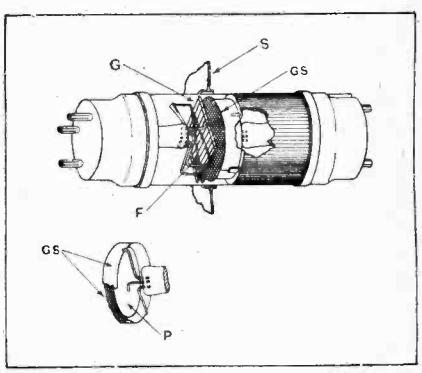
Owing to the mass of the filament it has considerable heat inertia, so that it maintains a constant temperature throughout the cycle of supply, and because of the close proximity of the two limbs the resultant magnetic field is practically nil. The construction is shown diagrammatically, the centre of the hairpin bend of the filament F being joined through a lead L to one of the external contact pins on the base of the valve. For power purposes the filament is designed to carry several amperes at the low pressure of half a volt. Patent issued to the Dubilier Condenser Co.

Screen-grid Valve. (No. 275,335.)

Application date: May 5th, 1926.

The use of a shielded grid to avoid the effects of inter-electrode capacity is an interesting development in valve design, as it affords a self-contained alternative to the use of external balancing or neutralising circuits. As shown in the diagram, the four electrodes are arranged transversely to the longitudinal axis of the glass case or bulb. The filament F is V- or W-shaped, and is mounted inside the inner or control grid G, which consists of a flattened oval winding of wire or wire gauze.

The shielding grid GS is a disc of metal gauze fixed to a metal rim, and the plate P lies immediately behind the gauze shield and consists of a plain metal disc. In order to increase the screening action of the grid GS, an auxiliary shield S, terminating in a flattened rim, is mounted outside the glass bulb. It is fixed as closely as possible to the grid GS, and is directly earthed. The filament F and control grid G are supported from a glass foot at one end of the tube, whilst the plate P and shielding grid GS are similarly mounted from the other end of the tube. Corresponding contact pins are provided at each end as shown. In use the shield-



Construction of the Round screen-grid valve. (No. 275,335.)

ing grid carries a biassing potential of 80 volts, when the plate-operating voltage is 120. Patent issued to H. J. Round.

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Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Empire Broadcast on Armistice Day.—Dominion Listening Points.—2LO Breakdown Drill. B.B.C. and School Wireless Question.—5IT's Birthday.—Friction in Stockholm.

First Programme for the Empire.

It is highly appropriate that the first official programme transmission from 5SW intended for the Empire should be of a truly national interest. This important event will take place on Friday next—Armistice Day—when the Armistice Day Remembrance Festival in the Royal Albert Hall, under the auspices of the *Daily Express*, will be broadcast from 5XX and the Chelmsford short-wave station, the latter operating on 24 metres with a power of 20 kilowatts.

During the programme a short address will be given by H.R.H. the Prince of Wales.

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Times of Reception Overseas.

The time at which the transmission will be made cannot be considered as ideal for reception in Australia and New Zealand, but drawbacks of this kind are bound to occur when any particular transmission is intended for the whole Empire, upon which, as wireless workers have reason to know, the sun never sets. It will be broad daylight in Australia while the Albert Hall Festival is in progress, Australian time being from 9 to 11½ hours in advance of G.M.T.

Reception in India may be more satisfactory, the time there being between 1.30 and 3.30 in the morning. In South and East Africa the programme should be heard fairly well from 10 o'clock onwards, but signals may be fainter in Canada and U.S.A., as listeners there will be in daylight at the time of the transmission.

o o o o

Where They Will Listen.

The B.B.C. states that all the Dominions and Colonies have been advised of this, Britain's first official short-wave effort. It is assumed that short-wave receivers will be brought into use for relay purposes at Sydney and Melbourne in Australia, Poona in India, Cape Town in South Africa, and Drummondville (Quebec) in Canada. It is also considered probable that the short-wave station attached to WGY, Schenectady, will pick up the concert for American listeners.

It is not known whether an official effort will be made to pick up the transmission in New Zealand, but it is highly improbable that all of the several short-wave receivers in Dunedin and Wellington will be inactive.

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The Programme.

Listeners overseas should have little difficulty in identifying the transmission, for the community singing items which will fill the major portion of the programme will include such favourites as

BROADCASTING A LAUNCHING CEREMONY. The B.B.C. has given us several running commentaries connected with the launching of new vessels. This photograph shows the microphone specially used to pick up the sound of the escaping cider used to christen H.M.S. "Devonshire" at Devonport.

"Pack up your troubles," "Blighty," "Soldiers of the King," "Tipperary," and "Long, long trail." The pipes and drums of the Grenadier Guards, the trumpeters of the Life Guards, the band of the 10th Hussars, and the pipes and drums of the Scots Guards will all help to swell the strain.

o o o o

Hats Off to Sydney.

It would be a pity not to place on record Keston's excellent relay of 2FC, Sydney, on Sunday, October 30th. This was certainly one of the best achievements of the B.B.C. in the realm of short-wave broadcasting, and, although not perfect, served to show that reliable short-wave reception is by no means the misty chimera which certain persons not unconnected with the B.B.C. would have us believe it is.

By the way, it ought to be noted that the "spaced aerial" system of reception has yet to be tried. When will Chelmsford give us a short-wave relay?

o o o o

Breakdown Drill.

The most impressive feature in connection with 2LO's breakdown last week was not the series of interrogatory howls which burst upon the silent ether but the promptitude with which the Marconi House stand-by transmitter was brought into action. Indeed, I am led to believe that Savoy Hill rather prides itself upon its emergency arrangements. When a breakdown occurs the way in which the spare engineer insinuates himself through the Strand traffic to reach Marconi House is said to be an improvement on anything accomplished by the London Fire Brigade.

o o o o

New Appointments at Savoy Hill.

Mr. J. M. Rose Troup, who has done good work at Bournemouth since his appointment as station director rather less than two years ago, is to be transferred to the London staff on the programme side.

Mr. B. E. Nicolls, who came from Manchester and became virtually chief of the London executive without the glorification connected with the title "station director," is now to become a sort of editorial director of all the publications issued by the B.B.C. Mr. Guy Rice will be in charge on the managerial side.

o o o o

B.B.C. and School Wireless.

A flutter has been caused in the Savoy Hill dovecot by the Editorial in *The Wireless World* of October 26th, questioning the policy of the B.B.C. in sending engineers to test and give advice upon sets in schools.

An official at Savoy Hill gave me the B.B.C. views on the subject:—

"The Corporation has no desire to

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trespass upon the ground legitimately occupied by the professional trader," he said. "It is against the B.B.C.'s own interest to undertake tests which can be performed equally well by other concerns. But the B.B.C. is a pioneer in a new field. It has to prove the value of wireless to school authorities. The greatest obstacle hitherto has been the inefficient apparatus in use and the difficulty of maintaining it at concert pitch. In the matter of school transmissions a much higher standard of reception is necessary than will satisfy the average home, and it should be realised by the trade that the Corporation's activities in this direction are wholly favourable to legitimate private enterprise. Special care is taken by the officials not to do or say anything of a contrary nature or tendency." I take this as an admission of trespass on the part of the B.B.C., and so long as they admit the fault but plead extenuating circumstances the question of principle is not so seriously violated.

oooo

Listeners of the Future.

"We have," continued my informant, "already caused the installation of some 3,000 sets in schools, all purchased ready made or constructed with ready-made components sold by the trade, and we are introducing hundreds of thousands of future citizens to the listening habit, teaching them to demand a good standard of reception. We never fail to advise our correspondents to make use of the services of trustworthy local experts when and where these are available."

oooo

For Your Diary.

The London staff are to shine in a programme of their own from 2LO on Monday, November 14th, this being the birthday of the B.B.C.

oooo

Birmingham's Birthday

Five years ago, on November 15, Birmingham station was opened. On that date this year a large part of 5GB's transmission will be provided from the Birmingham studio in celebration. "All In" is the title of the anniversary programme, which will be provided by the Birmingham station orchestra and staff.

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Arnold Bennett, by "A.G.G."

No. 4 of Mr. A. G. Gardiner's series of personal sketches will deal with Mr. Arnold Bennett, and the date of the broadcast is November 17.

oooo

A Lyric Drama.

On November 23 the lyric drama "Penelope" will be broadcast from 2LO and 5XX, having been given on the previous day from 5GB. Dale Smith will take the part of "Odysseus," Stuart Robertson will play "Eumæus," and Rachel Morton "Penelope." Other members of the cast are Jonn Armstrong, Doris Vane, John Parry and Samuel Dyson. The Wireless Symphony Orchestra will be under the direction of the composer, Herbert Ferrers.

Machinery Music.

When Karel Kapek's Robot play "R.U.R." was given from London three months ago it proved to be one of the most popular broadcast plays of the year. 5GB listeners will have the opportunity of hearing a repeat performance on November 18. The translation from the Czech is by Paul Selver, and the broadcasting arrangement and production will be in the capable hands of Cecil Lewis. The action takes place on a remote island in the decade 1950-60. The music, which is intended to convey the impression of machines of the future, has been composed by Victor Hely-Hutchinson.

FUTURE FEATURES.

London and Daventry (5XX).

Nov. 13TH.—"The Messiah," conducted by Stanford Robinson.
Nov. 14TH.—Birthday programme.
Nov. 15TH.—Military Band concert.
Nov. 16TH.—"The Arcadians," a fantastic musical play in three acts.
Nov. 17TH.—Star Variety programme.
Nov. 18TH.—"The Tempest," acted by Old Vic Players.
Nov. 19TH.—"I Pagliacci," an opera in two acts by Leoncavallo.

Daventry (5GB) experimental.

Nov. 13TH.—Popular Symphony concert.
Nov. 14TH.—Chamber music.
Nov. 15TH.—The Liverpool Philharmonic Society's fourth concert, relayed from the Philharmonic Hall, Liverpool.
Nov. 16TH.—Light music from Birmingham.
Nov. 17TH.—"The Arcadians," a fantastic musical play in three acts.
Nov. 18TH.—"R.U.R." (Rossum's Universal Robots), a play by Karel Kapek.
Nov. 19TH.—Popular Orchestral concert.

Manchester.

Nov. 19TH.—"Thanks to Mr. Milligan," a play in one act by Constance Enne. "High Tension," a new comedy drama by W. Huntley Adams.

Newcastle.

Nov. 15TH.—"Froth and Flummery," a radio revue presented by Hugh McNeill.

Glasgow.

Nov. 15TH.—Gems of Opera.
Nov. 19TH.—Star Variety programme.

Aberdeen.

Nov. 15TH.—Some Scottish favourites.

oooo

B.B.C. In Hot Water.

Members of the Manchester Athenæum Debating Society voted unanimously the other day in favour of a resolution, moved by Mr. J. E. Kemp, "that this meeting considers the administration of the British Broadcasting Corporation is in entirely wrong hands, and the policy hitherto adopted with regard to programmes is not wholly in accordance with public taste."

The mild onlooker (like myself) may be forgiven for butting in with the suggestion that, because the policy is not *wholly* in accordance with public taste, it is not sufficient reason for assuming that the administration is in *entirely wrong hands.*

oooo

A Nasty Nightcap.

A London listener is still suffering from the shock of hearing an announcer say "Good night to you" instead of "Good-night everybody: good-night."

Listeners must be protected from such insults.

oooo

Awkward Problem in Stockholm.

I am sorry to learn from a Stockholm correspondent that the maintenance of "amicable neighbourly relations" in the big apartment houses in Sweden is threatened by the advent of radio. This is due, he says, to the disturbing influences caused by the many aerials.

On the roofs of many of the houses there is a chaotic tangle of aerials, and as the "earth" is the heating and water installation of the house there is a consequent irregularity in the strength of signals depending upon the number of users of receivers.

oooo

A Solution?

A co-operative apartment house in Gothenburg has, however, tried to bring order into the chaos by a new contrivance, consisting of a central iron held by steel wires strung across the yard. From this ring the aerials radiate and are attached to the tops of the surrounding roofs, and from the middle of each aerial a wire is connected with the radio sets in each private apartment. The whole contrivance looks exactly like a huge spider's web, about fifty aerials being fixed to the central ring. Every tenant has to pay a fee of 15 kroner (16s. 3d.) to have his set connected.

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Sir Harry Lauder.

Sir Harry Lauder will receive the freedom of the City of Edinburgh on November 24. His speech at the ceremony, as well as that of the Lord Provost of Edinburgh, will be relayed from Usher Hall and broadcast from the Edinburgh station.

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An Orchestral Hour and a Play.

On November 23rd an hour of orchestral music and a play will be relayed from Birmingham to 5GB. Among the orchestral items will be heard the First Suite from "Peer Gynt" (Grieg) and a selection from "The Bohemian Girl," while Stuart Vinden will present "Her Bonny Boy," a comedy in one act by H. Bromley Taylor.

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Speech by Prince Henry.

Prince Henry's speech at the unveiling of the Edinburgh Cenotaph will be broadcast from the Edinburgh station of the B.B.C. on Friday next, November 11.

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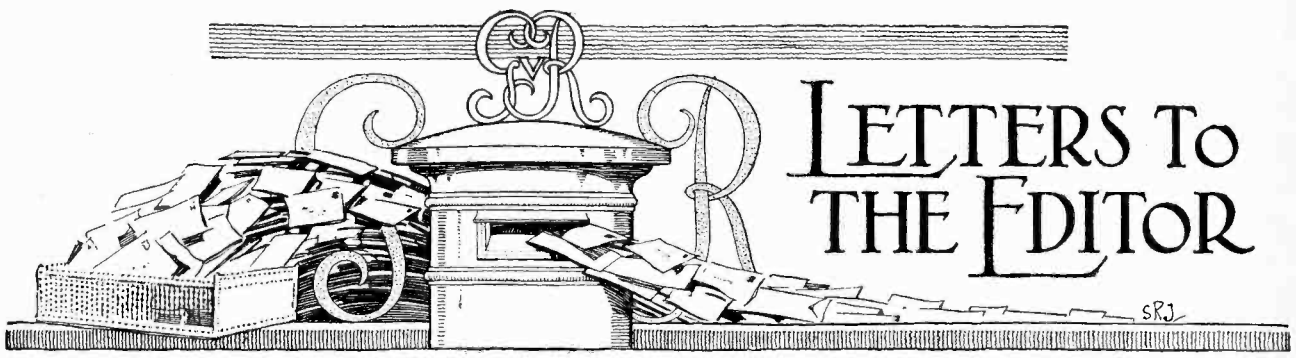

The Editor does not hold himself responsible for the opinions of his correspondents.

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.

MORSE INTERFERENCE.

Sir,—May I say a few words in answer to BM/MHNF, whose letter appears in your issue of the 26th inst.?

The set I am using is the "All-Wave Four," and anyone who has had experience of this receiver would hardly, I fancy, advise it being made more selective. I get all the more powerful stations without reaction, although I admit to unbalancing on occasion to catch some of the weaker.

I agree with BM/MHNF that a H.F. stage, if not essential, is at least highly desirable in this neighbourhood. I admit that 5XX lately has been almost entirely free from Morse and is received well The transmissions of Radio Paris—though, of course, I can get him quite clear of 5XX—are, in my opinion, so poor as to make it hardly worth while tuning him in, and I seldom do so. But all the other long-wave stations are badly interfered with.

As regards the medium waves, it is quite possible, no doubt, to find one or two stations during the course of an evening which are not completely blotted out. But it is, I think, true to say that, throughout the entire waveband, there is a continual background of Morse quite sufficient to ruin anyone's pleasure who wishes to hear music unaccompanied by an eternal cackle. Even when a station is free of it, one is always expecting it to start, which is almost as wearing to the nerves, if not more so.

But, after all, this is mere detail, and irrelevant. The ideal at which we should aim is to be able to tune in any station within the range of the receiver, and listen to any particular item, with the complete assurance that there will be no interference with our enjoyment save from sources outside human control. Of all the possible causes of such interference, Morse is infinitely the worst, because it is the only one which cannot be largely mitigated, if not entirely eliminated, by one's own efforts. It is this, I think, that makes it so peculiarly infuriating. Surely, with modern methods and proper organisation, there is room on the ether for both Morse and broadcasting without the former interfering with the latter. I maintain that this separation is the most urgent need at the present day, and that it behoves all those who have the best interests of wireless at heart, and who are in a position to exercise the needful authority, to put their chief efforts into the attainment of it. What technical problems are involved or what difficulties stand in the way I do not pretend to know, but this I know, that until these problems are solved and difficulties overcome wireless, instead of being the joy it undoubtedly should and could be, can only be the exasperation it is now.

A. H. B.

Brighton,
October 29th, 1927.

Sir,—If your correspondent BM/MHNF would bring his selective receiver here, and endeavour to follow the London programme for an evening or two, I feel sure that he would once more redesign the receiver and also some of his conclusions on the subject of interference. I do not read Morse, so am not able to name the chief offenders, but there are many who perform during the evening with well-designed peaks around 350 metres. One fellow in particular has a hesitating, spluttering note with a sharp peak on 363 metres, and often sends out a continuous, devastating dash for several minutes before beginning his stuttering speech. A frame aerial seems to show that most of the trouble comes from a line passing due north and south of this position. Quite apart from Morse, however, London is usually distorted, both at midday and from 5 p.m. onwards until about 10.30 p.m. This distortion began definitely just a year ago, and from fragments of speech which can sometimes be glimpsed I imagine it comes from a Spanish station. Anyhow, it destroys all pleasure in listening to London, even if the Morse enabled one to make the attempt.

5GB is, of course, in the middle of the hornet's nest, and is perfectly useless to us here. Its strength, too, is no more than that of London.

5XX is the backbone of British broadcasting. He may be a nuisance to manufacturers who have to design double-range receivers, but if one travels about with a portable he is worth more than all the low-wave stations put together, for he does not fade in daylight. He is also reasonably free from Morse.

Perhaps I should add that by Morse interference I do not refer to the gentle background which is always with us, but to the signals that quite obliterate both music and speech.

Isle of Wight, DONALD STRAKER.
October 27th, 1927.

Sir,—Your correspondent Mr. J. B. Wilson appears to misapprehend the question when he says, "it appears improbable . . . that any change can now be justified."

FFB at 40 miles causes a great deal more interference than GNF at two miles. Both are spark stations, but GNF has succeeded in restricting the width of band of wavelengths he covers, which apparently FFB cannot or will not do. A certain amount of jamming is inevitable from spark, but the present position can be very materially improved, either by the adoption of I.C.W. or the bringing of spark transmitters up to date.

This change would most certainly be justified, and is no more than other users of etheric waves have a right to expect.

Margate, ARTHUR HOBDAY.
October 26th, 1927.

BURNDEPT FILAMENT RHEOSTATS.

Sir,—I would like to take this opportunity of pointing out a little experience that has recently overtaken me.

I purchased a number of Burndept rheostats recently with the idea of putting some of these in my "Everyman Four." Imagine my surprise on testing these rheostats to find that there is no "off" position on them, especially as they make a master rheostat which in the sense of the word takes the place of the usual filament switch.

My chief grumble on this score is that not a word is said about the nature of these rheostats on the box they are packed in, nor have I ever seen anything in print referring to their difference to any other rheostat. I wonder how many readers, in using these rheostats, have turned their sets "off" and still left them "on," not knowing that there was *no* "off" posi-

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tion? This, I am sure, is easily done, especially with the modern "glowless valves." Accumulators must be running down rather quickly, and if the plug is still left in the H.T. that also will be deteriorating rather mysteriously.

I hope the firm in question will realise that it is about time they gave the purchaser some idea of the nature of the rheostat he is buying. Actually, one end of the resistance is soldered to the metal frame, so that those already in possession of these components can correct them merely by breaking the wire at this point.

Trusting these remarks will be of some value to other readers.

Uxbridge, October 22nd, 1927. W. G. PHILLIPS.

[*A copy of the above letter was sent to Messrs. Burndept, Ltd., from whom the following reply has been received.*—ED.]

[COPY.]

29th October, 1927.

The Editor, *The Wireless World*,
Dorset House, Tudor Street,
London, E.C.4.

Dear Sir,—A short time ago the design of Burndept rheostats and potentiometers was altered slightly in that the resistance element at the "off" end was connected to the metal frame, thus giving no off position.

This was done on account of the numerous requests we received for rheostats arranged in this manner, where they are volume controls, for battery eliminator work, etc., as we thought that this small point might make them more valuable to the user.

On page 54 of the catalogue issued by us in September, 1927, we made reference to this alteration, and stated that should an "off" position be required all that was necessary was to cut through the end wire where connected to the frame. Printed matter giving similar instructions was also prepared for inclusion in the carton containing each rheostat, but recently it has come to our notice that a certain batch of rheostats has left this factory without the printed instructions being enclosed.

We deeply regret to learn that a number of your readers who have used our rheostats with circuits described by you have failed to notice the absence of an "off" position, and consequently have suffered some annoyance through valves of the black filament type continuing to pass current. As the names of such readers are not known to us, we cannot communicate with them individually, and we should be most grateful if you could see your way to publish this letter in the hope that the individual purchasers may see it and may act accordingly. Should any of your readers feel in any way aggrieved at the slip on our part, if they will communicate with the undersigned a special effort will be made to remove any such feeling of grievance.

Yours faithfully,

CHAS. W. ROOKE, Receiver and Manager,
Burndept Wireless Limited,
FRANK PHILLIPS, M.I.E.E., Chief Engineer.

H.T. ACCUMULATOR CHARGING.

Sir,—I recently purchased an H.T. accumulator for use with my wireless set. Small cells had proved useless, and I thought that with an accumulator my troubles would end. From the point of view of reliability, they did; from the standpoint of finance, they only commenced with the initial outlay.

I made enquiries of a local firm of accumulator chargers as to the cost of charging, and was informed that this would cost 9d. per 20-volt unit, or 4s. 6d. for a 120-volt battery. This charge seemed outrageous, so I tried another firm still farther afield, with the same results. In desperation I rang up two or three firms still more distant, with the same results. The battery has a capacity of 2,500 milliampere-hours and the makers recommend that for best results it be recharged once a month. Thus I am faced with a yearly H.T. bill of £2 14s. plus depreciation on original outlay.

Surely there is something radically wrong with such a charge! Current in this district costs 2d. per unit for power, and it does not need a very intricate calculation to ascertain approximately how much profit the charging firms must be making out of this very paying proposition.

Perhaps other readers of *The Wireless World* have had a similar experience, and if so, it would be interesting to hear their remarks upon this point. A. E. BULLOCK.

London, N.8,
November 1st, 1927.

INTERFERENCE FROM ELECTRICAL MACHINERY.

Sir,—I should be grateful if any of the wireless experts could advise how to get rid of local interference which arises under the following circumstances. Reception, what with Daventry fading and Plymouth seriously interfered with, is seldom good, but a new terror has now arisen in this small town.

A local electric supply, 200 v. D.C. with overhead distributing mains, has started, and during the time the supply is given from the running plant there is a very audible background of engine noise on all wavelengths on which we receive. Is this curable, if so, how? In spite of this background we can listen-in. Some of us who are close to the mains are prevented from doing so by one insignificant motor used in one of these modern refrigerators which comes into action, day and night, at its own sweet will whenever the temperature rises in the refrigerator; when that motor starts and as long it continues reception has to stop, for there is nothing to receive but noise. Daventry is completely wiped out. As we are a progressive town we assume that this refrigerator is but the harbinger of others, and we ask ourselves what the result to the wireless licensees will be when many of these refrigerators are cutting in and out at indefinite intervals. If one can create pandemonium on sets about a quarter of a mile apart, where shall we be with a dozen in the district?

We have had about three months of it, and as it appears to be an insoluble problem to the supply company and to the refrigerator company, I wonder whether any expert can recommend a remedy, either technical, legal or official, which can be relied on to work when applied. "Supply Stations" and "Motors on Mains" there must be—need they be "Stops to wireless"?

H. E. MOUL.

Looe.

A DUTCH RECEIVING STATION. R 005, owned by Mr. W. H. de Gorke at Essenburgstraat 120b, Rotterdam. The QSL cards and journals indicate that Mr. de Gorke is largely interested in the reception of English and American stations, and is always willing to report on experiments of British amateurs.

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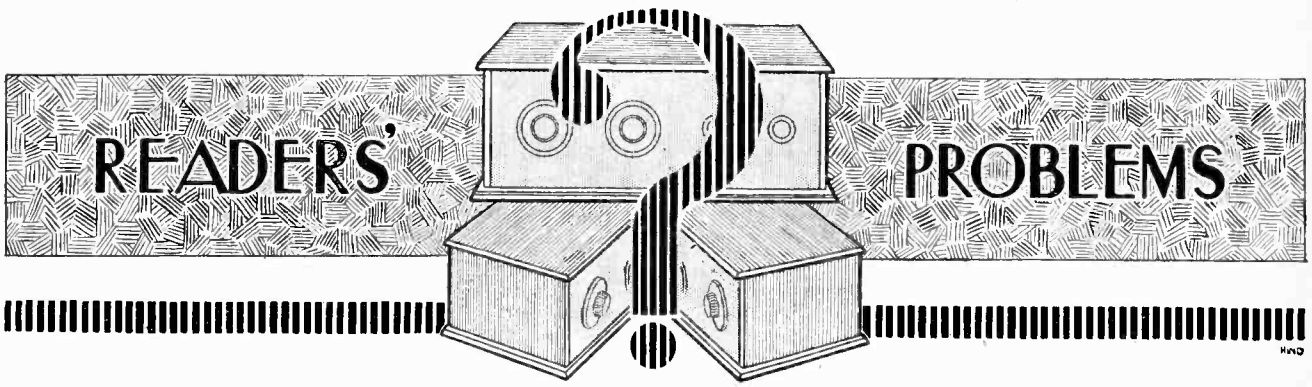

"The Wireless World" Supplies a Free Service of Technical Information.

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

A Grid Battery Question.

Can you tell me how long a grid battery should last in a five-valve receiver, and how long in a three-valve receiver? N. S. T. R.

A grid battery should give service for an equal period both in the case of the five- and the three-valve receiver. It must be pointed out that the grid battery is used to place a negative potential on the grids of the L.F. valves, and also on anode bend detectors, in order, among other things, to prevent the flow of grid current. If they completely fulfilled their function of at all times preventing grid current, no energy whatever would be taken from them, but, of course, even with large power valves, sometimes overloading occurs on loud passages of music, and also when atmospherics are bad, and so grid current will occasionally flow. However, the actual amount of current taken from the battery during the course of its life is very small indeed, and it should maintain its voltage for practically as long as it would maintain it if merely kept stored on a shelf. In other words, its demise will be brought about by chemical changes taking place in the cells, and not through ordinary usage. A good grid battery should give service for a year.

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Biassing a Detector Valve.

I am building a modern receiver with an anode-bend detector and am adopting your suggestion of a potentiometer in order to be able to apply critical value of grid bias to the detector valve. I cannot understand, however, why you insist on the necessity of using two dry cells as well; surely since I use a six-volt accumulator all the bias necessary can be obtained by the potentiometer alone? R. B. J.

In the case of giving a negative bias to the detector valve, or, in fact, to any valve in the receiver, it is necessary to make the grid of that valve so many volts more negative than the negative end of the filament. That is to say, that, if the valve grid is connected *via* a transformer secondary directly to the negative end of the filament of the same valve, it is obvious that the grid will be at the same potential as the negative end of the filament, and we say that it has a zero bias.

Now it will be clearly seen that if we use a potentiometer and put the slider right over to the negative side, then the grid will merely be at the same potential as the negative end of the filament, and will have zero bias. Now we can only move this slider towards the positive end of the filament, and this has the effect of giving the grid a positive and not a negative bias, and, of course, in the case of a six-volt accumulator, we can give the grid a six-volt positive bias by putting the slider right over to the positive end. If we put the slider over to the negative end and put two dry cells in the grid return lead, it is obvious that, since the E.M.F. of a dry cell is 1.5 volts, the grid will receive a three-volt negative potential. Now, by slightly moving the slider towards the positive end, we can subtract from the negative voltage of the grid battery, and so obtain a critical adjustment of grid bias, which is necessary on the detector valve. It will be seen, therefore, that in the case of the six-volt accumulator, and using two dry cells in this manner that if we put the slider over full to the positive side we shall have a three-volt positive bias on the grid.

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Precautions when Using a Battery Eliminator.

I am constructing the "Regional Receiver," described in your issues of August 17th and 24th, and should like to know if this receiver is suitable for operating from an H.T. battery eliminator. K. T. B.

Any well-designed receiver, such as the "Regional," can be used in conjunction with a good H.T. battery eliminator, but in all cases it is advised that when using a battery eliminator a choke-filter output circuit, or, of course, an output transformer be used. Also, apart from taking the precaution of choosing an eliminator made by a reputable manufacturer, great care should be taken always to obtain one which has an adequate output—that is to say, one which will deliver the maximum plate current demanded by the set with a large margin of overload. If an attempt is made to obtain more plate current from an eliminator than it is designed to give, "mains hum" is bound to occur.

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The "Flewelling" Circuit.

Can you supply me with a circuit diagram of the Flewelling receiver, together with the values of the various resistances, condensers, etc., used in the instrument? P. S. M.

Full details of this receiver, together with a circuit diagram, will be found on page 771 of our issue dated June 15th, 1927, and on page 64 of our issue dated July 13th, 1927

RULES.

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

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

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

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

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

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

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

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Advantages of the Screened Valve.

I am intending to build the "Everyman Four" receiver, but am doubtful whether to construct the original model or the new model using a screened valve. Will the new model give me much greater efficiency?
W. B. H.

As stated in the article, slightly less amplification is obtained when using the new screened valve. At the same time, however, selectivity is better than when using the ordinary type of valve in the H.F. stage. Before making a decision which set you would build, you should consider your local conditions. If high selectivity is not essential, it would probably be better for you to build the original model, as somewhat greater H.F. amplification would be obtained.

o o o o

An Impossible Proposition.

I am intending to construct the L.T. battery charger described in your October 5th issue; I am, however, going to use a U5 valve, and should be glad if you will give me the necessary alterations to the transformer so that it may suit this valve.
D. E. G. B.

It is quite imposible to use this valve in this charger because a total emission exceeding 1 ampere is required from the valve. Whilst this is readily given by the special "arc" rectifier used, it is quite beyond the capabilities of a valve of the U5 class. The U5, of course, is intended to be used in an H.T. battery eliminator or for the charging of an H.T. accumulator and not for the charging of L.T. accumulators.

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Local or Distant Reception.

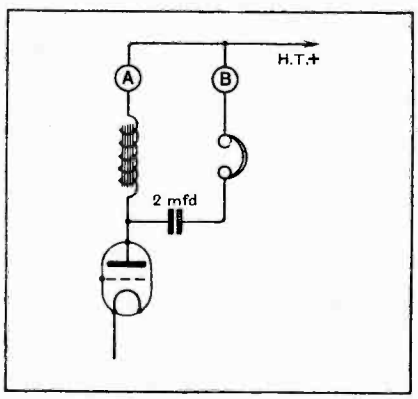
When using my "Regional" receiver on the local station, which is 10 miles distant, quality is all that could be desired. In the matter of sensitivity the receiver is satisfactory, as I can bring in several stations at the same strength as my local station, but when receiving a distant station transmission is accompanied by a persistent background of noise. Can you explain this? L. D.

When the receiver is tuned to the local station you naturally have to make drastic use of the H.F. valve filament rheostat, which controls volume in order to prevent overloading both loud-speaker and output valve. The result is that the receiver is rendered very insensitive and does not pick up much in the way of atmospheric noises, nor "mush" from high-powered long-wave stations, although it is sufficiently sensitive for giving good loud-speaker results from the local station. In order to receive distant stations at similar strength to the local station, you naturally have to bring the receiver into its most sensitive condition, and then, unfortunately, owing to its sensitivity atmospheric disturbances, etc., are brought in as well as the distant stations. It may be said definitely that from this point of view distant reception is never so satisfying as local station reception.

Using a Milliammeter.

I am using a choke-filter output circuit with my set and desire to use a milliammeter to give me an indication of overload distortion. I am not quite sure, however, of the correct position in which to connect the meter. I have tried both position A and position B in the diagram enclosed, and in each case get a reading. Surely this should not be so? T. G. H.

We reproduce your diagram below, showing the two positions A and B in which you have tried the meter. The position A is the correct one, and if a milliammeter is connected in position B no reading should be obtained at all. If you will study the diagram this will be obvious to you, as the steady D.C. plate current is prevented from flowing in this branch circuit owing to the presence of



Using a milliammeter in a choke-feed output circuit.

the blocking condenser. It is clear from what you tell us that the dielectric of this blocking condenser must have been completely broken down, or, alternatively, that there is a short-circuit across it in your wiring. You should attend to this point as, of course, if this condenser is short-circuited your choke-filter circuit is serving no useful purpose whatever. When the fault has been cleared, no reading should be shown when the meter is in position B. It should be finally connected and left in position A, when it will serve as an indicator of overload distortion.

o o o o

The Function of an H.F. Choke.

Can you explain in simple language the purpose of an H.F. choke, and the manner in which it operates?
B. R. D.

It would be entirely beyond the scope of our Information Service to deal with this matter adequately. Briefly, however, we would say that an H.F. choke is inserted in any part of the circuit in which it is desired to prevent the passage of high frequency oscillatory current although leaving a perfectly free path for direct current. For example, in the Reinartz circuit, a choke is inserted in the plate circuit for the purpose of diverting H.F. energy from the normal passage offered round this circuit back to the filament to the path offered by the reaction coil and reaction condenser, where it will do useful work.

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Transformers in the "Everyman Four."

I am building the original "Everyman Four" receiver, but do not relish the task of constructing the special H.F. transformers. Can I use ordinary standard commercial transformers instead? R. L. T.

It is rather difficult to understand exactly what you have in mind when you refer to "standard" commercial transformers, as, of course, there are no H.F. transformers which can be taken as being definitely of standard type. There is, as you may know, a large number of firms who now market transformers specially for the "Everyman Four" receiver, and these may be used with every confidence, but be sure to get the type which are built to the specifications given in the "Everyman Four" book.

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Good Quality Reception on 80 Volts H.T.

Can you tell me if it is possible to obtain distortionless loud-speaker results using three-electrode valves when the available H.T. voltage does not exceed 80 volts? I should, of course, use a power valve in the output stage. I do not want to use four-electrode valves if possible.
G. S. W. R.

It will be possible for you to obtain excellent loud-speaker results with only 80 volts H.T. using the valves you mention, if you adopt the push-pull system in the last stage. You will, of course, need two power valves in the output stage.

With regard to the first L.F. valve, if you are using two stages, we would inform you that although only 80 volts H.T. will be used on the anode of the valve, it will still be possible for you to obtain adequate volume from the loud-speaker without overloading this valve. By this we mean to indicate that the two output valves will overload before the one in the first L.F. stage. You will appreciate the fact that since this valve will be followed by a transformer, one of the R.C. type of valves with its comparatively small permissible grid swing must not be used, as its high A.C. resistance renders it unsuitable for use in front of an L.F. transformer.

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Important to "Everyman Four" Users.

I am constructing the "Everyman Four" receiver, and intend to incorporate the important modifications advised by you on page 289 of the August 21st issue, and page 316 of the September 7th issue. Can you explain, however, why the grid condenser C_3 in Fig. 1 (c) on the latter page is omitted.
D. S. H.

It is regretted that owing to an unfortunate error, this condenser C_3 was omitted in Fig. 1 (c). It is correctly shown in Figs. 1 (a) and 1 (b) on that page, and should, of course, be inserted in the same position in Fig 1 (c).

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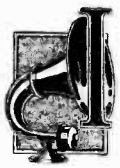
As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

BUYER'S GUIDE TO SETS.



IN this issue we include our annual feature of a list with essential details and prices of commercial receivers. Our reason for publishing the list at this period of the year is that we are thereby able to include the manufacturers' new models produced for the Olympia Show.

In addition to the list of sets, we give an analysis of features in set design, so that the trend of development can be seen at a glance.

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EMPIRE BROADCASTING.

ONE or two of our friends who have been following with close interest our campaign for the establishment of an Empire broadcasting station have taken us to task somewhat for what they regard as our attitude of "burying the hatchet" with the B.B.C. in our editorial reference to the subject in the issue of November 2nd. Perhaps a word of explanation is necessary in order that our readers may be quite clear as to our attitude.

In our comment in the issue of November 2nd, after congratulating the B.B.C. on the establishment of an experimental short-wave station at Chelmsford, we expressed the view that if the B.B.C. would continue in this new spirit and press on to the development of an Empire broadcasting service then we, for our part, intended to forget their unfortunate past record of procrastination and pessimism. It has been pointed out to us that although the B.B.C. are at last doing something in the direction of short-wave transmissions, it is not Empire broadcasting, but a series of short-wave tests carried out in conjunction not with the Empire, but with the United States of America, and that we are, therefore, no nearer Empire broadcasting than we were. With this point of view we disagree. The initial short-wave transmissions must, of necessity, be in the nature of experiments. There is much work to be done and experience to be gained before short-wave broadcasting to the Empire can be perfected, and we are fortunate in having the co-operation of America in the initial tests. In the meantime, the distant parts of the Empire which have shown their enthusiasm for an Empire broadcasting service have also their part to play; they can now get busy with improving their methods of reception of the Chelmsford station, and can develop the best system for rebroadcasting the reception on their own broadcasting stations. When they are able to do this with a reasonable degree of success it will then be time enough to make arrangements for Empire programmes. For the moment, let us concentrate on improving the machinery wherewith to bring the programmes into the homes of the Empire.

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DAVENTRY 1,600 METRES.

A RECENT letter published in these columns, in which it was suggested that with the construction of the regional scheme the Daventry 1,600-metre station should be abolished altogether, has met with a storm of protest from listeners in various parts of the country, particularly those who have the misfortune to live in areas affected by Morse. It would seem that there may be some foundation for the anxiety concerning the possibility of that station being abandoned, for that some rumour to that effect is abroad is indicated by the fact that from our American correspondent we hear that the keenest interest on the part of the American manufacturers is shown in the reported prospect that Daventry will either be closed down or abandon its 1,600-metre wave. At the present time Canada, with a population of less than 10 millions, is America's largest radio customer abroad. Obviously, therefore, the prospect of a new market of approximately 40 millions, if the wave-band requirements of British and American broadcast receivers are to be identical is interesting to the American manufacturer.

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EXPONENTIAL LOUD-SPEAKER HORNS.

General Principles of Loud-speaker Horn Design.

By A. DINSDALE.

WHEN broadcasting first started, the only type of loud-speaker on the market was one which had been expressly designed for wireless telegraph work, and it had a straight conical horn. This was soon found to be unsatisfactory, so the shape of the horn was altered to various forms suggested by the prevailing gramophone practice. The results were still unsatisfactory, for the shapes and dimensions were chosen at random, with no real understanding of the principles involved.

Only recently has it been realised that our ideas as to the function of the horn were all wrong. According to Clinton R. Hanna and Dr. Slepian, the Westinghouse engineers responsible for the development of the exponential horn, the horn of either a loud-speaker or a gramophone is *not* a mechanical amplifier of sound waves, as it was formerly held to be. Nor is it necessary for the horn to resonate in order to perform the duty assigned to it. In fact, the best horns do not resonate strongly at any frequency.

Sound Radiation.

The true function of a loud-speaker horn, according to the above-mentioned engineers, is to act as a sound radiator, in much the same fashion as a transmitting aerial acts as a radiator of electromagnetic waves. The horn, therefore, really acts as a coupling device between the transmitter, *i.e.*, the telephone diaphragm, and the transmission medium, *i.e.*, the atmosphere.

A wireless transmitter would be of very little use without an aerial. It would radiate to some extent, but in order to achieve the best results an aerial, or radiator, is necessary. The same thing applies to a telephone diaphragm. Of itself, it is capable of radiating sound, but only in very small volume. Its "transmitting range" is small. This range can be increased by increasing the size of the diaphragm, just as the range of an aerialless wireless transmitter can be increased by increasing the power of the set. In both cases, the latter alternative would be highly inefficient, and in the case of the diaphragm, serious mechanical difficulties would immediately appear with any increase in physical dimensions.

Thus, by coupling a diaphragm to the air by means of a properly designed horn, very large amounts of sound can be radiated into the atmosphere by the use of quite a small telephone unit.

The question now arises as to how the horn succeeds in acting as a radiator.

Delving into elementary physics for a moment, we find that, in a mechanical system, power is measured by multiplying together force and velocity. Therefore, in the case of two vibrating diaphragms of widely different size, radiating equal amounts of sound power when moving with the same velocity, the total force must be the same in each case.

This means that the pressure per square inch on the smaller diaphragm must be very much higher than it is on the larger. The device which is responsible for this state of affairs is the horn. For a given velocity it causes the pressure per square inch on the surface of the diaphragm to be very much greater than it would be if the diaphragm were allowed to vibrate freely in air.

The horn, therefore, increases the force exerted by the diaphragm; or, in other words, it makes the diaphragm work harder than it would otherwise be able to do. Instead of acting as an amplifier, as it was thought to do, the horn's function is to place a greater load on the diaphragm. Fitting a horn to a diaphragm may, therefore, be compared to increasing the radiation resistance of an aerial in order to extend the transmitting range of the station.

It is therefore clear that, in order to achieve the most

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Exponential Loud-Speaker Horns.—

efficient transformation of electrical energy into mechanical energy, the diameter and mass of the diaphragm deserve careful attention, so that it shall match the impedance of the horn. In this article, however, we are solely concerned with the horn itself.

Definition of an "Exponential" Horn.

The perfect reproducer functions uniformly over the entire range of frequencies that it is called upon to handle, and the best type of horn is that which enables this desirable accomplishment to be achieved.

For all horns of a given size, *i.e.*, same length and terminal areas, it has been demonstrated that the exponentially shaped horn comes nearest to fulfilling the above specification. The secret, therefore, lies in the contour of the horn, that is, the manner of tapering.

An exponential horn (sometimes referred to as a logarithmic horn) may be somewhat loosely defined as one which doubles its diameter at equal intervals along its length. Whereas a conical horn increases in diameter by a constant additive factor per unit of length, the exponential horn increases its diameter by a *constant multiple* per unit of length.

This definition does fairly well for a straight horn of round or square section, but as we desire to deal with horns of other shapes, we must be more scientifically accurate and define the exponential horn as one whose *cross-sectional area* doubles at equal intervals throughout its length.

For example, if the area of the throat, or narrow end of the horn is half a square inch, the area one foot from the end will be one square inch; at two feet from the end, two square inches; at three feet from the end, four square inches, and so on. This is an example of an exponential horn in which the area doubles every foot. If the area doubled at lesser intervals, the horn would be described as expanding more rapidly; if the area doubled at longer intervals, the horn would be said to expand at a lower rate.

Upon the rate of expansion depends the "cut-off" frequency of the horn, that is to say, the lowest frequency at which it will radiate uniformly. Below the cut-off frequency the radiation falls off with increasing rapidity.

A horn whose cross-sectional area doubles every foot cuts off at 64 cycles. One expanding half as rapidly, *i.e.*, doubling its area every *two* feet, cuts off at 32 cycles; and a horn expanding twice as rapidly, *i.e.*, every six inches, cuts off at 128 cycles. Thus, the contour (and length) of an exponential horn is determined by the value of the lowest frequency it is desired to reproduce without loss of volume. The curve given in Fig. 1 will make this clear.

It should be mentioned in passing that the question of the length of the horn is purely incidental, not fundamental. This will be more clearly understood later.

The Mouth of the Horn.

Having ascertained from Fig. 1 the rate of expansion, according to the selected cut-off frequency, we automatically determine the contour or shape of the morn. The next point to be settled is how far the horn should be extended before being terminated at the mouth. This is not a question of length. The fundamental requirement is the area of the mouth.

As already stated, a good horn should not resonate strongly at any frequency within the band it is desired to reproduce. In order to prevent air-column resonance, therefore, the mouth of the horn should be large enough to transmit to the atmosphere without reflection the pressures emanating from the interior of the horn. That is the ideal. Its practical achievement is, of course, virtually impossible, like the achievement of most other ideals. The difficulty in this case is that air waves emanating from within the confining walls of the horn are subject to a sudden relief of pressure immediately they are released into the free atmosphere.

However, if the diameter of the mouth is made equal to one-quarter of the wavelength corresponding to the cut-off frequency of the horn, the amount of resonance due to reflection will be extremely small.

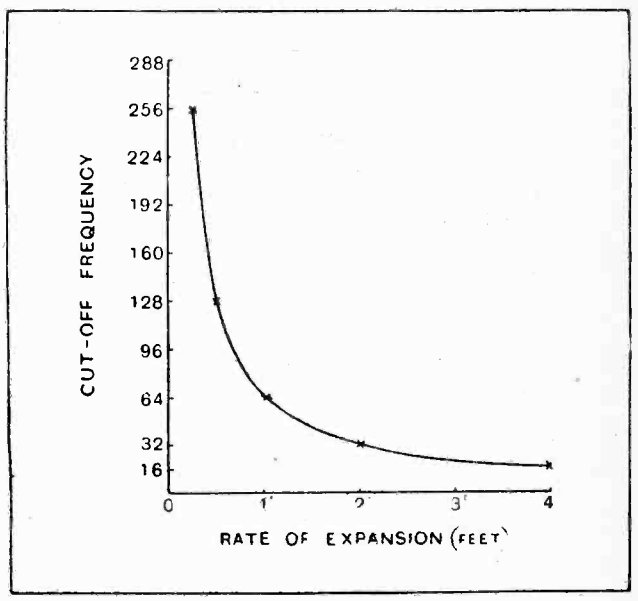

Fig. 1.—Curve showing relationship between cut-off frequency and rate of expansion of an exponential horn.

Since the velocity of sound in air is 1,120ft. per second, the wavelength in feet corresponding to the predetermined cut-off frequency is obtained by dividing 1,120 by the frequency. A round horn should then be extended until the diameter of its mouth is equal to about one-quarter of the wavelength. The relationship between the cut-off frequency and the diameter of the mouth of a round horn is clearly shown in the curve given in Fig. 2.

In the case of a square horn, or one of any other shape, the conditions will be met equally well if the dimensions of the mouth are made such that the area approximately equals that of the mouth of a circular horn.

From the lower cut-off frequency we have now determined the rate of expansion of the horn, or contour, and the diameter of the mouth. We have now to settle the size of the throat.

Having already likened a loud-speaker horn to a transmitting aerial, we will continue to trace the simile, in this case likening the throat of the horn to the aerial lead-in.

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Exponential Loud-Speaker Horns.—

The dimensions of the flat top of a transmitting aerial depend chiefly upon the frequency of the transmitted wave, and we have just seen that the size of the large end of a loud-speaker does, too. The physical arrangement and dimensions of an aerial lead-in depend largely upon the power to be handled, and the same applies roughly to the throat of a loud-speaker horn. As in everything else electrical and mechanical, it is a case of arranging for the most convenient method of coupling between the driver and the driven—in this case, between the diaphragm and the air within the horn, so that the imprisoned air shall be acted upon to the best advantage.

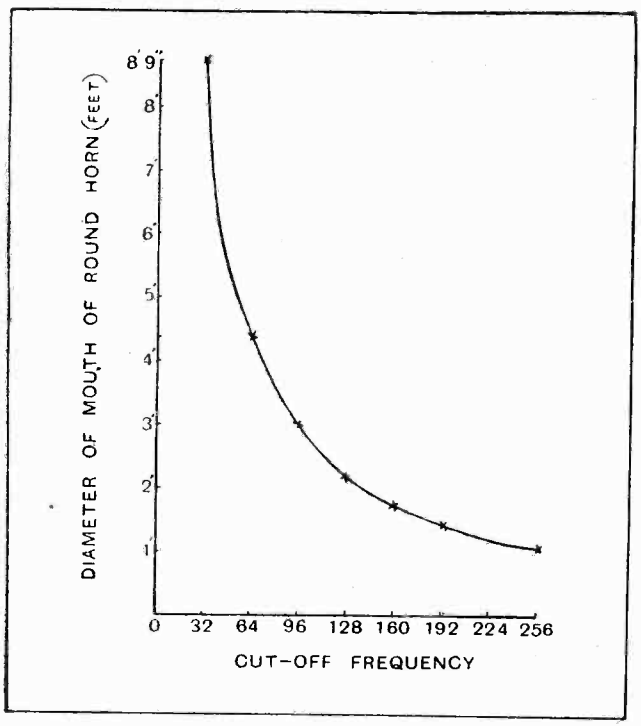

Fig. 2.—Relationship between cut-off frequency and diameter of mouth of a circular-section exponential horn.

The area of the throat, therefore, depends upon the vibrating mechanism, or diaphragm, and it is fixed by three factors: (1) the mass of the diaphragm, (2) the area of the diaphragm, (3) the highest frequency that the horn is required to reproduce with uniformity.

In order to obtain a thorough grasp of this part of the problem, it is necessary to get a clear idea of the manner in which the horn loads the diaphragm. To that end, let us consider a diaphragm vibrating so that every part of it is moving through the same amplitude, like a piston. Under such conditions it is pumping air in and out of the throat of the horn, and if the air cavity just over the diaphragm is small, almost all the air displaced by the diaphragm will move into the horn, only a small fraction of the diaphragm motion being lost in compressing the air within the cavity.

As an example, let us assume that the diaphragm, by virtue of its vibratory movement, moves 100 cubic inches of air per second into the horn. If the latter has a throat area of half a square inch the velocity of the air in the throat will be $\frac{100}{0.5}$, or 200 inches per second. If the area of the throat were only one-quarter square inch, the velocity would be twice as great, or 400 inches per second.

Now, it is a characteristic of a horn that when air is being pumped in and out of its throat at a frequency greater than the cut-off frequency, a pressure is created. This pressure, known as the radiation pressure, is directly proportional to the velocity of the air at the throat, and reacts back into the cavity and all over the surface of the diaphragm. It is like a back E.M.F in an electrical circuit, or the radiation resistance of an aerial.

This back pressure of air on to the diaphragm will be greater for a horn having a smaller throat, because the velocity of the air through the throat is greater. Thus, the total force exerted on the diaphragm, which is the product of the pressure and the area of the diaphragm, will be greater.

Part of the force employed in vibrating the diaphragm will be utilised to overcome the radiation pressure, and part will be used to overcome the inertia of the diaphragm itself, just as part of an electrical force is spent in overcoming the back E.M.F., and part in overcoming the resistance of the circuit. In the first case, as in the second, it is desirable that as much energy as possible be spent in overcoming the radiation pressure, *i.e.*, in doing useful work, over as great a part of the range of frequencies required as possible. In order to achieve this, the radiation pressure must be high, and therefore the throat of the horn must be made relatively small. In practice, the actual dimensions should be such that the throat of the horn makes a good fit with the particular reproducing unit selected for the job.

The requirements of a good horn may thus be summed up under the following three heads:—

(1) It must be exponential in shape in order to transmit the lower frequencies.

(2) The mouth must be large in order to eliminate noticeable horn resonance.

(3) The throat must be relatively small in order to cause sufficient radiation pressure to be exerted on the vibrating diaphragm.

The latter requirement makes for small vibrating mechanisms, of which more anon. All three requirements make for a long horn, but, as already stated, length is merely incidental, not fundamental. All good horns are long, but the exponentially shaped horn is shorter than any other horn covering the same range of frequencies, and it has the added advantage of being free from horn resonance.

(*To be continued.*)

Wireless World . . .

"SUPER-SEVEN."

The concluding instalment of the above constructional article will be included in our next issue.

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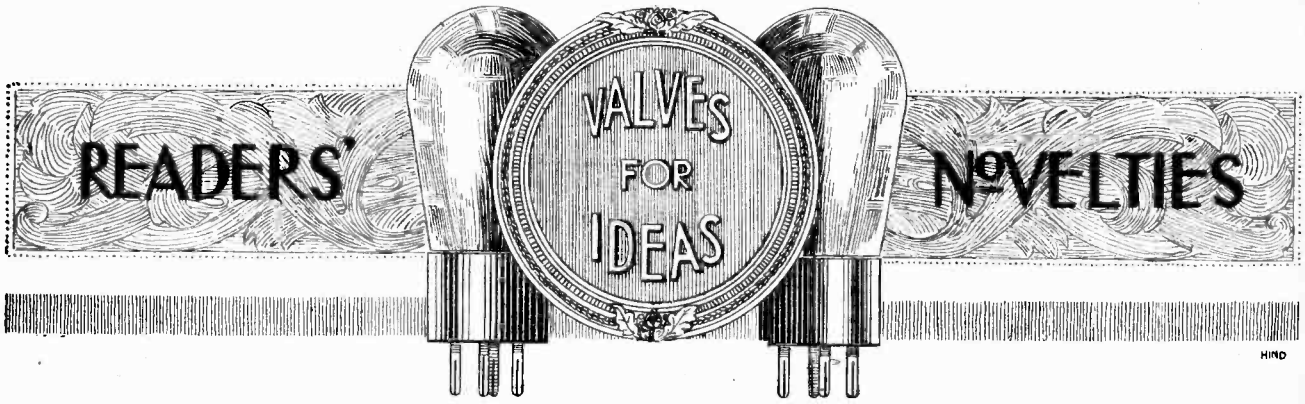
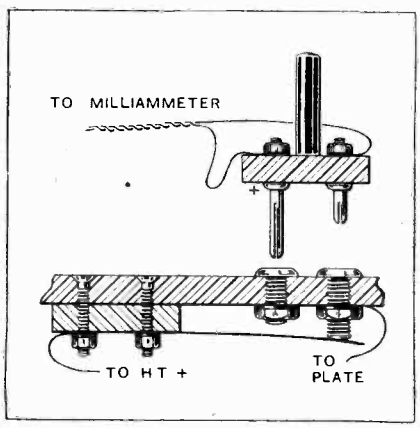


A Section Devoted to New Ideas and Practical Devices.

MILLIAMMETER CONNECTIONS.

It is common practice nowadays to insert a milliammeter in series with the final plate circuit of a multi-stage L.F. amplifier, as any movement of the needle will show that distortion is taking place in the last valve circuit due to overloading or incorrect grid bias or high tension. If it is desired to ascertain if distortion is taking place in any preceding stage, it is necessary to disconnect the meter and to connect it in turn in each of the other circuits. This could be done by means of switches or by a plug and jacks.



Automatic switching arrangement for connecting milliammeter in anode circuit.

The accompanying rough sketch shows a simple home-made arrangement to do this costing only a few pence, all that is required being two valve pins, two or more flush-mounted valve sockets, a piece of scrap ebonite and a piece of springy brass.

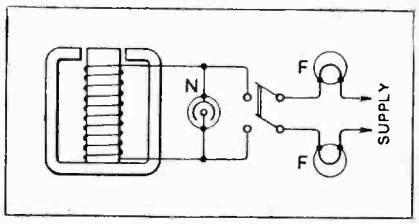
When the plug is inserted, the brass strip is forced down by the longer pin, thus opening the plate circuit and inserting the milliammeter at the same time. E. C. M.

SAFETY RESISTANCE FOR LOUD-SPEAKER FIELD MAGNETS.

The growing popularity of loud-speakers of the moving-coil type has brought to the attention of many the large inductive "kick" obtained on breaking a circuit containing considerable potential energy in a magnetic form. The effect is very familiar to those accustomed to large electrical machinery, and, in fact, the sudden rupture of the field circuit of a large generator would probably result in a breakdown. The transient voltage generated is proportional to the inductance and to the rate at which the current is varied. Thus if a coil of 200 henries carrying 0.1 ampere has its current reduced to zero at a uniform rate in 1/100th of a second, the "kick" E.M.F. maintained for that period is $200 \times 0.1 \times 100 = 2{,}000$ volts.

In the case of a Rice-Kellogg field magnet working at 100 volts and taking approximately 0.1 ampere, the effect was distinctly annoying, as each time it was switched off the lamp fuses protecting the circuit were blown. This led to a trial of a shunt resistance across the coil, but, as the resistance had to be low enough to pass a current of the order of that taken by the coil in order to be of any use, the disadvantage of this method was obvious. What was wanted was a resistance which would only pass current when the voltage rose above normal. This requirement is admirably fulfilled by the neon lamp, which does not pass any current until the voltage across its terminals is of the order of 160. The current then rises very rapidly indeed.

The field coil can thus be connected as shown in the diagram where N is the lamp; F, F are fuses, usually small flash-lamp bulbs. It is not essential for the switch to be double-pole, but it should be of the quick-break variety. It will be found that all objectionable surges are abolished, as on switching off, the neon lamp discharges anything over 160 volts, while drawing no current when the coil is in use. With a coil working between about 150 and 300 volts, two lamps in series must be used.



Neon lamp safety resistance to prevent surges when breaking loud-speaker field-magnet current.

The commercial neon lamp usually contains a wire-wound ballast resistance in the cap, and this should be removed for satisfactory results, though it is understood to be possible to obtain lamps with the resistance omitted. The side of the cap can be punctured and cut away sufficiently to allow the resistance to be short-circuited, or alternatively the whole cap may be removed by unsoldering the contacts and nipping the brass so as to draw it away.

M. G. S.

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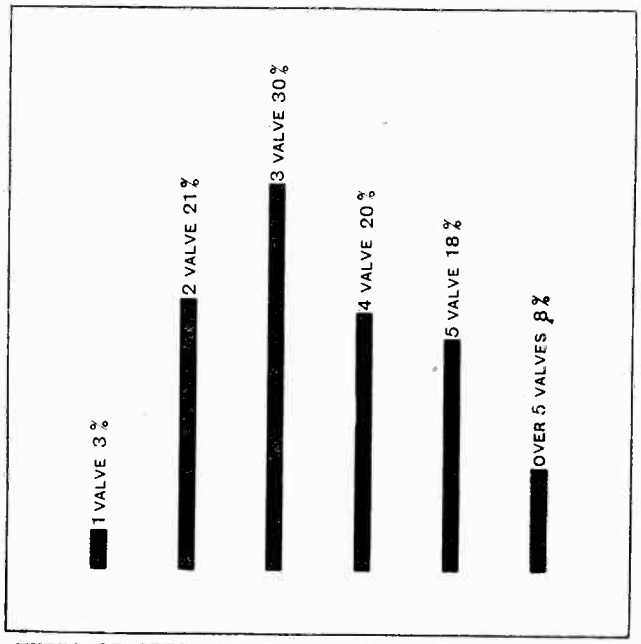
RECEIVING SETS OF TO-DAY

A Review of Current Practice.

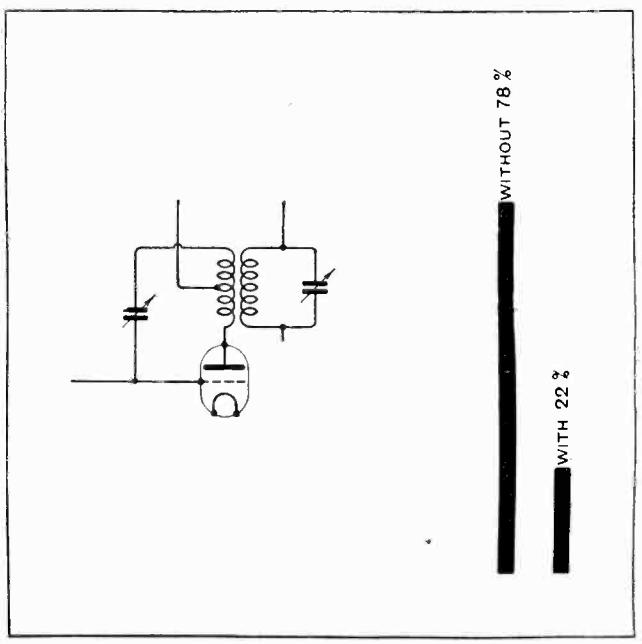
"WHAT kind of set shall I buy?" is a question often asked of the wireless enthusiast, and one which is by no means easy to answer. The greater his knowledge the more difficult does it become to reconcile his, perhaps, exaggerated ideas to the modest requirements of the enquirer. On the other hand, the expert is not infrequently asked to recommend a set capable of long-range loud-speaker reception, possibly with one-dial tuning and a guaranteed performance superior even to his own prized and carefully developed set.



TYPES OF SETS.—Although there are actually more types of receivers in which three valves are employed, the two-valve set is probably the most popular.

To endeavour to elucidate requirements is to at once realise how vague is the general idea of set performance. One is forced to take the initiative and usually compromise between conditions, cost, and the desired results.

By question 1 it is ascertained whether an elevated, indoor, or frame aerial is to be used, strongly recommending the first, tolerating the second, and adopting the last only under compulsion. Question 2 should deal with alternative programmes, London area listeners requiring 5GB, and in provincial areas 5XX. The problem of selectivity must not be overlooked under this heading.



STABILISED H.F. STAGES.—It is significant to note that comparatively few sets are stabilised by neutralising.

Question 3 reveals the source of power. If electric supply is available, whether A.C. or D.C., it will ultimately be adopted as a source of H.T., even for the modest two-valve set. Battery charging may also have to be considered. In brief this is best done by interposing the accumulator battery in a circuit carrying the required

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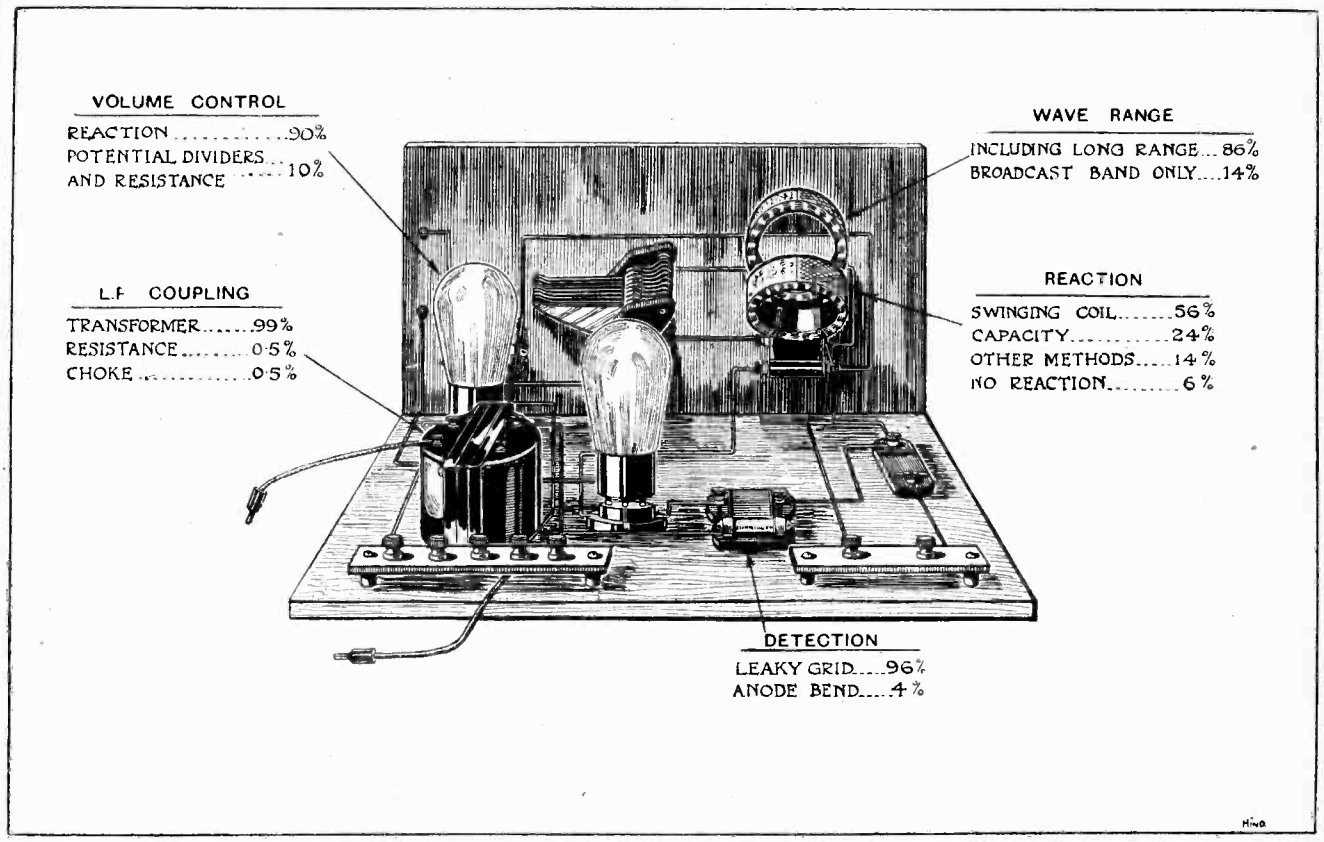


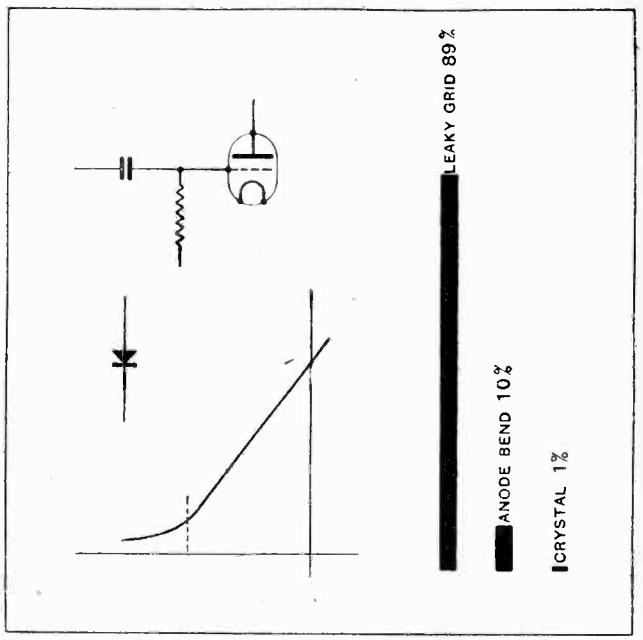
TWO-VALVE RECEIVER DESIGN.—A marked similarity exists between all two-valve receivers. From the figures given here t is apparent that the majority of sets comprise interchangeable coils, swinging coil reaction, leaky grid detection and transformer L.F. coupling.

current in the case of D.C., while an A.C. rectifier giving 3 to 5 amperes will keep the L.T. battery in good condition. Question 4 should relate to volume and quality. The common form of cone loud-speaker generally fulfils the ordinary requirements. Care is necessary to select a model capable of giving pleasing results, and at the same time being reasonably sensitive. Horn models may sometimes give louder signals on a limited output. Do not entertain the idea of setting up a moving coil loud-speaker, which incidentally is in great demand to-day, unless heavy filament current consumption valves, possibly parallel-connected, are to be used in the output stage, a high anode voltage is available, and a source of field current, either D.C. or rectified A.C. These needs can only be met when supply mains are available.

The Popular Two-valve Set.

In this country there are more two-valve sets sold than the sum total of all other types. Such a set gives local station loud-speaker reception with a small elevated aerial, and with the aid of reaction provides alternative programmes. It consumes about 0.2 ampere, so that over 100 hours' reception can be obtained at a cost of not more than 1s. The H.T. battery of 100 volts costs some 15s., and if it is required to deliver only about 5 mA. will give from three to six months' service. With a single tuning control the set is easy to operate, and the whole outfit, including aerial and royalties, need only cost from £5 to £8.

Of the three-valve sets on the market the majority consist of detector valve with reaction followed by two L.F. stages. Although little improving the range of recep-



DETECTION.—This data, compiled from all types of valve receivers, clearly indicates that leaky grid detection still predominates.

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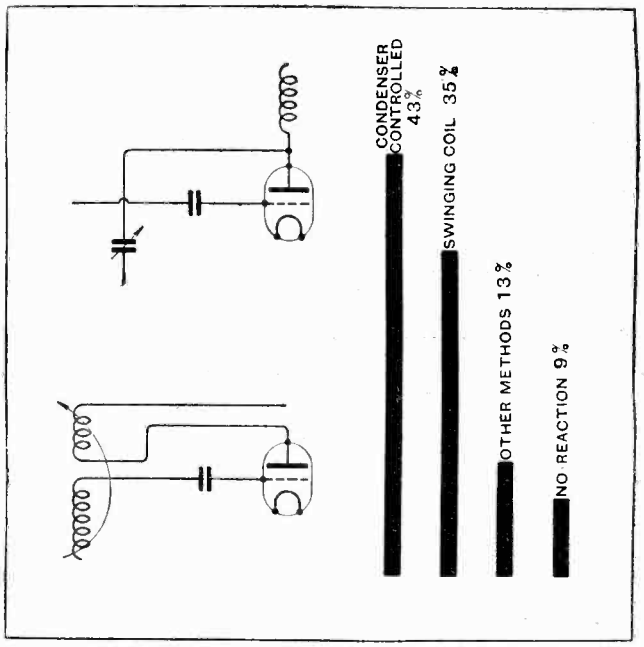
Receiving Sets of To-day.—

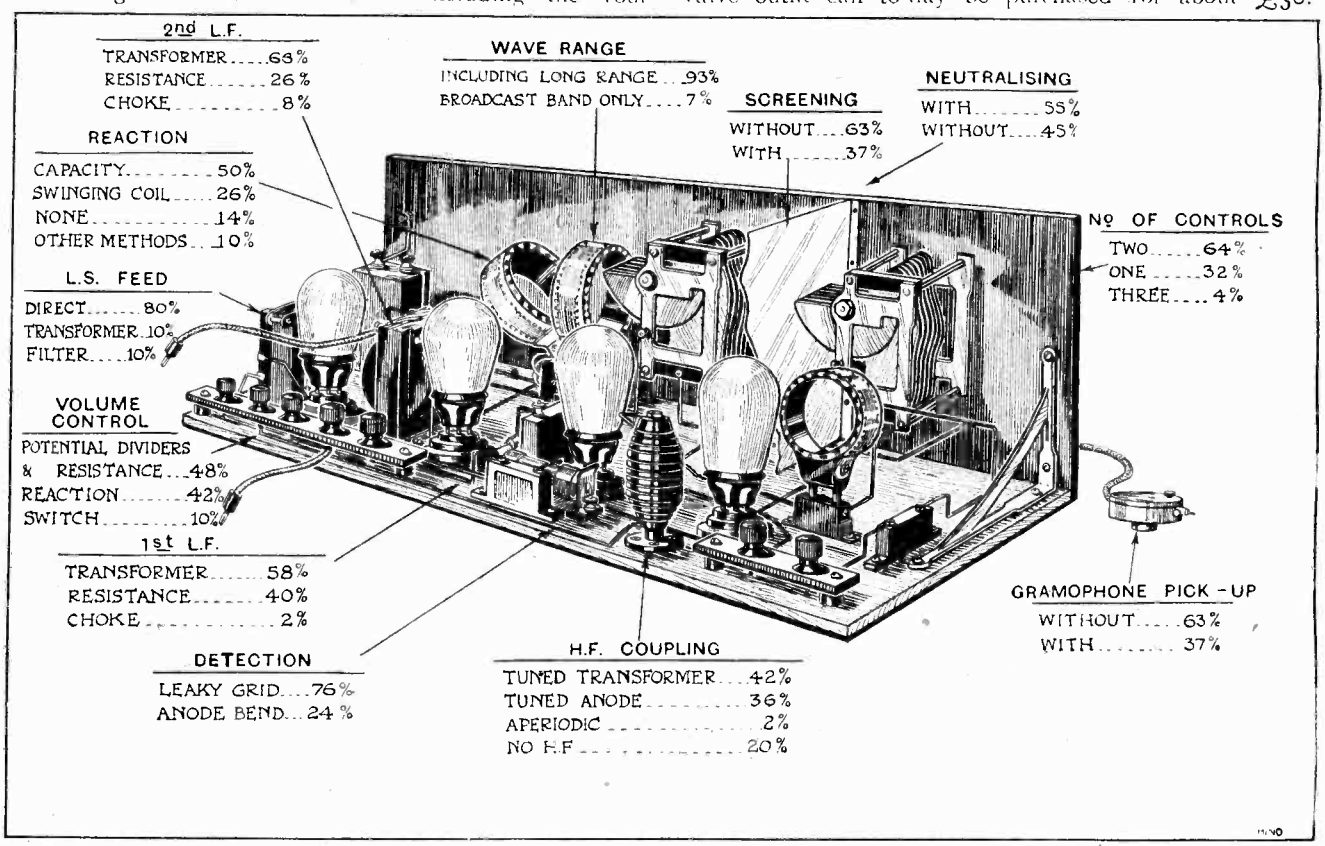
tion as compared with the two-valve outfit, the set is more suited for quality reproduction from a large loud-speaker. The first L.F. stage may be resistance-coupled, the detector valve being an anode bend rectifier. Few three-valve sets are available incorporating an H.F. amplifier. Such sets can be regarded as selective long-range receivers giving only moderate loud-speaker results.

For Long-range Loud-speaker Reception.

When distant-station reception is needed a minimum of four valves is to be stipulated. This limitation to four valves for long-range loud-speaker reception is only permissible when the high-frequency amplifier has been carefully designed. A well-designed set is easy to tune, should not self-oscillate, as evidenced by heterodyne whistle, and, on a good outdoor aerial, during the hours of darkness, bring in stations at intervals of every few degrees on the dials. As two L.F. stages are provided the output power valve will draw a current of between 8 and 20 amperes from the high-tension battery. It is for this reason that the "super" high-tension batteries have been introduced, and their adoption is an economy in the long run. As the first three valves may only draw a high-tension current totalling 2 or 3 mA., they may be fed from a small type 100-volt battery, permitting of a very simple form of single voltage battery eliminator, feeding only the output stage. In this way the risk of mains noises occurring, particularly in the case of an oscillating receiver, is avoided. Including the four valves, a six-volt L.T. battery, large type H.T. battery of 150 volts, and a good cone type loud-speaker, a four-valve outfit can to-day be purchased for about £30.



REACTION COUPLING.—That more sets have condenser controlled reaction is due to the general adoption of this method in portable sets.



FOUR-VALVE RECEIVERS.—Some of the figures given here, indicate an important trend in design. Note in particular the significance of anode bend detection, the extensive use of screening, that several sets have no reaction control and that many are fitted with resistance volume control as well as a provision for gramophone pick-up.

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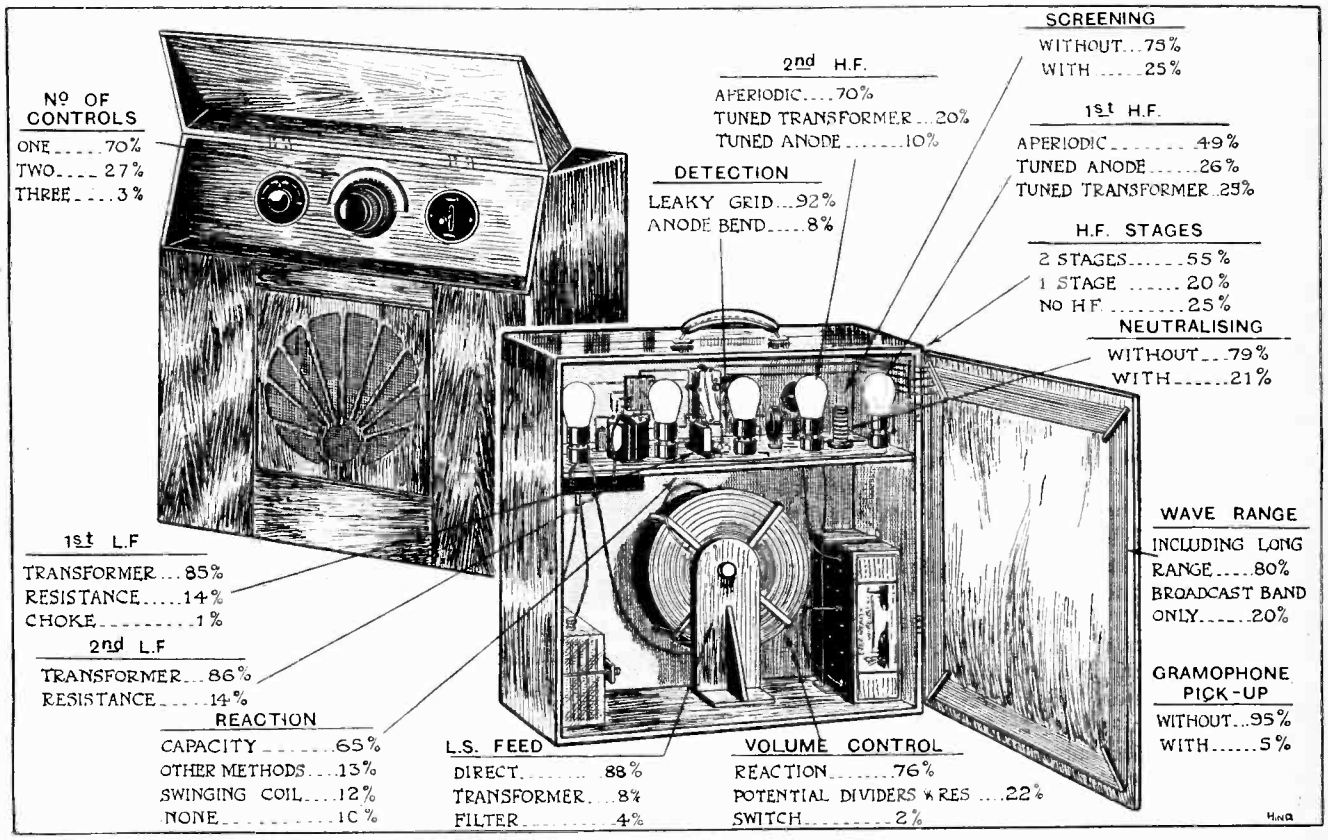


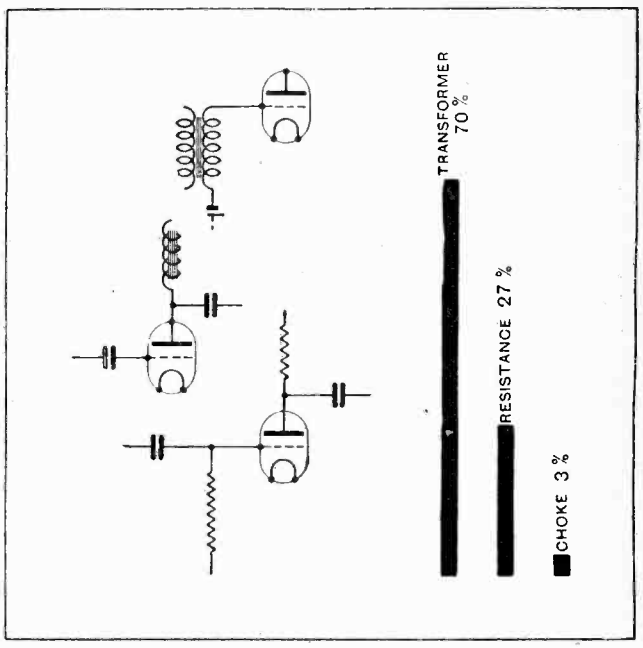
PORTABLE AND SELF-CONTAINED RECEIVERS.—Compare these figures with those of the four-valve cabinet type set. There are distinct differences of circuit principle and actual design.

Outfits at lower cost will be seen to be available in the following pages, while the price of the more expensive models is usually made up by the cost of a superior cabinet.

It must not be thought that five-valve sets of the cabinet type are almost non-existent, owing to the vogue of the five-valve portable or self-contained set. Certain manufacturers, however, for long-range reception prefer to provide two high-frequency amplifying stages of robust construction in place of a high-efficiency single-stage. Compared with the four-valve set the extra filament and anode current consumed is of small importance, and there is perhaps a growing tendency towards the adoption of the "five." Wave changing in long-range five-valve receivers presents formidable constructional difficulties tending to appreciably increase the cost of production. Ease of operation with absence of heterodyning should be looked for in selecting a receiver of this class.

Self-contained and Portable Sets.

During the past two years the five-valve portable receiver has become exceedingly popular. Portability is not always the feature that recommends its adoption, and its rapid development marks the demand for a self-contained set. Several sets classified as "portables" in the following pages are specified by their makers as merely being self-contained. Limitations of space prevent the use of high-efficiency single-stage amplifiers, though generally the additional stage more than makes up for the smaller amplification obtained by untuned H.F. couplings. Portable receiver design is made unduly difficult by the need for tuning to the 1,600-metre band as well as normal broadcast wavelengths. Little can be



L.F. COUPLING.—That the majority of L.F. valves are transformer coupled is a condition supported by the predominance of leaky grid detection.

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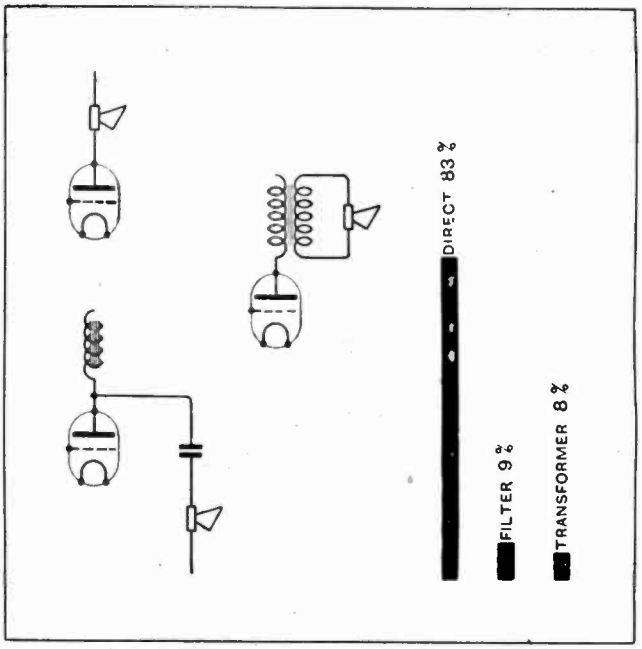
Receiving Sets of To-day.—

said by way of definitely specifying the arrangement of controls of the self-contained receiver. On the other hand, no advice is required when determining whether or not such a set meets the requirements of a home receiver. Range and quality with ease of control are its principal merits. Hours of running with the self-contained batteries should also be investigated. The merit of a set is only judged by its comparison with others.

Receivers de Luxe.

The easiest class of set to recommend or pass judgment on is one which has been constructed regardless of cost. Built into a large cabinet it might include a large frame aerial suitably placed for local station reception, with provision for connection to an elevated aerial, the two-stage H.F. amplifier might be one-dial controlled with logarithmic condensers having adjustable minimum capacities. Detection might be carried out with an anode bend detector, or even a two-electrode valve, avoiding overloading, while the L.F. amplifier could incorporate resistance and transformer coupling with, perhaps, a push-pull input to the power stage and a push-pull output transformer. Battery power for filament heating can be derived from the mains by means of a two-way key arranged to charge a reserve battery. A high-voltage battery eliminator, or, in the case of D.C. supply, a battery charger, might feed 350 volts to one or more parallel-connected output valves, indicating meters showing anode current and anode and filament potentials. With the cabinet forming a baffle of liberal size, a moving coil loud-speaker mounted behind a grill at its centre may be brought into operation by a plunger switch, volume control being obtained without adjustment of tuning.



LOUD-SPEAKER FEED.—Low cost of production probably accounts for the large number of receivers in which no provision is made to keep the D.C. component out of the loud-speaker.

A BATTERY ELIMINATOR WARNING.

WHERE an H.T. battery eliminator is used on alternating current mains great care must be taken that at no time is the eliminator allowed to run "light" with no current being drawn from its output terminals. This warning is applicable to instruments which do not include a potential divider, which is the case in many such instruments designed and made to deliver a single voltage

If such an eliminator is run light the voltage applied to the smoothing condensers rises very far above the normal working voltage, and these condensers, unless of exceptionally robust construction, may very probably break down under the strain. An eliminator designed to deliver 200 volts on load will probably incorporate a transformer delivering about 275 volts of A.C. to the rectifying valves, and if no current is taken the condensers will charge up at least to the corresponding peak voltage, which is about 390 volts. If the apparatus is then switched on and off a few times, current surges on switching on may develop momentarily higher voltages still, which are passed through the valves into the condensers and there retained. Under such conditions even a thousand volts is a possible voltage.

Switch off H.T. before L.T.

It will be seen, then, that if the condensers are designed to withstand only the normal working voltages, with a reasonable margin for safety, they may quite conceivably break down, with disastrous results not only to themselves but also, in all likelihood, to the rectifying valves and the transformer as well.

High voltages such as these might easily be obtained, even with the eliminator permanently connected to the receiving set, by switching the L.T. and H.T. off and on again in the wrong order. Suppose that, after using the receiver, the L.T. supply is switched off, the set then takes no load, and in the few moments that elapse before the eliminator is in turn switched off the condensers are charged up to the full peak voltage delivered by the transformer. The condensers will retain this charge, and if, subsequently, the eliminator is switched on before the valve filaments of the receiving set are lighted, the momentary voltage developed at the moment of switching on, superimposed on the peak voltage already present, might well cause a breakdown of the insulation in the condensers.

In all cases, therefore, an eliminator working off A.C. mains might incorporate within itself a resistance shunted across the output so that at least a small current is taken at all times, thus entirely preventing the development of these destructively high voltages. This resistance need not pass a heavy current; if it takes no more than one-tenth of the normal load it will act as an effectual safeguard against mishaps of this type without appreciably increasing either the first cost of the instrument or the power consumption when in use. A. L. M. S.

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BUYERS' GUIDE, 1927-28.

The "Wireless World" Reference List of Receiving Sets.

CABINET-TYPE RECEIVERS, EXCLUDING PORTABLES AND SELF-CONTAINED SETS.

ABBREVIATIONS USED IN THE TABLES.—High-frequency Stages: **Ap** = Aperiodic Interstage Coupling. **TT** = Tuned H.F. Transformer. **TA** = Tuned Anode. **Detection:** **LG** = Grid Condenser and Leak. **AB** = Anode Bend. **Low-frequency Stages:** **TC** = Transformer Coupled. **RC** = Resistance-capacity Coupled. **Ch** = Choke-capacity Coupled. **Reaction:** **CC** = Condenser-controlled, generally in conjunction with a fixed coil and H.F. choke. **SC** = Swinging or Rotary Coil.

Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties).	Remarks.
													in.	£ s. d.	
Arclite, Ltd., 54, Theobalds Road, London, W.C.1.	Arclite Popular R.R. III	—	—	—	—	LG	RC	RC	—	One	S.C.	300–500 and 1,000–2,500	10½×7½×5½″	12 12 0	Complete with accessories and loud-speaker.
,, ,, ,, ,,	Arclite Home No. 1 Cabinet Model.	Home cabinet	—	Ap	Ap	LG	RC	RC	—	One					
Automobile Accessories (Bristol) Ltd., 17, Redcliffe Street Bristol.	P.D. Mark XXI.	Flat oak cabinet	—	—	—	LG	—	—	—		'P.D.' Spec. Unit	300–500 and 1,000–2,000	9×6″	2 10 0	Receiver only with loading-coil socket for intermediate wavelength.
,, ,, ,, ,,	P.D. ,, XV.	,, ,,	—	—	—	LG	TC	—	—	One	,,	300–500 and 1,000–2,000	9×6″	4 8 0	
,, ,, ,, ,,	P.D. ,, XV. A.	Oak American cabinet	—	—	—	LG	TC	—	—	One	,,	,, ,,	12×9×7½″	5 9 0	,, ,, ,, ,,
,, ,, ,, ,,	P.D. ,, VIII.	Oak, roll top	—	—	—	LG	TC	TC	—	One	,,	,, ,,	15×10″	12 17 6	Tuning fixed when set is installed. Change-over switch for Daventry.
,, ,, ,, ,,	P.D. ,, XIV. A.	Oak, American cabinet	—	—	—	LG	TC	TC	—	—	,,	,, ,,	12×9×7½″	8 12 6	
,, ,, ,, ,,	P.D. ,, XVI. A.	,, ,,	—	—	—	LG	TC	TC	—	One	'P.D.' Spec. Unit	,, ,,	12×9×7½″	8 3 6	Loading-coil socket for intermediate wavelength.
,, ,, ,, ,,	P.D. ,, XIX.	Oak or mahogany American cabinet.	—	—	—	LG	TC	TC	—	One	C.C.	,, ,,	22×13½×10″	12 17 6	
,, ,, ,, ,,	P.D. ,, XIX. S.	Mahogany, totally enclosed cabinet with stand, and cupboard for batteries.	—	—	—	LG	TC	TC	—	One	C.C.	,, ,,	—	17 1 6	
,, ,, ,, ,,	P.D. ,, XX.	Oak or mahogany, American cabinet.	—	—	TT	AB	TC	—	—	Two	C.C.	,, ,,	22×13½×10″	14 17 6	With calibration chart.
,, ,, ,, ,,	P.D. ,, XVII.	,, ,, ,, with drop front.	—	—	TT	AB	TC	TC	—	Two	C.C.	,, ,,	26×13×11″	18 10 0	,, ,,
,, ,, ,, ,,	P.D. ,, XVII. S.	Oak or mahogany, totally enclosed with stand and loud-speaker.	—	—	TT	AB	TC	TC	—	Two	C.C.	,, ,,	—	27 19 0	,, ,,
Auto Sundries, Ltd., 10A, Lower Grosvenor Place, London, S.W.1.	R.S.N.	—	—	*	*	*	*	*	—	One	—	250–550	22×10×11″	22 10 0	* *5 valves special cascade R.C. circuit.* Complete with valves, batteries and frame aerial.
Barnett & Soans, Sheep Street, Kettering.	Barsone 2-valve	Oak box	—	—	—	LG	TC	—	—	One	S.C.	250–3,000	9×9×9″	8 15 0	Price complete with valves, batteries and accumulator, £11 10s.
,, ,, ,, ,,	Barsone 3-valve	Mahogany cabinet	—	—	—	LG	RC	RC	—	One	S.C.	250–3,000	23×12×12″	13 7 0	Price complete with valves, batteries and accumulator, £16 16s.
,, ,, ,, ,,	Barsone 4-valve	Mahogany cabinet	—	—	—	LG	RC	RC	RC	One	S.C.	250–3,000	23×12×12″	15 10 0	Price complete with valves, batteries and accumulator, £19 15s.
Baty, Ernest J., 157, Dunstable Road Luton, Beds.	Baty Two	Mahogany cabinet	—	—	—	AB or Cry.	TC	—	—	Three	—	200–2,000	13×7×10″	18 0 0	Complete with Main's outfit.
,, ,, ,, ,,	Baty Four	,, ,, on stand with cupboard.	—	—	TA	AB or Cry.	TC	RC	—	Three	—	200–2,000	22×13×10″	36 0 0	,, ,, ,, ,,
Bedford Electrical & Radio Co., Ltd., 22 Campbell Road, Bedford.	Peerless 1-V., RC.	Oak cabinet, totally enclosed.	—	—	—	LG	—	—	—	—	C.C.	250–500 and 1,000–2,000	13×9×10″	6 2 6	Price with H.T. and L.T. batteries, valve and headphones, £8 17s.
,, ,, ,, ,,	,, 2-V., RC	,, ,,	—	—	—	LG	RC	—	—	—	C.C.	,, ,,	16×9×10″	7 15 6	Price with H.T. and L.T. batteries, valves and loud-speaker, £12 12s.
,, ,, ,, ,,	,, 3-V., RC	,, ,,	—	—	—	LG	RC	RC	—	—	C.C.	,, ,,	18×9×10″	10 7 6	,, ,, £16 15s.
,, ,, ,, ,,	,, 102, 2-V.	Oak cabinet with loud-speaker.	—	—	—	LG	TC	—	—	One	S.C.	250–2,000	19×19×9″	10 0 0	Including H.T. and L.T. batteries, valves, aerial and cone loud-speaker.
,, ,, ,, ,,	,, 102, 3-V.	,, ,,	—	—	—	LG	RC	TC	—	One	S.C.	250–2,000	19×19×9″	12 10 0	,, ,, ,, ,,

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties). £ s. d.	Remarks.
Bligh, S. W., 1 and 2, North Lane, Canterbury.	Bligh Duovalve	Mahogany cabinet	—	—	—	LG	TC	—	—	One	S.C.	180–3,000	in. 7×6×6×	6 7 6	Price complete with valves, batteries and accumulator, and loud-speaker, £11 14s.
,, ,, ,, ,,	,, ,, de Luxe	Oak or mahogany cabinet.	—	—	—	LG	TC	—	—	One	S.C.	280–3,000	17×17×12″	18 1 0	Complete with valves, batteries, aerial unit and accumulator. (Loud-speaker extra.)
,, ,, ,, ,,	Bligh Triovalve de Luxe	,, ,,	—	—	—	LG	RC	RC	—	One	S.C.	280–8,000	17×17×12″	23 7 6	Complete with accessories as above. (Eliminator if required.)
,, ,, ,, ,,	Bligh Radio/4	Oak or mahogany cabinet with doors.	—	—	TT	LG	TC	Ch	—	One	C.C.	250–550 and 1,000–2,000	25×20×14″	37 10 0	Complete with accessories, as above.
,, ,, ,, ,,	Bligh Solodyne	Mahogany	—	TT	TT	LG	TC	Ch	—	One	C.C.	250–550 and 1,000–2,000	44×26×22″	72 10 0	Complete with loud-speaker and accessories as above, with eliminator.
Bowyer Lowe Co., Ltd., Radio Works, Letchworth, Herts.	Short-Wave 2-valve	Walnut	—	—	—	LG	TC	—	—	One	C.C.	20–200	18×11×6½″	12 15 0	
,, ,, ,, ,,	Short-Wave 3-valve	,,	—	—	—	LG	TC	TC	—	One	C.C.	20–200	18×17×6½″	16 7 6	
,, ,, ,, ,,	Vox Populi, Model III. (2-valve).	Oak or walnut cabinet, holding batteries, sloping panel.	—	—	—	LG	TC	—	—	One	C.C.	250–2,000	22×10×11″	10 10 0	Price complete with valves, batteries and loud speaker, £14 9s. 6d.
,, ,, ,, ,,	,, ,, (3-valve)	,, ,,	—	—	—	LG	TC	TC	—	One	C.C.	250–2,000	26×10×11″	13 10 0	Price with accessories as above, £18 7s.
,, ,, ,, ,,	Standard Super-Heterodyne.	Walnut cabinet	*	*	*	*	*	*	*	Two	—	35–2,000	28×11×11″	37 17 6	* *7-valve super-Het.*
,, ,, ,, ,,	,, ,,	,, ,,	—	*	*	*	*	*	*	Two	—	35–2,000	28×11×11″	42 10 0	* *8-valve super-Het.*
Brandes, Ltd., 2 and 3, Norfolk Street, London, W.C.2	Brandeset III. A.	Oak cabinet	—	—	—	LG	TC	TC	—	Two	S.C.	200–600 and 950–2,200	17⅛×9¼×8½″	8 12 6	No accessories.
,, ,, ,, ,,	,, III. B.	Oak cabinet with battery compartment.	—	—	—	LG	TC	TC	—	Two	S.C.	—	17⅛×17×8½″	9 2 6	,,
British General Manufacturing Co., Ltd., Brockley Works, London, S.E.14.	All-wave	Oak cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	—	250–2,000	19×14×10″	8 0 0	Receiver only. Without valves, batteries or other accessories.
British Thomson-Houston Co., Ltd., Alma Street Works, Coventry.	2-valve L.F.	Semi-enclosed	—	—	—	LG	TC	—	—	One	S.C.	300–500 and 1,500–1,800	10×7×5″	4 15 0	Receiver only.
,, ,, ,, ,,	Resistor Three	Mahogany cabinet, totally enclosed.	—	—	—	AB	RC	RC	—	One	C.C.	200–650 and 900–2,000	14½×10×9½″	9 17 6	,,
Brownie Wireless Co., of Great Britain, Ltd., Nelson Street Works, Mornington Crescent, London, N.W.1.	Brownie 2-valver	Moulding	—	—	—	LG	TC	—	—	One	S.C.	200–500 and 1,000–2,000	—	3 15 0	Receiver only with two coils.
B.S.A. Radio, Ltd., Sparkbrook, Birmingham.	B.S.A., o-v-1		—	—	—	LG	TC	—	—	One	S.C.	250–1,800	7½×13×8″	9 3 0	
,, ,, ,, ,,	,, o-v-2		—	—	—	LG	TC	TC	—	One	S.C.	250–1,800	8×11¾×12″	17 1 0	
,, ,, ,, ,,	,, o-v-3		—	—	—	LG	TC	TC	—	Two	S.C.	275–2,000	13×13×17½″	32 6 0	
,, ,, ,, ,,	,, 1-v-2		—	—	TA	LG	TC	TC	—	Four	—	200–2,000	13×13×17½″	29 14 0	
,, ,, ,, ,,	,, 7-valve		*	*	*	*	TC	TC	—						
,, ,, ,, ,,	,, 8-valve		*	*	*	*	TC	TC	—	Two	—	200–2,000	13×22×17½″	69 13 0	* *5-valve super-Het.* 1 oscillation 1st Det. 2 intermediate (Ap.) with 2nd Det. (L.G.). H.T. eliminator can be used.
													13×20½×13½″	60 18 0	
Burndept Wireless, Ltd., Blackheath, London, S.E.3.	Ethophone Two	Mahogany cabinet	—	—	—	LG	TC	—	—	One	S.C.	200–650 or 150–5,000	9×11×10″	8 5 0	Receiver only. Price with 2 valves, £9 8s.
,, ,, ,, ,,	Ethophone Three	,, ,,	—	—	—	LG	RC	TC	—	One	C.C.	200–650 and 1,200–1,900 or 150–5,000	10½×13½×11″	13 17 6	Receiver only. Price with 3 valves, £15 18s. 6d.
,, ,, ,, ,,	Ethophone Four	Mahogany cabinet, open front, double doors.	—	—	TA	LG	RC	TC	—	Two	S.C.	280–525 or 150–5,000	20×12×11½″	20 10 0 22 10 0	Receiver only (open front). ,, (double doors). 4 valves, £2 11s. 6d. extra. Provision for battery eliminator.
,, ,, ,, ,,	Ethodyne	,, open front ,, double doors	*	*	*	*	*	*	*	Two	C.C.	250–600 and 600–1,200 and 1,000–2,200	26×13×12″	50 12 6 55 12 6	* *7-valve super-Het.* Receiver and two frame aerials, open front. Do. with double doors. 7 valves £4 3s. extra. Provision for battery eliminator.
,, ,, ,, ,,	Short-wave	Mahogany cabinet, completely shielded.	—	—	—	LG or AB	RC	TC	—	Two and Vernier	C.C.	11.5–103	16¾×12¼×10¼″	35 0 0	Including 3 valves and 8 coils.
,, ,, ,, ,,	Screened Four	,, ,,	—	—	TA	LG	RC	TC	—	Two	C.C.	200–570 and 750–2,000	17×16×12″	On application.	Shielded grid valve. Provision for battery eliminator.
Burne-Jones & Co., Ltd., 288, Borough High Street, London, S.E.1.	Magnum Cube	Cubical oak cabinet	—	—	—	LG	RC	RC	—	One	C.C.	250–550	12×12×12″	12 7 6	Including aerial, H.T. and L.T. batteries.
	Magnum Purity Three	Oak cabinet	—	—	—	LG	RC	RC	—	One	C.C.	250–550 550–1,000 1,000–2,000	12×7×9″	8 3 6	Price with valves, aerial supplies, H.T. and L.T. batteries, £11 17s. 6d.
,, ,, ,, ,,	Magnum Screened Three.	,,	—	—	TT	LG	RC	—	—	One	C.C.	,, ,,	15×7×11″	12 12 6	,, ,, ,, £18 17s. 6d.
,, ,, ,, ,,	Magnum Screened Four	,,	—	—	TT	LG	RC	TC	—	One	C.C.	,, ,,	16×7×13″	15 5 0	,, ,, ,, £23
,, ,, ,, ,,	Magnum Screened Five	,,	—	TT	TT	LG	RC	TC	—	One	C.C.	,, ,,	17×7×15″	18 12 6	,, ,, ,, £28 2s. 6d.

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties).	Remarks.
													in.	£ s. d.	
Cantophone Wireless Co., 310–312, Regent Street, London, W.1.	Cantophone V.2	Mahogany cabinet enclosed.	—	—	—	LG	TC	—	—	One	C.C.	250–550 and 1,350–1,800	12×6×6″	6 15 0	Price with valves, battery, accumulator and loud-speaker, £12 12s.
,, ,, ,, ,,	,, V.3	,, ,,	—	—	—	LG	TC	TC	—	One	C.C.	,, ,,	12×6×6″	9 0 0	,, ,, ,, £15 15s.
Castagnoli, Gordon, Castaphone Radio Works, 71, Culver Street, Colchester.	Castaphone E.II	Mahogany cabinet	—	—	—	LG	TC	—	—	One	S.C.	250–550 and 1,000–2,000	9×6×8″	5 15 0	Price with valves, accumulator and H.T. battery, £7 10s,
,, ,,	,, 33	,, ,,	—	—	—	LG	TC	TC	—	One	S.C.	,, ,,	13½×7×9½″	11 17 6	,, ,, ,, £15 5s. 3d.
Climax Radio Electric Ltd., Quill Works, Putney, S.W.15.	Mains 4	Oak, mahogany or walnut, totally enclosed.	—	—	TT	AB	RC	TC	—	Two	C.C.	200–500 and 750–2,000	16×16×10″	From £28	*For D.C. Mains.*
														,, £32	*For A.C. Mains.*
Cole, E. K., Ltd., Ekco Works, London Road, Leigh-on-Sea.	Ekco, Mains II.	Mahogany cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	300–550 and 1,200–2,000	12×12×5″	£14 (approx.)	Complete with valves and aerial. Including valves and loud-speaker (*working off D.C. mains*). £4 *extra for A.C. Mains.*
,, ,, ,, ,,	,, Mains III.	,, ,,	—	—	TA	LG	TC	—	—	Two	C.C.	250–550 and 1,200–2,000	17×17×14″	27 1 6	*For D.C. Mains.* (valves extra).
,, ,, ,, ,,	,, Mains IV.	,, ,,	—	—	TA	LG	RC	TC	—	Two	C.C.	,, ,,	17×17×15″	31 0 0	*For A.C. Mains* ,, ,,
														30 17 0	*For D.C. Mains.* ,, ,,
														37 15 6	*For A.C. Mains* ,, ,,
Cook's Wireless Co., Ltd., 23, St. Helens Street, Ipswich.	C.W.C., 2-v. Popular	Cabinet with space for batteries.	—	—	—	LG	TC	—	—	One	—	250–2,000	11×13×11½″	6 15 0	——
,, ,, ,, ,,	C.W.C., 3-v. Popular	,, ,, with sliding front.	—	—	—	LG	TC	RC	—	One	S.C.	,, ,,	18¾×11×12″	9 15 0	——
,, ,, ,, ,,	C.W.C., 4-v. Popular	,, ,,	—	—	—	LG	TC	RC	RC	One	S.C.	,, ,,	18¾×11×12″	12 0 0	——
,, ,, ,, ,,	C.W.C., 2-v. Standard	Cabinet with doors and battery container.	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	14½×14×11	7 10 0	——
,, ,, ,, ,,	C.W.C., 3-v. Standard	,, ,,	—	—	—	LG	TC	RC	—	One	S.C.	,, ,,	19×14×11″	10 17 6	——
,, ,, ,, ,,	C.W.C., 3-v. de Luxe	Cabinet with revolving shutter and battery container.	—	—	—	LG	TC	RC	—	One	S.C.	,, ,,	18½×13½×12″	12 0 0	——
,, ,, ,, ,,	C.W.C., 4-v. de Luxe	,, ,,	—	—	—	LG	TC	RC	RC	One	S.C.	,, ,,	18½×13½×12″	14 5 0	——
Denison Bros., Halifax	Celestaphone Three	—	—	—	—	LG	TC	Ch	—	Two	S.C.	230–3,000	17×8×7″	20 0 0	Including valves, battery accumulator and loud-speaker.
,, ,, ,,	,, Four	American type	—	—	—	AB	RC	RC	TC	Two	C.C.	17–70 230–590 and 850–1,900	29×8×12″	27 0 0	Without accessories. Provision for battery eliminator.
,, ,, ,,	,, Orpheus Five.	"Chair side," pedestal period cabinets.	—	—	TT	AB	RC	Ch	TC	Two	C.C.	230–600 and 800–2,800	37×12×10″	On application	——
Eagle Engineering Co., Ltd., Warwick.	Chakophone, 1A	Open type in oak case	—	—	—	LG	—	—	—	One	S.C.	250–2,000	10×8×6″	3 5 0	Price with valve, H.T. and L.T. batteries and headphones, £5 4s. 3d.
,, ,, ,, ,,	,, No. 9	Vertical panel in oak cabinet with compartment for H.T. battery.	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	12×8×12″	6 5 0	Price with valves, H.T. and L.T. batteries and loud-speaker, £10 4s. 3d. Provision for battery eliminator.
,, ,, ,, ,,	,, Junior Two.	Oak cabinet enclosed	—	—	—	LG	TC	—	—	One	S.C.	220–520 and 850–1,900	11×8×8″	5 0 0	Price with valves, H.T. and L.T. batteries and loud-speaker, £8 10s.
,, ,, ,, ,,	,, Junior Three	,,	—	—	—	LG	TC	TC	—	One	S.C.	,, ,,	16×8×7¼″	7 15 0	,, ,, ,, £12 6s. 6d.
,, ,, ,, ,,	,, No. 1B.	,, ,, with compartment for H.T. battery.	—	—	—	LG	TC	TC	—	One	S.C.	250–2,000	11×10×16½″	11 17 6	——
,, ,, ,, ,,	,, Cabinet Three	,, ,,	—	—	—	LG	TC	TC	—	One	S.C.	250–520 and 850–2,000	20×10×18″	15 12 6	Price with valves, H.T. and L.T. batteries and built-in loud-speaker, £18 9s. Provision for battery eliminator.
,, ,, ,, ,,	Everyman Four	Oak cabinet, totally enclosed disappearing front.	—	—	TT	AB	RC	TC	—	Two	C.C.	250–520 and 1,000–2,000	22½×12½×11″	24 10 0	Price with valves, H.T. and L.T. batteries and Amplion cone loud-speaker, £35 17s. 9d.
,, ,, ,, ,,	Chakophone Five-valve (Everyman type).	Walnut cabinet, totally enclosed with disappearing front.	—	TT	TT	LG	TC	TC	—	Three	C.C.	250–520 and 1,000–2,000	26½×12½×12″	33 2 6	Price with valves only, £36 6s. 6d.
Ede, C., & Co., Ltd., Byfleet, Surrey	Orchestral Three	Oak, American type	—	—	—	LG	RC	RC	—	One	C.C.	45 upwards	19×7×7½″	10 5 6	With coil for broadcast band and G.B. battery. Mahogany cabinet, 10s. extra
,, ,, ,, ,,	Power Four	,, ,,	—	—	—	LG	RC	RC	RC	One	C.C.	,, ,,	19×7×7½″	13 0 0	,, ,, ,, ,,
Edison Bell, Ltd., Glengall Road, London, S.E.15.	Gem	Flat type	—	—	—	LG	TC	—	—	One	S.C.	220–500 and 1,000–2,000	12½×10½×3½″	4 5 0	Receiver only.
,, ,, ,, ,,	Don	—	—	—	—	LG	—	—	—	One	S.C.	250–520 and 1,000–2,000	9×8×8″	3 2 6	,,
,, ,, ,, ,,	Bijou	—	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	12×10×10″	5 0 0	,,
,, ,, ,, ,,	Prince	—	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	13×12×10″	5 15 0	,,
,, ,, ,, ,,	King	Cabinet type	—	—	—	LG	TC	RC	—	Two	S.C.	,, ,,	14×9×6″	8 5 0	,,
,, ,, ,, ,,	Majestic	,, totally enclosed.	—	—	TA	LG	TC	RC	—	One	S.C.	250–3,000	31×11×10″	17 10 0	,,

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties). £ s. d.	Remarks.
Edison Swan Electric Co., Ltd., 123/5, Queen Victoria Street, London, E.C.	Ediswan Compactum	Circular moulded	—	—	—	LG	TC	—	—	One	S.C.	250–10,000	in. 9" dia. × 6"	4 0 0	Price with valves, H.T. and L.T. batteries, loud-speaker and aerial supplies, £10 6s.
	Ediswan Toovec, long-wave model.	Walnut cabinet	—	—	*	LG	TC	—	—	Two	C.C.	300–4,000	18×12×8"	6 5 0	(*Reflex) Price with valves, H.T. and L.T. batteries and aerial supplies, £9 10s. 9d.
	Ediswan 4-v., long-range Radiophone.	,, totally enclosed.	—	—	*	LG	TC	RC	—	Two	C.C.	200–4,000	23×12×15"	27 10 0	,, ,, ,, £32 3s.
Elven Mains Receiver Co., 109, Kingsway, London, W.C.2.	Elven Mains	Mahogany or oak, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	300–3,000	13×14×15"	16 5 0	*For A.C. Mains.*
			—	—	—	AB	RC	TC	—	One	S.C.	,, ,,	20×10×9"	15 15 0	*For D.C. Mains.*
														22 17 6	*For A.C. Mains.*
														20 0 0	*For D.C. Mains.*
Empress Radio & Electrical Co., Stonehouse, Plymouth.	Concert Three	Mahogany, totally enclosed.	—	—	—	LG or Ap	TC	TC	—	One	C.C.	250–3,000	15½×10×7"	10 10 0	(No batteries needed.) ——
	Concert Four	Mahogany or oak, totally enclosed.	—	—	TA	LG	TC	TC	—	One	C.C.	,, ,,	16×9×10"	13 0 0	——
	Empress Classic	Mahogany, totally enclosed.	—	—	TT	LG	TC	TC	—	Two	C.C.	275–3,500	21×12×12"	16 10 0	——
Falk, Stadelmann & Co., Ltd., 83/93, Farringdon Road, London, E.C.	Efescaphone Cromwell	Mahogany, upright cabinet.	—	—	—	LG	TC	—	—	One	S.C.	250–550 and 1,000–2,000	12×9½×9"	6 15 0	Receiver only.
	Efescaphone, Wolfe	,, ,,	—	—	—	LG	RC	RC	—	One	S.C.	250–550 and 1,000–2,000	12×9½×9"	8 17 6	,,
	Efescaphone Wellington	,, ,,	—	—	—	LG	RC	RC	—	One	S.C.	,, ,,	18×9½×9"	11 2 6	,,
	Efescaphone Kitchener	,, ,,	—	—	TA	LG	RC	TC	—	Two	S.C.	,, ,,	24×12×10"	18 10 0	
Fallowfield, Jonathan, Ltd., 61 and 62, Newman Street, London, W.1.	Fallowfield Two, Type A.	Oak or Mahogany cabinet.	—	—	—	LG	TC	—	—	One	S.C.	200–600 and 1,000–2,000	10×7×8"	9 17 6	With valves, battery accumulator and loud-speaker.
	,, Type B.	,, ,,	—	—	—	AB	RC	—	—	One	—	—	10×7×8"	9 11 0	,, ,, ,,
	Fallowfield Corner cabinet.	Oak cabinet, totally enclosed.	—	—	TA	LG	TC	TC	—	To	S.C.	,, ,,	63×36×24"	52 10 0	With valves, battery accumulator and enclosed loud-speaker.
	Everyman Four	Oak or mahogany cabinet.	—	—	TT	AB	RC	TC	—	Two	—	200–600 and 1,000–1,800	26×8×8"	28 0 0	With valves, battery accumulator and loud-speaker.
Freed Eisemann Radio of Great Britain, Ltd., 91, Regent Street, London, W.1.	N.R.8	—	TT	TT	TT	LG	TC	TC	—	Two	—	200–575 and 1,000–2,000	18½×10½×9½"	28 15 0	*Lower waveband only.*
														34 5 0	*Both wavebands.*
	N.R.9	—	TT	TT	TT	LG	TC	TC	—	One	—	,, ,,	18½×10½×9½"	31 15 0	*Lower waveband only.*
														37 5 0	*Both wavebands.*
	N.R.800	—	2 TT	TT	TT	LG	TC	TC	—	One	—	200–575	15×16×32"	92 10 0	Four stages H.F. amplification, T.T. independently screened. Provision for two valves in parallel in last stage.
Gambrell Bros., Ltd., 76, Victoria Street, London, S.W.1.	Gambrell Mains Receiver Cabinet-Two D.C.	Mahogany cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	250–550 and 1,000–2,000	13½×17×12"	17 0 0	With valves and accessories, except loud-speaker and aerial.
	,, A.C.	,, ,,	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	13½×17×12"	22 17 6	H.T., L.T. and G.B. from D.C. Mains.
	Gambrell Mains, Receiver Cabinet-Three D.C.	,, ,,	—	—	TA	LG	TC	—	—	Two	C.C.	,, ,,	19×18×12"	25 7 6	,, for A.C. Mains.
	,, A.C.	,, ,,	—	—	TA	LG	TC	—	—	Two	C.C.	,, ,,	19×18×12"	33 0 0	,, D.C. mains.
	Gambrell Mains, Receiver Cabinet-Four D.C.	,, ,,	—	—	TA	LG	RC	TC	—	Two	C.C.	,, ,,	19×18×12"	31 0 0	,, ,, for A.C. Mains.
	,, ,,	,, ,,	—	—	TA	LG	RC	TC	—	Two	C.C.	,, ,,	19×18×12"	38 2 6	,, D.C. mains.
General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.	Gecophone, 2-valve	Mahogany cabinet, vertical panel.	—	—	—	LG	TC	—	—	One	S.C.	280–510	9⅜×11⅞×5¼"	10 10 0	,, ,, for A.C. Mains.
															Receiver only.
															Price with valves, batteries and loud-speaker, £13.
	Gecophone, 3-valve	,, ,,	—	—	—	LG	TC	TC	—	One	C.C.	230–3,100	11×23½×11"	17 17 6	Coils for other wavebands can be inserted.
	Gecophone, 3-valve, "L. and D." Model.	,, ,,	—	—	—	LG	TC	TC	—	—	—	Fixed for Local and D.	11×21×11"	15 17 6	With valves.
															Receiver only with valves and grid battery.
															Price complete with valves, batteries and leads, £18 2s. 6d.
	Gecophone, 4-valve, stabilised.	,, ,,	—	—	TT	LG	TC	TC	—	Two	—	200–550 and 940–12,000	13½×21¾×14"	28 10 0	Receiver only.
															Price with valves, batteries and leads, £33 10s.
	Gecophone "Compact" Four-valve.	Console cabinet with vertical panel and doors.	—	—	—	LG	TC	Ch	Ch	One	C.C.	230–3,100	34⅝×23×14⅝"	35 0 0	With valves, batteries and leads.
	Gecophone, 6-valve stabilised.	Mahogany cabinet with vertical panel and doors.	—	TT	TT	LG	Ch	Ch	Ch	Three	—	200–550 and 940–2,000	13⅛×26½×15¾"	53 15 0	Receiver only.
															Price with valves, batteries and leads, £61 5s.
	Gecophone, 8-valve Super-Heterodyne.	,, ,,	*	*	*	*	*	*	*	Three	C.C.	250–2,800	13×28×14"	70 0 0	* *8-valve super-Het.*
															With valves, batteries and leads.

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties). £ s. d.	Remarks.
Gent & Co., Ltd., Faraday Works, Leicester.	Radiomatic D.	—	—	—	—	LG	TC	—	—	One	S.C.	—	10×8×8½"	8 5 0	Receiver only without valves. Provision for battery eliminator.
" " " "	Radiomatic E.	—	—	—	—	LG	TC	Ch	—	One	C.C.	280–500 and 1,000–1,800	7½×11×16½"	13 17 6	" " "
" " " "	Radiomatic C.	—	—	—	TA	LG	TC	Ch	—	Two	C.C.	" "	26¾×11×9¾"	22 5 0	With valves. Provision for battery eliminator.
Gillan Radio Electric, Ltd., 64, High Holborn, London, W.C.1.	Gillan I.	Mahogany vertical panel.	—	—	—	LG	—	—	—	One	S.C.	—	9×7×6"	3 12 6	Receiver only.
" " " "	Gillan II.	Oak or mahogany vertical panel.	—	—	—	LG	TC	—	—	One	S.C.	—	14×10×9"	7 5 0	Receiver only without valves.
" " " "	Gillan III.	Oak or mahogany vertical panel.	—	—	—	LG	TC	RC	—	One	S.C.	—	16×10×10"	12 7 6	Receiver only.
" " " "	Gillan III. A.	" "	—	—	TA	LG	TC	—	—	Two	S.C.	—	16×10×10"	12 7 6	"
" " " "	Gillan L.G. III.	Mahogany totally enclosed with battery compartment.	—	—	—	LG	TC	RC	—	One	S.C.	—	16×14×14"	14 9 6	"
" " " "	Gillan IV.	Oak or mahogany vertical panel.	—	—	TA	LG	TC	RC	—	Two	S.C.	—	16×10×10"	15 2 0	"
" " " "	Monodyne IV.	Oak or mahogany, totally enclosed with compartment for batteries.	—	—	Ap	LG	TC	TC	—	One	S.C.	200–500 and 1,000–2,000	18×16×12"	25 0 0	" Provision for battery eliminator.
Goulden, H.J., Ltd., 39–40, High Street, Canterbury.	Itonaphone	Oak or mahogany, open vignette.	—	—	—	LG	TC	—	—	One	S.C.	250–2,500	13×11×9"	16 16 0	Complete with all accessories, including loud-speaker and aerial.
" " " "	Itonaphone	" "	—	—	—	LG	RC	TC	—	One	S.C.	"	13×11×9"	21 0 0	" " " "
Graves, J. G., Ltd., Westville, Sheffield.	Vulcan 2	Oak cabinet	—	—	—	LG	TC	—	—	One	S.C.	270–2,000	10×8"	7 10 0	With valves, batteries, loud-speaker and aerial.
" " " "	Vulcan 3	"	—	—	—	LG	TC	TC	—	One	S.C.	250–3,000	14×8"	11 10 0	" " ——— " "
" " " "	Aeolus 4	"	—	TA	TA	LG or AB	TC	†	—	Three	—	"	27×11×10"	24 10 0	
Hargave, Stanley, Ltd., Gay Street, Bath.	Harleyphone Three-valve.	Mahogany or oak, enclosed.	—	—	—	LG	TC	TC	—	One	C.C.	200–500 and 1,000–2,000	—	16 0 0	Receiver only. Price with valves, batteries and aerial supplies, £19 15s.
Hart Collins, Ltd., 38, Bessborough Road, Westminster, S.W.1.	Cabinet Model, 3-valve	—	—	—	—	LG	RC	RC	—	One	C.C.	200–500 and 900–2,000	16×12×7"	18 9 0	With valves, batteries and loud-speaker. Provision for battery eliminator.
" " " "	Orthosonic Spirit, 8-v.	—	*	*	*	*	*	*	*	Two	C.C.	200–600 and 900–2,000	31×20×36"	71 6 0	* *8-valve Super-Heterodyne.* With valves, H.T. and L.T. accumulators, and built-in loud-speaker. Provision for battery eliminator.
Henderson, W. J., & Co., Ltd., 281, Fulham Road, London S.W.10.	Super-four	—	—	—	TT	LG	TC	RC	—	One	C.C.	250–550 and 1 000–2,000	22×8×9"	25 15 0	With valves but not batteries. Provision for battery eliminator.
Janes, W. H., 202, Dale Street, Chatham.	Janettephone	Teak or mahogany, sloping front.	—	—	TA	LG	TC	TC	—	Two	S.C.	200–500 and 1,000–2,000	18×10×5"	16 10 0	Receiver only. Price with valves and batteries, £22 7s. 6d.
Lamplugh, S.A., Ltd., King's Road, Tyseley, Birmingham.	Popular II.	Oak cabinet with battery compartment.	—	—	—	LG	TC	—	—	Two	S.C.	250–500 and 1,000–2,000	19×9×5½"	6 5 0	——
" " " "	Popular III.	"	—	—	—	LG	TC	TC	—	Two	S.C.	" "	24×10¾×9½"	8 11 6	——
" " " "	Quality II.	Oak cabinet, totally enclosed.	—	—	—	LG	TC	—	—	Two	S.C.	" "	21×9½×10½"	11 5 0	Receiver only. Price with valves, batteries and loud-speaker, £16 4s. 7d.
" " " "	Quality III.	" "	—	—	—	LG	TC	TC	—	Two	S.C.	" "	23×9½×10½"	14 17 6	" " " £20 10s. 3d. Mahogany cabinet £1 extra.
London Electrical Co., 1, Sherborne Lane, London, E.C.	Lecodyne 2	Oak or mahogany, open front.	—	—	—	LG	TC	—	—	One	C.C.	250–550 and 1,000–2,000	12×7×9"	6 5 0	Receiver only. Price with valves, batteries and loud-speaker, £10.
" " " "	" R.2	" "	—	—	—	LG	TC	—	—	One	C.C.	" "	12×7×10"	9 0 0	Receiver only. Price with valves, batteries and loud-speaker, £16.
" " " "	" R.3	" " totally enclosed.	—	—	—	LG	TC	Ch	—	One	C.C.	" "	16×7×10"	12 10 0	Complete with valves, batteries and loud-speaker.
" " " "	" R.4	" "	—	—	TT	LG	TC	Ch	—	Two	C.C.	" "	21×8×10"	16 0 0	" " " "
McMichael, T., Ltd., Wexham Road, Slough.	M.H. Dimic Three	Oak cabinet, enclosed.	—	—	—	LG	Ch	TC	—	One	C.C.	275–600 and 900–2,000	20¾×12×11¼"	12 17 6	Provision for battery eliminator.
" " " "	M.H. Dimic Four	" "	—	—	TA	LG	Ch	TC	—	Two	C.C.	250–600 and 900–2,000	26¾×11½×12"	20 7 0	" " "
" " " "	M.H. Transportable Five.	" " with oak frame aerial.	—	*	*	LG	TC	TC	—	One	S.C.	270–2,000	†30×20¾×11¼"	25 3 6	* *Semi-Aperiodic-choke.* † *With frame aerial.* Provision for battery eliminator.

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties). £ s. d.	Remarks.
Marconiphone Co., Ltd., 210–212, Tottenham Court Road, London, W.1.	Marconiphone VI. ...	Cabinet with vertical ebonite panel.	—	—	—	LG	—	—	—	One	—	300–4,600	in. $8\frac{3}{4}\times7\frac{1}{2}\times6\frac{3}{4}$"	3 3 0	Receiver only.
	Sterling Anodion, 1-valve.	Desk type	—	—	—	LG	—	—	—	One	S.C.	225–925 and up to 5,000	$9\frac{1}{2}\times6\frac{3}{4}\times11\frac{1}{2}$"	2 14 6	Price with valve and batteries, £6 1s. Receiver only.
,, ,, ,, ,,	Marconiphone 22	Mahogany cabinet, vertical panel, hinged top.	—	—	—	LG	TC	—	—	One	S.C.	250–550 and 1,000–2,000	$13\times10\frac{1}{2}\times9$"	7 15 0	Price with valve and batteries, £4 19s. 10d. Receiver only. Prices complete (without loud-speaker) :— 2-volt equipment, £11 7s. 4 ,, ,, £12 0s. 6d. 6 ,, ,, £13 18s. 6d. D.C. Mains ,, £15 15s. 6d. A.C. ,, ,, £19 8s.
,, ,, ,, ,,	,, 32.....	Mahogany cabinet, sloping panel.	—	—	—	LG	TC	RC	—	One	S.C.	250–550 and 1,000–1,800	$17\frac{1}{8}\times10\frac{3}{4}\times12\frac{3}{4}$"	13 17 6	Receiver only. Prices of complete equipments, as above, £18 18s. 6d. to £26 15s.
,, ,, ,, ,,	,, 32A.....	Pedestal cabinet	—	—	—	LG	TC	RC	—	One	S.C.	,, ,,	$42\frac{1}{2}\times17\frac{1}{4}\times12\frac{3}{4}$"	25 15 0	Receiver only.
,, ,, ,, ,,	,, 51.....	Mahogany cabinet, sloping panel.	—	TA	TA	LG	TC	RC	—	One	C.C.	,, ,,	$22\frac{1}{2}\times12\frac{1}{2}\times14\frac{1}{2}$"	27 2 6	,,
,, ,, ,, ,,	,, 51A.....	Mahogany cabinet	—	TA	TA	LG	TC	RC	—	One	C.C.	,, ,,	$22\times43\frac{1}{4}\times15$"	41 12 6	Prices of complete equipments, as above, £34 6s. to £41 1s.
,, ,, ,, ,,	,, 51B.....	Mahogany pedestal cabinet.	—	TA	TA	LG	TC	TC	—	One	C.C.	,, ,,	$22\frac{1}{2}\times43\frac{1}{2}\times15$"	77 7 6	Receiver only.
															,,
														79 17 6	*For D.C. Mains.* Receiver only. *For A.C. Mains.* Complete equipment, D.C., £84 16s. 6d. Complete equipment A.C., £88 19s. 6d.
,, ,, ,, ,,	,, 81.....	Mahogany cabinet, sloping front.	TA	TA	2TA	*	TC	TC	—	Six	—	,, ,,	$25\times16\frac{3}{4}\times13\frac{1}{2}$"	54 10 0	R.K. moving coil, cone, loud-speaker * *Special circuit.* Receiver only.
,, ,, ,, ,,	,, 82.....	,, ,,	*	*	*	*	*	*	*	One	—	,, ,,	$24\times41\times17\frac{1}{4}$"	59 5 0	Price complete with valves, £64 18s. * *8-valve Super Heterodyne.* Receiver only. Valves and L.T. accumulator, £7 17s. 6d. extra. H.T. accumulator, £6 extra. Provision for eliminators.
Metro-Vick Supplies, Ltd., 155, Charing Cross Road, London, W.C.2.	Cosmos, 3-valve.....	Circular moulded stand	—	—	—	LG	RC	RC	—	Two	S.C.	250–550 and 1,500–2,000	10" Diam. × 8"	6 5 0	With valves only.
	Met-Vick 5 ..... (*a*) Battery Model.	Oak or mahogany cabinet.	—	TA	TA	LG	RC	RC	—	Four	C.C.	120–3,000	$32\times14\times14$"	38 15 0	In oak (mahogany, £3 10s. extra). Works off batteries or H.T. eliminator, complete with valves, batteries and headphones.
,, ,, ,, ,,	(*b*) A.C. Model	,, ,,	—	TA	TA	LG	RC	RC	—	Four	C.C.	,, ,,	$32\times14\times14$"	51 2 6	In oak (mahogany, £3 10s. extra), complete with eliminators, valves and headphones.
,, ,, ,, ,,	(*c*) D.C.C. Model	,, ,,	—	TA	TA	LG	RC	RC	—	Four	C.C.	,, ,,	$32\times14\times14$"	51 2 6	In oak (mahogany, £3 10s. extra), complete as above.
Nutter, C. H. P., 243, Selhurst Road, South Norwood, London, S.E.25.	Standard Two	Oak table cabinet	—	—	—	LG	TC	—	—	One	S.C.	200–20,000	$11\times14\times8$"	12 12 0	Complete with valves, batteries, loud-speaker and aerial supplies.
	Mains Three	Jacobean oak, gramophone type, on legs.	—	—	—	AB	RC	RC	—	Two	C.C.	250–550 and 900–1,900	$36\times16\times34$"	47 5 0	Complete with valves, loud-speaker and aerial supplies. 2 rectifiers, and resistance lamp, *for A.C. Mains.*
Ormond Engineering Co., Ltd., 199–205, Pentonville Road, London, N.1.	Ormond, 2-valve	Oak cabinet	—	—	—	LG	TC	—	—	One	C.C.	250–550 and 1,000–2,000	$7\times11\times10$"	5 15 0	Receiver and coils only. Price with valves and batteries, £8 17s.
	,, 3-valve	,, ...	—	—	—	LG	TC	RC	—	One	C.C.	,, ,,	$7\times14\frac{3}{4}\times10$"	8 7 6	Receiver and coils only. Price complete as above, £12. Loud-speaker, £3 3s. extra.
Oxford Wireless Telephony Co., Ltd., Titmouse Lane, Oxford.	Oxford Two	—	—	—	—	LG	TC	—	—	One	C.C.	20–1,800	$14\times14\times9$"	18 10 0	With valves and batteries.
,, ,, ,, ,,	Oxford D.E. 3	—	—	—	—	LG	TC	TC	—	One	C.C.	,, ,,	$14\times14\times9$"	18 10 0	,, ,, ,,
	Oxford Four.....	Flat cabinet	—	—	—	LG	TC	TC	RC	One	C.C.	,, ,,	$14\times14\times9$"	18 10 0	,, ,, ,,
Phillips, F. D., 42a, Catharine Street, Street, Liverpool.	Classic, 2-valve	Mahogany case, open front.	—	—	—	LG	TC	—	—	One	C.C.	250–500 and 1,000–2,000	$15\times9\times9\frac{1}{2}$"	12 12 0	With valves, batteries, and loud-speaker.
,, ,, ,, ,,	,, 3-valve	,, ,, ,,	—	—	—	LG	TC	TC	—	One	C.C.	250–500 and 1,000–2,000	$18\times9\times9\frac{1}{2}$"	16 16 0	,, ,, ,, ,,
Pye, W. G., Ltd., Granta Works, Montague Road, Cambridge.	Pye 222.....	—	—	—	—	LG	TC	—	—	One	C.C.	260–3,000	$10\frac{3}{4}\times9\times7$"	6 15 0	Receiver only with valves.
,, ,, ,, ,,	Pye 720.....	—	—	—	—	LG	TC	—	—	One	C.C.	260–2,170	$19\frac{3}{4}\times14\times9\frac{1}{4}$"	9 18 0	,, ,, ,,
	Pye 730.....	—	—	—	TT	LG	TC	—	—	Two	C.C.	230–560 and 1,000–2,000	$17\frac{1}{2}\times14\frac{1}{4}\times17\frac{3}{4}$"	17 1 0	,, ,, ,,
,, ,, ,, ,,	Pye 740.....	—	—	—	TT	AB	RC	TC	—	Two	—	260–550 and 1,000–2,000	$17\frac{1}{2}\times14\frac{1}{4}\times17\frac{3}{4}$"	21 4 0	,, ,, ,,
,, ,, ,, ,,	Pye 740M.	—	—	—	TT	AB	RC	TC	—	Two	—	,, ,,	$17\frac{1}{2}\times14\frac{1}{4}\times17\frac{3}{4}$"	37 2 6	,, ,, ,, With unit for taking H.T., L.T., and G.B. supply from *A.C. Mains.*
,, ,, ,, ,,	Pye 750.....	—	—	TT	TT	LG	TC	TC	—	Three	C.C.	200–600 and 900–2,700	$31\frac{1}{2}\times16\times12$"	38 13 0	Receiver only with valves.

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves.							No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties).	Remarks.
			H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.						
Pye, W. G., Ltd., Granta Works, Montague Road, Cambridge.	Pye 830	—	—	—	—	LG	TC	TC	—	One	C.C.	270–570 and 990–2,280	in. 21×14×10⅜"	£ s. d. 16 1 0	Receiver only with valves.
R. M. Radio, Ltd., 19, Garrick Street, London, W.C.2.	—	—	—	—	*	*	*	*	—	1 or 2	—	200–2,000	—	40–100 guineas	* 2, 3 *or* 4 *valves to order.* With all accessories and loud-speaker.
Radiax, Ltd., 16, Palmer Place, Holloway Road, London, N.7.	Challenge, No. 46	Oak cabinet, totally enclosed.	—	—	TA	LG	TC	—	—	Two	C.C.	250–550 and 1,100–2,000	18×9×12"	10 5 0	Receiver only.
,, ,, ,, ,,	,, No. 48	,, ,,	—	—	TA	LG	TC	TC	—	Two	C.C.	,, ,,	21×9×12"	13 10 0	,,
,, ,, ,, ,,	,, No. 50	,, ,,	—	—	TA	LG	RC	RC	TC	Two	C.C.	,, ,,	25½×9×12"	16 15 0	,,
Radiocraft Supplies, Ltd., The Arcade, Walsall.	Radiocraft, A.R. 2	American type cabinet	—	—	—	LG	TC	—	—	One	S.C.	200–500 and 1,000–2,000	12×7×8"	5 10 0	With valves and batteries.
,, ,, ,, ,,	,, A.R. 3	,, ,,	—	—	—	LG	RC	TC	—	One	S.C.	,, ,,	15×5½×8"	8 10 0	,, ,, ,,
,, ,, ,, ,,	,, Table Two	Oak, enclosed table type.	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	12×12×36"†	7 0 0	,, ,, ,, † *Height of table.*
,, ,, ,, ,,	,, Table Three	,, ,,	—	—	—	LG	RC	TC	—	One	S.C.	,, ,,	12×12×36"†	9 10 0	,, ,, ,,
,, ,, ,, ,,	,, Screened Four	Mahogany cabinet with compartment for batteries.	—	—	TT	AB	RC	TC	—	Two	—	100–500 and 1,000–3,000	36×8×11"	28 0 0	With valves and batteries. Provision for eliminator.
Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, London, W.1.	Interdyne	Mahogany cabinet and front.	—	TT	TT	LG	RC	TC	—	One	C.C.	250–550	26×13¾×13"	28 2 6	Receiver only. Price complete with valves and batteries, £37 8s. 9d.
,, ,, ,, ,,	,,	,, ,,	—	TT	TT	LG	RC	TC	—	One	C.C.	250–500 and 1,000–2,000	26×23⅞×13½"	45 2 6	Receiver only. Price complete with valves and batteries, £54 8s. 9d.
Radio Supply Co., Superfone Works, Four Oaks, Birmingham.	Superfone Maxum II.	Mahogany cabinet.	—	—	—	LG	TC	—	—	One	—	200–600 and 1,000–2,000	11×11×6"	6 15 0	Receiver only.
,, ,, ,, ,,	,, Maxum III.	,, ,,	—	—	—	LG	TC	RC	—	One	—	,, ,,	11×11×6"	8 17 6	,,
,, ,, ,, ,,	,, Maxum III.	,, ,, all enclosed, sloping and shaped front, compartment for batteries.	—	—	—	LG	TC	RC	—	One	S.C.	,, ,,	19×10½×12½"	10 17 6	,,
,, ,, ,, ,,	,, Maxum IV.	Mahogany cabinet, shaped front.	—	—	—	LG	TC	RC	RC	One	—	,, ,,	19×9×8½"	14 10 0	,,
Radolian Company, 52, Bushey Grove Road, Watford, Herts.	Radolian	Oak or mahogany, enclosed type.	—	—	—	AB	RC	RC	—	One	C.C.	300×550	14×7×10"	27 6 0	With valves and batteries. H.T. battery "Konverter," £10 10s. extra.
Read and Morris, Ltd., 31, East Castle Street, Oxford Street, London, W.	Home-Stations Mains	Mahogany cabinet, totally enclosed.	—	—	—	AB	TC	TC	—	One	—	300–600 and 1,000–2,600	18½×18×14"	45 0 0	*For A.C. Mains*, with valves.
	All-Stations Mains de Luxe.	Walnut or mahogany, totally enclosed.	—	TT	TT	LG	RC	TC	—	One	C.C.	250–550 and 1,000–2,000	23×11½×20½"	75 0 0	*For A.C. Mains*, with valves.
,, ,, ,, ,,	,, Special Power Model.	,, ,,	—	TT	TT	LG	RC	TC	2 TC	One	C.C.	,, ,,	23×11½×20½"	90 0 0	*For A.C. Mains*, with valves. Last stage, two valves in parallel.
,, ,, ,, ,,	Simplicity Five	,, ,,	—	TA	TA	LG	TC	TC	—	Two	—	200–4,000	20×25×9½"	40 0 0	With coils but not valves. Provision for battery eliminators.
Regent Radio Supply Co., 21, Bartlett's Buildings, Holborn Circus, London, E.C.4.	Regentone D.C. Junior II.	Oak cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	250–1,400	—	8 15 0	*For D.C. Mains*, with valves.
,, ,, ,, ,,	Regentone, D.C. II.	Mahogany cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	—	17 15 0	,, ,, ,,
,, ,, ,, ,,	,, D.C. III.	,, ,,	—	—	—	LG	TC	RC	—	One	S.C.	,, ,,	—	22 17 6	,, ,, ,,
,, ,, ,, ,,	,, D.C. IV.	,, ,,	—	—	TT	LG	TC	RC	—	Two	S.C.	,, ,,	—	29 10 0	,, ,, ,,
,, ,, ,, ,,	,, A.C. II.	,, ,,	—	—	—	LG	TC	—	—	One	S.C.	,, ,,	—	20 17 6	*For A.C. Mains*, ,,
,, ,, ,, ,,	,, A.C. III.	,, ,,	—	—	—	LG	TC	RC	—	One	S.C.	,, ,,	—	27 10 0	,, ,, ,,
,, ,, ,, ,,	,, A.C. IV.	,, ,,	—	—	TT	LG	TC	RC	—	Two	S.C.	,, ,,	—	35 2 6	,, ,, ,,
Reproduction, Ltd., 5–7, Dysart Street, Finsbury Square, London, E.C.2.	Rhapsody-Twin, Type D.	Twin oak cabinet, totally enclosed.	*	*	*	*	*	*	*	Two	—	250–500 and 1,000–2,000	32×47×18"	126 0 0	* 8-*valve Super-Heterodyne.* Complete with valves, accumulator and H.T. eliminator. Two synchronised loud-speakers and gramophone pick-up.
Rothermel Radio Corporation of Great Britain, Ltd., 24–26, Maddox Street, Regent Street, London, W.1.	Rothermel Grebe	Walnut cabinet	—	TT	TT	LG	TC	TC	—	Three or One	—	150–600	22×13×9½"	30 12 6	——
,, ,, ,, ,,	,,	,, ,,	2 TT	TT	TT	LG	TC	TC	—	One	—	200–600	23×13×10½"	43 7 6	——
	Rothermel Crossley Bandbox.	Metal cabinet totally shielded.	Ap	TT	TT	LG	TC	TC	—	One	—	,, ,,	17×7½×5½"	20 11 0	——
Runnymede Engineering & Electrical Co., Dacre House, Victoria Street, London, S.W.1.	Runnymede Junior	Oak cabinet	—	—	—	LG	TC	—	—	One	S.C.	250–500 and 1,000–3,000	10×8×8"	5 10 0	Receiver only. Price with valves, batteries, loud-speaker and aerial supplies, £10.
,, ,, ,, ,,	Runnymede	Mahogany cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	150×3,600	24×9×8	9 15 0	Receiver only. Price with valves, batteries, loud-speaker and aerial supplies, £14 15s.
,, ,, ,, ,,	,,	,, ,,	—	—	—	LG	TC	TC	—	One	S.C.	,, ,,	24×9×8"	15 0 0	Receiver only. Price with accessories as above, £21 5s.

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Manufacturer.	Trade Name of Set	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excluding Reaction).	Reaction.	Wave Range (Metres).	Dimensions.	Price of Receiver only (including Royalties).	Remarks.
													in.	£ s. d.	
Scott, James, & Co., 57-59, Queen Anne Street, Dunfermline.	Allscott III. B.	Mahogany cabinet, open front.	—	—	—	LG	TC	TC	—	One	S.C.	250–520 and 1,000–2,000	17×9×9″	14 11 0	With valves and batteries.
" " " "	" IV.	Oak or mahogany, with double doors.	—	—	TA	AB	TC	TC	—	Two	C.C.	250–550 and 1,000–2,000	22×9×13″	23 10 0	Receiver and coils only.
" " " "	" V.	" "	—	TA	TA	AB	TC	TC	TC	Two	C.C.	" "	22×9×18″	On application.	——
Sherman, P., 12, River Street, Clerkenwell, E.C.1.	Claremont II.	Oak cabinet, with battery compartment.	—	—	—	LG	TC	—	—	Two	C.C.	200–500 and 1,000–2,000	24×10×10″	6 10 0	With valves, batteries and aerial supplies.
" " " "	" III.	" "	—	—	TT	LG	TC	—	—	Two	C.C.	" "	30×12×10″	10 0 0	
" " " "	" IV.	" " with legs	—	—	TT	AB	TC	TC	—	Two	C.C.	" "	36×18×12″	18 10 0	With " valves, batteries, loud-speaker and aerial supplies. Provision for battery eliminator.
Stanley, M., & Co., 174, London Road, Liverpool.	Stanaphone, Super-Two	Oak or mahogany cabinet.	—	—	—	LG	TC	—	—	One	C.C.	200–3,000	12×7×9″	7 15 0	With valves and batteries.
" " " "	" Super-Three	" "	—	—	—	LG	RC	TC	—	One	C.C.	" "	12×7×9″	11 15 0	With valves and batteries. Provision for eliminator.
Station " Radio " Stores, 38, Palmer Street, Westminster, S.W.1.	S.R.S. " Super-Four	" "	—	—	TT	AB	RC	TC	—	Two	C.C.	" "	16×7×9″	15 10 0	" " " "
" " " "	"	Cloth covered, with battery compartment.	—	—	—	LG	TC	—	—	One	S.C.	—	15×12×9″	8 8 0	With valves and batteries.
" " " "	"	Mahogany cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	—	15×12×9″	10 10 0	" " "
" " " "	"	Cloth covered with battery compartment.	—	—	—	LG	TC	TC	—	One	S.C.	—	15×12×9″	10 10 0	" " "
" " " "	"	Mahogany cabinet, totally enclosed.	—	—	—	LG	TC	TC	—	One	S.C.	—	15×12×9″	12 12 0	" " "
Stevens, A. J., & Co. (1914), Ltd., Walsall Street, Wolverhampton.	Symphony Two-valve	Mahogany cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	C.C.	250–550 and 900×2,400	$22\frac{5}{8}\times14\frac{13}{16}\times10\frac{7}{16}$	15 0 0	With valves, batteries and aerial supplies.
" " " "	" 3-valve	"	—	—	—	LG	TC	TC	—	One	C.C.	" "	$22\frac{5}{8}\times14\frac{13}{16}\times10\frac{7}{16}$	22 10 0	
" " " "	" 5-valve Super-Het.	Table model, mahogany cabinet.	—	*	*	*	*	*	—	Two	C.C.	250–540 and 900–2,000	$24\frac{1}{2}\times16\frac{11}{16}\times11\frac{13}{16}$	37 10 0	* *Five Valve Super-Heterodyne.*
" " " "	" 5-valve Super-Het.	Bureau model, Mahogany cabinet.	—	*	*	*	*	*	—	Two	C.C.	" "	$23\frac{1}{4}\times15\frac{1}{8}\times39\frac{5}{8}$	45 0 0	With valves, batteries, enclosed loud-speaker, coils and aerial supplies. * *Five valve Super Heterodyne.* With accessories as above.
" " " "	" 7-valve Super-Het.	Table model, mahogany cabinet.	*	*	*	*	*	*	*	Two	C.C.	" "	$24\frac{1}{2}\times16\frac{11}{16}\times11\frac{13}{16}$	52 10 0	* *Seven valve Super-Heterodyne.* With accessories as above and 2 frame aerials.
" " " "	" 7-valve Super-Het.	Bureau model, mahogany cabinet	*	*	*	*	*	*	*	Two	C.C.	" "	$23\frac{1}{4}\times15\frac{1}{2}\times39\frac{5}{8}$	60 0 0	* *Seven valve Super-Heterodyne.* With accessories as above.
Stockall Marples & Co., Ltd., 6–10, Clerkenwell Road, London, E.C.1.	Big Ben, A.W.3 Dual Programme.	Oak or mahogany cabinet, totally enclosed.	—	—	—	LG	TC	Ch	—	One	S.C.	200–500 and 1,000–2,000	24×11×9	24 16 9	With valves, batteries, coils, headphones and loud-speaker.
Vandervell, C. A., & Co., Ltd., Warple Way, Acton, London, W.3.	Baby Grand, 3-v.	Pedestal type, totally enclosed.	—	—	—	LG	RC	TC	—	One	S.C.	200–500 and 1,000–2,000	31×27×20″	26 17 6	With valves, batteries and loud-speaker. Provision for battery eliminator.
" " " "	" 4-v.	" "	—	—	TT	LG	RC	TC	—	Two	S.C.	" "	31×29×20″	32 10 0	" " " "
" " " "	" 5-v.	" "	—	Ap	Ap	LG	TC	TC	—	One	C.C.	" "	31×27×20	38 2 6	" " " " with frame aerial.
Warwick Radio Co., 22, St. Laurence Avenue, Warwick.	Warwick	Oak cabinet, totally enclosed.	—	—	—	LG	TC	—	—	One	S.C.	200–500 and 1,000–2,000	15×8×10″	5 15 0	Receiver only.
" " " "	"	" "	—	—	—	LG	TC	TC	—	One	S.C.	" "	15×8×10″	7 0 0	Price with valves and batteries, £7 15s. Receiver only.
" " " "	Everyman Four	" "	—	—	TT	AB	RC	TC	—	Two	—	200–600 and 1,000–2,000	28×10×12″	14 0 0	Price with valves and batteries, £9. Receiver only.
Watmel Wireless Co., Ltd., Imperial Works, High Street, Edgware.	Watmel Imperial Two	Oak mahogany cabinet	—	—	—	LG	Ch	—	—	One	C.C.	250–2,000	13×7½×7½″	5 0 0	Price with valves, £16 5s. Receiver only in oak, 3s. 6d extra for mahogany.
Western Laboratories, Ltd., 11, Hanbury Road, Acton, London, W.3.	W.L.L. R.C.3	—	—	—	—	LG	RC	RC	—	One	S.C.	280–500 and 1,400–3,000	9×6×7″	7 5 0	Price with valves and batteries, £10 10s. ——
Wholesale Wireless Co., 103, Farringdon Road, London, E.C.	Crossley, 51	Mahogany cabinet	—	—	—	AB	TC	—	—	One	S.C.	200–600	12×6×6″	3 0 0	Receiver only.
" " " "	" 5.50	" totally enclosed	—	TT	TT	AB	TC	TC	—	One	S.C.	200–600	$20\frac{1}{4}\times12\frac{1}{4}\times10\frac{1}{4}$	20 0 0	
Wingrove & Rogers, Ltd., Arundel Chambers, 188–189, Strand, London, W.C.2.	Polar Twin	Enclosed oak case	—	—	—	LG	TC	—	—	One	S.C.	250–5,000	6×4½×5″	10 12 0	Complete with all accessories and loud-speaker.
" " " "	Polar Two	Mahogany cabinet	—	—	—	LG	TC	—	—	One	S.C.	" "	12×10×9″	12 2 6	" " " "
" " " "	Polar Three	" "	—	—	—	LG	TC	RC	—	One	S.C.	" "	12×10×9″	17 8 6	" " " "
" " " "	Polar Four	" "	—	—	—	LG	RC	RC	RC	Two	S.C.	" "	22×9×7″	35 1 0	" " " " except H.T. batteries.

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PORTABLES AND SELF-CONTAINED SETS.

Additional Abbreviations used in this section. **Form of Aerial:** A = Enclosed Frame. B = External Frame. C = Portable Elevated Aerial.

Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excl. React.)	Reaction.	Wave Range (Metres).	Aerial.	Dimensions.	Weight Complete.	Loud-speaker.	Price, including Royalties, Valves and Batteries.	Remarks.
														in.	lbs.		£ s. d.	
Arclite, Ltd., 54, Theobalds Road, London, W.C.1.	Arclite No. 1 Portable	—	—	Ap	Ap	LG	RC	RC	—	One	S.C.	1,000–3,000	A.	17½ × 12½ × 6½"	23	Amplion, built in.	18 18 0	With valves and batteries.
	,, All-wave	—	—	Ap	Ap	LG	RC	RC	—	One	S.C.	300–500 and 1,000–3,000	A.	17½ × 2½ × 6½"	23	,,	25 5 0	,, ,,
Automobile Accessories (Bristol), Ltd., 17, Redcliffe Street, Bristol.	P.D. Portable, Mark XVIII.	Oak cabinet, waterproof cover.	—	TT	TT	LG	TC	TC	—	One	—	1,600	A.	17 × 18½ × 7"	42	Amplion	29 12 6	—
Atkinson, C. Creswick, 35–36, High Street, Bedford.	Nulli Secundus	Oak cabinet	—	TA	Ap	LG	TC	TC	—	Two	C.C.	280–500 and 1,000–1,800	A.	—	38	Mullard, built in.	30 0 0	—
Bowyer-Lowe Co., Ltd., Radco Works, Letchworth.	4-Electrode Portable	Attaché-case	—	—	—	LG	—	—	—	One	C.C.	250–2,000	C.	18 × 10¾ × 5"	10	—	8 17 2	—
Burndept Wireless, Ltd., Aerial Works, Blackheath, S.E.3.	Burndept Portable Five.	Oak cabinet	—	Ap	*	LG	TC	RC	—	One	C.C.	230–600 and 1,000–2,120	A.	18 × 17 × 8"	34	Celestion, built in.	31 10 0	With valves and batteries. * *Semi-Aperiodic.*
Campbell & Addison, 40, Howland Street, London, W.1.	Caydon Portable	Suit-case	—	Ap	TA	LG	TC	TC	—	Two	C.C.	200–500 and 1,000–2,000	A.	15½ × 12½ × 8½"	28	,,	36 15 0	—
	,, Table Model	Walnut or mahogany	—	Ap	TA	LG	TC	TC	—	Two	C.C.	,, ,,	A.	15 × 18 × 10"	30	—	36 15 0	—
	,, Long-Range 1	Walnut	—	TA	TT	LG	TC	TC	—	One	—	,, ,,	A.	21½ × 4½ × 17"	28	—	31 10 0	—
	,, ,, 2	Oak	—	TA	TT	LG	TC	TC	—	One	—	,, ,,	A.	21½ × 4½ × 17"	28	Beco	26 5 0	—
Cantophone Wireless Co., Remo House, 310–312, Regent Street, London, W.1.	Cantophone Portable Two	Leather Attaché-case	—	—	—	LG	TC	—	—	One	C.C.	250–550 and 1,350–1,800	A.	12 × 9 × 5"	10	—	11 0 0	With headphones.
	,, Portable Three	,, ,,	—	—	—	LG	TC	TC	—	One	C.C.	,, ,,	A.	16 × 11 × 6"	20	Cantophone, built in.	20 15 6	—
	,, Portable Four	,, ,,	—	—	TA	LG	TC	TC	—	Two	S.C.	,, ,,	A.	16 × 11 × 6"	22	,,	26 5 0	—
	,, Cabinet Portable Three.	Mahogany cabinet, double doors.	—	—	—	LG	TC	TC	—	One	C.C.	,, ,,	A.	18 × 15 × 8"	—	,, ,,	23 5 6	—
	,, Cabinet Portable Four.	,, ,,	—	—	TA	LG	TC	TC	—	Two	S.C.	,, ,,	A.	18 × 15 × 8"	—	,, ,,	28 15 0	—
Climax Radio Electric, Ltd., Quill Lane, Putney, S.W.12.	Portable Four	Leatherette	—	—	TT	AB	RC	TC	—	Two	C.C.	200–500 and 750–2,000	A.	16 × 16 × 10"	42	Cone	23 10 0	—
Denison Bros., Stonecliffe Works, Halifax.	Celestaphone Four, Portable.	—	—	—	TT	LG	TC	TC	—	Two	S.C.	1,000–2,500	A. or B.	15 × 15 × 9	27	Cone (Amplion)	31 0 0	—
	Celestaphone Five Portable.	—	—	Ap	*	AB	Ch	RC	—	Two	S.C.	230–590 and 850–2,700	C.	17 × 17 × 10"	33	,, ,,	35 0 0	* *Reflex.*
Eagle Engineering Co., Ltd. Warwick.	Chakophone Five, 2-Station Model.	Walnut case	—	TT	TT	LG	TC	TC	—	One	—	490 × 1,600	A.	18 × 7 × 16"	30	G.E.C., built in.	26 17 6	—
,, ,, ,,	Chakophone, Everyman Four, Portable.	,, ,,	—	—	TT	AB	RC	TT	—	Three	C.C.	250–500 and 1,000–2,000	A.	19 × 7½ × 17½"	32	Cone (Amplion) built in.	30 0 0	—
,, ,, ,,	Chakophone Portable Super-Het.	Leather case	*	*	*	*	*	*	*	Two	S.C.	,, ,,	A.	22 × 9 × 16"	40	Cone (Beco), built in.	56 0 0	* *8-valve Super Heterodyne.*
Elven Mains Receiver Co., 109, Kingsway, London, W.C.2.	Elven Mains	Mahogany or oak	—	—	TA	AB	RC	TC	—	Three	C.C.	300–2,000	A.	17 × 17 × 8"	15	Celestion, built in.	31 10 0	*Portable set worked from A.C. or D.C. Mains.*
Empire Electric Co., 303, Euston Road, London, N.W.1	Empire Standard	Cloth covered	—	—	—	LG	TC	TC	—	One	C.C.	300–500	A.	19 × 16 × 5"	15	Built in	12 7 6	With valves and batteries.
	,, de Luxe	Leather covered	—	—	—	LG	TC	TC	—	One	C.C.	,, ,,	A.	19 × 16 × 5"	16	,, ,,	11 9 6	,, ,,

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excl. React.)	Reaction.	Wave Range (Metres).	Aerial.	Dimensions.	Weight Complete.	Loud-speaker.	Price, including Royalties, Valves and Batteries. £ s. d.	Remarks.
														in.	lbs.			
Engineering Works (Electrical and General), Ltd., 7 and 8, Great Winchester Street, London, E.C.2.	Rayol V. S.C.	—	—	Ap	Ap	LG	TC	TC	—	One	C.C.	250–600 and 1,100–2,600	A.	14×14 ×9½″	30	Sferavox, built in.	27 19 0	—
	,, ,, ...	—	—	Ap	Ap	LG	TC	TC	—	One	C.C.	,, ,,	A.	14×14 ×9½″	30	Celestion, built in.	29 10 0	—
	,, V.R.C.....	—	—	TT	TT	LG	TC	TC	—	Two	C.C.	,, ,,	A.	14×14 ×9½″	30	,, ,,	32 10 0	—
	,, V. Cabinet ..	—	—	TT	TT	LG	TC	TC	—	One	C.C.	,, ,,	A.	13×27½ ×9″	40	,, ,,	31 10 0	—
General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.	Gecophone, 5-valve Portable.	Oak cabinet, totally enclosed.	—	*	*	LG	TC	TC	—	Two	C.C.	250–650 and 740–2,200	A.	14½×20½ ×8½″	36	Cone (Gecophone), built in.	30 0 0	* *Special circuit.*
,, ,, ,,	Gecophone, 7-valve Portable.	,, ,,	*	*	*	*	*	*	*	Two	C.C.	250–650 and 800–2,800	A.	15×9 ×21″	45	Horn (Gecophone), built in.	40 0 0	* *7-valve Super Heterodyne.*
Gillan Radio-Electric, Ltd. 61, High Holborn, London, W.C.1.	Ubique IV.	Leather suit-case ...	—	—	Ap	LG	TC	TC	—	Two	S.C.	200–500 and 1,000–2,000	A.	18×12 ×7″	21	Horn (Amplion), built in.	25 0 0	—
Gottlieb, J. L., & Co., Ltd., 89, Upper Thames Street, London, E.C.4.	J.L.G., Portable V. ..	Oak or mahogany cabinet.	—	Ap	Ap	LG	TC	RC	—	One	C.C.	240–600 and 900–2,200	A.	8½×17 ×15″	33	Amplion, built in.	28 2 6	—
	R.S.V.P.	Leatherette case	—	Ap	Ap	LG	TC	RC	—	One	C.C.	,, ,,	A.	8½×18 ×15½″	30	,, ,,	22 0 6	—
Hart Collins, Ltd., 38a, Bessborough Street, Westminster, S.W.1.	4-valve Portable	—	—	—	Ap	LG	TC	TC	—	One	C.C.	250–500 and 1,000–2,000	A.	17×16 ×7¼″	28	Wooden horn	26 3 6	With valves and batteries.
	5 ,, ,, ...	—	—	Ap	Ap	LG	TC	TC	—	One	C.C.	,, ,,	A.	16×16½ ×6½″	30	Radiolux	30 0 0	,, ,, ,,
																Cone	32 11 0	,, ,, ,,
Henderson, W. J., & Co., Ltd., 351, Fulham Road, London, S.W.10.	Henderson	—	—	Ap	Ap	LG	TC	RC	—	One	C.C.	300–500 and 1,200–1,800	A.	16½×12¾ ×9½″	30	Celestion, built in.	30 0 0	,, ,, ,,
Hoare & Jagels, Ltd., 28–29, Great Sutton Street, London, E.C.1.	Rolls, 2-v.....	—	—	—	—	LG	TC	—	—	One	S.C.	250–500	A.	14×11 ×6″	15	—	14 7 0	For headphones only.
	,, 3-v.....	—	—	—	—	LG	TC	TC	—	One	S.C.	,, ,,	A.	14×11 ×6″	17	—	19 0 0	—
,, ,, ,,	,, 3-v. L.S.	—	—	—	—	LG	TC	TC	—	One	S.C.	,, ,,	A.	14½×11½ ×7¼″	23	Celestion ...	23 10 0	—
,, ,, ,,	,, 5-v.....	—	—	Ap	Ap	LG	TC	TC	—	One	S.C.	250–500 and 1,000–2,000	A.	14½×11½ ×7½″	23	,, ...	26 10 0	—
,, ,, ,,	,, 5-v. L.S.	—	—	Ap	Ap	LG	TC	TC	—	One	S.C.	,, ,,	A.	14½×11½ ×7½″	23	,, ...	30 10 0	—
Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.	Daventry Portable ...	Oak or mahog. cabinet totally enclosed.	—	TA	TA	AB	RC	TC	—	—	—	1,600	A.	18×16 ×8″	30	Celestion cone, built in.	25 0 0	Fixed wavelength.
	Neutrosonic Seven ...	Leatherette case with separate battery box.	TT	TA	TA	2AB	Ch	—	—	Three	—	280–1,800	B. or C.	16¾×12 ×10″	24	Celestion and Brown.	44 11 6	With valves, long-wave unit and headphones. Battery box complete and frame aerial extra, £13 5s. Weight 45 lbs. ,, with loud-speaker, £21
London Electric Co., 1, Sherborne Lane, London, E.C.4.	Lecodyne, P.3	Oak case, totally enclosed.	—	—	—	LG	TC	TC	—	One	C.C.	250–500 and 1,000–2,000	A.	17½×15½ ×10″	27	Sferavox cone, built in.	17 17 0	—
	,, P.N. 4	Fretted front, lined old gold silk.	—	—	Ap	LG	TC	TC	—	One	C.C.	,, ,,	A.	17½×15½ ×10″	30	,, ,,	21 10 0	—
Marconiphone Co., Ltd., 210–212, Tottenham Court Road, London, W.1.	Marconiphone, Model 43.	Oak case	—	—	TA	LG	TC	RC	—	Two	C.C.	250–550 and 1,000–2,000	A.	—	—	Marconiphone cone, built in.	31 10 0	—
McMichael, L., Ltd., Wexham Road, Slough.	M.H. Portable Five ..	Leather case.....	—	*	*	LG	TC	TC	—	One	S.C.	270–2,000	A.	15½×12¾ ×8½″	30	Celestion cone, built in.	31 10 0	* *Semi-Aperiodic and choke.*
Mic Wireless Company, White Horse Place, Market Street, Wellingborough.	Zampa, Mark III. ...	—	—	—	TT	LG	TC	TC	—	Two	C.C.	250–560	A.	18×18 ×7″	25	Kone, built in	22 10 0	With valves and batteries. —
Ormond Engineering Co., Ltd., 199–205, Pentonville Road, London, N.1.	Ormond, 5-valve	Mahogany or oak	—	Ap	Ap	LG	TC	RC	—	One	C.C.	250–550 and 1,200–2,000	A.	18×14 ×9″	32	Ormond cone, built in.	27 12 6	With valves and batteries.

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Manufacturer.	Trade Name of Set.	Style of Cabinet.	Valves. H.F.	H.F.	H.F.	D.	L.F.	L.F.	L.F.	No. of Tuning Controls (excl. React.)	Reaction.	Wave Range (Metres).	Aerial.	Dimensions.	Weight Complete.	Loud-speaker.	Price, including Royalties, Valves and Batteries.	Remarks.
														in.	lbs.		£ s. d.	
Oxford Wireless Telephony Co., Ltd., Tittmouse Lane, Oxford.	Oxford Portable	Mahogany case	—	—	TA	LG.	TC	TC	—	Two	S.C.	200–1,800	A.	18×17 ×9½"	28	Amplion horn, built in.	29 10 0	—
	„ „	„ „	—	—	TA	LG	TC	TC	TC	Two	S.C.	„ „	A.	18×17 ×9½"	28	„ „	32 10 0	—
Portable Utilities Co., Ltd., Eureka House, Fisher Street, London, W.C.1.	Eureka Orth-o-dyne Five.	—	—	Ap	Ap	LG	TC	TC	—	One	C.C.	200–2,000	A.	16½×13½ ×10½"	33	Celestion, built in.	35 0 0	—
Pye, W. G. & Co., Granta Works, Montague Road, Cambridge.	Pye 333	—	—	—	—	LG	TC	TC	—	One	C.C.	260–560 and 1,000–2,000	A.	16½×7½ ×17"	30	Cone, built in	19 17 6	—
	„ 555	—	—	TT	TT	LG	TC	TC	—	One	—	1,600	A.	16×7½ ×18½"	30	„ „	25 12 6	—
„ „ „	„ 25	—	—	Ap	Ap	LG	TC	TC	—	One	S.C.	250–560 and 1,000–2,000	A.	16½×7½ ×17"	32	„ „	30 12 6	—
Radiocraft Supplies, Ltd., 9, The Arcade, Walsall.	Radiocraft Ideal Four	Leather covered	—	—	Ap	LG	TC	TC	—	One	C.C.	200–500 and 1,000–2,000	A.	15×15 ×6"	32	Crosley Musicone.	26 5 0	—
„ „ „	„ Portable Five	Oak cabinet	—	Ap	Ap	LG	RC	TC	—	One	C.C	„ „	A.	15×15 ×6"	32	„ „	26 5 0	—
Radio Supply Co., Supertone Works, Four Oaks, Birmingham.	Superfone Maxum III.	Mahogany	—	—	TA	LG	TC	—	—	Two	C.C.	200–500 and 1,000–2,000	A.	15×16 ×17"	21	Cone	18 0 0	Reflex receiver with valves and batteries.
	„ „ V.	—	—	TA	Ap	LG	TC	TC	—	Two	S.C.	„ „	A.	17×18 ×7"	26	„	25 0 0	With valves and batteries.
Read Radio, Ltd., 67, Newman Street, Oxford Street, London, W.1.	Real	Polished or leather covered.	—	*	*	*	*	*	—	One	—	200–500 and 1,000–1,800	A.	15×14½ ×7"	21	Diaphragm type.	27 2 6	* *Special circuits.*
Runnymede Engineering and Electrical Co., Dacre House, Victoria Street, London, S.W.1.	Runnymede	Mahogany cabinet, totally enclosed.	—	Ap	Ap	LG	TC	RC	—	One	C.C.	200–500 and 950–3,000	A.	18×18 ×10"	36	2ft. horn, built in.	28 0 0	With valves and batteries.
Selectors, Ltd., 1, Dover Street, London, W.1.	Selector III.	Oak or mahogany	—	—	—	LG	TC	TC	—	One	C.C.	200–600 and 1,000–2,000	A.	16½×12 ×8"	25	Amplion, built in.	18 18 0	(Mahogany case, £1 1s. extra.)
„ „ „	„ V.	Leatherette or mahogany.	—	*	*	*	*	*	—	Two	C.C.	„ „	A.	16½×12 ×6½"	25	„ „	33 12 0	* *5-valve Super-Heterodyne.*
„ „ „	„ Super	—	*	*	*	*	*	*	*	Two	—	„ „	A.	18×18 ×8"	48	„ „	57 15 0	* *7-valve Super-Heterodyne.*
Sherman, P., 12, River Street, Clerkenwell, London, E.C.1.	Claremont Portable	Fibre case	—	—	Ap	LG	TC	TC	—	Two	C.C.	200–500 and 1,000–2,000	A. & C.	21×12 ×8"	28	Beco, diaphragm type, built in.	24 0 0	With valves, batteries and aerial supplies.
Shore, G. C., 28, Newman Street, Oxford Street, London, W.1.	Shore Portable V.	Oak cabinet, totally enclosed.	—	TA	Ap	LG	TC	TC	—	Two	—	250–550 and 1,000–2,500	A.	18×17 ×8"	28	Cone, built in	29 7 6	With valves and batteries.
Stanley, M., & Co., 174, London Road, Liverpool.	Stanaphone	Oak, leatherette covered.	—	—	—	LG	TC	TC	—	One	C.C.	280–500	A.	14×12 ×10"	16	Stanaphone horn, built in.	15 15 0	—
Station Radio Stores, 38, Palmer Street, Westminster, S.W.1.	S.R.S., 3-valve	—	—	—	—	LG	TC	TC	—	One	S.C.	300–2,000	A.	13×12 ×6"	20	Amplion, built in.	17 17 0	—
Stevens, A. J., & Co., Ltd., Walsall Street, Wolverhampton.	Symphony 5-valve	Oak cabinet	—	Ap	Ap	LG	TC	TC	—	One	C.C	250–550 and 900×2,500	A.	16⅜×8½ ×13½"	35	Symphony cone, built in.	27 10 0	—
Stockall, Marples & Co. (1912), Ltd., 6–10, Clerkenwell Road, London, E.C.1.	Big Ben Portable Six.	—	—	*	*	*	*	*	*	Two	S.C.	200–600	A.	18×19 ×8½"	19	Celestion, built in.	34 5 0	* *6-Valve Super-Heterodyne.* Battery in separate box, 6×11×9", weighing 18 lbs.
Vandervell, C. A., & Co., Ltd., Warple Way, Acton, London, W.3.	C.A.V. Portable	Leatherette covered	—	—	—	LG	TC	TC	—	One	C.C.	200–500 and 1,000–2,000	A.	16½×11 ×9"	26	Built in	21 17 6	With valves and batteries.
Western Laboratories, Ltd., 11, Hanbury Road, Acton, London, W.3.	W.L.L. Simplex 3	Mahogany or oak, totally enclosed.	—	Ap	Ap	LG	RC	TC	—	One	S.C.	260–500 and 1,000–3,000	A.	17×17 ×6½"	23½	Amplion, built in.	26 5 0	With valves and batteries.
	„ 5-valve R.C.	Leather case	—	Ap	Ap	LG	RC	RC	—	One	S.C.	„ „	A.	17×12 ×6"	23½	Horn, built in	19 10 0	„ „
Whittingham Smith & Co., 110, Kew Green, Kew, Surrey.	Portadyne	—	—	*	*	LG	TC	TC	—	One	C.C.	250–600 and 1,000–2,600	A.	14½×15½ ×7"	28	—	30 9 0	* *Special circuits.*

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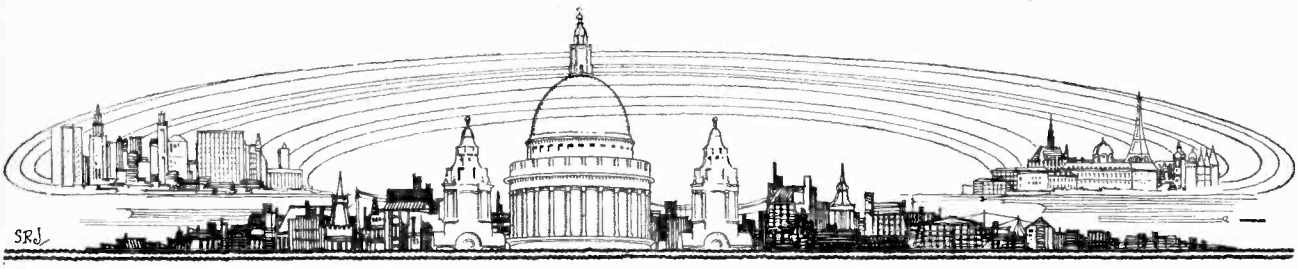

CURRENT TOPICS

Events of the Week in Brief Review.

STILL CALLING.

Birthday congratulations are due to KDKA, the famous pioneer broadcasting station at Pittsburg, U.S.A., which has just celebrated its seventh birthday. KDKA was one of the first American stations to be heard in this country on the short waveband.

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PHONING ACROSS THE ATLANTIC.

Americans are making more use of the transatlantic telephone service than the British, according to a statement by the Postmaster-General, who says that the total calls up to November 6th were: From Great Britain, 830; and from the United States, 991.

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PCJJ TO "STARTLE THE WORLD."

PCJJ, the famous Dutch short-wave station, has now gone into temporary retirement pending its reopening with improved equipment at Hilversum. Messrs. Philips Lamps, Ltd., the owners of the station, prophesy that when it resumes operations PCJJ will "startle the world with even better achievements with short-wave telephony." So it looks as if the B.B.C. may still miss those coveted laurels!

PORTABLE SET AT BUCKINGHAM PALACE.

The attractions of portable wireless have secured its entry into Buckingham Palace, in the private apartments of which a self-contained portable receiver is now in frequent use.

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BROADCASTING IN BURMA.

A new broadcasting venture in India is promised by the news that a 250-watt transmitting plant is being erected by the Burma Radio Syndicate, which hopes to transmit programmes very shortly.

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DUTCH TELEPHONY FOR AMATEURS.

Wireless telephony tests on 18 metres are being conducted every Wednesday from 2 to 3 p.m. (G.M.T.) by the Dutch State telegraph station PCLL, at Kootwijk. Reports by amateurs on the quality of these transmissions will be warmly welcomed and should be addressed to the Radio Laboratory, State Telegraph Service, The Hague, Holland.

Every report will receive a written acknowledgment and, if possible, an acknowledgment by wireless. Several languages are used, and the transmissions are sometimes preceded or followed by other interesting telephony experiments.

ITALIAN WIRELESS HERO.

A meeting to commemorate the heroism of the wireless operator of the ill-fated Italian liner *Principessa Matulda* was held last week by the Radio Club of Buenos Aires. A posthumous award of a gold medal was sent by the wireless operators of the Dutch vessel *Athena*.

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WHAT OSCILLATION SOUNDS LIKE.

Noise caused by local oscillation has produced a nice variety of opprobrium, but it is doubtful whether a better description has been applied to the nuisance than that by an Ilford listener, who likens his neighbour's receiver to "a parrot with the asthma." Unfortunately, parrots are long-lived birds!

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SMALL BUT SELECT.

What broadcasting station has the smallest clientele? The question is prompted by the grave announcement that the Tallinn broadcasting station in Esthonia now has over 1,820 subscribers! Half of these reside in the city of Reval, the remainder being distributed over the surrounding country.

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I.E.E. LECTURE ON TELEPHONY TECHNIQUE.

A subject of interest to many wireless enthusiasts will be dealt with at tomorrow's ordinary meeting of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, at 6 p.m., when Capt. B. S. Cohen will lecture on "Apparatus Standards of Telephonic Transmission, and the Technique of Testing Microphones and Receivers."

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AUTO ALARM IN LONDON STREETS.

Perhaps the most spectacular attraction in the Lord Mayor's Show was the Marconi auto alarm car, which depicted the course of events when an operator off duty is summoned to his post by the S.O.S. bell. A model of a lifeboat in distress occupied one portion of the car, and at intervals it transmitted an S.O.S., luridly indicated by a flashing aerial. The promptitude with which the operator accepted the call, manipulated the Marconi direction finder, and gave the lifeboat crew their position excited the admiration of crowds all along the route.

S.O.S. IN THE LORD MAYOR'S SHOW. The Marconi car, which provided one of the thrills of the procession. At intervals along the route the auto alarm bell signalled the receipt of an S.O.S. from the distressed lifeboat and onlookers were shown how an operator at sea deals with emergencies of this kind.

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A WIRELESS LORD.

Among the Admiralty appointments announced last week was that of Lieutenant Lord Louis Mountbatten as assistant wireless telegraphy officer on H.M.S. *Queen Elizabeth*.

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POLICE WIRELESS IN YORKSHIRE.

Following the example of the Lancashire County Police, the police authorities in the West Riding of Yorkshire are about to adopt a system of wireless intercommunication between police stations. The installation will be experimental at first, but it is expected that developments will ensue which will materially increase the anxieties of a life of crime in West Riding.

Unfortunately, much of the talk is in Chinese, and the Britisher who succeeds in translating it often finds that he is listening to undisguised advertisements.

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WASHIN TON WAVELENGTH PARLEYS.

Reports regarding the progress of the Washington International Radio Conference continue to be vague, but it is understood that an important agreement has been reached regarding the voting power of the various nations. Six votes each, according to a Washington message, are to be allowed to the United States, France, Italy, Japan, and Germany, while Great Britain will have eight.

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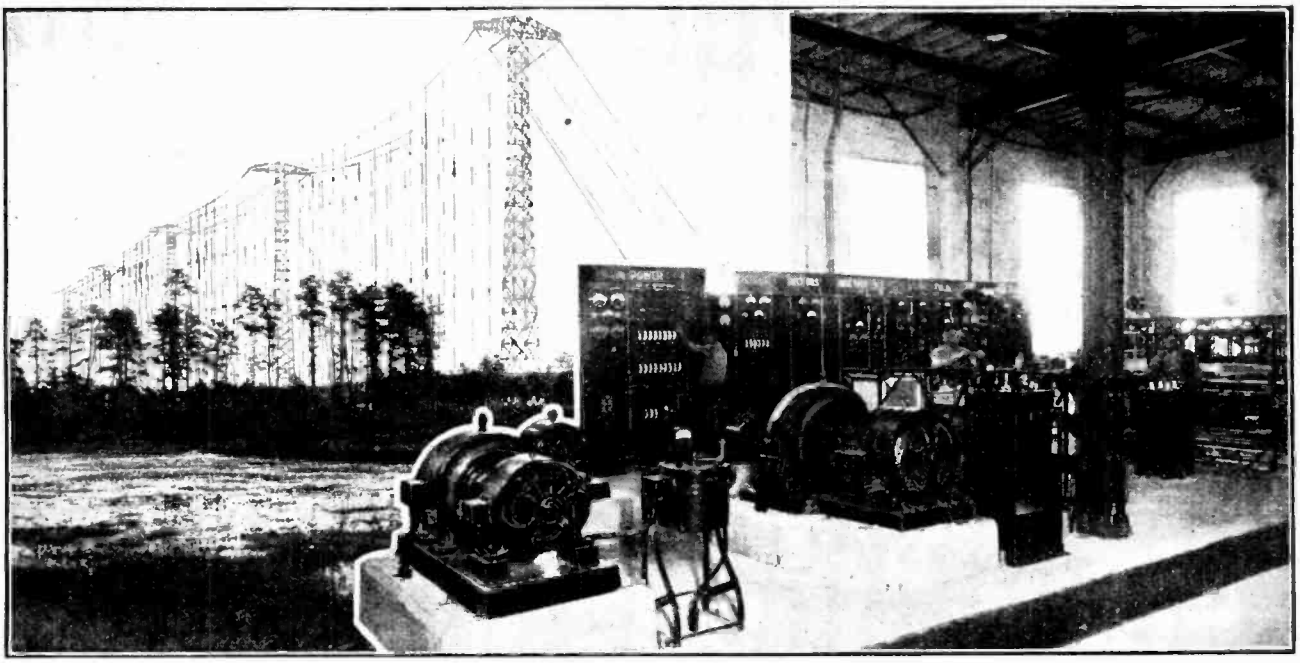
LEEDS WIRELESS EXHIBITION.

A wireless exhibition is being held this week and next at Fenton Street Drill Hall, Leeds, under the auspices of *The Yorkshire Evening Post*. Many prominent firms are represented, and there are special attractions, including constructional competitions, for the benefit of amateurs.



TRANSATLANTIC BEAM SERVICE. Two views showing the aerials and the generator room of the Marconi beam station under construction at Rocky Point, Long Island, N.Y. This station will work in conjunction with the English beam stations at Dorchester and Somerton.

LEGAL VICTORY FOR AMERICAN "HAMS."

There is rejoicing in the camp of American wireless amateurs over a decision handed down by Judge A. M. J. Cochran at the Kentucky district court to the effect that municipal authorities have no power to limit or regulate amateur transmitting stations licensed by the U.S. Government.

The case in question concerned the operator of 9ALM, of Wilmore, Kentucky, who refused to pay a municipal tax in respect of his transmitter. He was legally supported by the American Radio Relay League.

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WIRELESS TRIALS IN SHANGHAI.

Although the Chinese Government forbids broadcasting, they cannot prevent it in the International Settlement in Shanghai, where, it is estimated, according to the *Chinese Economic Bulletin*, that there are 10,000 listeners to the local station.

Discussions on the weighty question of international wavelength distribution, particularly in regard to the short wave-band, are reported to be progressing satisfactorily.

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POLYGLOT CATALOGUE FOR B.I.F.

Many British wireless manufacturers were represented at this year's British Industries Fair. In preparation for the 1928 Show, a special catalogue is being prepared in nine languages for publication on New Year's Day, seven weeks before the opening of the Fair.

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A USEFUL COMPANION.

If it were possible to recollect every useful wireless fact at a moment's notice there would be no need for those interesting notes and memoranda included in the 1928 edition of "The Wireless World Diary and Notebook," just published. But the desired fact often eludes one at a critical moment, and for this reason the wireless amateur will find the Diary and Notebook is an invaluable pocket companion. Among the special features are a glossary of technical terms, a list of British and European broadcasting stations, receiver notes and valve data.

Copies are obtainable from the leading booksellers and stationers, or from the publishers, Iliffe and Sons Ltd., Dorset House, Tudor Street, London, E.C.4. The cloth edition is 1s., postage 1½d. extra; the leather case edition with pencil and season-ticket holder is 2s. 6d., postage 2d. extra.

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Books Received.

Hints and Tips for Motor Cyclists, 10th Edition, by "Road Rider." Revised and brought up to date, containing in a compact form the essence of the knowledge and experience gained by a generation of motor cyclists using many different types of machines. Published by Iliffe and Sons Ltd., London. Price 1s. 6d. net.

A Study of Radio Direction Finding, by R. L. Smith-Rose, D.Sc., Ph.D., A.M.I.E.E. Pp. 37, with 15 diagrams and Gnomic chart of the transmitting and observing stations referred to. Issued by the Department of Scientific and Industrial Research (Special Report No. 5) and published by H.M. Stationery Office. Price 1s. 9d. net.

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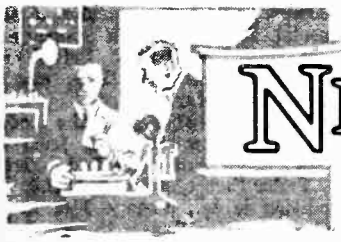
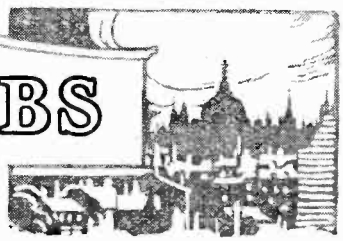


NEWS from the CLUBS



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

Activities at Southport.

The enterprise of the Southport and District Radio Society in organising the recent radio exhibition in that town did not stop short at that achievement. In addition, an excellent programme was prepared which not only dealt with the exhibition itself, but gave an excellent review of the Society's activities, and included articles on "Television" by Mr. John L. Baird, and on "The Possibilities of Empire Broadcasting," by Mr. Gerald Marcuse, the famous short-wave expert. The Society has an active and interesting period ahead, to judge from the syllabus which has been prepared for the first half of the present session.

Full particulars regarding membership can be obtained on application to the hon. secretary, Mr. E. C. Wilson, "Lingnell," Kirklees Rd., Birkdale.

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Tottenham Society's Winter Programme.

Members of the Tottenham Wireless Society paid a visit to the works of Messrs. Wright and Weaire on Tuesday, Nov. 1st, when they were able to watch the processes of the manufacture of litzendraht coils, copper screening boxes and low-capacity switches, plugs and jacks.

At the Society's business meeting on the following evening it was decided to hold a club dinner early in December. Among the interesting fixtures for the New Year will be a loud-speaker demonstration by H.H. the Prince de Mahé, a lecture by a representative of the B.B.C. and evenings devoted to gramophone pick-up devices and television.

Hon. Secretary: Mr. F. E. R. Neale, 10, Bruce Grove, Tottenham, N.17.

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South Manchester Society's Programme.

The syllabus for the winter session issued by the South Manchester Radio Society gives promise of an unusually interesting period of activity. Among features of special note may be mentioned the lecture on "L.F. Amplification," on December 16th, by Mr. A. Hall, Chief Radio Engineer of Messrs. Ferranti, Ltd.; the demonstration on Jan. 20th of members' own moving coil loud-speakers, and the competition on Feb. 17th in which members' sets will be judged according to their purity of reproduction.

From lectures and demonstrations already given, members have obtained much information, particularly on the "All-Wave Four" and the "Moving Coil Loud-speaker" described in *The Wireless World*.

New members are welcomed, and full particulars can be obtained from the Hon. Secretary, Mr. G. A. F. Mercer, 5, Ruabon Rd., Didsbury.

Ilford and District Radio Society.

The Hon. Secretary of the Ilford and District Radio Society is Mr. H. H. Carr, 39, Lynford Gardens, Goodmayes, Essex. We regret it was otherwise stated in a report of a recent meeting of that Society.

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Special Transmitter for Field Days.

A transmitter specially designed for use on club field days was discussed at the last meeting of the North Middlesex Wireless Club, and it was agreed that the Hartley circuit most nearly fulfilled the necessary conditions. An excellent paper on nickel iron accumulators was given by Mr. L. F. Summers, A.M.I.E.E., a member of the club. The speaker first gave a description of the ordinary lead cells, comparing them with the nickel iron type, and the chemical changes taking place in both kinds of cell were described.

Hon. Secretary, Mr. H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 16th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way. Lecture: "The Design of the Valve and Possible New Developments," by Mr. G. C. Marris, B.Sc.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "The Care and Upkeep of Accumulators," by the Hart Accumulator Co.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Lecture and Demonstration: "Recent Developments in Valves for Broadcasting."

THURSDAY, NOVEMBER 17th.

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. Lecture: "The Co-axial Mounting of the Valve," by A. C. Cossor, Ltd.

FRIDAY, NOVEMBER 18th.

South Manchester Radio Society.—At the Co-operative Hall, Wilmslow Road, Didsbury. Demonstration of Members' Own Sets.

Leeds Radio Society.—At Leeds University. Lecture: "Neutrodyne Sets in Practice," by Mr. E. N. Kent-Lemon.

SATURDAY, NOVEMBER 19th.

Muswell Hill and District Radio Society.—Dance and Whist Drive.

MONDAY, NOVEMBER 21st.

Hackney and District Radio Society.—At 8 p.m. At Hackney Electricity Halls, Lower Clapton Road, E.5. "West Pocket Lectures."

Southport and District Radio Society.—At St. John Hall, Scarisbrook Street. Lecture: "Transmission and Reception on Short Waves," by Mr. O. B. Kellett (G5KL).

Neon Tubes in Wireless.

Neon tubes and their many applications were dealt with by Mr. Leonard Hartley, B.Sc., in an interesting lecture before the Muswell Hill and District Radio Society on October 26th. The lecturer dealt with their advertising possibilities, and then dealt with some common wireless uses. First he placed the tube in circuit, and at 120 volts it began to glow, but at 140 volts no light was visible. The lamp was then placed in parallel with the mains with a resistance in series and a 1-mfd. condenser in parallel. A number of experiments were undertaken to determine the varying values of condensers and resistances by timing the flashes as the condenser charged and discharged. Research had proved that pure iron was best for the electrodes. Hints were given on the best way of using the Neon tubes in a battery eliminator.

The Society will hold a dance and whist drive on November 19th, when music will be supplied by the latest type of loud-speakers. Tickets at 3s. 6d. can be obtained from the Hon. Secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10, who will also forward a copy of the syllabus and membership application form on application.

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A Destructive Transmitter.

Short-wave transmitting and receiving apparatus formed the topic of demonstration and debate at the last meeting of the Wembley Wireless Society on Nov. 4th. A talk on his short-wave transmitter was given by the president, Mr. Chapman, whose weekly transmissions are well known to members of the Society. The transmitter, which was designed to work on a wavelength of 45 metres, was built with the assistance of the Society's members, many of whom testified to the strength at which they receive signals, one member creating amusement by declaring that the President's signals had burnt out the windings of his loud-speaker!

All communications should be addressed to the Hon. Treasurer, Mr. H. E. Comben, B.Sc., 24, Park Lane, Wembley.

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Evolution of the Condenser.

Members of the Hounslow and District Wireless Society spent one of their most interesting evenings this season on Tuesday, Nov. 1st, when a lecture covering the whole subject of condenser manufacture was given by a member of Messrs. Dubilier Condenser Co., Ltd. With the help of lantern slides, those present were able to follow the many processes in the evolution of a condenser from the early stages when the raw mica is obtained from mines in India to the time when the finished product leaves the test room of the Dubilier Works.

Readers interested in the Hounslow Society are asked to write for particulars of membership to the Hon. Secretary, Mr. C. N. Yates, 21, Witham Rd., Isleworth.

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Simplified Aids to Better Reception.

SMOOTHING CHOKES.

APART from troubles brought about by the more obvious departures from correct practice, it is probably true to say that the majority of failures to obtain freedom from "hum" in H.T. battery eliminators working from the mains are due to faulty or badly designed smoothing chokes. In most cases the windings of discarded L.F. transformers are not suitable, particularly with the fairly heavy anode currents consumed by present-day valves. The amateur would be well advised not to restrict his expenditure unduly as far as these components are concerned, and to obtain chokes with ample inductance and current-carrying capacity; where necessary, economies may be effected in other directions with less risk of disappointing results.

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GRID BIAS PRECAUTIONS.

PROBABLY because it is now generally realised that no current is taken from grid bias batteries there seems to be a tendency to neglect them. This is wrong, because a failure, either complete or partial, is certain to result in trouble of a more or less serious kind. It may be pointed out, for instance, that a complete disconnection of the battery resulting in the application of "no volts" to the grid of a super-power valve may cause this valve to lose its emission, particularly if it is allowed to run for any length of time with a zero grid and full H.T. voltage.

There is another point which does not always receive the attention it should. It is observed that amateurs generally test the voltage across the whole battery, and if this is normal assume that everything is in order. This may not be so, as there is the possibility of a disconnection through internal corrosion between individual cells and the tapping sockets, in spite of the fact that there is continuity between each cell. It is as well to test each section of the battery.

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GANG CONDENSERS.

THE majority of gang condensers on the market are constructed in such a way that the rotors of individual units are in metallic connection with each other. This being so, special precautions have to be taken when dissimilar grid voltages are to be applied to the valves with which the circuits tuned by components of this class are associated. This remark does not apply in every case (as, for instance, when the interconnected condensers are across "tuned anode" coils), but it is applicable in a transformer-coupled transformer arrangement, such as that shown in skeleton form in Fig. 1. Here it is assumed that the two variable capacities C_1 and C_2 are linked together mechanically, and tune respectively the grid circuits of the H.F. amplifier and the secondary of the transformer, which is connected across the detector valve grid circuit. Now it is quite possible that these valves will require different bias voltages; these cannot be applied in the usual way, or the batteries will short-circuit through each other and the rotor shaft.

There are two possible solutions of the problem which therefore arise when the "gang" condenser is of the type under consideration. The first is to connect the bias battery between grid and the high-potential end of the tuned circuit; this is generally (and rightly) regarded as bad practice, although it is just possible to adopt it without seriously impairing efficiency if very small cells ("fountain-pen" flash-lamp refills) are carefully inserted in such a way that they are supported on the wiring. The second method is that shown in the diagram already referred to; here the bias cells are inserted directly in the low-potential end of the tuned circuits, and are shunted by large condensers (C and C_1, each of some 0.25 mfd.), which will become necessary as the battery resistance increases with age.

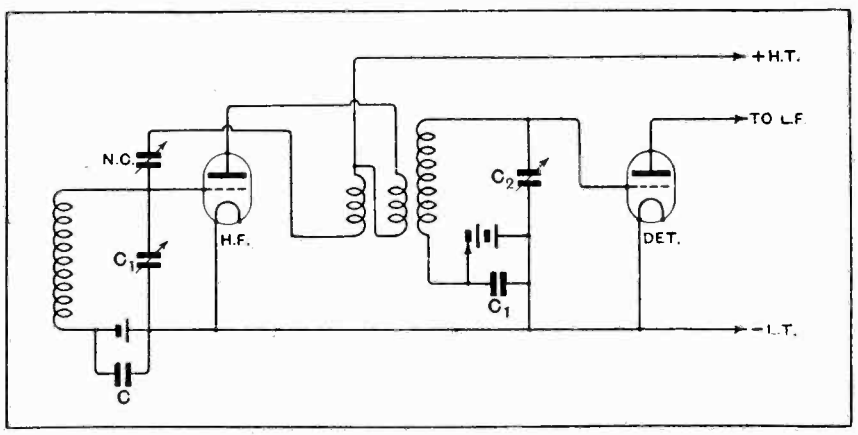

Fig. 1.—Instead of connecting bias batteries in the grid return leads, they may be inserted in the tuned circuits when "gauged" condensers with a common shaft are used.

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LONG AND SHORT WAVES.

THERE is a growing tendency on the part of set manufacturers to provide a switch change-over from long to short waves; indeed, it is quite understandable that the non-technical wireless user prefers this method to the process of changing coils, and is also willing to make the slight sacrifice in efficiency resulting from its adoption. As far as the amateur constructor is concerned, the position is somewhat different; as a rule, he requires the maximum possible sensitivity and selectivity obtainable from his circuit, but there are cases where the convenience of a switch change-over will be appreciated, particularly as the loss in efficiency will be but slight if the greatest possible care is taken in arranging the switching and relative positions of components.

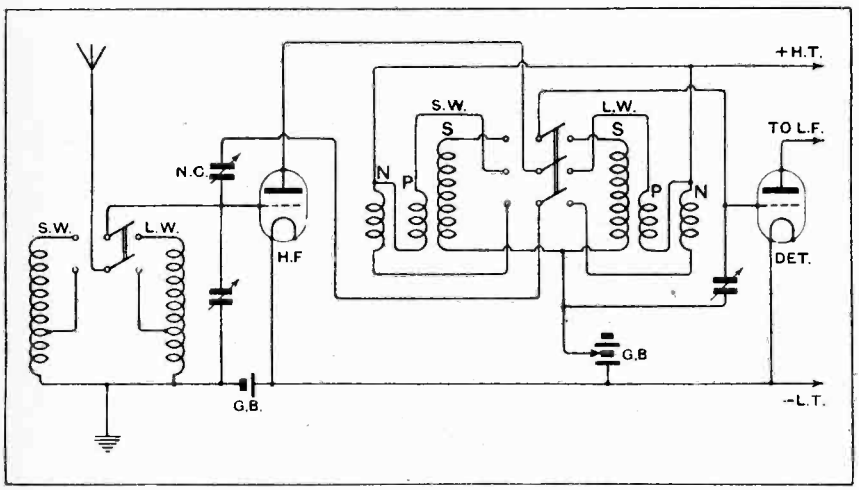

Fig. 2.—Switch connections for waveband change in a typical H.F.-detector receiver.

A circuit diagram showing connections for the change-over in question is given in Fig. 2; the neutralised high-frequency transformers are of the type described in several recent issues of this journal, which, as is well known, have five external connections. It is unnecessary, however, to change over each of these five connections; in practice, only those which are at high potential are brought to the switch, which accordingly need have but three contacts.

Reference to the diagram will show that the simplest possible aerial coupling arrangement is suggested, in order to avoid further complication. The grid coils are tapped at a point to include about one-fifth of the total number of turns from the earthed end in the aerial circuit, and this forms an auto-coupled "untuned aerial" coupler. Despite its simplicity, good results are obtainable, particularly on the normal broadcast waveband, where it compares well with more elaborate aerial-grid transformers. On the long waves there may be some trouble from interference, but only when the set is operated in the immediate vicinity of a station. It should be added that the exact position for the aerial tapping should be the subject of experiment, as the best coupling will depend on aerial characteristics, etc.; moreover, the wavelength to be received will also influence performance, but it is not difficult to find a connection giving a good compromise.

Apart from the usual screening between grid and plate inductances, it is highly recommended that an additional screen be inserted between the two high-frequency transformers, which should be arranged in such a way that the switch wiring is more or less symmetrical.

As an additional refinement, it is possible to couple the two switches together mechanically, so that both circuits may be changed over by a single movement.

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VOLTS AND MILLIAMPS

IT is not generally realised that any voltmeter can be made to serve as a milliameter for reading anode current; as a rule, however, the moving-iron type of instrument is insufficiently sensitive to have a practical application, so, generally speaking, it is necessary to consider only moving-coil instruments.

Provided that the resistance of the meter is known, it is a perfectly simple matter to calculate the current corresponding to a given deflection of the needle. The necessary information is generally given by the manufacturer as "ohms per volt"; the total resistance is ascertained by multiplying this figure by the voltage indicated at full-scale deflection, at which the current consumed is given by dividing voltage by resistance (in ohms).

All this will be made clear by taking the typical example of an o – 6 voltmeter rated at, say, 200 ohms per volt. The total resistance is $200 \times 6 = 1{,}200$ ohms. The current taken for full-scale deflection is $6 \div 1{,}200 = 0.005$ amp. (or 5 milliamperes). Thus a reading of 6 volts shows that a current of 5 milliamperes is flowing. Each single volt division, therefore, represents $5 \div 6$, or about 0.8 milliampere. When the meter is of the popular two-range type, the lower range terminals should be used, as otherwise the resistance will be excessive for most purposes.

It should be added that the high resistance of the voltmeter is likely to be a disadvantage when the instrument is used as a milliameter, although for its normal function this property is desirable.

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A SAFETY HINT.

IT is customary nowadays to include single- or double-cell grid bias batteries for H.F. and detector valves in the receiver itself. A little consideration will show that there is a possibility of short-circuiting these batteries at several points during the process of wiring the set; it is therefore recommended that the connections to the cells should be made after the rest of the wiring has been completed. It will be realised that a cell which has been completely short-circuited for any length of time will show almost full voltage after it has been allowed to recuperate for an hour or two, but it will quickly deteriorate, and may give rise to troubles which are not always easily traced, as grid cells are often mounted in an inaccessible position, where voltage tests cannot easily be applied.

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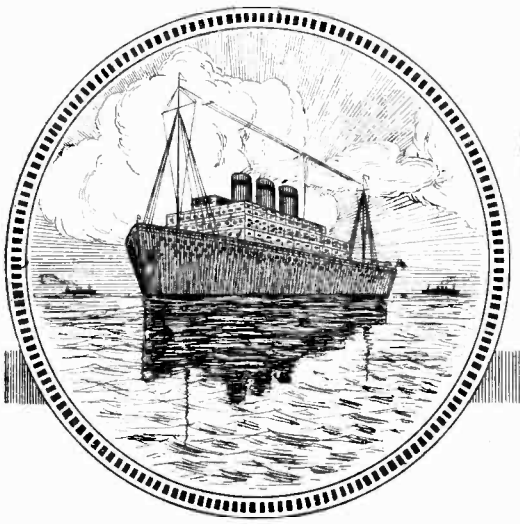

BROADCAST RECEIVERS ON AMERICAN LINERS

Coil-driven Loud-speakers Operated from Gramophone Records. Super-heterodyne and Short-wave Receivers.

By Our New York Correspondent.

FOLLOWING the example set some time ago by certain British liners, four ships of the American Grace Line were recently equipped with broadcast receivers and means for reproducing music in different parts of the ship. The reproducing apparatus may be employed either for broadcasting or for gramophone records.

In each case two broadcast receivers have been installed in the wireless room of the vessel concerned. For medium-wave reception a Radio Corporation of America Radiola 20 is used, and for short-wave reception a Crossley 0-v-2 short-wave receiver is supplied.

The Radiola 20, shown in Fig. 2, is a superheterodyne of a new and improved type, which takes up much less room than the older models. It is only about 16in. long. In the wireless room of the ship concerned it is installed on the top shelf of a large copper-lined wooden box. The bottom half accommodates H.T. batteries, a 2-volt filament accumulator, and a trickle charger. The short-wave receiver, which is supplied with interchangeable plug-in coils, is mounted in any suitable and convenient position.

Controlled by the Wireless Operator.

Both receivers are tuned by the wireless operator, who may use a loud-speaker or wear phones during the process. Having picked up a suitable programme, he plugs the output of the receiver concerned on to a line leading to the reproducing equipment in the public parts of the ship.

In the case of one of the ships in question, the s.s. *Santa Luisa*, which the writer visited recently, the passenger accommodation is of such size that but two reproducing points are necessary, one on deck for dancing and one overlooking the dining saloon. At a suitable point on the deck an R.C.A. Type 104 coil-driven loud-speaker is mounted in a weatherproof box, together with its associated power amplifier. The standard Type 104 speaker is illustrated in Fig. 1. For marine use the instrument is similar, but with the legs removed. An internal back view of the speaker, together with its incorporated "power pack" and L.F. power amplifier, is also shown.

The Type 104 loud-speaker is designed essentially for A.C. operation (*i.e.*, rectified current from 110-volt A.C. mains), and as ships are invariably equipped with direct-current dynamos, provision has to be made for an

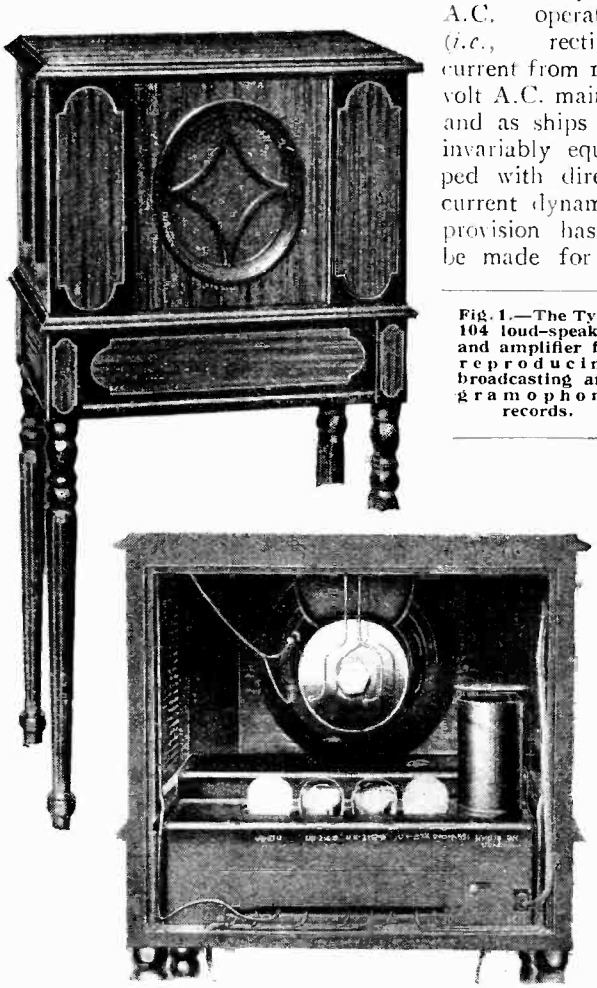

Fig. 1.—The Type 104 loud-speaker and amplifier for reproducing broadcasting and gramophone records.

A.C supply of the usual standard American characteristics, *i.e.*, 110 volts 60 cycles. This current is supplied from

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Broadcast Receivers on American Liners.—a special motor-generator which is installed in a spare corner of a convenient deck locker.

On its arrival at the loud-speaker, the A.C. supply is (1) full-wave rectified, smoothed, and fed to the field coils of the loud-speaker; (2) transformed up, full-wave

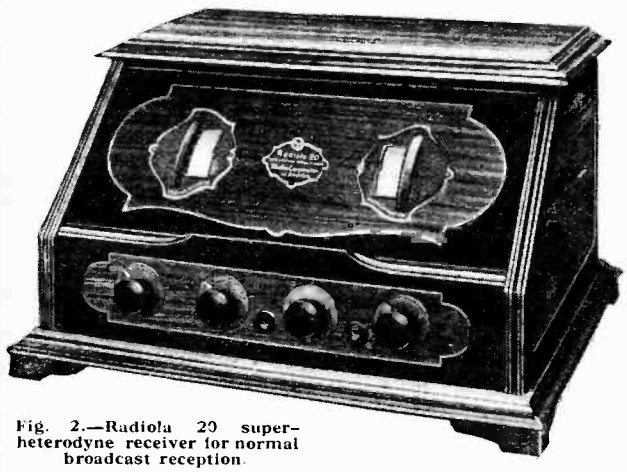

Fig. 2.—Radiola 20 super-heterodyne receiver for normal broadcast reception.

rectified, smoothed, and fed to the plate of the power amplifier valve, which is a UX-210 of 7.5 watts rating. This valve takes its input from the wireless room or from the output of the gramophone pick-up amplifier. Thus there are two rectifying and smoothing systems.

Inside the ship, on a balcony overlooking the dining saloon, there is a Brunswick Panatrope. This type of gramophone is arranged to reproduce electrically at all times. Instead of the usual sound-box, it is equipped with an electrical pick-up device, the output of which is amplified and then applied to a Type 104 loud-speaker exactly similar to that already described. This speaker, together with its own associated transformers, rectifiers, smoothing equipment, and power amplifier, is permanently built into the instrument. This associated equipment is known collectively as the "power pack," and receives its power from the same 110-volt A.C. source as the deck speaker.

Switching arrangements on the Panatrope permit it to reproduce either gramophone records or radio broadcasting, and the deck speaker may be fed with either type of entertainment in a similar manner.

The Grace Line ships which have been equipped with this apparatus are engaged upon the New York-Valparaiso service, which takes them through one of the world's worst regions for atmospherics, so that broadcast reception, from the point of view of entertaining passengers, is out of the question for the greater part of the voyage.

During the winter season in Chile, however, very good reception is obtained from the American and Dutch short-wave stations, and as far south as Valparaiso it has been possible on many occasions to switch very agreeable short-wave broadcast reception on to the deck and Panatrope speakers, even from PCJJ, which is received in that part of the world during the afternoon.

A NOTE ON FILAMENTS.

Temperature Control of Coated and Thoriated Filaments.

IN these days, when coated filaments, running at a dull red heat and consuming very small currents, are so widely used, one is perpetually being reminded that the life of the valve will be considerably shortened if the filament is run too bright. The advice generally given is to reduce the filament current by means of the rheostat until a point is reached at which further dimming results in a loss of either strength or quality. While this is undoubtedly the best possible way to treat filaments of this particular type, these instructions must not be taken to apply to all valves, for some can be injured even more quickly by running at too low a temperature.

With a coated filament, as the name implies, the emission is supplied entirely by a thin coating on the outside of the filament, and the useful life of the valve is dependent solely upon the life of this coating. The rate of dissipation of the coating, in turn, is governed chiefly by the temperature at which the filament is used, so that for long life the lowest temperature at which satisfactory working can be had should be used.

With a thoriated filament, on the other hand, conditions are rather different. Here the emission is again obtained from a surface layer, but in addition there is a further supply of thorium in the body of the filament, which slowly diffuses out to the surface in use, and replenishes the surface coating as it is used up. The rate of this diffusion, as well as the rate of disappearance of the surface layer, depend on the temperature of the filament, and it so happens that an adequate emission can be obtained at a temperature too low to permit of a sufficient amount of diffusion. It will readily be seen that if the valve is run at this temperature the surface layer will be used up more rapidly than it is replaced by fresh thorium from the body of the filament, so that the emission will fall off, and finally the valve will be rendered useless.

An understanding of the cause of this trouble shows that a valve in this condition can be rejuvenated if the filament is heated up to full brightness for some time, with the H.T. supply disconnected so that emission is not encouraged. During this process, known as "cooking," fresh thorium diffuses out from the body of the filament faster than it is used up, and the lost emission is regained after a few hours.

It is better, however, to ensure that the trouble does not arise in the first place, which can be done by making a point of running any valve with a thoriated filament at the *highest* rating given by the makers, more especially if the plate current required is high—as, for example, with power valves.

Thoriated filaments can be distinguished from coated filaments by the fact that the former run at a bright yellow heat in use, while the latter attain only a dull red glow, or, in the case of a heavily "gettered" valve, cannot be seen to glow at all.

A. L. M. S.

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By Our Special Correspondent.

Oscillators: New P.O. Move.—B.B.C. and Dog Races.—Visitors at Gloucester.—Brussels Listening Post.—5SW Talks to Australia.—Cost of Empire Experiments.

Oscillation Bugbear.

It was hardly to be expected that oscillation disturbance would show a lessening tendency at this time of the year. The sober truth is that it is markedly on the increase, judging by the correspondence received at Savoy Hill. At the end of September the average weekly number of complaints was 73; at the end of October it was doubled.

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Telephone Engineers as Detectives.

The Post Office is taking a very keen interest in the oscillation question, and I learn that P.O. telephone engineers are now being given intensive training in wireless in the hope that their new qualifications, added to their knowledge of local topography, will be of greater use in locating offenders than were the "anti-oscillation" D.F. vans.

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An Unrecorded Disaster.

We have heard of the big troubles caused by the recent gales—how, among other things, the Daventry and Liverpool B.B.C. stations were temporarily put out of action. But a minor catastrophe would go unrecorded if I did not mention it here. Last week the receiving aerial on the roof of 2, Savoy Hill, was blown down and the administrative staff were unable to hear 5GB and 5XX. The aerial was repaired two days later.

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Going to the Dogs.

A suggestion that the B.B.C. should give us a running commentary on the greyhound races at the White City or some other course was put forward by a correspondent in the November *Listener*. I learn at Savoy Hill that this idea will be taken up early next year and that arrangements will be made to broadcast dog races probably at the White City.

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A Select Station.

By far the most modest of the B.B.C. stations must surely be the Gloucester Repeater Station, which is shielded from the noonday glare of publicity because its services to listening humanity are of the "behind the scenes" type. But the repeater station enjoys a kind of esoteric distinction which vulgar main stations can hardly hope for. According to the engineer-in-charge the repeater station has recently been visited by numerous members of the cathedral clergy and by the Dean himself, not to mention the mayor and other municipal celebrities.

It is interesting to know also that the precincts of Gloucester cathedral contain so many aerials that, with the addition of one more, the place might show signs of becoming disfigured.

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FUTURE FEATURES.

London and Daventry (5XX).

Nov 20TH. — Popular Chamber Music.

Nov. 21ST.—A Programme for the Eve of Saint Cecilia.

Nov. 22ND.—The Roosters' Concert Party.

Nov. 23RD.—Military Band Concert.

Nov. 24TH.—Ballad Concert.

Nov. 25TH.—Symphony Concert. Bridge Broadcast.

Nov. 26TH.—Variety Concert.

Daventry (5GB), experimental.

Nov. 20TH.—Chamber Music.

Nov. 21ST. — "This Programme Business," an entertainment written and arranged by Cecil Lewis.

Nov. 22ND.—"Penelope," a lyric drama in two acts by Herbert Ferrers.

Nov. 23RD.—A Concert in aid of the Cardiff Station's "Sets for the Sick" Fund.

Nov. 24TH.—Hallé Concert.

Nov. 25TH.—"The Cousin from Nowhere," a musical comedy in three acts by Fred. Thompson.

Nov. 26TH.—"Dancing Time," a variety programme.

Bournemouth.

Nov. 20TH.—Bournemouth Musicians' Benevolent Fund Concert.

Cardiff.

Nov. 25TH.—A Concert by the Society of Somerset Folk.

Manchester.

Nov. 21ST.—Layton and Johnstone, relayed from the Theatre Royal, Manchester.

Newcastle.

Nov. 21ST. — A Programme of Works by Henry Purcell.

Glasgow.

Nov. 24TH.—The Radioptimists.

Aberdeen.

Nov. 22ND.—"Sauce for the Goose," a Scottish comedy in two acts.

Brussels Listening Post.

Most of the relay stations are suffering badly from heterodyning at the present moment. In some cases the heterodyne note is overpowering at a distance of only three miles from the transmitter.

The whole question of heterodyning will shortly be tackled by the central listening post at Brussels, which I understand will be opened in the course of a week or two. It will be remembered that the decision of the International Broadcasting Bureau to institute this listening post was made public some three months ago. It is under the direction of M. Braillard, the engineer who designed the famous "Geneva wavemeter."

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From Leamington Spa.

Sir Henry Wood will conduct a symphony concert through 5GB from the Pump Room, Leamington Spa, on December 2nd. This will be given by the Birmingham Studio Symphony Orchestra of 65 players, and Harold Williams will sing baritone solos. Mr. Williams is one of those Australian artists in England to whom greetings were broadcast from Sydney on Sunday, October 30th, when the B.B.C. relayed a special short-wave transmission.

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"Tilly of Bloomsbury."

"Tilly of Bloomsbury," a comedy adapted from Ian Hay's novel, "Happy-go-lucky," will be broadcast from 2LO and 5XX on November 30th.

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5SW's 36-hour Test.

It was a brilliant move on the part of the Chelmsford engineers to conduct a 36-hour continuous transmission test with the object of finding the most suitable times for broadcasting to Australia.

This test was carried out on Saturday and Sunday, November 5th and 6th, from 12 noon (G.M.T.) on the 5th to 12 midnight on the 6th. By special arrangement the Amalgamated Wireless (Australasia), Ltd., kept continuous watch during that period.

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How Australia Heard.

The following reception log is interesting as showing the regular rise and fall in signal strength throughout the day :—

Time of Transmission.	Signal Strength in Sydney.
12.0 —14.0 (G.M.T.)	R7
14.0 —17.0 "	R8
17.0 —18.30 "	R5
18.30—19.30 "	R7
19.30— 3.0 "	nil
3.0 — 4.0 "	R2
4.0 — 5.0 "	R4
5.0 — 6.0 "	R6
6.0 —12.0 "	R7
12.0 —17.0 "	R8

Sydney time is ten hours ahead of G.M.T., and it will be seen that the most favourable reception period for Australia listeners is between 10 p.m. and midnight, *i.e.*, early afternoon here, assuming that the 24-metre wavelength used on this occasion became a standard. There is a distinct possibility, however, that experiments with other wavelengths would produce different results, and I have no doubt that the Chelmsford engineers will soon be making tests in this direction.

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The Question of Cost.

The question has not unnaturally cropped up : What proportion of listeners' money is being spent on Empire transmissions? Incidentally, one of the enquirers is a Scotsman.

When I put this perfectly legitimate question to an official at Savoy Hill it was swiftly answered. "Not a penny," he said. "The B.B.C. is collaborating with the Marconi Co. in these tests, but we are not spending more money than the ordinary programmes demand. Our part in the experiments is to provide the Marconi Co. with broadcasting material. As on Armistice Day, transmission of this material is also suitable for the British public; the Dominions merely have the opportunity to share it."

In the 36-hour test gramophone records were broadcast.

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Bristol's Radio Week.

Cardiff station gives a special Bristol Week during the seven days beginning on Sunday next, November 20th. This is the first week of the kind in the country, for the civic authorities and wireless trade and representatives of all kinds of thought in Bristol are uniting together for the good of broadcasting.

The week will open with a broadcast from the famous old church of St. Mary Redcliffe—the first time a service has ever been broadcast from it. On Monday, a West Country play will be given, and Bristol artists will give a concert. On Tuesday, Mr. Harold G. Beer, a new Bristol tenor, will make his *debut*. On Wednesday, a popular concert will be given in the Central Hall, Bristol. On Friday, the Society of Somerset Folk will give a programme. On Saturday, a programme will be relayed from the Colston Hall, the second largest hall in England.

During the "week," lectures and demonstrations will be given in various parts of the city.

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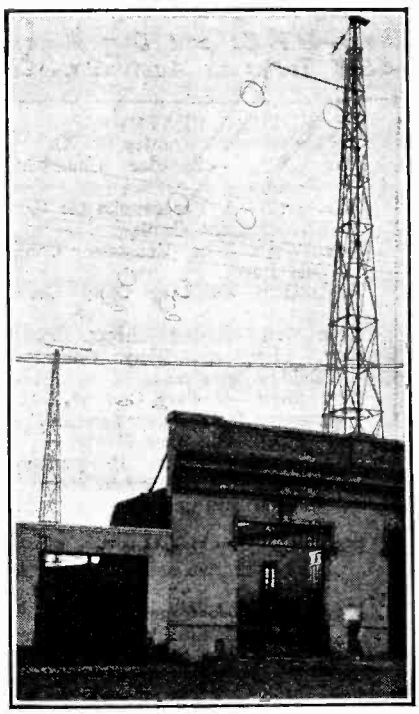
Lord Mayor's Show : Notable Omissions.

While the Marconi people were well represented in the Lord Mayor's Show last Wednesday there was nothing, I believe, to symbolise the broadcasting aspect of wireless. Even if the B.B.C. was too busy answering critics to take part, I think the Post Office might have been allowed to include an anti-oscillation van in the procession. Then, too, a stirring tableau depicting an oscillator undergoing the extreme penalty (whatever that might be) would have had a salutary effect.



PLOUGHING A LONE FURROW. A glimpse of OAK, Lima, the only broadcasting station in Peru. Broadcasting has received little encouragement from the Peruvian Government, which levies an annual tax of about 29/- from each listener. Naturally there are many pirates.

As it is, we must contain ourselves in hope for another year. May the dreary months roll quickly.

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Cecil Lewis on "This Programme Business."

As a former chairman of the B.B.C. programme board and one who has been associated with broadcasting since early days when the B.B.C. staff numbered five persons, Mr. Cecil Lewis should know as much about programme building as most people. Listeners, however, may not expect to hear all about the complex problems involved in such work, when Mr. Lewis broadcasts from 5GB "This Programme Business" on November 21st. It will prove instead an amusing entertainment that he has written and arranged; and it will have a humorous moral for the officials of the B.B.C., as well as those who know wireless entertainment only from the receiving end.

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The Radio "Raffles."

The gentleman thief who is reported to be touring the Birmingham area posing as an inspector of wireless sets has shown marked intelligence in the choice of territory. Owing to the present inadequacy of 5GB, there are many houses in the Midlands where the receiving set has failed to give satisfaction of late, and the unsuspecting feminine gladly accepts the offer of the gallant caller to "put the set right." The law of the land forbids the use of man traps, otherwise our ambitious inventors might evolve a set with a concealed circuit of the handcuff variety.

o o o o

Hope for South London Listeners

Overhead wires on the Southern Railway in the London and suburban district are still causing much interference to broadcast reception in houses near the line. The residents have not despaired, however, being buoyed up by the hope that the change to the conductor rail system will at least mitigate the trouble.

Preparations for the change-over are now being made, so let us hope that the denizens of Croydon, Streatham, Norwood, and the surrounding districts will soon enjoy a peace they have never experienced before.

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Gramophone Transmissions Criticised.

It is difficult not to sympathise with Dublin listeners who are protesting against the growing use of gramophone records in the transmissions from 2RN. To my mind the only justification for broadcasting gramophone records at all is the opportunity it gives gramophone lovers to hear the latest records available; such transmissions should be limited to one hour a week. Perfect reproduction has not yet been achieved either by the gramophone or the loud-speaker. The combination of the two fails to cancel their individual frailties.

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Tommy Handley Again.

Tommy Handley, the wireless comedian, whose engagement to Miss Jean Allistone, the popular musical comedy actress, was recently announced, will have charge of the variety programme to be broadcast from 5GB on November 29.

The artists in this programme include Brampton Hawkins (dialect entertainer), Lena Copping and Joan Meredith (entertainers with a piano), and Helena Millais (the actress-entertainer).

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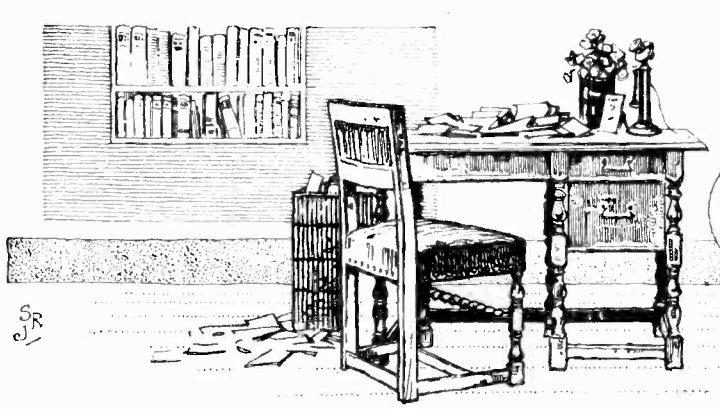

The Week's Postbag

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

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

THE REGIONAL WAVELENGTH SCHEME.

Sir,—One wonders how much longer the present chaotic condition of the European ether is to last. When the new wavelength scheme was introduced the promoters made the fundamental error of considering nothing but the spacing of stations in kilocycles. The real trouble, that of relative power, was left entirely out of account.

As a result, instead of all the British stations being audible here (Geneva) as they used to be, with comparatively little interference, the ether seems to have been given practically entirely over to the Germans. Wherever one turns on the dial they come booming in, swamping 2LO, 6BM, 5WA, and all the rest. The only station in England that can be obtained at all regularly is 5GB, and that only when Königswusterhausen graciously permits.

It may be all very well for places served by a local station, but for towns like Geneva, where the local station's transmissions are negligible and the nearest big station is 300 miles away, the present wavelength allocation is worse than useless—it is exasperating! G. D. MILLAR.

Geneva.
November 5th, 1927.

EMPIRE BROADCASTING.

Sir,—I have been receiving a good many reports from listeners in this country on my transmissions, and, while I fully appreciate them, I would like to point out that the object of my short-wave telephony tests are primarily for the benefit of the distant parts of the British Empire.

Owing to the extraordinary interest shown by those enthusiasts across the seas, I receive huge mails from all parts of the world, and, as a result, it will be impossible for me in future to send individual acknowledgments of reports to listeners in this country.

A good many listeners here appear to have been disappointed that they cannot get good reception of my transmissions after dark; but they must realise that wavelengths in the neighbourhood of 30 metres have peculiarities after dusk; although between, say, 4 and 5 o'clock in the afternoon, during daylight, they may receive strong signals, after dark they may not hear me at all, and the same applies to early morning. This is naturally due to the skip effect, which perhaps they will take into consideration in future should they be disappointed in not getting my transmissions.

I am continuing these special Empire experiments until April 1st, 1928. GERALD MARCUSE.

Experimental Wireless Station 2NM.
November 4th, 1927.

MORSE INTERFERENCE.

Sir,—Mr. Maurice Child seems to be under some misapprehension regarding the competency and duties of a British seagoing operator, and as his letter is obviously intended to cast a slur upon our name we take this opportunity of vindicating ourselves.

As far as we can judge, Mr. Child would have us use C.W. on all waves calibrated dead true by the use of calibration waves. Has Mr. Child ever had any practical experience in clearing traffic in congested waters as, for example, the English Channel? It is difficult enough now, but if every station were working on C.W. on 600 metres it would be absolutely impossible to pick out the required station. How would we then get our long ranges with GLD? It is our experience that under good conditions C.W. is more efficient than spark, but when more C.W. jamming or bad X's such as are not encountered in Great Britain crop up, the old spark set comes into its own again. And on top of all this jamming we are to have calibration tuning notes sent out, which will further increase the chaos. Our wavemeters are tested periodically and are seldom found inaccurate, and each of our seventeen radiated waves on spark, I.C.W. and C.W. are always within a fraction of a metre of their nominal wave, which is the best we can do till ships cease to roll—a point which Mr. Child has forgotten.

Passing over the rest of his letter, which is, to quote a technical professional not at sea, "merely the vapouring of a theoretical amateur who cannot tune out Morse interference," we come to the last paragraph, in which Mr. Child flies his true colours He uses the phrase "disastrous to the progress of broadcasting and other vital wireless services." Since when has broadcasting been a vital wireless service? In conclusion we may say that no distress working will ever be jammed by broadcasting, as in that event we should take official steps to have the broadcasting station closed down temporarily.

We shall be unable to continue this controversy as next week we sally forth to contribute to the jamming in the Channel with our five independent transmitters, but shall be very glad to meet Mr. Child on our return and discuss the matter with him from the viewpoint of

Southampton. "SEA-GOING OPERATORS."
November 5th, 1927.

Sir,—I am pleased Mr. Maurice Child has entered this discussion as the matter is of general interest.

We should not overlook the fact that the shipowner was first in the field and no doubt considers he has just as much right to protection from the encroachment of an entertainment service as the broadcast listener has to hinder legitimate commercial activity or reduce the margin of safety of life at sea!

Fortunately we may rest assured that whatever the outcome of the Washington Conference the frequency bands and types of wave allotted to various services will be the result of full discussion and argument between experts in possession of all relevant facts and in a position to assess the rival claims of conflicting interests. No doubt the decisions will represent fair and reasonable compromise.

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I think, however, Mr. Child takes me to task unjustifiably on one or two points.

He says spark or I.C.W. is not technically essential for a reliable emergency service—perhaps not technically, but I am speaking practically. Elaborate and costly arrangements can be devised, but can Mr. Child show these to be more effective from a safety point of view than, say, the present simple and straightforward emergency battery and coil? I think he would find it difficult, and before he could advocate such a policy he would in justice have to prove it more effective.

The trouble with C.W. is that the tuning is too sharp. Mr. Child suggests more accurate tuning; but will he, as an experiment, some night cover the European broadcast band to discover the following: that stations tuned with the greatest possible care by wavemeters calibrated in the same laboratory may heterodyne each other even when technically separated by 10 kC.?

This in the case of fixed stations; from my own experience the presence of a steel frame warehouse alongside a vessel may introduce a tuning error even in a spark set which is noticeable when the vessel gets to sea.

With regard to the law and the Auto-Alarm there is no doubt, I think, that within 12 months from the date of approval all foreign-going vessels carrying between 50 and 200 persons must fit it and in fact have already begun to do so.

What the shipowner has to pay is the point, not what the apparatus has cost to produce. I agree expert attention will be required, but feel this is fully within the competence of a properly qualified operator.

And finally I entirely agree with Mr. Child that once installed it will be extremely difficult to compel further change.

Liverpool. J. B. WILSON.
November 3rd, 1927.

Sir,—I have followed with pleasure the letters you have published concerning the impossibility of reception in coast towns owing to continuous interference by Morse—English and foreign.

In this part the interference is practically complete, except for Daventry 5XX (even that is subject to Morse), but as their doleful programme is depressing the less said about it the better.

Is the P.O. impotent to end this scandal? A commercial company would have had to face the Bankruptcy Court long ago. Truly we are a long-suffering race!

W. Cornwall. "LIVELY MUSIC."
November 4th, 1927.

LOUD-SPEAKER MOVING COILS

Sir,—There seems to be a considerable divergence of opinion regarding the merits of high- and low-resistance coils used in moving coil loud-speakers, and I believe your readers' opinions would be of considerable interest.

For myself, I prefer a coil of low resistance: one of 100 turns of 36 S.W.G. wire when used in conjunction with a Ferranti 25/1 step-down transformer.

The reasons for this preference are as follows:—

(1) Expense.

As a choke and condenser or similar D.C. current-isolating device is necessary when a high-resistance coil is used, and such a choke, to be as efficient as a transformer, is just as difficult to design and expensive to manufacture, nothing in cost is saved; in fact, when a large blocking condenser is added the cost is decidedly greater.

(2) Ease of construction.

The merest novice can successfully wind two layers of No. 36 S.W.G. wire on evenly, but an expert could not do this with, say, No. 47 S.W.G. wire without a special winder, and if it is wound on in a haphazard manner usually two or three breaks will occur.

(3) Space factor.

Working on the basis of 1,000 amps. per square inch cross section of wire, the number of ampere turns of single silk-covered No 47 gauge wire that can be wound in a given space is only about one-fifth the number that can be wound on if No. 36 gauge is used.

(4) Performance.

Although it can be taken for granted that a low-resistance coil will have a practically even response over the whole musical scale, this cannot be said about a coil of, say, 1,500 turns, especially when it is remembered that this coil has virtually an iron core.

Further, as curves are now published showing that step-down transformers are obtainable having practically an even characteristic from 50 to 8,000 cycles, this piece of apparatus need not be feared as a source of distortion.

Perhaps your readers will point out my errors in reasoning.

London, N.W.9. November 5th, 1927. A. R. TURPIN.

THE PROPOSED REGIONAL SCHEME.

Sir,—In regard to the B.B.C.'s proposed regional scheme, would Captain Eckersley indicate at once, or as soon as possible:—

(*a*) The probable situation of each of the five centres of distribution, and

(*b*) The radius of the service-area of each station?

This information is essential if listeners are to be in a position to satisfy themselves beforehand as to the practicability of the scheme before it is actually proceeded with.

Newcastle-on-Tyne, K. McCORMACK.
October 31st, 1927.

Sir,—With reference to your Correspondence column of the above, that none of the writers has mentioned "fading" on the lower broadcasting wavelengths, not counting Morse.

I noticed in this part of the country and also Devonshire that everyone listens to 5XX. I can assure you if 5XX were done away with, most people would give up their wireless altogether.

5SB is no good up here, as it fades completely away as well as *all* other stations. Belfast, the nearest station just across the water, say 35 miles, is as bad, and Morse is awful.

If 5XX were placed on the border of England and Scotland one would not want another station to listen to in the United Kingdom as it is so good. R. R. H.

Wigtownshire, Scotland. November 3rd, 1927.

B.B.C. RECEPTION IN SCOTLAND.

Sir,—Mr. Geo. M. Mayer's letter interested me very much, as I have the misfortune, from a radio point of view, to live four miles from Melrose. I may say that my experience is in every way similar to that of Mr. Horne, and I consider it disgraceful that, while the Border districts generally—stretching from coast to coast—must contribute quite a large sum to the revenue of the B.B.C., there is no station which one can listen to and guarantee that—local thunderstorms being excepted—one may listen to an enjoyable concert. Daventry fades badly at times, and seems to be very prone to atmospheric interference. Edinburgh is a joke, and on the short wavelengths Newcastle is the only station which can be said to be really passable. I mean British station. Germany is good, as also are the various Norwegian stations, and, frequently, France and Spain, but it seems scandalous that no British station is even in "C" category here. C3, yes! We are all hoping that something may be done with the arrangement of the regional stations to guarantee listeners here a degree of *good* reception. BRYAN GROOM.

Galashiels. November 2nd, 1927.

TRESPASSING.

Sir,—If the engineers of the B.B.C. can do a job better than the trade why should not the public have the benefit of their skill and knowledge?

I took advantage of it when I built the B.B.C. Quality Four, and I have never regretted it.

London, N.W.11 G. CHEERS-CHALONER.
October 26th, 1927.

MANCHESTER EXHIBITION.

Sir,—Would you please allow me to thank all those who were present at the closing stages of the Manchester Wireless Exhibition for the generous support given to the jollification, the exhibitors for the gifts which were auctioned by me, and the visitors for their generous bidding, and also those who contributed to the appeal, which resulted in realising £20 for the Fleetwood Flood Fund. W. H. MILLER.

Liverpool, Nov. 7th, 1927.

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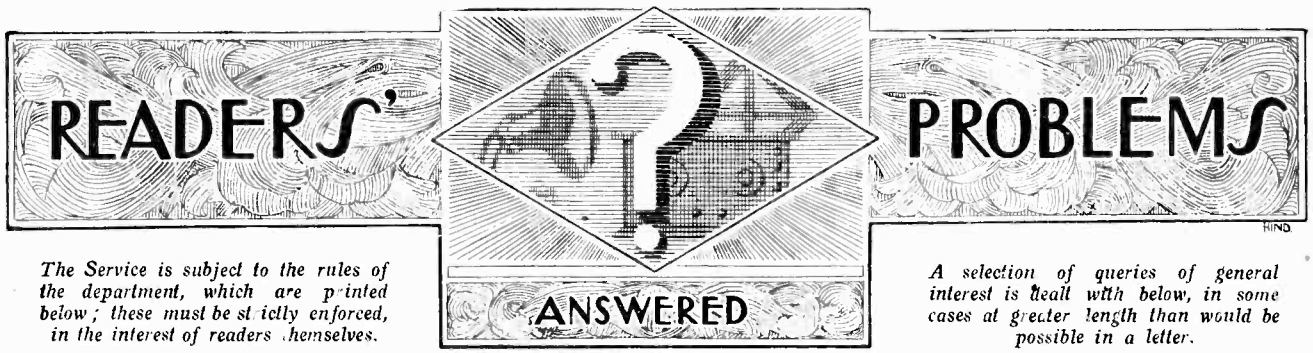

The Service is subject to the rules of the department, which are printed below; these must be strictly enforced, in the interest of readers themselves.

A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

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

Determining Condenser Capacities.

Can you tell me what are the factors which determine the capacity of a fixed condenser? T. L. O.

The capacity of any condenser, whether it be fixed or variable, depends directly upon the area of the overlap between the two electrodes, inversely upon the distance between the electrode (that is to say, the greater the distance, the smaller the capacity), and also upon the specific inductivity of the dielectric.

With regard to the factor "area of overlap," it will be appreciated that in the case of both variable and fixed condensers a large number of plates, or vanes, are used to compose each electrode, and, of course, the greater the number of vanes the greater the area of overlap; and so, in this sense, the number of vanes in the condenser determine the capacity also.

With regard to specific inductivity, it should be pointed out that the specific inductivity of air is taken as unity, and measurements of this property in all other substances are based on this, their specific inductivity being in all cases greater than air.

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A Two-range Portable.

I have lately constructed a single-valve described in "The Wireless World" for July 6th last, and now wish to alter this so that the Daventry long-wave station can be received. Can you suggest the most efficient methods of achieving this? C. L. M.

You should slightly modify the H.F. circuit to enable interchangeable plug-in H.F. transformers to be used, and, of course, it will be necessary to employ a separate frame aerial wound for the long waves. No difficulty should be experienced in constructing this so that it can be made to replace the short-wave frame, and the simplest method would be to mount two sockets on the sub-baseboard and attach two suitable plugs to the frame so that this can be plugged in. The long-wave frame should have 50 turns of No. 26 D.C.C. wire closely wound. Constructional details of interchangeable H.F. transformers were published in *The Wireless World* for April 27th last, and we suggest you refer to this back number for the desired information.

RULES.

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

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

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

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

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

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

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

Modifying the B.B.C. "Quality Four."

I am building the B.B.C. "Quality Four," but wish to change over to capacity-controlled reaction instead of using the ordinary swinging coil method adopted by them. Can you tell me how to do this? R. D.

To effect this change it is necessary to remove the present reaction coil and in its place to insert an ordinary commercial H.F. choke. At the same time, the grid coil of the detector valve can be mounted in a single coil holder instead of in the moving coil holder, and another fixed coil holder should be placed parallel with the grid coil holder, and at a distance of about 1½in. from it measuring between the centres. This new coil holder will hold the reaction coil. One side of it must be connected directly to the plate of the detector valve, and the other side to the fixed plates of a 0.0003 mfd. variable condenser, the moving plates of the variable condenser connecting to earth. This condenser will be for the control of reaction.

Using a Step-down Transformer.

I have lately constructed a single-valve receiver, and have obtained fair results. I am told, however, that I ought to use a transformer with my headphones, as each earpiece is marked 60 ohms. Will this give me better results, and, if so, what kind of transformer shall I purchase? D. R. S.

The telephones you have in your possession are what are known as low-resistance telephones, and must be used with a step-down transformer if the fullest results are to be obtained from them. Undoubtedly, the purchase of such a transformer will give you better results. You must have a special type of transformer, known as a telephone transformer, and it would be best for you to apply to the makers of your telephones, who would probably be able to supply an instrument to suit their telephones, although any make of step-down telephone transformer will give reasonably good results.

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Using a Frame Aerial with an "Ordinary" Receiver.

Can you give me a general rule for converting any ordinary receiver designed for use with an outdoor aerial so that it can be used in conjunction with a frame aerial? R. N.

Any receiver can be very simply converted for using with a frame by merely removing the tuning coil connected across the tuning condenser in the grid circuit of the input valve, and substituting the frame aerial in place of the coil. It should be pointed out, however, that it would be of little use doing this in the case of a receiver designed solely to receive only the local station on an outdoor aerial, as, of course, the amount of energy picked up by a frame is very small. Furthermore, precautions are necessary when the receiver has an H.F. stage, because, in spite of any screen that may be built into the receiver for separating the aerial-grid and the inter-valve H.F. transformers, the set is likely to oscillate when used with a frame owing to direct magnetic interaction between the frame and H.F. transformer. It is necessary in most cases to completely screen the H.F. stage, as in the case of the "Portable Receiver" described in our July 6th issue.

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Pitfalls of Filaments in Series.

I have been running three 2-volt valves in series from a 6-volt accumulator. The results were at first quite good, but a rapid falling off in efficiency has been noticed until now the receiver will scarcely function at all. The actual valves used are two Mullard P.M.1. valves, and a Mullard P.M.2. Can you explain the reason for this? D. R. J.

The reason why your results have fallen off is because you have overrun the P.M.1. valves. It is a mistake to think that one can take any three 2-volt valves and operate them in series from a 6-volt accumulator. This only applies if the filament current taken by each valve is the same. Thus, if three P.M.1. valves were used, all would be well, because the current through all three filaments would be the same, namely, 0.1 ampere. The P.M.2. valve, however, takes 0.15 ampere, and it is obvious, therefore, that since it requires the same voltage as the P.M.1., the resistance of its filament must be lower. We shall not, therefore, have so much total resistance in circuit as if three P.M.1. valves were used. From this it follows that the total current through the circuit will exceed 0.1 ampere, and if this is so, the P.M.1. valves will be overrun.

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A Question of R.C. Coupling.

I am constructing the "All Wave Four," using the modified circuit given in your June 8th issue. Will it be in order for me to use a commercial R.C. unit in place of the separate resistance, coupling condenser and leak used in the original receiver?

You can, of course, use any good commercially made R.C. unit, as you propose, but it must not be forgotten that such units will not contain the 0.0001 mfd. fixed conderser, which in this receiver connects from plate of detector valve to L.T.—nor will such units contain the stabilising existence connected to the grid of the first L.F. valve. You must not forget to add these two devices to the set in addition to the unit. The condenser and resistance to which we refer are marked C_6 and R_6 respectively in the diagram on page 737 of the June 8th issue.

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A Grid Bias Trouble.

I have recently constructed an H.F. detector and L.F. set in which the detector is of the anode bend type, the L.F. stage being resistance coupled. I notice that best results are obtained when the grid return lead joins direct to L.T.— and biasing by even one cell causes practically all signals to cease. Why is this, and what can I do to remedy it? G. T.

It is assumed that the valve you are using is of the high impedance R.C. type. Such valves usually require not more than 1½ volts grid bias in order to bring the working point down to the bottom bend. In many cases, however, it will be found that slightly less grid bias than 1½ volts negative is needed. It would appear to us either that your valve is one which requires rather less grid bias than the majority, or alternatively that you are using too low a value of H.T. We should advise you to try raising the value of H.T. We advise in any case, however, that you insert a potentiometer in the manner shown in conection with the "All Wave Four" receiver published in our April 27th, 1927, issue, not only in order that you may be thus in a position to apply less than 1½ volts to the grid, but also in order that you may be able to adjust the grid potential critically.

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Safety First.

I propose to wind the pot magnet of my coil drive loud-speaker so that this can be connected to a D.C. supply of 240 volts. Can you supply me with the circuit, and indicate any special precautions that should be taken to safeguard the speaker in the event of a short-circuit? D. V.

When the pot magnet of a coil-driven loud-speaker is connected to a high voltage D.C. supply, it will be necessary to employ an arrangement similar to that shown in Fig. 1. The guard lamp must be chosen so that the current it will pass is much greater than that taken by the pot magnet, and a suitable fuse should be included in the other mains lead.

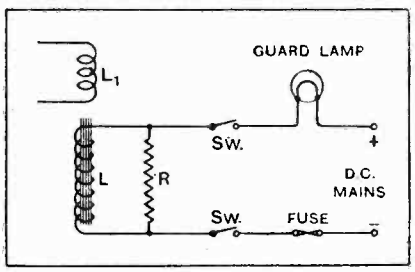

Fig. 1.—Connections of loud-speaker field winding.

When the circuit is broken the lines of force will collapse very rapidly in the electro-magnet, and a very high voltage will be developed across the ends of this coil, which will result in arcing at the switch contacts. To overcome this a buffer resistance R, having a value about 10 times that of the coil resistance, should be connected across the winding, and this must be capable of carrying the mains voltage without overheating. A suitable value to adopt would be about 10,000 ohms, and it must be wire-wound.

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Blue Prints.

I wish to construct the "Everyman Four" receiver, and should be obliged if you could inform me where I can obtain a complete set of blue prints of this receiver. J. G.

We do not supply blue prints of "Wireless World" circuits, for the reason that full constructional details, together with all necessary drawings, practical and theoretical, are published in connection with the receiver described. The issues in which the "Everyman Four" receiver was described have been out of print for some time, and we have published, therefore, a handbook dealing exclusively with this receiver. Full constructional details are given, together with practical wiring diagrams, and some very interesting tables show the amplification obtained with different types of valves.

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Reception in the East.

I propose to construct a receiver which will enable me to receive European broadcasting stations in Northern India, and should like your advice on the most suitable type to take with me. W. R. A.

We do not think that it would be possible to achieve either regular or satisfactory reception of European broadcasting stations working on wavelengths over 200 metres, and suggest that you concentrate on the reception of those stations transmitting on the very short wavelengths, in the region of 30 metres or thereabouts. For this purpose you could supply either the "Empire Short-wave Receiver" described in *The Wireless World* for June 29th last, or either of the short-wave sets discussed in our issue of September 14th last.

Reception of the very short wavelengths can be achieved over great distances with a certain regularity, and in addition the interference from atmospherics is far less troublesome on these wavelengths than on the normal broadcast bands of 200-2,000 metres. In the latter case these atmospheric disturbances often render reception impossible for many days on end, added to which long-distance reception is possible only under very favourable conditions.

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A Case of Overloading.

For the reception of local broadcast an 0-v-2 receiver is used; the first L.F. is resistance-capacity coupled and the second transformer coupled. High-class components are employed throughout, but the quality in reproduction is below expectation, and on loud passages very harsh. The valves are Marconi D.E.2. H.F. for detector and D.E.2. L.F. for second and third positions. I should be obliged if you could suggest a cure for this trouble. R. M.

The harshness and poor quality is due, no doubt, to the overloading of the last valve In cases where two L.F. stages are employed the output valve must be capable of handling a reasonably large voltage swing on the grid; that is to say, this valve should have a generous negative grid bias. You could not apply the required bias to the valve mentioned for the reason that it has not been designed to handle a large input. The Marconi and Osram companies have recently placed on the market a D.E.P. 240 which has been designed for use in the last stage of a receiver. This valve will require an anode potential of about 120 volts, with a grid bias in the order of 12 to 14 volts negative.

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

THE B.B.C. BIRTHDAY.

THE B.B.C. birthday anniversary was celebrated by a special broadcast conducted by the staff of the B.B.C. The broadcast, although frivolous in itself, served to mark the completion of the fifth year of a service which, it will be admitted, has already had a pronounced influence on the everyday life of this country, and is likely in the future to take an even more important position than it has ever done in the past period of five years. Much of the work of organisation of the broadcasting service has been in the nature of experiment, and the experience gained will, it is hoped, show results in the introduction of the regional scheme. No doubt there will be criticism of the regional scheme when it comes into operation, but whatever may be said, we know that it is the outcome of very careful deliberation on the part of the broadcasting authorities, and that it is introduced in the honest endeavour to provide this country with the most efficient system of distribution of broadcasting with alternative programmes. We take this opportunity of congratulating the B.B.C. on the progress which has been made up to the present, and we look forward to a continuance of the same enthusiasm on the part of the personnel of the B.B.C., which we are confident can only result in even greater developments in the near future.

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EMPIRE BROADCASTING.

Writing in a recent number of the B.B.C. journal *World Radio*, the Chief Engineer opens his subject as follows: "Flogging a dead horse is said to be a waste of time. Flogging any horse seems to be unnecessary. In view of the continued misrepresentation of a point of view by anyone who speaks and writes on the subject, in spite of repeated official statements, I am impelled, if not to flog, at least still to continue to try and urge the Empire Broadcasting horse to pull hard along the bumpy and difficult road of real progress."

Believing that we are included amongst those whom the Chief Engineer regards as "misrepresenting a point of view in spite of repeated official statements," we feel that we cannot let these comments go by without a word in reply. Flogging a dead horse is certainly waste of time, we agree thus far, but we never considered that the B.B.C. was dead when we did a little flogging to urge forward the endeavour to achieve Empire Broadcasting. Our point of view was that the horse was not a horse, but a rather obstinate mule which suffered from inertia, or whatever one may like to call it, and required a certain amount of judicious flogging before it would start, though we felt confident that once started it would proceed satisfactorily along its course.

How Empire Broadcasting May Develop.

Now that we know the development of empire broadcasting is under way it is interesting to consider the lines along which a service is likely to develop. Direct broadcasting from the home country to all parts of the empire would be the ideal arrangement from many points of view, but if we are going to have a truly efficient service with the minimum of failures to receive the programmes, it seems probable that the service will have to be developed on the principle of a chain of stations, each link in the chain re-radiating from a transmitter at its own location on a short wavelength most suitable for communication with the next point in the chain. Development on these lines will, no doubt, be slow and can only come as the result of a good deal of experiment which the existence of the Chelmsford short-wave station now renders possible. If it is found necessary to relay the home transmissions then, of course, the question of the cost of conducting the relays will have to come into consideration. It would seem probable that a short-wave transmitter in this country, definitely established on a service basis for programmes to the empire, would eventually have to be financed from some source of revenue other than the licence fees of the home listeners.

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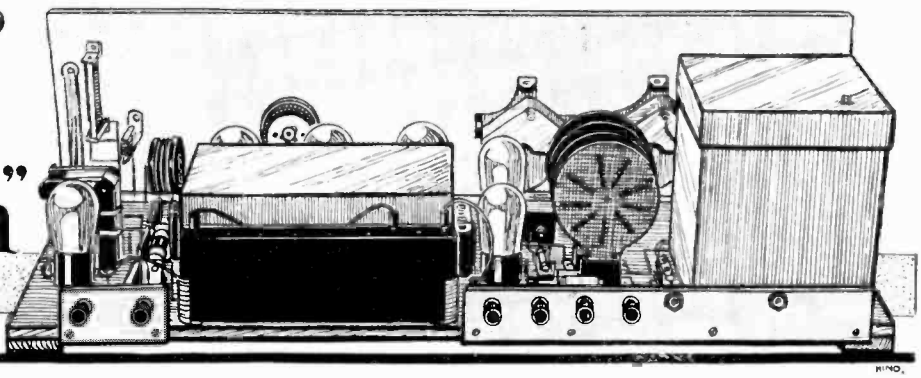
WIRELESS WORLD

"Super Seven"



(Concluded from page 637 of the November 9th issue.)

Further Constructional Details, Choice of Valves, and Hints on Tuning.

By H. B. DENT.

THE second detector valve is preceded by three stages of high-frequency amplification, so that it becomes necessary to employ a valve capable of handling a reasonably large grid voltage swing, and a 20,000-ohm valve with a negative bias of between 3 and 4.5 volts is recommended. It has been proved experimentally that the presence of H.F. oscillations in the low-frequency amplifier and output circuits renders a receiver very unstable, and the failure to obtain satisfactory neutralisation of the H.F. circuit can often be traced to this cause. This applies perhaps more to the signal frequency amplifier than to the long-wave unit, for the reason that H.F. currents in the loud-speaker lead will feed back energy to the frame, and this will eventually lead to uncontrollable oscillation of the frame circuit. A very careful system of filtering is therefore demanded, and a special high-frequency choke, with a by-pass condenser at either end, has been connected in the anode circuit of the second detector valve.

The Low-frequency Amplifier.

When two or more stages of efficient H.F. amplification are used, one L.F. valve only will be found ample to give loud-speaker results from practically all the worth-while stations. However, this valve should be a really good power valve with a reasonably high anode voltage, and accordingly the plate current may be of the order of 8 to 10 milliamps. It would be unwise to pass this current through the loud-speaker windings, so that a choke-capacity output circuit, or a one-to-one ratio transformer, is recommended. In addition, this localises the H.T. supply and obviates the necessity for passing this through lengthy leads should the loud-speaker be located at a distant point.

Valves.

The various circuits comprising a modern receiver are designed to suit a definite type of valve, and it is for this reason that very little latitude can be taken in the choice of valves without seriously impairing the performance of the set. The employment of a tuned anode circuit in the signal frequency amplifier would seem to indicate that the impedance of the valve used in this position is of little importance, but in practice this is not so. Very high-impedance valves render a circuit extremely selective, and if selectivity is carried too far the upper audio-frequencies are lost, with the result that speech and music become distorted. In addition, considerable difficulty will be experienced in stabilising the input circuit when using valves having a very high voltage amplification; however, this could be overcome by careful design of the anode coil. Commercially made centre-tapped anode coils fall very far short of the ideal, as the leakage inductance between the anode portion of the coil and the neutralising portion is very high, and until a really good coil is marketed this method of obtaining H.F. amplification will be subject to certain disadvantages. Experiments have shown that it is not practicable to employ a valve in this position with a higher A.C. resistance than about 30,000 ohms. A low-impedance valve is recommended for the local oscillator for the reason that these valves give more even oscillation over the full tuning range of any one coil, and accordingly the recommendation for this position is a valve between 4,000 ohms and 8,000 ohms A.C. resistance.

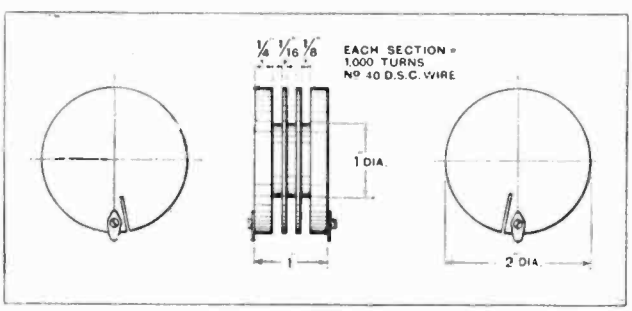


Fig. 8.—Details of the special bobbin for the H.F. choke.

In the long-wave amplifier it will be possible to employ high-impedance high-amplification valves, and full advantage can be taken of this by making use of valves with A.C. resistances of the order of 60,000 to 70,000 ohms, and having the highest voltage amplification for this resistance. The stability of the amplifier is obtained by feeding back oscillations from one stage to the preced-

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ing stage, and the amount fed back should be just sufficient to neutralise that which is transferred *via* the inter-electrode capacity of the valves. The number of turns given for the neutralising winding will be applicable only to valves of the same type and internal capacity as those used in the original receiver, so that no deviation should be made from the valves recommended. The first detector valve and the two I.F. valves should be the Mullard range of P.M. high-magnification valves, such as the P.M.1A in the two-volt range or P.M.3A or P.M.5B in the four- and six-volt range respectively.

A little latitude can be allowed in the choice of a valve for the second detector, and any efficient valve possessing an A.C. resistance of between 13,000 and 45,000 ohms will be permissible. The output stage must, of course, be provided with a really good super-power valve with an A.C. resistance of from 2,500 ohms to 4,000 ohms. The original receiver employed the following valves in the order named, commencing with the signal frequency amplifier: Mullard P.M.1 H.F., P.M.2, P.M.1A, P.M.1A, P.M.1A, P.M.1 H.F., and P.M.252 This will no doubt prove a useful guide in the choice of suitable valves, and it might be mentioned in passing that the satisfactory performance of the set is dependent to a great extent upon the valves.

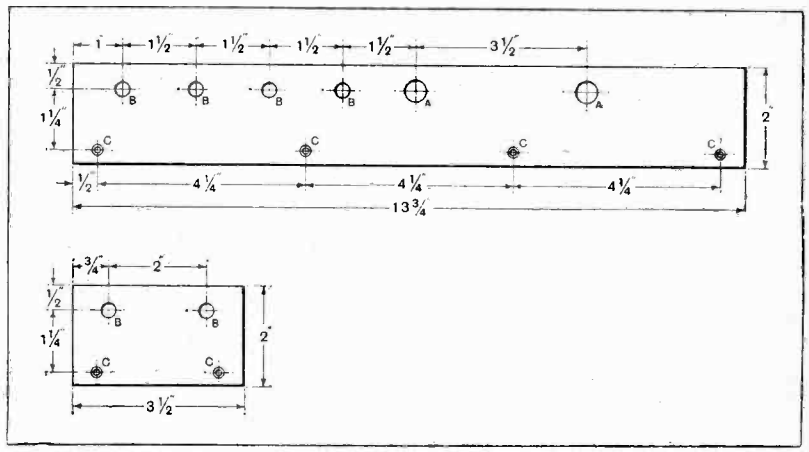

Fig. 9.—Drilling details of the front panel. A, 9/16in. diam.; B, 3/8in. diam.; C, 1/4in. diam.; D, 5/32in. diam.; E, 1/8in. diam., countersunk for No. 4 wood screw; F, 3/32in. diam., drilled from back of panel and tapped 6 B.A. (these are blind holes and not carried through panel).

Operating Notes.

When a receiver is nearing completion and there remain only a few wires to solder in position, the patience and care exercised in the earlier stages of the construction are often thrown to the winds and the finishing is hurriedly executed so that the receiver can be connected up to its batteries for a test. The concluding stages are often the most important, and this tendency should be rigidly combated, otherwise great disappointment may be encountered and unnecessary expense incurred, due to valves burning out through lack of a little patience, or time, devoted to a careful check of the wiring. This precaution should be taken in the simplest of receivers, but it is vitally necessary in multi-valve sets, where a slight error in one of the many circuits may lead to hours being wasted in fruitless " knob turning " without a sound being heard. The constructor should curb any inclination to rush matters, and, having completed the wiring, embark on a series of careful tests and check each circuit stage by stage. The tests should be carried out with the help of a pair of telephones and a battery; all coils should be tested for continuity and each circuit checked, from point to point, so as to make certain that all circuits are completed. Perhaps the most important test of all is a check of the H.T. and L.T. wiring to ascertain that the filament sockets of the valve holders are connected to the L.T. terminals and not to the H.T. Attention should be given to the copper screening boxes to see that these are connected to L.T. negative and that the H.T. leads are completely insulated where they pass through the holes in the screens.

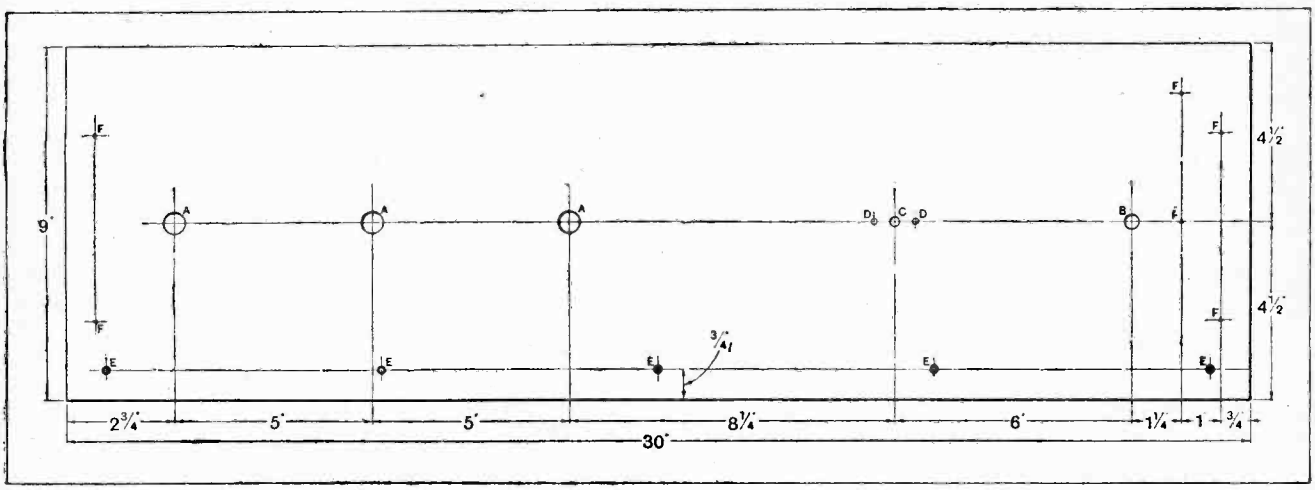

Fig. 10.—Drilling details of the two terminal battens. The sizes of the holes are as follow: A, 7/16in. diam.; B, 5/16in. diam; C, 1/8in. diam., countersunk for No. 4 wood screws.

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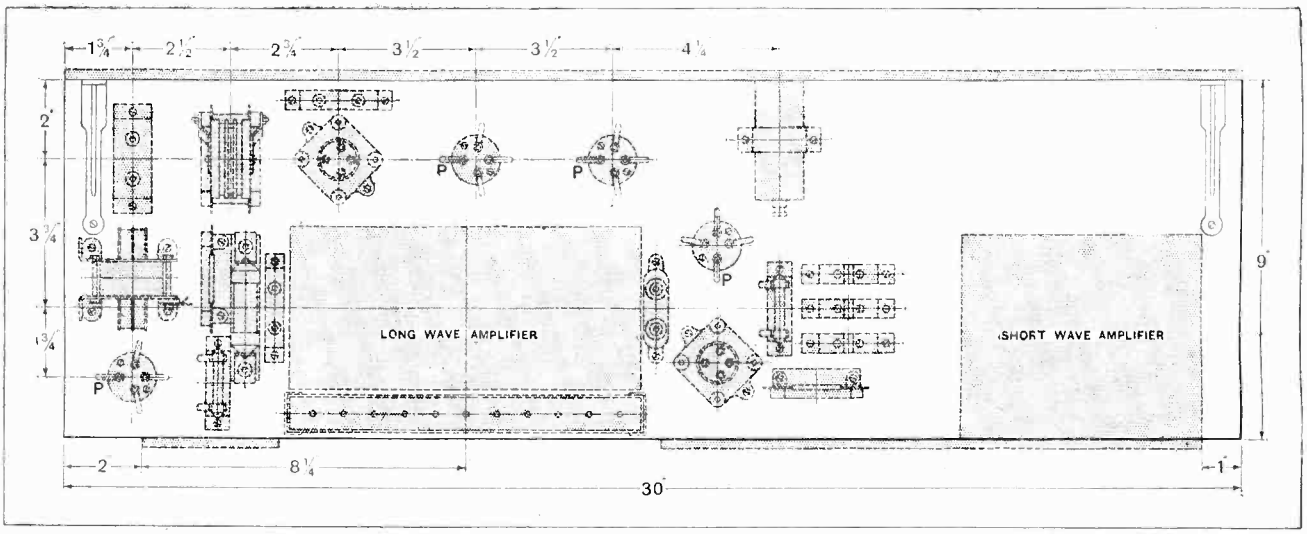
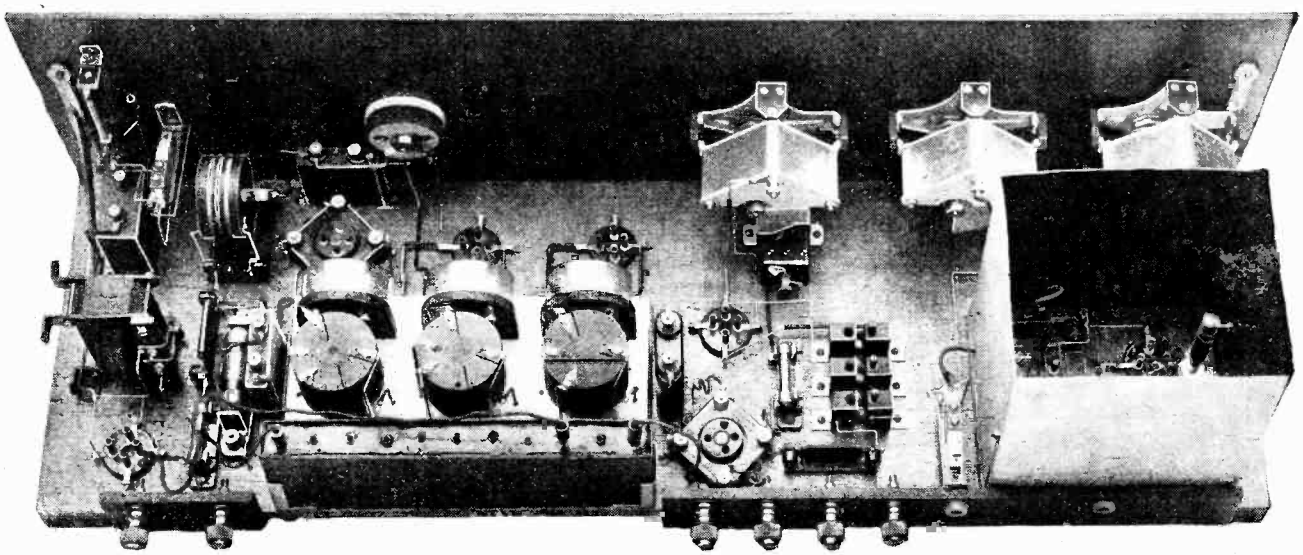


Fig. 11.—Disposition of the components on the baseboard. The long-wave and short-wave amplifiers are each assembled on separate wooden bases and secured in position when completed.

When the constructor has satisfied himself that everything is in order, then the valves can be placed in their respective holders and L.T. and H T. batteries connected up. The author believes in a policy of "safety first," and always connects a small 3.5-volt flash-lamp bulb in the H.T. negative lead so that should a short-circuit accidentally occur the H.T. battery will not suffer. A lamp can be purchased for 3d., but an H.T. battery costs many shillings, and in addition this will save the filaments of the valves should an H.T. positive lead accidentally fall on one of the L.T. positive wires. This, of course, holds good only when dealing with a multi-valve set taking a filament current of about 1 amp.; usually a small flash-lamp bulb will burn out at about 0.5 amp.

To obtain the best results it will be necessary to experiment with various values of H.T. voltages. However, in the initial stages the following should be used: H.T. + 1, about 90 volts; H.T. + 2, 25 volts; H.T. + 3, 120 to 150 volts. The second detector valve will require about 3 volts negative grid bias and the output valve between 18 and 20 volts negative.

The original receiver was fitted with Gambrell plug-in coils, and the following can be taken as a guide in the choice of suitable coils for the various positions. The oscillator grid coil was a Gambrell "B," the anode or reaction coil a "B1," and for the pick-up coil a Gambrell "A" was used. In an earlier part of this article it has been mentioned that a commercial type of plug-in coil, with a centre tapping, will function satisfactorily in the anode circuit of the signal frequency amplifier, and reference to the circuit diagram will show that the variable condenser is connected across the whole coil; therefore, a Gambrell "B" centre-tapped coil should be used. A frame aerial will be required, and this should tune from about 200 metres to 600 metres when a 0.0005 mfd. variable condenser is connected in parallel. "The Experimenter's Frame Aerial," described by the writer in *The Wireless World* for July



Plan view of the receiver with screening covers, valves and coils removed.

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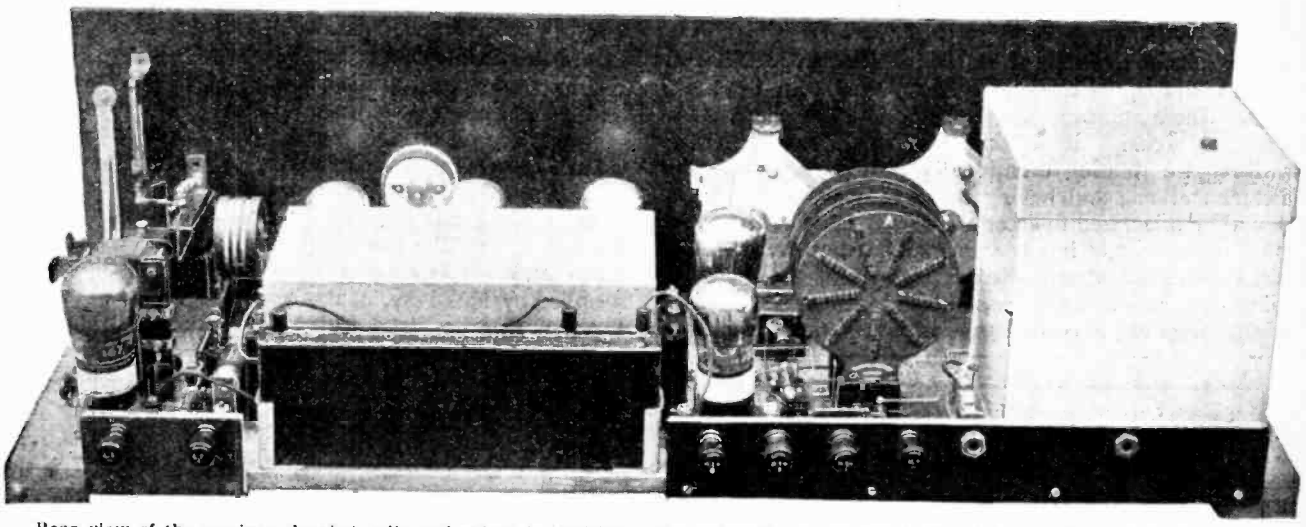

Rear view of the receiver showing coils and valves in position. The coil in the foreground is the pick-up coil and behind this are the oscillator grid and plate coils.

27th, 1927, or an Igranic collapsible frame, would be suitable for this purpose. However, to meet the present requirements a simple frame of rigid construction, with sides 2ft. in length, could be assembled and wound with 80ft. of wire, the turns being spaced about ¼in. apart. The telephones, loud-speaker, and frame aerial leads must be fitted with suitable plugs, and although twisted flex can be used for the first two mentioned this is not recommended for the frame aerial lead, owing to the relatively high self-capacity of this arrangement. The lead for the frame aerial should consist of two insulated flexible wires run parallel but spaced about 1in. apart, using either ebonite or paxolin strips for this purpose.

The left-hand condenser tunes the frame aerial and the right-hand condenser the local oscillator, so with these two controls no difficulty will be experienced in tuning-in quite a number of stations. When two-volt valves are employed the filament rheostat should be adjusted so that no resistance is in circuit, but with four- or six-volt valves it may be found advisable to have a small amount of resistance in. The potentiometer can be turned to the full negative position and adjusted after a signal has been received, and thenceforward used as a volume control.

It is advisable first thoroughly to master the tuning of the receiver with the signal-frequency amplifier out of action, and when this has been achieved the frame plug can be changed over to the first jack. When the first valve is brought into action violent oscillation may ensue, but this will be overcome by adjusting the neutralising condenser. The usual method of stabilising an H.F. circuit is to turn out the valve and adjust the neutralising condenser until signals disappear, but this necessitates a separate filament control for the H.F. valve. In practice, however, no difficulty will be experienced in obtaining stability by the adoption of the method suggested above.

A superheterodyne receiver is extremely selective, and it naturally follows that tuning is very critical; under these conditions greater care will be required in searching for stations than would be necessary with a receiver embodying a straight circuit. At about one mile from 2LO this station could be entirely eliminated by moving the oscillator condenser a matter of 5 degrees, which represents but a few metres in wavelength; however, this portion of the receiver has not been calibrated, so that exact figures cannot be given. There is one very important point which must not be overlooked, and that is the directional proper-

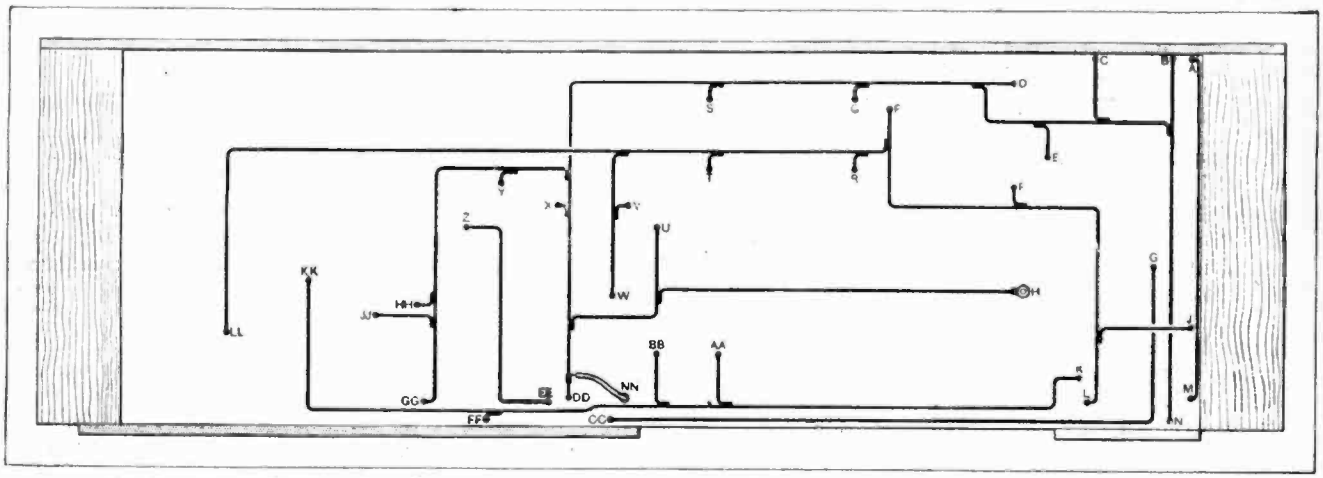

Fig. 12.—Practical wiring plan of the underside of the baseboard. The lettering corresponds with Fig. 13.

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ties of a frame aerial. Usually the maxima are broadly defined, but signal strength falls off rapidly as the plane of the frame approaches a right-angle to the plane of the incoming signal. It follows, therefore, that the frame will require rotating occasionally during the search for distant stations, and having tuned in a signal the frame should be orientated to ascertain the direction of the maximum response. It has been explained that every station will be received at two distinct settings of the oscillator condenser, and in many cases advantage can be taken of this to overcome a certain type of interference. If it is assumed that the oscillator is adjusted to n cycles more than the frequency of the desired signal, and that another signal is present which has a frequency of n cycles more than the oscillator, then beat notes from both stations will be produced and neither will be intelligible owing to heterodyning. However, by changing the oscillator frequency to n cycles *less* than the frequency of the desired signal, the interfering station will not be heard owing to the fact that $3n$ cycles now separate the oscillator and interfering station, and the beat note formed will not pass through the I.F. amplifier. This type of interference is generally referred to as "second channel interference," and may be encountered quite often, but it is highly improbable that both oscillator settings for any one station will be affected, and usually one will be free.

When completed the receiver should be fitted into a cabinet to prevent dust depositing on the valve holders or other exposed parts and thus introducing a surface leakage. It is realised that individual tastes differ widely in this respect, so that the choice of a cabinet can be left to the constructor. The cabinet shown in the illustration was supplied by F. Digby, 9, Banbury Road, South Hackney, London, E.9, and is provided with a compartment below the receiver in which the batteries can be accommodated.

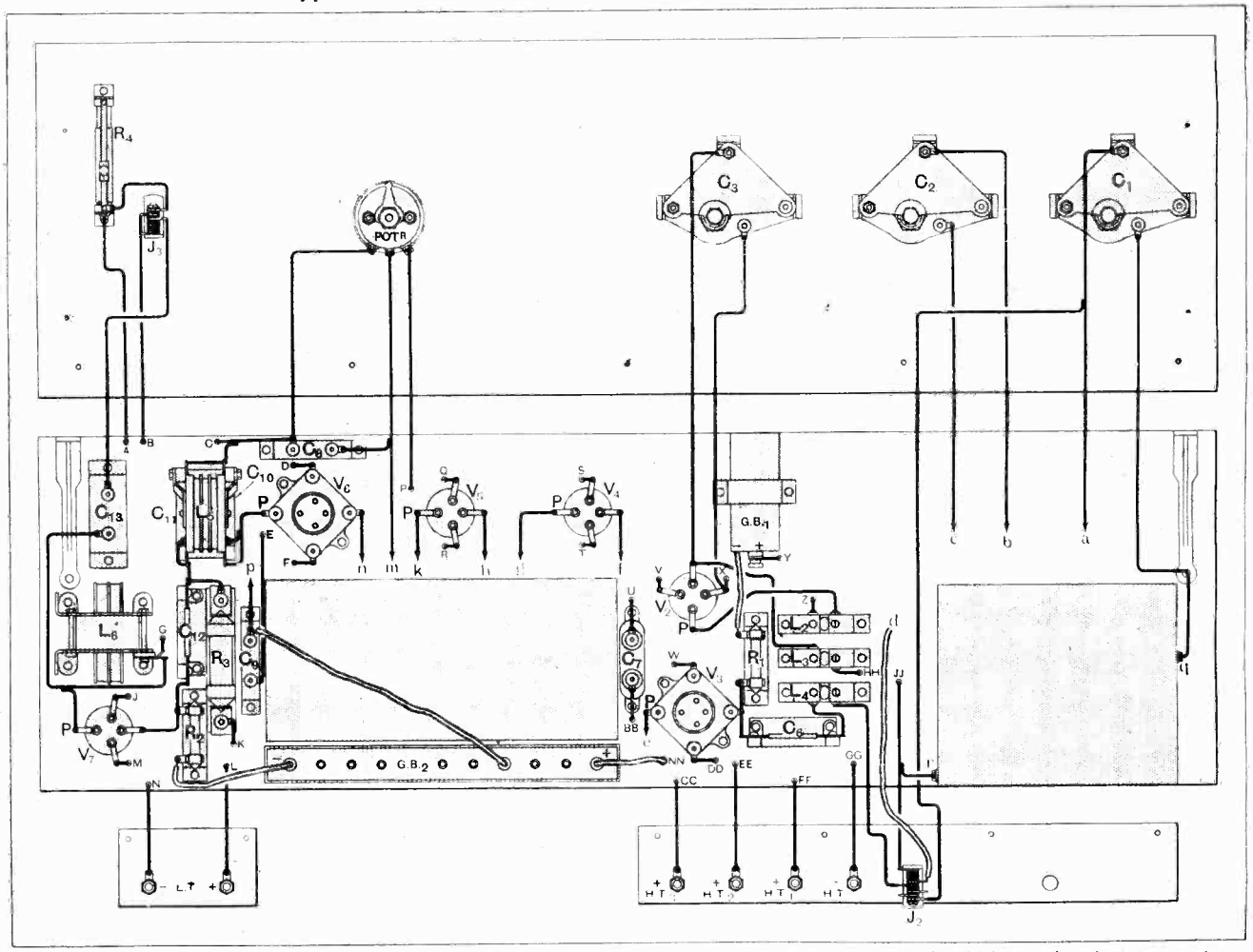

Fig. 13.—The practical wiring plan. The lettering indicates the holes in the baseboard through which certain wires pass and this corresponds with the lettering in Fig. 12.

The experimenter who has not access to a lathe may experience some difficulty in making the I.F. transformer bobbins, but a little ingenuity will always enable a way out to be found, and it is suggested that these could be assembled from circular discs cut with a fretsaw to the dimensions given. However, some of those firms specialising in the manufacture of parts for *Wireless World* sets will be prepared, no doubt, to supply either the completed transformers or the special bobbins so that the amateur can wind these himself.

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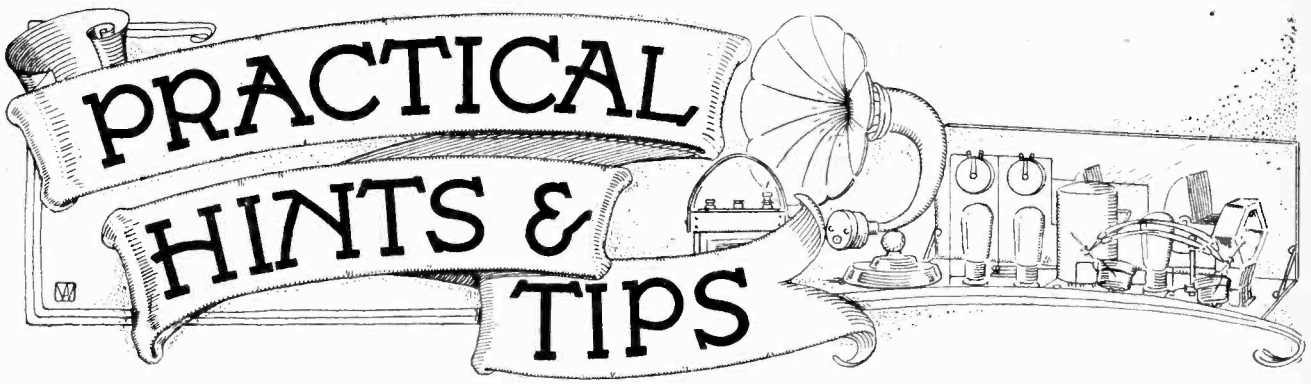

A Section Devoted to the Assistance of the Beginner.

CUTTING OUT THE H.F. AMPLIFIER.

ALTHOUGH switching arrangements are not as a rule recommended in modern H.F. circuits, it is a fact that conditions often arise where for local station reception it is desirable, if not essential, completely to eliminate the first valve of the "Everyman Four" type of receiver. This valve provides so much H.F. amplification that otherwise it is difficult to prevent overloading, even when the fullest use is made of the form of volume control which is included. Fortunately there are several ways of doing this in such a manner that the operation of the set is not impaired as far as its sensitivity and stability are concerned when all valves are in use for distant reception.

Three alternative methods are shown in Fig. 1. In the first (a) the H.F. transformer is converted into an aerial-grid coil by making its primary serve as the aerial winding of an "aperiodic" coupler. This is done by removing the valve and plugging the aerial into the plate socket. As a measure of safety, and to prevent any possible short-circuit of the H.T. battery, it is advisable to remove the plug connected to the H.T. + 2 terminal. The aerial circuit will still be completed to earth, as there is a path through the H.T. shunting condenser. In addition, the neutralising condenser should be set at minimum capacity. Where less sensitivity is necessary the aerial lead may be clipped to the wire joining the H.F. anode and the transformer primary, without the necessity for removing the valve itself. Needless to say, its filament should be switched off.

The second arrangement (b) is probably the best and simplest for use in the immediate vicinity of a broadcasting station, although if it is adopted it will hardly be possible to tune the set to wavelengths below about 300 metres. The long-wave loading coil should be replaced by another plug-in coil having some 10 to 15 turns, which acts as the common section of an auto-transformer winding. The aerial is connected to the A_3 terminal as for long-wave reception, the switch being opened. Lastly, the very simple circuit shown in Fig. 1 (c) can easily be arranged by fitting a socket, into which the aerial plug may be inserted, to the grid of the detector valve. This socket may be attached to either the grid terminal of the valve, to the H.F. transformer secondary, or perhaps more conveniently to the high-potential terminal of the variable condenser.

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POTENTIOMETER CONTROL OF SELECTIVITY.

IT is not generally known that the potentiometer commonly used for adjusting the negative bias of an anode bend detector valve can under

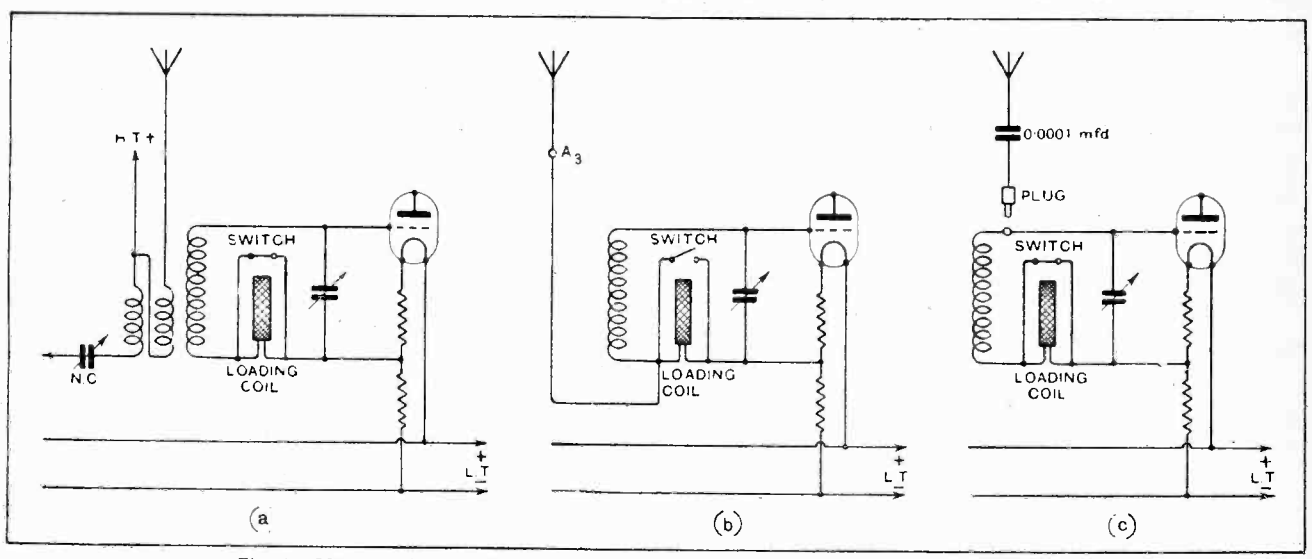

Fig 1.—Methods of eliminating the high-frequency valve of the "Everyman Four" receiver.

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certain conditions be used to improve selectivity. When a distant station is received with a weak but nevertheless unpleasant "background" of the local transmitter, it will often be found that by making the detector grid more negative, the local signals will no longer be heard.

The reason for this is that the H.F. voltages due to the near-by station are so small (as the circuits are detuned) that they are not rectified at all when an excessive negative potential is applied. The higher voltages induced from the distant station will, however, be quite well detected if their amplitude is sufficient to reach the bend of the curve. There will, of course, be some weakening of signals, but the method is an eminently practical one, applicable to such sets as the "Everyman Four" (with the addition of a potentiometer), the "All-Wave Four," and the "Regional" receiver. It will be fairly obvious, however, that one cannot expect it to operate satisfactorily unless the desired incoming signals are considerably stronger than those from the local station.

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BY-PASS CONDENSERS AND STABILITY.

THE need for taking every possible precaution to avoid stray reaction between the circuits of a multivalve receiver increases with each improvement in the efficiency of valves and coupling components. It is accordingly desirable nowadays to observe precautions formerly considered as unnecessary, in order to prevent the development of high- or low-frequency voltages in positions where they may be applied to several circuits. A good deal may be done in this respect by connecting by-pass condensers in such a manner that the flow of oscillatory currents is restricted as far as possible. In other words, a direct path of low resistance should be provided between the low potential end of each anode circuit and earth.

Possible improvements to receivers which show a tendency towards instability will be suggested by a consideration of Fig. 2, which shows in skeleton form the connections of a typical four-valve receiver. In the first diagram (a) the arrangement of by-pass condensers which was until recently in general use is shown. It will be noticed that C_1, the by-pass condenser for the H.F. anode circuit, is connected directly across the H.T. terminals. C_2, the detector anode by-pass, is in shunt with the coupling resistance, while C_3, the choke feed condenser, is arranged in such a way that L.F. impulses are passed through the H.T. battery.

In the second diagram (b) the various by-pass condensers (denoted by the same lettering) are shown in the positions which they usually occupy in modern sets. C_1, it will be noted, is joined directly between the low potential end of the H.F. transformer primary and earth. C_2, instead of being connected in parallel with the anode resistance, is between anode and negative filament, while the choke-filter output circuit is rearranged so that the majority of the L.F. current is deflected through the condenser and loud-speaker instead of passing through the H.T. battery.

When a separate H.T. voltage is provided for the first L.F. valve its by-pass condenser (C_5) may with advantage be connected as shown in dotted lines.

It should be pointed out that the gain resulting from each of these alterations is not likely to be very considerable in itself, but the cumulative effect of the rearrangement is almost certain to make a very real improvement in stability.

For the sake of completeness, and because its effect is analogous, the connections of the choke-filter circuit have been dealt with. It will be realised, however, that the condenser C_3 is not a by-pass condenser.

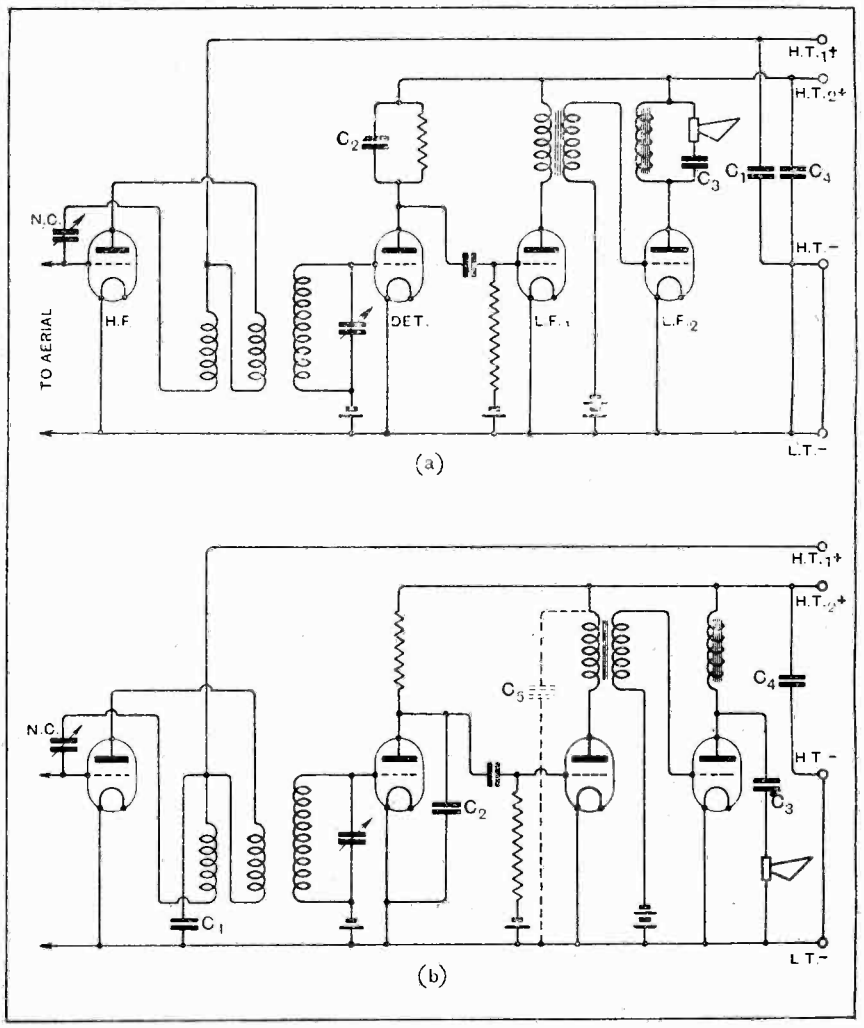

Fig. 2.—Alternative arrangements of anode by-pass condensers; that in the second diagram (b) tends to restrict the circulation of H.F. and L.F. currents, and this improves stability.

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EXPONENTIAL LOUD-SPEAKER HORNS.

Constructional Details for Building Exponential Horns of Various Types.

(*Continued from page 666 of the previous issue.*)

By A. DINSDALE.

THE design and construction of an exponential horn is not by any means so difficult a matter as it appears at first glance. It is, in fact, no more difficult than the construction of any other type of horn, and may be undertaken by anyone possessing an elementary knowledge of wood-working. We will therefore proceed to give some practical details, and for this purpose we have elected to design an exponential horn with a cut-off frequency of 128. This figure may be considered somewhat high, but it does not mean that lower notes will be inaudible; they will be reproduced, but not proportionally to the diaphragm movement as in the case of frequencies above 128 cycles.

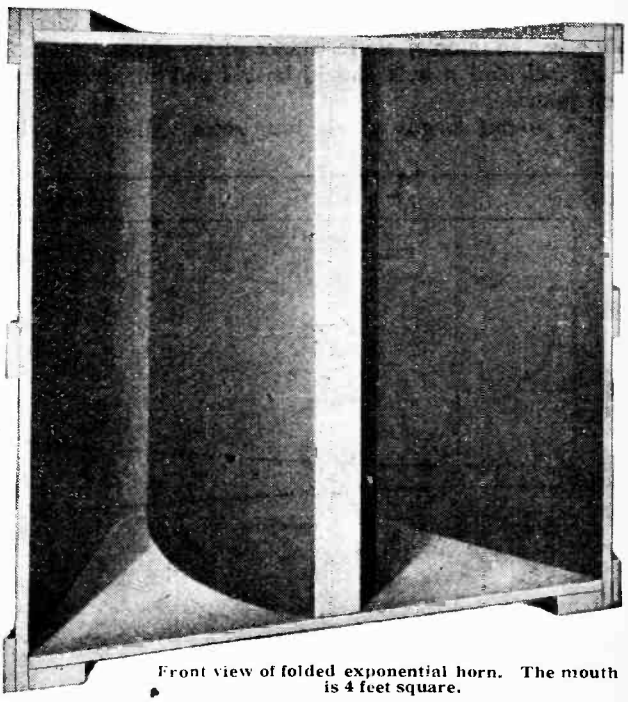
The first point to be settled is the rate of expansion. Referring to the curve in Fig. 1 of the previous instalment, this is found to be six inches, so the cross-sectional area of our horn must double itself every six inches of its length.

The size of the mouth of the horn can be ascertained from Fig. 2, or we can work it out. Dividing 1,120, the velocity of sound in air, by 128, gives us 8.75 feet, which is the wavelength corresponding to the cut-off frequency. Dividing this figure by four, we get 2.2 feet, approximately. This, then, must be the diameter of the mouth of a round horn.

Square Section Horn.

Since a square horn is easier to construct than a round one, we will work out all measurements in terms of a square horn. The square having an area equal to a circle 2.2 feet in diameter measures approximately 2 feet along its sides. The area of the mouth is then 4 square feet, and by halving this figure we get the cross-sectional area at a point six inches from the mouth of the horn. By halving that figure again, we get the area one foot from the mouth. In this way the figures in column 1 of the table were arrived at. Column 2 gives the square root of these areas, *i.e.*, the dimensions of the sides of the horn at every expansion point.

This table has been terminated so as to make the throat



Front view of folded exponential horn. The mouth is 4 feet square.

of the horn three-quarters of an inch square, partly on account of convenience in calculation, and partly because this is a convenient size for most loud-speaker units. There are ten intervals between expansion points, so it follows that the length of the horn is five feet. The complete horn, of square section, is shown in Fig. 3, drawn to scale in accordance with the measurements given in column 2 of the table.

A moment's consideration of this drawing will make it abundantly clear wherein lie the shortcomings of the old type of horn speaker, which was, on an average, no more than about two feet long and about a foot or so in diameter across the mouth. Considered in the light of the principles of horn design herein described, it is a wonder that it performed as well as it did.

DATA FOR AN EXPONENTIAL HORN HAVING A CUT-OFF FREQUENCY OF 128 CYCLES.

Wavelength $= \frac{1120}{128} = 8.75$ft.

Diameter of mouth (round horn) $= \frac{8.75}{4} = 2.2$ (approx.).

Mouth of Square Horn, 2ft. square. Length of horn, 5ft.

Areas of Cross-sections.	Straight Horn. Side of Cross-section.	Folded Horn. Measurements of Cross-sections at Expansion Points.
4 sq. ft.	2ft.	2 (1ft. × 2ft.).
2 sq. ft.	1ft. 5in.	2 (6in. × 2ft.).
1 sq. ft. (144 sq. in.).	1ft.	2 (3in. × 2ft.).
72 sq. in.	8½in.	2 (1½in. × 2ft.).
36 sq. in.	6in.	2 (1ft. × 1½in.).
18 sq. in.	4¼in.	2 (6in. × 1½in.).
9 sq. in.	3in.	2 (3in. × 1½in.).
4½ sq. in.	2⅛in.	2 (1½in. × 1½in.).
2¼ sq. in.	1½in.	1½ × 1½in.
1⅛ sq. in.	1 1/16in.	1 1/16 × 1 1/16in.
9/16 sq. in.	¾in.	¾ × ¾in.

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Exponential Loud-Speaker Horns.—
An Experimental Five-foot Horn.

A horn five feet long by two feet across the mouth is, of course, decidedly too unwieldy for general use in the home, but it forms a very useful starting point for experimenters who may wish to investigate the possibilities of exponential horns. The design shown in Fig. 3 can be made up without any great difficulty, using either cardboard or plywood, according to the degree desired.

If cardboard is selected, the sides will probably have to be cut out in sections, unless large sheets of cardboard are obtainable. The sections will then require to be glued and/or riveted together with strong paper fasteners, taking care to lay the larger diameter section over the *outside* of the smaller diameter section, in order to minimise the internal air resistance of the sides. An inch to an inch and a half should be allowed for overlap at such joints.

The overall length of all four sides will have to be 5 feet 3 inches, to allow for the curvature of the contour. Various methods of joining the edges of the sides together will suggest themselves to the resourceful constructor. For example, they may be fastened together by means of small sheet metal angle pieces riveted on to the outside at frequent intervals along the length of the horn; or, in the case of a very temporary job, they may be held together with wide strips of adhesive plaster.

The structure will require to be braced square at intervals with a square form, or collar, made up of light wooden laths, and attached to the outside of the horn. About three such bracings will be necessary. If the cardboard used is very thick, the sides of the mouth may not need support; otherwise thin wooden laths should be glued to the outside edges of the mouth.

If plywood is used, the construction will be more difficult. When cutting out the sides, two of them must be made wider than the other two to allow for overlap at the edges. The best way to go about the assembly is to prepare, first of all, a wooden jig, just under two feet square. To the four sides of this the wide ends of the four cut-out sections of plywood should then be loosely screwed. Then a block of wood about three or four inches long by three-quarters of an inch square should be placed at the throat of the horn, and the narrow ends of the four sides closed in round it and tightly bound there temporarily.

The four sides have now to be drawn together till they meet evenly all along the length of the horn. This can be achieved temporarily by binding round and round with cord, starting at the throat and working towards the mouth. Or a series of square wooden collars of different sizes may be slipped over the throat and forced along the horn till they draw the edges together. These collars may be a purely temporary measure, or some or all of them may be left *in situ*; for some sort of bracing will be necessary to strengthen the structure and preserve its square section.

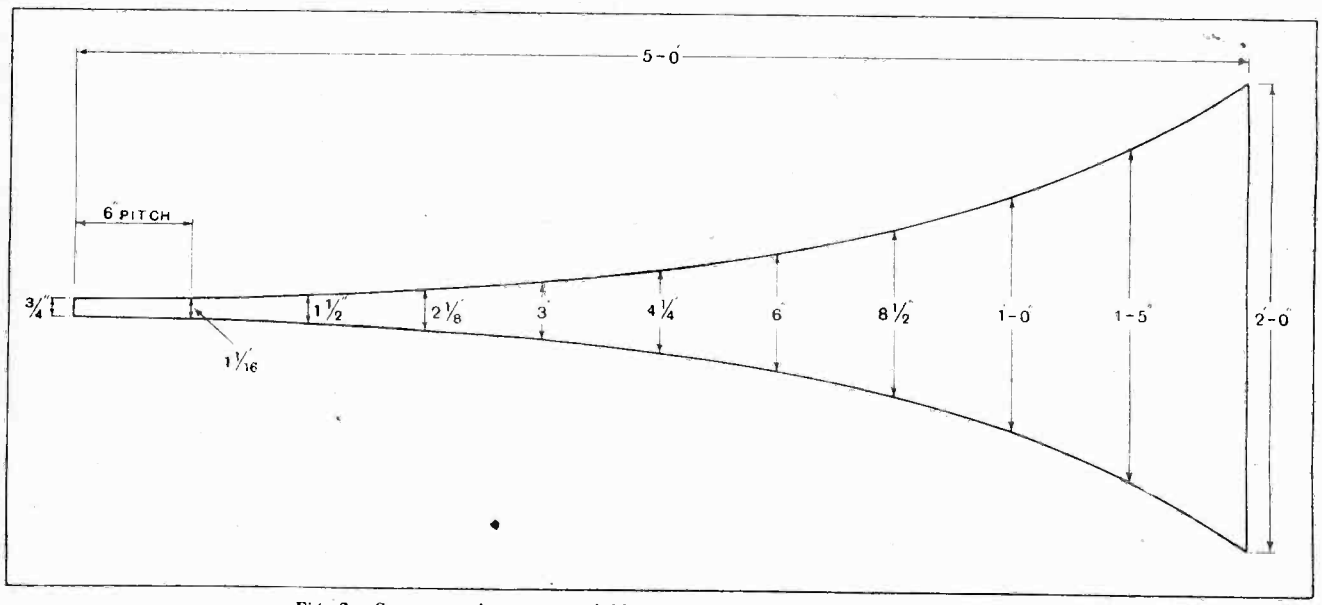

Fig. 3.—Square section exponential horn having a cut-off frequency of 128 cycles.

To complete the job permanently, the edges can now be tacked, or, preferably, held together with metal angle strips riveted through the plywood. Towards the narrow end of the horn a single binding of stout wire at each expansion joint will, in addition to tacking together at the edges, make a firm job of it. When finished, the jig can be unscrewed from the mouth and removed, and the wooden block withdrawn from the throat.

It is admitted that the use of tacks along the edge of plywood is not the most brilliant of ideas, but, with suitable bracing to provide the necessary strength, it is a useful way of correcting uneven tendencies where the edges meet, and good enough for an experimental model.

To make connection between the throat and the loud-speaker unit, it will be necessary to make use of a short length of metal tubing, one end being inserted into the rubber union of the unit and the other into the throat of the horn. If this is done, care must be taken to suitably

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Exponential Loud-Speaker Horns.—

pack the junction between the metal tube and the wooden throat, to make it airtight. Unless this is done, serious loss of air pressure will result at the most vital point of the system, and mechanical vibration may also become apparent.

After having constructed an experimental horn out of coarse cardboard, in a rough-and-ready fashion, the writer proceeded to test it out in comparison with an ordi-

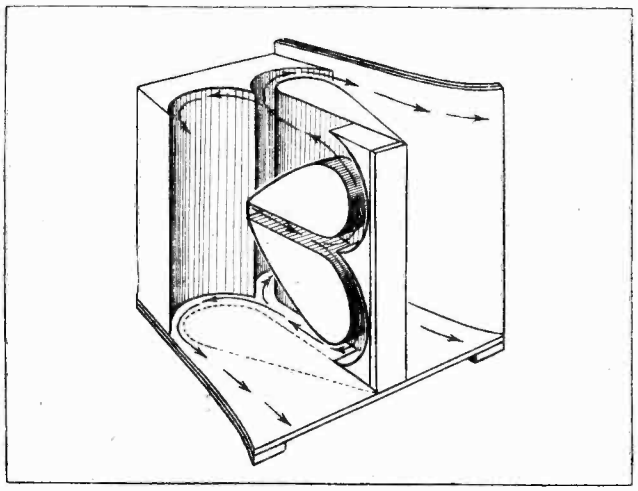

Fig. 4. Exponential horn folded into small compass, after the manner developed by the American Telephone and Telegraph Company.

nary horn, using the same amplifier and the same speaker unit. In spite of the very temporary nature of the construction, the results were a revelation! Low notes which could scarcely be heard on the ordinary horn, or which were totally inaudible, came out of the exponential horn at full volume, and with great depth and clarity.

As nearly as could be judged, after a long period of careful observation, the reproduction appeared to be absolutely uniform over the entire range of frequencies. The increase in volume was very surprising, too, the exponential horn giving between two and three times the volume of the ordinary horn.

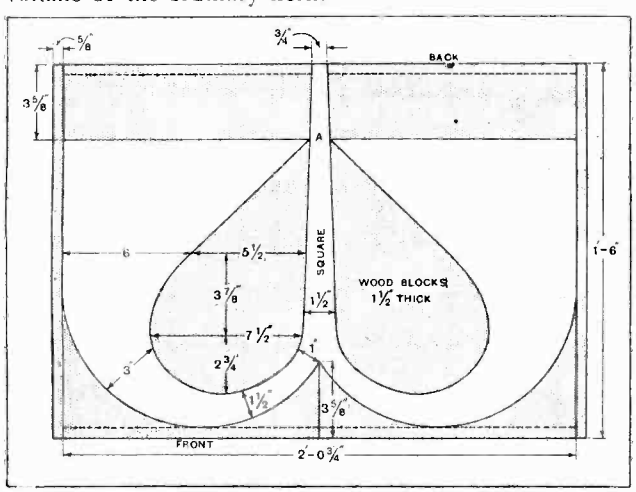

Fig. 5.—Section of central part of folded exponential horn. The entire section is 1½ inches thick, and fits into the central section of Fig. 6 (cf. Fig. 4). The dimensions of this horn are essentially the same as those of the horn shown in Fig. 3.

The Folded Exponential Horn.

As has already been mentioned near the beginning of this article, the credit of having compressed the exponential horn into a reasonable space belongs to the American Telephone and Telegraph Co. The manner in which this was accomplished is shown in Fig. 4. Starting at the input, in the middle of the back, the sound waves travel towards the front, then divide and follow two similarly expanding channels till they reach the back again. Here the previously divided air waves simultaneously meet and again divide, travelling back again to the front and out of the mouth.

This ingenious triple folding does not impair the performance of the horn in the least, provided that the channels are properly designed in accordance with the definition of an exponential horn, *i.e.*, so that the total cross-sectional area of parallel channels doubles at equal intervals along its length. Splitting that area equally over two parallel channels has no detrimental effect.

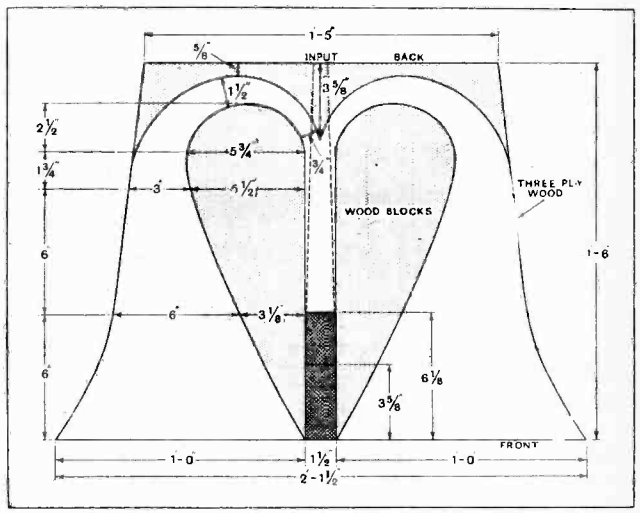

Fig. 6.—Plan showing layout of baseboard and central section of folded exponential horn (cf. Figs. 4 and 5). The dimensions of this horn are essentially the same as those of the horn shown in Fig. 3.

After having heard the results obtainable on a rough experimental model, such as that shown in Fig. 3, many readers will undoubtedly wish to make up a permanent model in the more convenient folded form. Complete designs have therefore been worked out, and the internal measurements of the sound channels are given in column 3 of the table. Complete drawings are given in Figs. 5 and 6.

It should be stated at the outset that not only will the finished product be bulky in size, as is apparent from the dimensions given; it will also be heavy, for it is a job calling for the use of some heavy timber. Light flimsy construction is not permissible, on account of the risk of resonance effects, or interference between sound waves in adjacent channels, which would undoubtedly take place through thin dividing walls.

The heaviest pieces of timber required are those for the heart-shaped blocks. Obviously these blocks cannot be replaced by hollow chambers enclosed by bent wood sides, because the enclosed spaces would resonate at their own

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Exponential Loud-Speaker Horns.—

frequency. Single blocks of timber of the size indicated not being readily obtainable, they will, in most cases, have to be built up from whatever wood is available, the laminations being carefully glued and screwed together.

The principal requirement is that the inner walls of the sound channels be as smooth and correctly shaped as possible. To this end the use of hardwood is preferable, so that, after using a grain filler, the inner walls can be french polished, thus making the air resistance of the surfaces as low as possible.

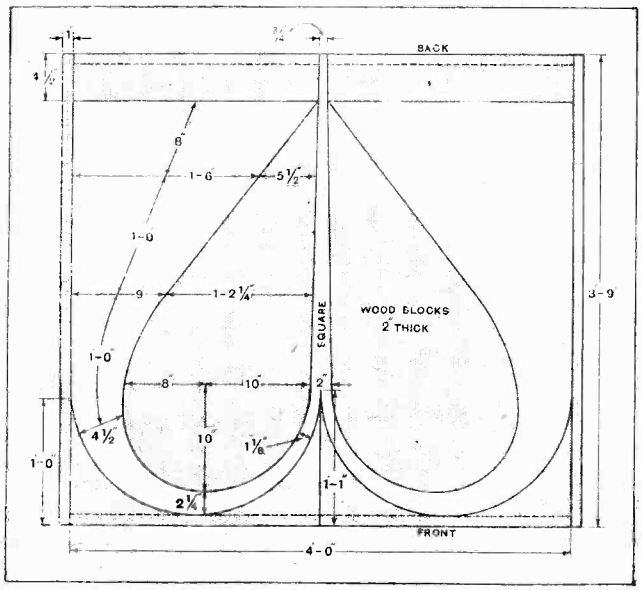

Fig. 7.—Section of central portion of a 12 foot exponential horn having a cut-off frequency of 64 cycles. The thickness is 2½" inches.

Method of Assembly

Work should be commenced by laying out the baseboard and top board (Fig. 6), which should be constructed of suitable planking closely fitted together and screwed to external battens. All the necessary blocks should then be prepared, and on the inside of *one* of the wedge-shaped blocks shown in Fig. 6 the full-size outlines of the wedge-shaped blocks shown in Fig. 5 should be marked in their correct positions; for the only method of supporting them is to screw them to one of the larger blocks.

That done, the back blocks and the marked block may now be screwed to the baseboard (from the underside) in their correct positions. The positions of the smaller blocks on the inner side of the large marked block should now be checked, and, if correct, they may be screwed in place. A connecting channel, consisting of a short length of metal tubing, preferably square, must now be carefully fitted to bridge the gap at the point A in Fig. 5, where the input channel jumps from the back blocks of Fig. 6 to the centre channel of Fig. 5. The internal dimensions of this connecting channel must be the same as those of the sound channel at this point, as nearly as possible, and the fitting must be done so that the sides of the channel are smooth and uninterrupted.

Next, the front blocks of Fig. 5 should be put in place and screwed to their supporting block and to the baseboard (from the underside). Then the remaining wedge-shaped block of Fig. 6 should be screwed in place, closing up the centre section shown in Fig. 5. The top may now be screwed in place, taking care that the blocks have not been warped aside from their correct positions, as previously marked on the underside of the top.

We are now ready to screw the plywood sides in place, and this will present no difficulty. Start by screwing the back edge to the back blocks (Fig. 6) and gradually work forward.

Throughout the entire assembly, and before making screw holes, the greatest care should be taken to see that all the parts fit accurately, so that the shape of the sound channels shall not be distorted in any way, and so that no open cracks are left between blocks, etc. Once the correct positions for all screw holes have been found, and the various parts fitted together, the structure may be taken apart again for sandpapering and polishing, after which it can be reassembled, every part in its exact place, without difficulty. During the final assembly, all parts should be glued together (if possible, under pressure) as well as screwed, so as to completely fill in any minute interstices between parts.

The manner of the external finish of the horn is a matter of personal taste. The outside may be stained and polished, the mouth covered with wire gauze stretched over a very light grill work, or the whole speaker may be made into a handsome piece of furniture by mounting it in a console cabinet. This latter may either be adapted for the purpose, or specially constructed, according to the taste and ability of the constructor.

For the benefit of more ambitious readers, the designs have been worked out for a folded exponential horn cutting off at 64 cycles. This horn has a mouth four feet square, and an effective length (sound channel) of twelve feet. The dimensioned drawings are given in Figs. 7 and 8.

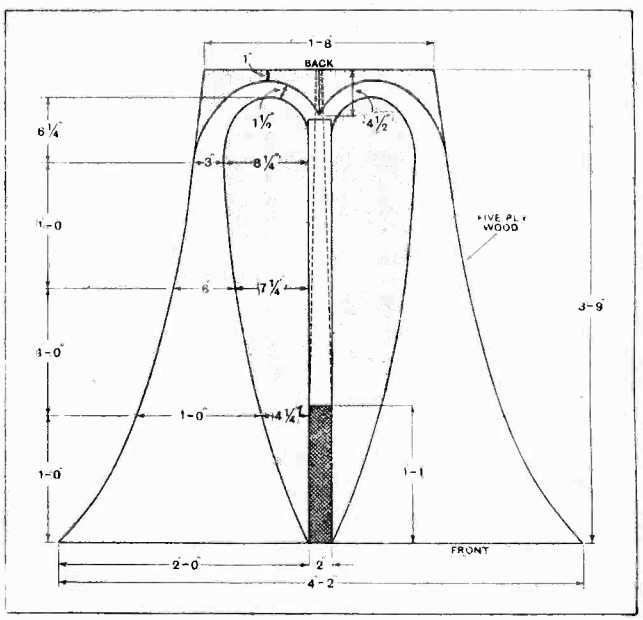

Fig. 8.—Plan of layout of baseboard and central section of 12 foot exponential horn having cut-off frequency of 64 cycles. The mouth is 4 feet square.

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Exponential Loud-Speaker Horns.—

Economy in Power.

One of the reasons why the cone type of loud-speaker has become so popular is that, used in conjunction with a suitable unit, such as the coil-driven type, it is capable of giving really excellent reproduction over an extremely wide range of frequencies; and some forms are capable, also, of giving great volume without chattering.

To get the same results from a horn requires, as we have seen, a long horn. Besides the inconvenience attached to the size of such an instrument, its construction has heretofore been both difficult and expensive. In favour of the new folded exponential horn it can be said that its construction is not only relatively simple, but also inexpensive; and, although it takes up more room than an ordinary loud-speaker, its size is not unreasonable.

Near the beginning of this article it was mentioned, in passing, that quite small driving mechanisms, requiring quite small power, will produce ample volume when coupled to this new type of horn. We will now go more closely into this matter, using as an example a horn having an area at the mouth of 2,304 square inches (corresponding to four feet square), a throat area of half a square inch, and a rate of expansion such as to put the cut-off frequency at 64 cycles.

Air Velocity.

If, under these conditions, a diaphragm pumps air in and out of the throat of this horn at the rate of 50 cubic inches per second, approximately one watt of sound will be radiated at frequencies above the cut-off frequency of the horn.

Consider now the mouth of the horn. The rate of flow of air in cubic feet per second does not remain the same throughout the length of the horn, but increases for the larger sections in proportion to the square root of the area. At the mouth of the horn the area is 4,608 times as great as it is at the throat, so that the flow of air, instead of being 50 cubic inches per second, will be $50 \sqrt{4,608}$, which is 3,400 cubic inches per second.

What is gained here in volume of air flow, however, is lost in pressure, so that the power remains the same. The increase in air volume, therefore, instead of being called amplification, might better be described as *multiplication*.

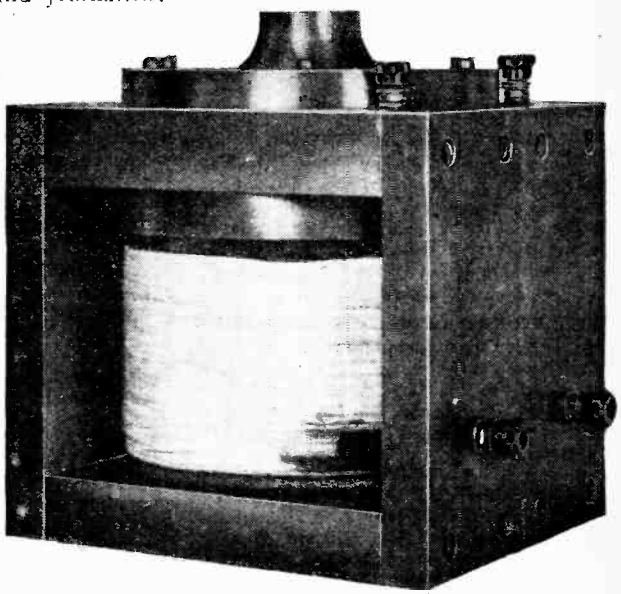
However, the important point is that a small diaphragm, say, two or three inches in diameter, displacing only 50 cubic inches of air per second at the throat of the horn, is capable of moving, in this example, 3,400 cubic inches of air per second at the mouth of the horn; and a diaphragm of this size requires but a small amount of power to energise it.

The same amount of air could be displaced, of course, by a large diaphragm moving in free air so as to displace 3,400 cubic inches of air per second, but it would have to be of a size equivalent to the mouth of the horn. The mechanical difficulties of arranging such a large diaphragm are obvious, and it would require a large amount of power to drive it. Much of this power would be required to overcome the inertia of the diaphragm, which would result in inefficiency.

For a given volume, therefore, the type of horn speaker under discussion requires very much less power from amplifiers than any form of open diaphragm speaker. Thus, by using such a horn, those in possession of moderate or low-power amplifiers and small speaker units can obtain more volume, free from horn or diaphragm distortion, than is possible in any other way.

A Convincing Demonstration.

If, however, a very large volume is required for the purpose of filling a very large hall, or for open-air work, the exponential type of horn speaker is the most efficient converter of electrical energy into sound waves. The possibilities of the folded exponential horn were demonstrated recently at Pittsburgh, from the research laboratories of the Westinghouse Electric Co. A horn having a mouth four feet square and a cut off frequency of 64 cycles was used, and on a hill three-quarters of a mile away there assembled a group of music critics, engineers and journalists.



Coil-driven loud-speaker movement used in conjunction with exponential horn during the Pittsburgh demonstration.

Gramophone records covering a wide musical range were played in the laboratory and reproduced by the giant speaker, which gave forth a volume sufficient to bridge the three-quarter-mile gap with ease, without blurring or any signs of overloading. The piccolos and bass horns of Sousa's Band and the treble and contra-bass notes of a pipe organ came across to the listeners with equal volume and clarity. A large reproducing unit (of the moving coil type), fed by a high power amplifier, was, of course, used for this demonstration.

In conclusion, it is perhaps unnecessary to remind readers that the performance of a horn can be no more perfect than the performance of the amplifier and reproducing unit connected to it. Probably the best possible unit for use with an exponential horn is the moving coil type, especially for high power work; but the balanced armature type performs very well, and almost any kind of a unit will show a decided improvement in its performance when connected to a properly designed horn.

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Events of the Week in Brief Review.

LAST DAYS OF LEEDS SHOW.

There are still a few more days in which to visit the Leeds Wireless Exhibition, now being held at the Fenton Street Drill Hall under the auspices of *The Yorkshire Evening Post*. The closing date is Saturday next, November 26th.

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RADIO WEEK IN BRISTOL.

This is Bristol's Radio Week. Special programmes of interest to Bristol listeners are being broadcast from the Cardiff station, while the local wireless trade is making a great effort towards introducing the "listening habit" into every home.

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UNIT SYSTEM OF RECEIVER DESIGN.

A lecture and demonstration dealing with the unit system of receiver design will be given by Mr. H. F. Smith, of *The Wireless World*, at this evening's meeting of the Muswell Hill and District Radio Society.

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ORPEN PORTRAIT OF DR. FLEMING.

A portrait of Professor J. A. Fleming, D.Sc., painted by Sir William Orpen, R.A., will be presented to University College, London, on Wednesday next, November 30th, by the Committee of the Fleming Portrait Fund.

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BIRDS AND BROADCASTING.

A Brussels scientist considers that migratory birds are guided by the same electro-magnetic waves as are employed for broadcasting. This suggests a reason why the start of the B.B.C. winter programmes coincides with the flight of the birds from this country.

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POLITICS AT THE MICROPHONE.

American politicians are taking full advantage of the "freedom of the ether" in that country. Our Washington correspondent states that the Republican progressive bloc have concluded arrangements for the use of station KTNT, Muscatine, Iowa, for the dissemination of political speeches during the coming winter. A special plea is being made to the Federal Radio Commission to permit a return to the station's original power of 10 kilowatts.

The other leading political parties are also reported to be negotiating for broadcast facilities.

FOR FRIENDS IN THE PHILIPPINES.

A new day and week-end letter telegram service "*via* Marconi" was opened last week to the Sandwich Islands and Philippine Islands.

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PHONING TO SHIPS.

The introduction of a wireless telephony service between ships and the mainland is reported to be under consideration by the German postal authorities. Although the idea is still in the experimental stage, certain tests which have already been carried out go to show that a practical service is quite possible in the near future.

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WASHINGTON CONFERENCE AND AMATEUR WAVELENGTHS.

The Wireless World understands that there is no foundation for the rumour that the International Radio Conference at Washington has decided to deprive amateurs of the 20- and 40-metre wavebands. There is a possibility, however, that the available bands may be somewhat narrowed, according to the latest information in the hands of the American Radio Relay League.

BELGIAN WIRELESS SHOW.

A wireless salon is to be held at the Parc du Cinquantenaire, Brussels, concurrently with the 21st Automobile and Cycle Show, from December 3rd to 14th.

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SILENT STATION REOPENED.

After a silence lasting twelve months the wireless station at Cocos Islands has just been reopened for private correspondence and distress calls.

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GOOD BUSINESS IN U.S.A.

According to the manager of the Radio World's Fair, held recently in New York, more than 25 large radio manufacturers have sold their entire output for the coming season.

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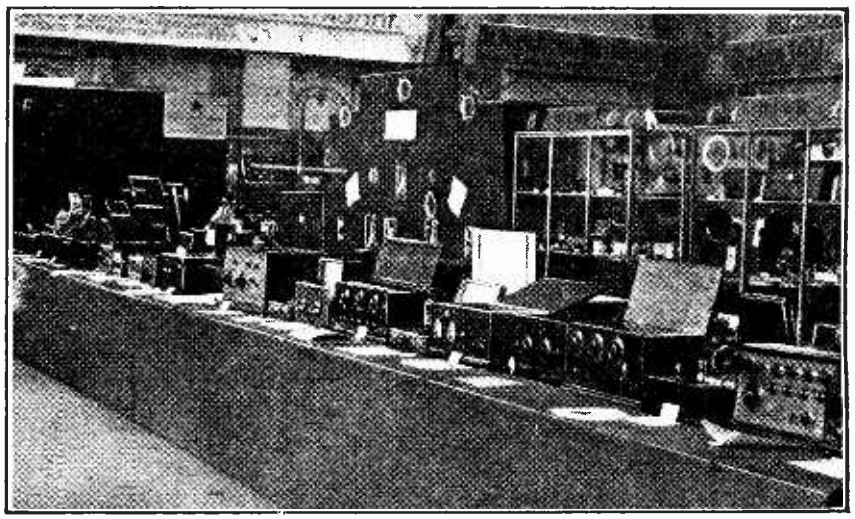
BRIGHTENING THE WORKHOUSE.

In spite of some opposition, the workhouses one by one throughout the country are being equipped with broadcast receivers. The latest is at Chesterfield, where the Guardians have decided to install apparatus in the infirmary and workhouse at an estimated cost of £290.



THE GERMAN AMATEUR DISPLAYS HIS HANDIWORK. A photograph taken at the Dresden Wireless Exhibition, which was held at the end of last month and constituted the biggest amateur wireless show yet held in Germany. All the above sets are of amateur construction.

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THE NEW WIRELESS LEAGUE.

An important amalgamation, just announced, is that of the Wireless League and the Wireless Association of Great Britain. This joining of forces is as natural as it is welcome, for the two organisations have in the past been actuated by the same purpose, viz., the encouragement of popular interest in wireless transmission and reception, besides the representation of the needs of the listening public.

The new organisation will be known as the Wireless League, incorporating the Wireless Association of Great Britain; members of both amalgamating bodies will continue in the full enjoyment of previous privileges. The address of the League is now 7, Southampton Street, Holborn, London, W.C.1.

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2NM HEARD IN INDIA.

Mr. Gerald Marcuse, owner of the amateur short-wave broadcasting station 2NM, Caterham, has received the following interesting cablegram from Bombay apropos his transmission of the Armistice Festival concert from the Albert Hall on November 11th :—

". . . TRANSMISSION RECEIVED NOT STRONG FADING BAD NEVERTHELESS VERY ENJOYABLE STOP NOBODY BOMBAY SUCCEEDED GETTING CHELMSFORD."

Mr. Marcuse relayed the concert on a wavelength of 32.5 metres.

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THANKS FROM CEYLON.

The Radio Society of Great Britain has received a letter of hearty congratulation from the secretary of the Ceylon Amateur Radio Society for its efforts towards the establishment of Empire broadcasting as shown by the transmissions of Mr. Gerald Marcuse.

"We wish you to know," says the writer, "that in these efforts you have the wholehearted support of all amateurs in Ceylon, who are looking forward eagerly to the day when the B.B.C. will have a 24-hour service of short-wave broadcasting to the Empire."

Ceylon amateurs report the regular reception of PCJJ (Eindhoven) at good telephone strength on a two-valve receiver.

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IN THE ARGENTINE.

Several readers in Buenos Aires have drawn our attention to a paragraph entitled "In the Argentine," appearing in our issue of September 21st, in which it was stated that there were approximately 159,000 holders of receiving licences in that country. We now learn that our correspondent was in error in referring to receiving licences, as these are not at present necessary. The estimated number of listeners was based on figures collected by the trade.

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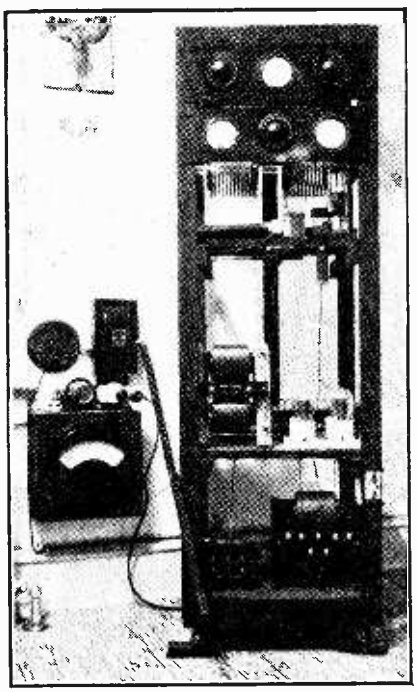
RELAYING SYDNEY IN AMERICA.

The reception and retransmission of signals from 2FC, Sydney, is becoming a favourite pursuit in America, where Australia is received at greater strength than over here. On two recent mornings WGY, the General Electric Station of Schenectady, N.Y., picked up 2FC's evening programme, which provided suitable "breakfast music" for the audience of WGY. Sydney is approximately 9,970 miles from New York.

In May of this year it was WGY which provided early morning programmes for Australian listeners. The transmissions were sent out from WGY's satellite stations 2XAF and 2XAD, working on short waves. Five Australian stations picked up and rebroadcast these transmissions with great success.



NU 3 PF, a well known American Amateur Station owned by Mr. W. P. Brown, 128, Sycamore Road, Monoa, Delaware, Pa. The bottom shelf of the transmitter contains the power transformer and chokes, and the middle shelf the rectifier. The long wooden lever operates the main power switch. The input is 100 watts and the wavelength 38.25 metres.

TRANSMITTERS' NOTES AND QUERIES.

General Notes.

Mr. S. Howard (BRS 73), 7, Churchfield Road, Acton, W.3, is willing to listen for transmissions on the 45-metre waveband at any time or day.

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Reception of Australian 2FC.

Among the numerous readers who have reported the successful reception of Sydney, 2FC, is one who states that he picked up this station on Sunday, October 30th, on the "Empire" Short-Wave Receiver described in our issue of June 29th, without an aerial or earth, the strength varying between R2 and R4. If this is indeed the case it seems a fine accomplishment, but we would suggest the possibility that the signals heard may have been a harmonic of 2LO, which was then relaying this transmission.

Short-wave Reception.

With reference to the note on page 648 of our issue of November 9th, several other readers have remarked on the difficulty they experienced in picking up distant signals on the 20-35-metre waveband during the early part of October. It may be of interest to compare observations from listeners at Porlock, Somerset, Letchworth, Herts, and London.

OCTOBER 7TH.

Porlock : 2XAD "Loud-speaker strength on 2 valves at 2000. Hardly audible on phones at 2300 G.M.T."

Letchworth : 2XAD "Hardly readable 2300-2400 G.M.T."

London : 2XAD "Very weak, carrier only, 2300 G.M.T."

OCTOBER 8TH.

Letchworth : 2XAF "Hardly readable."

London : 2XAF "Even I.C.W. schedule not read in full."

OCTOBER 11TH.

Letchworth : 2XAD "Bad again."
2XAF "Much improved."

OCTOBER 14TH-15TH.

London : 2XAD "R3 on phones 2315. R4-5 0015 G.M.T."

OCTOBER 15TH.

London : 2XAF "Loud-speaker strength 2400 G.M.T."

OCTOBER 18TH.

London : 2XAF "Speech mostly readable on loud-speaker 2310 G.M.T.

OCTOBER 22ND.

Porlock : 2XAD "Good on loud-speaker."

OCTOBER 23RD-27TH.

London and Porlock : "Nothing doing."

OCTOBER 28TH.

Porlock : 2XAD "R4 on phones."

Our correspondent, who had kindly collected these reports from friends, states that on November 6th-8th conditions were excellent, and, on the 8th especially, clear speech from 2XAF filled the room.

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A Correction.

We regret an error in the address of Mr. J. W. J. Tyrrell (2BLX) as printed on page 648 of our issue of November 9th. The correct number is 14, Boundary Road, Ramsgate, and not 15, Boundary Road.

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New Call-Signs and Stations Identified.

6AU	G. A. Blyde, Nether House, Rannoor, Sheffield. (Change of address).
6OQ	A. H. Broomfield, 54, Harbut Rd., Battersea, S.W.11. Transmits on 23 and 45 metres and welcomes reports from 200 miles or over.
6PP	M. W. Pilpel, 54, Purley Ave., N.W.2. (Change of address.)
6QJ	(ex-2A WK) H. J. Humphries, Garrick House, 7, Elmwood Rd., Herne Hill, S.E.24. Transmits on 45, 90, and 150-200 metres.
6UC	A. C. Chatwin, 1, York Rd., Edgbaston, Birmingham. (Change of address.)
6UN	A. E. Watts, 58, Woodside Ave., Highgate, N.6. Transmits on 45 metres.
6YF	C. P. Allinson, 38, Barrow Hill Rd., St. John's Wood, N.W.8. Transmits on 45 metres and welcomes reports.
2AZI	B. W. S. Challans, 1, Baltic House, Balham Hill, S.W.12.
2BUW	W. C. Roe, "Minydon," Ridgway Rd., Farnham, Surrey.
2BXC	Battersea Grammar School Wireless Society, St. John's Hill, Clapham Junction, S.W.11. (Hon. Sec., B. W. S. Challans, 2AZI.)
FK 5CR	S. A. Pegoume, P.O. Box 23, Nairobi, Kenya Colony. Transmits on 20-30 metres.

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RECENT INVENTIONS

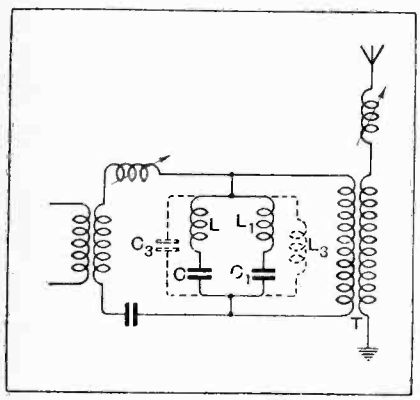
The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 26, Southampton Buildings, London, W.C.2, price 1s. each.

Eliminating Side-frequencies.
(No. 263,825.)

Convention date (Germany): December 24th, 1925.

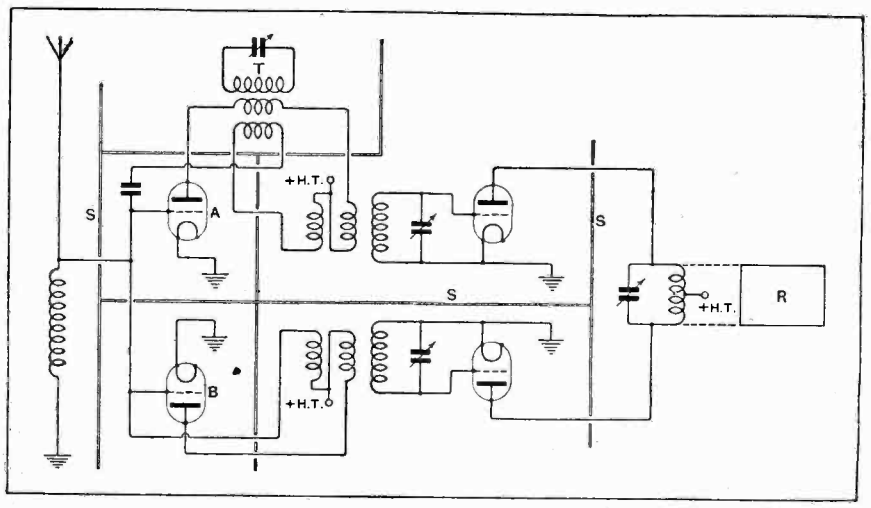
When the high-frequency supply to a transmitting station is derived from static frequency-transformers, disturbances are usually present in the form of side-band frequencies, similar to those found in the output from a thermionic or other modulator. In other words, the disturbing frequencies lie symmetrically above and below the fundamental signalling frequency.

In order to remove these undesirable disturbances, two accepter circuits L C and L_1 C_1 are shunted across the input coupling as shown, and are tuned to the upper and lower side-bands respectively, so as to by-pass them from the transmitting aerial. The circuit tuned to



Eliminating generator noises from carrier wave. (No. 263,825.)

the higher frequency will act as a capacitative impedance to the fundamental frequency, whilst that tuned to the lower frequency will have an inductive impedance. These values are indicated by the dotted line circuit L_3, C_3, and their combined effect is to form a blocking or rejector circuit for the fundamental frequency, which is thus forced to pass through the coupling coil T to the aerial. Patent issued to the Lorenz Co.



Receiving system for suppressing interference. (No. 276,195.)

Filter Circuits.
(No. 271,031.)

Convention date (U.S.A.): May 17th, 1926.

A smoothing unit particularly suitable for use with a high-resistance rectifier comprises a number of series resistances R and shunt capacities C, the whole being shunted by a terminal resistance R_1. Such a system will have no inherent period of oscillation, whilst the shunt resistance R_1 acts as a constant load on the mains and serves to facilitate voltage regulation.

Patent issued to Dubilier Condenser Co.

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Eliminating Interference.
(No. 276,195.)

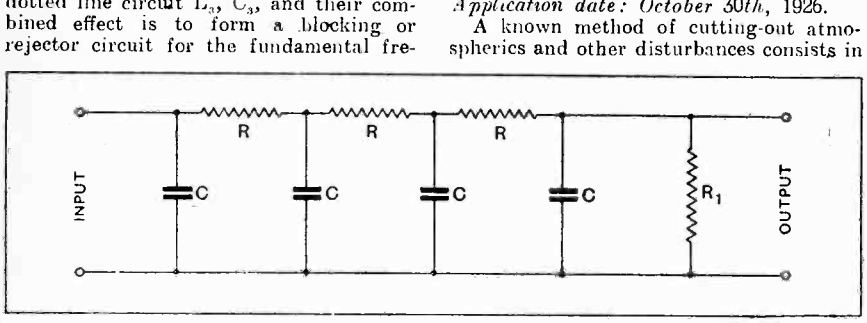
Application date: October 30th, 1926.

A known method of cutting-out atmospherics and other disturbances consists in providing two separate channels or circuits between the aerial and the receiver, and arranging that one circuit transfers only the undesired signals or disturbances, whilst the second circuit transfers both the desired and the undesired signals. By opposing the outputs from both circuits across a common coupling coil, the undesired signals, which are present in both circuits, can be cancelled out, leaving the desired signals free to operate the telephones.

The present invention improves on such a system by providing neutralising means for the high-frequency amplifiers, together with suitable screens or shields to prevent any interaction effects between the various circuits. As shown in the circuit diagram, there are two channels or transferring circuits, A and B, joining the aerial to a common receiving or detector circuit R. The channel B transfers both the desired and undesired signals. A wave trap T, coupled to the channel A, tuned to the frequency of the desired signals, prevents their passage in this direction.

Accordingly the undesired signals or disturbances are mutually opposed and their effect neutralised in the common input coil to the receiver R, whilst the desired signals in the circuit B, being unbalanced, will find their way through to the telephones. Metal screens S are provided as shown, to prevent interaction between the coils, whilst the H F valves are neutralised to prevent inter-electrode capacity coupling

Patent issued to R. Custerson.



Resistance-capacity smoothing circuit. (No. 271,031.)

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THE NEW COSMOS A.C. VALVE

A Power Output Valve of Excellent Characteristics with Indirectly Heated Cathode.

OF the various new valves which the recent Show brought forth, none is more interesting than the new Cosmos A.C. valves, of which two types are made. One of these, distinguished by a green spot and known as the AC/G, we have not yet been able to examine. The other, distinguished by a red spot, and known in consequence as the AC/R, we have just tested.

In common with other valves intended to be run, through a step-down transformer, from A.C. mains, the Cosmos AC/R has a filament or "heater" which is quite independent of the emitting surface. The necessary emission is obtained from a long, fine tube which occupies the position in the valve usually filled by the filament, this tube being made, we are informed, of nickel and coated with a mixture of barium and strontium oxides. This mixture is similar to that used as a coating on the filament of most modern valves, and emits a copious stream of electrons at a comparatively low temperature. The emitting surface is thus identical with that used in valves which operate with their filaments at dull red heat, or, if heavily "gettered," without visible glow, and it is therefore safe to assume that the valve under review will give similar prolonged service.

The Heater Element

The heater is in the form of a hairpin filament enclosed within the nickel tube, and insulated from it by a layer of porcelain. The consumption is one ampere at four volts, which, as indirectly heated valves go, is extremely reasonable. It is interesting to note that the thermal inertia of the combined heater and cathode is very high, so that an appreciable interval elapses between the moment of switching on the heater current and the commencement of operation. This lag is a very reassuring indication of the probable freedom from hum when the valve is supplied with A.C., for it is obviously quite impossible for the rate of emission to follow the very rapid alternations (usually 100 per second) of the supply current.

The general appearance of the valve is closely similar to that of its D.C. relations, the Cosmos SP55/R and SP55/B. The most obvious external difference is one of size only, the A.C. valve being decidedly the larger. The cap, too, is different, for it is fitted with three long pins and two short ones, the latter being connected to the heater element. This design has been chosen so that the valve may be used, with the aid of a special adaptor, in any receiver without dismantling the existing wiring, though it is, of course, necessary to provide extra wiring for the heater current supply. A special five-pin holder is also available, in both panel and baseboard mounting types, for those who may wish to build a receiver for the A.C. valves only. In the latter case we would recommend, as a precaution, that lead-covered wire be used for all leads carrying alternating current. If, in addition, the covering of the wire is efficiently earthed, the chance of hum making its way to the loud-speaker might fairly be regarded as very remote.

"Short-path" Construction.

The bulb is "gettered," but not so heavily, in the sample examined, that there is any difficulty in examining the construction. This is of the well-known and highly efficient "Short-path" type, in which filament, grid and plate are very close to one another. It is probably to this construction that the extraordinarily high efficiency of the valve is due.

The table below gives the more important figures relating to the valve, taken at a number of different anode voltages, but with the heater supply maintained at four volts throughout. The values for the amplification factor and impedance that are shown in the table were in every case measured with the correct grid bias, as shown in the second column, applied to the grid. The anode current, too, is in every case the actual working value when correct grid bias is in use.

COSMOS AC/R.

Fil. volts 4. Anode Volts 100–180.
Fil. Current 0.95 amp. Total Emission over 60m A.

Anode Voltage.	Grid Bias (Volts).	Anode Current (mA).	Anode Impedance (Ohms).	Amplification Factor.	Mutual Conductance (mA per volt).
100	−5.5	11.0	3,800	8.6	2.26
120	−7	12.7	3,630	8.35	2.30
140	−8.5	15.0	3,570	8.25	2.31
160	−10	16.6	3,520	8.2	2.32
180	−12	18.5	3,470	8.0	2.33
200	−13	21.5	3,340	8.0	2.35
220	−14.5	23.5	3,170	8.0	2.44
240	−16	25.5	3,120	8.0	2.55

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The New Cosmos A.C. Valve.—

The low anode impedance of this valve makes it admirably suited for the output valve of a receiver working a loud-speaker, for which purpose it is chiefly intended. It is an especially valuable valve for this purpose in that, unlike the vast majority of "super-power" valves, it is rated for an anode voltage up to 180. On this plate voltage its distortionless output is very nearly double that at 120 volts, which is the maximum permissible voltage for the usual "super-power" valve. In consequence, the temptation towards overloading the output valve, which is responsible for a large proportion of the poor quality that one so often hears, can be lessened very considerably by employing the Cosmos AC/R valve with its maximum rated voltage.

It is quite usual, in comparing the output to be expected from different valves, to take the grid bias required as an approximate measure of the volume that should be obtained. This method of comparison, however, would be extremely misleading with the valve under review, for the small grid bias suggested in the table is all that is required for this valve to give full volume.

The reason for this is to be found in the fact that the amplification factor of the Cosmos AC/R is far higher than is usual in valves of similar impedance, so that full volume may be obtained in the loud-speaker with quite a small input from the preceding valve. This means, in effect, that by simply substituting this valve for an ordinary "super-power" valve, the volume of sound will be rather more than doubled.

If this valve is to be used in any position in the receiver other than the output stage, the anode voltage chosen should be nothing like the maximum for which the valve is rated, or such troubles as saturation of transformer or choke are liable to occur, owing to the heavy anode current. Moreover, this large current is merely wasteful in the earlier stages. Resistance coupling is, of course, another matter; in this case the resistance, which should have a value of some 25,000 ohms, will cause a sufficient voltage drop to ensure economical operation.

Grid Current.

It must be mentioned that in this valve, unlike the rest of the "Short-path" family, quite heavy grid current, up to 10 microamperes, flows if no grid bias is used. This is useful if the valve is employed as a grid detector, when the grid-leak should be connected direct to the cathode, but in all other cases it is essential that grid bias be used. If it be omitted, distortion in low-frequency amplifiers and unnecessary damping in high-frequency circuits will be caused.

We can recommend this valve to readers who are thinking of obtaining their filament current from the mains, and, in addition, it may appeal to some who require an ultra-efficient valve, and do not grudge the necessary filament current from an ordinary accumulator.

Low-frequency Amplification.

The subject of low-frequency amplification was interestingly dealt with by Messrs. Garside and Miller (of Messrs. Ferranti, Ltd.) in a recent lecture before the Southend and District Radio Society. The lecturers dealt with every aspect of transformer amplification, and the members present took full advantage of the opportunity to ask questions regarding improvements to their sets.

Hon. Secretary, Mr. F. J. Waller, Eastwood House, Rochford, Essex.

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Loud-speakers and a Pick-up at Club Dance.

A novel feature at the annual dance of the Stretford and District Radio Society on October 29th was the provision of music by three C 12 type Celestion loud-speakers working from an Igranic Pacent Gramophone Pick-up. The quality and volume were all that could be desired.

Hon. Secretary, Mr. W. Hardingham, 21, Burleigh Road, Stretford.

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Programmes All the Year Round.

The Thornton Heath Radio Society has recently entered its sixth year of life and usefulness. Recent events in its winter activities have included an instructive lecture by Mr. H. Bevan Swift and a gramophone pick-up demonstration by the courtesy of Messrs. S. G. Brown, Ltd. The Society's own members have also contributed lectures and demonstrations embracing such subjects as "The Employment of Screened Grid Valves for H.F. Amplification" and "Experiments in the Making of Cone Loud-speakers."

CLUB NEWS.

The Thornton Heath Society sets out to provide an interesting programme every week throughout the year. Prompted by the success of annual dinners in previous years, the Society is holding its first dance at the Baths Hall, High Street, Thornton Heath, on Wednesday next, November 30th. New members are being enrolled; more are welcome.

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

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Demonstrating a New Transmitter.

A lecture describing the Tottenham Wireless Society's new transmitter (G5TT) was given by Mr. F. Dyer at the last meeting. The transmitter is a 20-watt instrument with a Hartley circuit for the oscillator. Choke control is used in the modulator system. The set is designed for use with or without a speech amplifier. Rigid but easily detachable tuning coils render the transmitter adaptable to use on all wavelengths from 23 to 200 metres. On the Redfern mahoganite panel are mounted a thermo couple type aerial ammeter, a voltmeter to check the valve filament, and a feed milliampere for each valve. A wire-wound non-inductive grid leak constructed by Mr. T. Vickery was used.

In the demonstration given after the lecture, two D.E.T.1 Osram valves were used in the transmitter, and a resistance capacity speech amplifier using two stages of Osram D.E.5b valves and an L.S.5 for the output. Speech and gramophone records were transmitted and picked up by the club's short-wave receiver, and passed through an amplifier on to a loud-speaker. After a demonstration of the Crossley Merola pick-up the same gramophone records were transmitted, using a pick-up designed and constructed by Mr. Dyer. Very good quality was given by this little home-made instrument.

On the following Sunday several test transmissions were made, and at a distance of thirty miles good loud-speaker strength was reported when using a wavelength of 200 metres. On 45 metres during the afternoon many stations in various parts of Europe were worked. Transmissions on 45 metres are being sent out daily outside broadcasting hours until November 27th.

Hon. Secretary, Mr. F. E. R. Neale, 10, Bruce Grove, Tottenham, N.17.

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Comparing Loud-speakers.

Some illuminating tests with various makes and types of loud-speaker were conducted at the last meeting of the Wireless Society of Ireland under the direction of Mr. G. A. Pemberton. By means of numbered switches, several different types of loud-speaker were connected in turn to a broadcast receiver, thus making comparison an easy task. Each member voted for the instrument he considered as giving, for a fixed output, the best volume, best quality range, greatest sensitivity, and best articulation of speech.

Hon. Secretary, Mr. H. Hodgens, 12, Trinity Street, Dublin.

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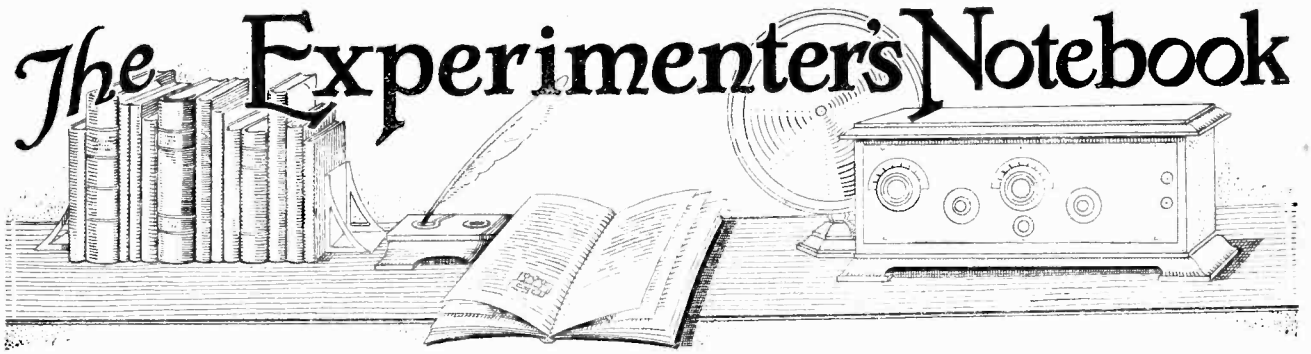
The Experimenter's Notebook



Screening in Wireless Receiving Circuits.

By "EMPIRICIST."

ONE of the most notable tendencies of design in radio receivers constructed during the past year or so has been the introduction of metallic screens between various parts of the circuit. This is bound up with the development of neutralising connections, whereby it has been found possible to neutralise the capacity coupling due to the valve electrodes. Prior to this possibility, there was so great a tendency for any receiver which embodied tuned high-frequency stages to oscillate that, except in quite abnormal cases, there was nothing to be gained by screening. Once, however, the inter-electrode couplings were eliminated, it became possible to deal with the remaining causes of instability, namely, the stray electromagnetic and electrostatic couplings between other circuit elements; and inasmuch as the latter are accessible, unlike the electrodes of a valve, the straightforward method of preventing stray couplings is by enclosing the sensitive parts in screening boxes.

Electrostatic and Electromagnetic Coupling.

In considering the screening problem, therefore, it is necessary to be clear as to what effect it is desired to counteract. For example, let us consider what is perhaps the first "worked out" case of screening, namely, that described by Rice in his original neutralising patent. Here, in stating the problem, he shows that it is impossible to balance electrostatic and electromagnetic couplings at all wavelengths, and that therefore it is necessary to consider these separately, that is to say, to counteract each of them as if the other were not present. For the purpose of counteracting the electrostatic coupling he employs the well-known centre-tapped grid circuit (see Fig 1), and to counteract the electromagnetic coupling he specifies the use of screening boxes. This will, incidentally, act as an electrostatic shield between the coils, but in this respect it is not necessary to take any precautions, as electrostatic coupling between the coils and condensers of adjacent circuits can be taken up by an adjustment of the neutralising condenser.

For the purpose of a single stage high-frequency amplifier (as in Fig. 1) it is, of course, really quite unnecessary to resort to screening at all, since the coils can be arranged so that their mutual inductance is zero. In this way there is left only the electrostatic coupling, which will balance out at all wavelengths, in the circuit shown in the figure, if the correct adjustment of the neutralising condenser is made. This is, of course, not the same, in general, as the adjustment for neutralising the valve capacity coupling alone, but the same means will adjust for both couplings.

Let us next consider a slightly more complicated case, namely, the "Everyman Four" circuit shown in Fig. 2 Here there is a transformer in the anode circuit of the H.F. valve instead of simply a tuned circuit as shown in Fig. 1. Referring to the figure it will be seen that the voltage on the anode, due to the potential drop across the coil L_3 is counteracted by the close-coupled winding L_3 and the condenser C_3 connected to the grid. This neutralisation may be regarded as perfect, but we are no longer in a position to say with complete certainty that stray electrostatic couplings between L_1 C_1 and L_2 C_2 will be neutralised by means of a "false zero" on the neutralising condenser. The reason for this is that L_2 and L_3 are definitely *not* closely coupled, and in consequence the voltages across them are not in exact opposition

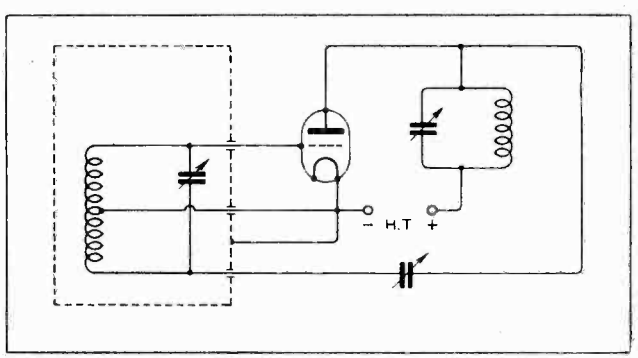


Fig. 1.—"Rice" type of neutralising circuit. Here screening is employed to protect the coils from magnetic induction.

of phase. As a result, if stray electrostatic couplings exist between L_2 C_2 and L_1 C_1, there will be a residual coupling at the point of neutralisation which will become greater the shorter the wavelength, and may give rise to instability.

In considering the layout of such an amplifying stage it is necessary, as before, to arrange the coils so that there is no magnetic coupling between them, and this presents no difficulties in the case where L_3 is a winding superimposed upon L_2. As far as the electrostatic couplings are concerned, a measure of screening is highly desirable so that the stray effects are reduced to a value where the

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The Experimenter's Note-book.—

residual coupling which cannot be neutralised has so small an effect as to be negligible. The screening plate, employed in the "Everyman Four" receiver, provides just this measure of screening without the introduction of excessive losses as a result of currents induced in it.

With regard to stray electrostatic couplings in an amplifier of this type, an interesting experiment can be made by simultaneously reversing the windings of L_3 and L_3' in relation to L_2. Neutralisation will then be found to take place at a different setting of the neutralising condenser, owing to the direct electrostatic coupling between L_1 C_1 and L_2 C_2. Screening will lessen this difference, and complete screening would eliminate it entirely.

The couplings between remote stages of a high-frequency amplifier require still more careful consideration, and although there are possibilities of neutralising these by various circuit connections, it may fairly be said that this becomes an impracticable proposition when three or more stages are used. However, we are still concerned, in the main, only with the electrostatic couplings as orientation of the coils will enable the electromagnetic couplings to be kept within negligible limits; furthermore, the electromagnetic coupling between two coils falls off very rapidly as the distance is increased, whereas the electrostatic coupling persists to a far greater extent. In cases of this sort it is advisable to house the later stages of the set within a screening box; this has the advantage that induction into the aerial from such stages is avoided.

External Interference.

Screening may be regarded from another standpoint, however—namely, that of protecting a receiver from induction from an external source. This becomes a vital problem in superheterodyne receivers, where it is necessary to protect the circuits of the intermediate amplifier from long-wave induction. This necessity is, of course, adequately met by housing the whole of the receiver in a metal box, but here a "snag" is encountered which caused the writer a very considerable amount of trouble at one time during the development of a superheterodyne set. Assuming that the coils of the instrument have been carefully arranged for zero magnetic coupling and all other steps taken to stabilise the set, it is sometimes found that, on inserting the outfit into a screening box, violent oscillation sets in. With the receiver used by the writer this was definitely proved to be due to magnetic coupling between extreme stages, resulting from currents induced in the screen, as it was only when the latter was completely closed so as to form a current loop that instability occurred.

In straight circuits a complete screen for the receiver is highly desirable when a frame aerial is employed. This is for two distinct reasons: first, that the frame aerial has invariably a tendency to couple with the other circuits, which gives rise to very troublesome effects; and secondly, that the directional properties of the frame can only be used to the fullest advantage when it is certain that signals are not getting in anywhere else. In cases of this kind, and in fact in all cases where really careful screening is required, it is necessary to ensure that there is very perfect contact along the joints. Holes, for the purpose of leading-in wires or allowing condenser spindles to be operated externally, make very little difference, but a contact which has high resistance in relation to that of the whole shield will greatly weaken the screening power of the latter.

The screening of frame aerials to eliminate "vertical effect" is an unusual arrangement, which was alluded to in a previous article. This, again, is for the purpose of protecting the frame aerial from undesired influences, but inasmuch as this type of aerial operates by virtue of the electromagnetic wave from the transmitting station, care must be taken that its sensitivity to this wave is left unimpaired. This object is achieved by enclosing the windings in a "cage," and ensuring that there are no completely closed loops in the "cage," one point only on the latter being connected to the "earthing" frame terminal. The "cage" then operates as an electrostatic, but not electromagnetic, screen.

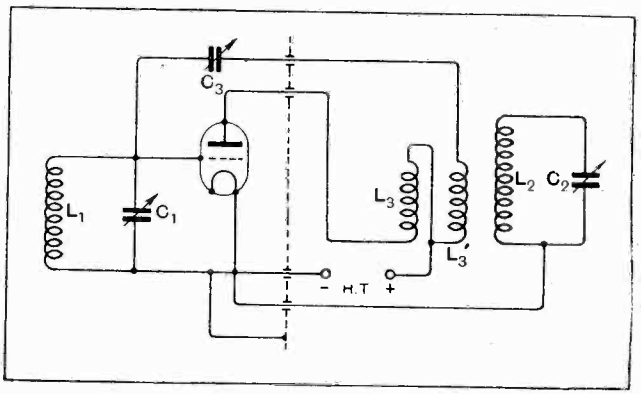

Fig. 2.—"Everyman Four" type neutralised circuit in which the coils are arranged so that there is no magnetic coupling but an auxiliary electrostatic shield is used to lessen stray electrostatic couplings.

With regard to current practice in general, shielded coils have made their appearance of recent years, and have admittedly simplified some of the problems of design by enabling the coil units to be placed in any desired position. Inasmuch as the condensers are left unscreened, however, this cannot be considered a satisfactory arrangement, as the "live" vanes would probably be responsible for more stray electrostatic field than even the coils themselves. More recently still, however, screening boxes have been advertised, of an adequate size to hold a condenser, a coil unit, and a valve, and this seems a far better arrangement for general use, provided the possibility is not precluded of "ganging" the condensers for the purpose of simultaneously tuning a number of circuits. Actually, the problem of screening appears to be of too general a character to be dealt with by any standardised arrangement, and it seems likely that every requirement will have to be dealt with on its own merits, and with screening means specially devised for it, and only it.

In conclusion, the writer would plead for economy of means as far as screening is concerned. It is very easy to resort to wholesale shielding when any trouble is experienced, but it is both costly and inefficient in most cases, and while it may take longer to get to the root of a trouble it is far more satisfactory to know precisely what is the cause, and then to employ whatever screening is necessary. The result, at any rate, will be an "engineering job," and as such a source of legitimate satisfaction to the designer.

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By Our Special Correspondent.

5GB's Power Jump.—Brussels and the Heterodyne Problem.—10-metre Signals from 5SW.—Madame Suggia's Broadcast.—Sir John Reith at the Microphone.

Is 5GB Growing Stronger?

Have you noticed an increase in the volume of 5GB? If not, why not?

Although the new aerial is not yet in commission, I am assured that during the last few days the power in the present aerial has been increased from 14 to 23 kilowatts, and that, therefore, I must have noticed the improved signal strength. Frankly, I have not.

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New Aerial and More Power.

There should be no question about it in a few days, however, for the new aerial is about to be brought into use, and the change will also see a jump in the aerial output from 23 to 30 kilowatts.

No one will regret a little more punch from 5GB, for Morse disturbance has been particularly noticeable of late, and, until the age of perfect selectivity arrives, the best way of combating Morse is to swamp it with more power.

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Heterodyning.

A bad epidemic of heterodyning is affecting 5XX, Bournemouth, Cardiff, Nottingham, and Manchester, while, to a lesser degree, Newcastle, Liverpool, Edinburgh and Sheffield are also affected.

The B.B.C. have been making wavemeter tests, with the result that certain European stations are being blamed for straying from their allotted wavelengths, among them being Toulouse, Prague, Breslau, Hanover, Lyons, Dresden, and Klagenfurt.

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A Difficulty at Brussels.

The opening of the Brussels "listening post," to which I referred last week, may help towards a solution, but the snag is that Brussels has no more real authority than the Bureau Internationale de Radiophonie at Geneva.

Still, a little tact can go a long way, as the announcer said when the cigars arrived. Supreme tact won acceptance for the Geneva scheme.

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The Empire Broadcast.

The short-wave broadcast on Armistice Day showed that Australia's best reception time was between 12 noon and 1 p.m., when the organ recital from St. Mary-le-Bow was clearly heard in various parts of the Commonwealth. In the evening nothing was heard.

Fading militated against good reception in the United States. In Canada, on the other hand, the retransmission was very successful, especially that of the evening programme, including the Prince of Wales's speech.

Not a sound was heard in India, and the absence of reports from South Africa is not a promising sign. A report from Lagos, however, states that, while speech was badly received, the music was passable.

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Next Saturday's Effort.

Another attempt at Empire broadcasting is to be made on Saturday next, November 26th, when music from the Folk Dance Festival at the Albert Hall will be transmitted by 5SW. I understand that, if this transmission is not successful, the B.B.C. will not undertake the Empire carol singing programme for which Australia is asking.

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10-metre Tests from 5SW.

There is no definite schedule of transmission from 5SW. The next tests will probably be in the direction of changing the wavelength, and it is likely that a drop to 10 metres may be made in the near future. Forty metres may also be tried.

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Suggia.

Madame Suggia's appearance before the microphone is *the* event of next week. The famous 'cellist will be heard during the B.B.C. National Concert at the Queen's Hall on Monday next, November 28th.

During the same concert listeners will have an opportunity of enjoying Schubert's Symphony in C, which is all too rarely performed in this country.

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Overhead *v.* Underground Land-lines.

Much as the Hallé Concerts from Manchester are appreciated by listeners all over the country, there is little doubt that, in London at least, the broadcast versions fail to give full justice to the performance. The Manchester-London

FUTURE FEATURES.

London and Daventry (5XX).

Nov. 27th.—Military Band Programme.
Nov. 28th.—National Symphony Concert conducted by Sir Landon Ronald.
Nov. 29th.—Variety Programme.
Nov. 30th.—Scottish Programme.
Dec. 1st.—Hallé Concert. S.B. from Manchester.
Dec. 2nd.—"The Rose of Persia," a musical comedy. Bridge.
Dec. 3rd.—Variety Programme.

Daventry (5GB), experimental.

Nov. 27th.—"The Messiah," an oratorio by Handel.
Nov. 28th.—"Tilly of Bloomsbury," a comedy in three acts by Ian Hay.
Nov. 29th.—"The Rose of Persia," a musical comedy.
Nov. 30th.—Symphony Concert.
Dec. 1st.—Music and Shakespeare, from Birmingham.
Dec. 2nd.—London Programme.
Dec. 3rd.—"The Masque of Comus," by John Milton.

Bournemouth.

Nov. 29th.—Songs by Richard Strauss and Hugo Wolf.

Cardiff.

Nov. 29th.—A Programme by Victors at the National Eisteddfod, Holyhead, 1927.
Dec. 3rd.—An Instrumental Programme.

Manchester.

Dec. 1st.—Hallé Concert relayed from the Free Trade Hall.
Dec. 3rd.—An Irish Programme.

Newcastle.

Nov. 29th.—"An Evening in the Wild West."

Glasgow.

Nov. 30th.—St. Andrew's Day Concert.

Aberdeen.

Nov. 27th.—An Orchestral Concert in aid of Lord Provost's appeal for the Aberdeen Joint Hospital Scheme.

Belfast.

Nov. 29th.—"La Mascotte," a comic opera in three acts.

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land-line is excellent when used for the purpose for which it was intended, viz., speed; but it is not quite equal to orchestral music. This is probably due to the fact that it takes the form of an underground cable, whereas the majority of lines used by the B.B.C. are overhead.

The overhead lines have always proved their superiority so far as music is concerned.

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Ham Language?

From the programme list of WJZ, New York: "Meat talk for housewives by Phillip Smith, entitled 'Blanketed Ham Covers up Hunger.'"

Does this refer to a DX-hound sitting up late and tightening his belt? If not, what *does* it mean?

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Farewell Appearance.

Aberdonians are said to be saving up their eggshells with the idea of sending them to Daventry to have them relaid.

This is positively the final appearance of the above joke—for the present year.

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The "D.G." in Variety.

Sir John Reith recently gave the world, with surprising frankness, his personal opinion of the Children's Hour and the average variety programme. But the "D.G.," as he is called, has since gone a step further, if I am to believe a certain little whisper which will not be silenced. Unlike most critics, he has shown us "how to do it." According to my information, it was Sir John who, in the Birthday programme last week, took the part of the Scotch applicant for the job of announcer. Ay, an' did it verra weel!

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Have You Heard Them?

Listeners who have not previously heard the Kedroff Quartette, the unaccompanied Russian singers, who make too rare appearances before the microphone, are recommended to tune in 2LO on December 6th. The singing of these four—high tenor, tenor, baritone and bass—is a sheer delight.

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In Victorian Days.

Listeners will be transported back to the spacious days of Queen Victoria on December 6th. They will be invited to join (*via* the ether) a party to be held in the Birmingham Studio. Old-fashioned parlour games will be played, and some family community singing will take place, led by Joseph Lewis, the pioneer of community singing in England.

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From His Majesty's Theatre.

Not many listeners will quarrel with the B.B.C. for limiting the number of relays from theatres direct. According to the agreement with the theatre managers, the Corporation is entitled to broadcast twenty-five excerpts from stage plays per annum. Actually the number transmitted this year will not exceed fifteen.

The average stage play is about as suitable for broadcasting as the average casual conversation in a tube lift. An exception is that vivacious production, "Oh Kay!" at His Majesty's Theatre. On December 7th 2LO will give us a half-hour excerpt from this play.

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The Travelling Companion.

On December 7th Cardiff Station will broadcast a performance from the Bristol Opera Season at the Victoria Rooms, Clifton, Bristol. The opera chosen is "The Travelling Companion," by C. Villiers Stanford, and the principals are Steuart Wilson, Arthur Cranmer, Johnson Douglas, Louise Trenton, Dorothy D'Orsay and Leyland White.

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Salty.

In accordance with Bournemouth's reputation as a sea-resort in winter and summer alike, a sea programme will be broadcast on December 3rd. Mr. David Openshaw, with the Wireless Chorus and Station Octette, will sing Stanford's "Songs of the Fleet" and Mendelssohn's "Fingal's Cave" overture, inspired by the composer's visit to the Hebrides, will be included in the orchestral section of this concert.

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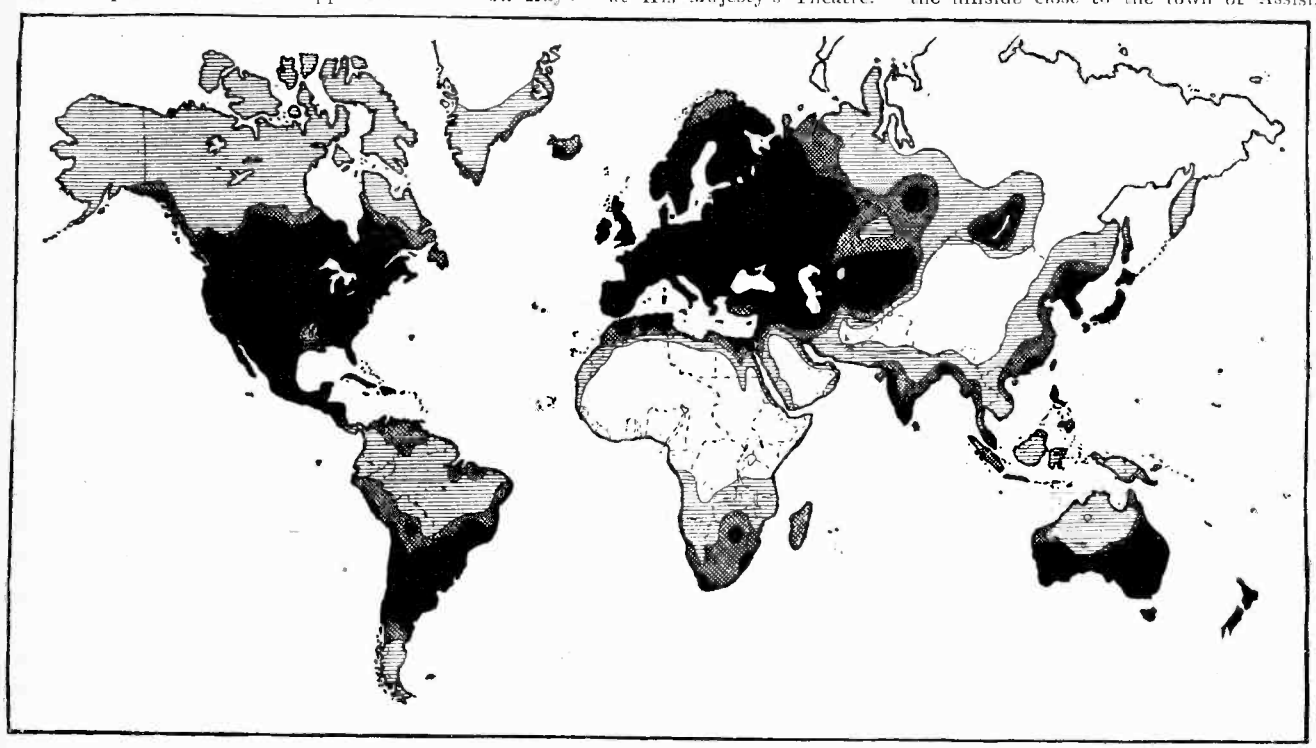
A Franciscan Play.

"St. Francis d'Assisi," a play for which the author, J. Vaughan Emmett, expresses his indebtedness to Sabatier's great work on St. Francis and to Miss Houghton's translation of it, is to be relayed from London to 5GB on December 8th.

Listeners are to "see" this play as being performed by Italian peasants on the hillside close to the town of Assisi.



WORLD BROADCASTING AT A GLANCE. This interesting map has been prepared by the United States Department of Commerce to show to what extent the globe is covered by broadcast transmissions. The black portions show where a reliable service is available, while the various gradations of shading denote the type of service given in less fortunate parts. It is a debatable point whether the all-black appearance of Great Britain will be endorsed by Birmingham listeners!

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AUTOMATIC VOLUME CONTROL.

Compensating for Changes of Signal Strength Due to Fading.

The information contained in this article is abstracted from a paper by Mr. Harold A. Wheeler read before the Institute of Radio Engineers on November 2nd, 1927, and constitutes an important contribution to the technique of broadcast reception. Compensation for changes of signal strength due to fading is obtained with negligible time lag and without making use of relays or moving parts.

THE volume control has come to be regarded as an essential component of every high-grade receiver, and generally takes the form of a variable resistance or potential divider applied, usually, to some part of the L.F. amplifier. Useful as is this component for re-adjusting volume after changing from one station to another, it does not provide a satisfactory means of compensating for fading effects. Assuming that one had sufficient skill to follow up changes of signal strength without occasionally overshooting the mark and producing grotesque effects in the loud-speaker, there would remain the objection that few of one's faculties would be left unoccupied for enjoyment of the programme.

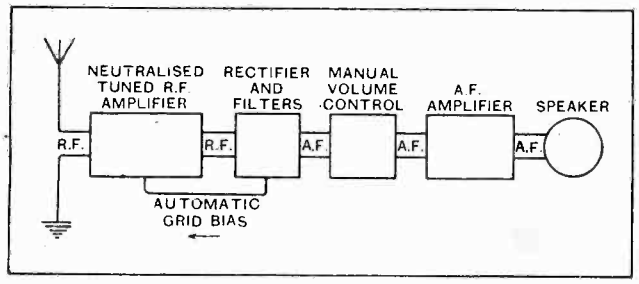

Fig. 1.—Schematic diagram showing natural sub-divisions of circuit.

What is required is a continuously variable volume control which will be actuated by the carrier wave of the received station and reduce the overall amplification as the amplitude of the carrier increases. This effect is achieved in the circuit under review.

Fig. 1 is a schematic diagram showing the natural sub-divisions into which the circuit may be divided; for further detail Fig. 2 should be consulted. The four sections are constituted as follows:—

R.F. Amplifier.—This consists of four stages of radio-frequency amplification, the circuit connections of one stage being shown in Fig. 2. Valves having an A.C. resistance of 12,000 ohms and an amplification factor of 8 are employed in a conventional neutralised circuit. There are two tuning controls, one for the aerial circuit and the other for simultaneously tuning the secondaries of the four H.F. transformers.

The grid bias for the first three valves is derived from the rectifier, which is of the two-electrode type. This negative grid bias increases with increased signal strength, thus causing the operating point to move to the left. This reduces the mutual conductance and consequently causes a reduction in amplification, the coupling conditions remaining constant.

Since the controlling bias is not applied to the last H.F. amplifier, full amplification will always be obtained from this stage. This means that for a given rectifier voltage, say 10 volts, only a fraction of a volt will be required as the output from the first three stages. Distortion due to operation on the curved portion of the valve characteristics is therefore negligible under normal conditions, since the characteristic may be regarded as virtually straight for such small amplitudes.

Rectifier and Filters.—The two-element rectifier consists of a three-electrode valve with the grid and anode joined together. The signal is applied between the combined anode and the filament. In parallel with the valve resistance is the output filter circuit, consisting of a network of resistances and by-pass condensers. The object of this filter is to segregate the direct and audio-frequency components of the rectifier output in order that the former may be used to obtain grid bias and the latter passed on to the low-frequency amplifier.

Manual Volume Control.—This takes the form of a potential divider in the grid circuit of the first L.F. amplifier.

A.F. Amplifier.—In the original receiver this consists of four stages of audio-frequency amplification, followed by the loud-speaker.

The performance of the receiver without control and

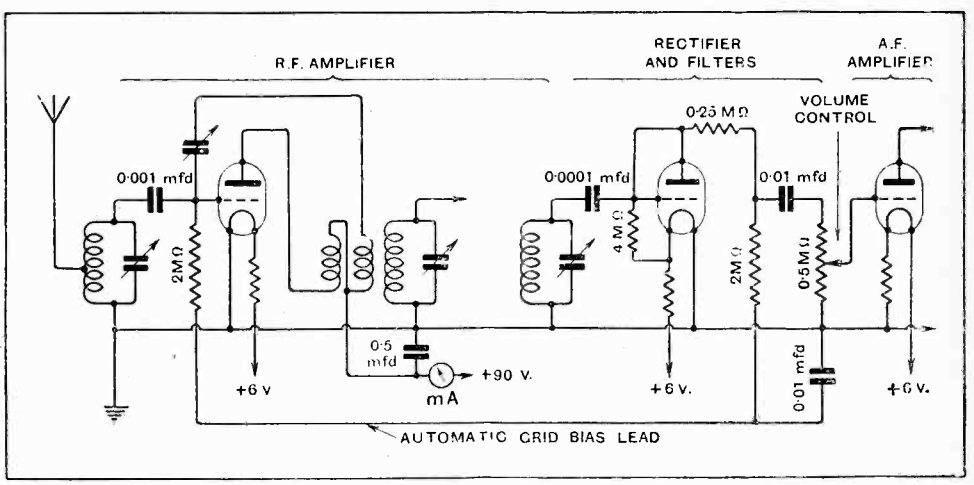

Fig. 2.—Essential circuit connections and values in the automatic volume control device.

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Automatic Volume Control.—

with automatic grid bias applied to one, two and three H.F. valves is shown graphically in Fig. 3.

Although for signals of small amplitude distortion is not apparent, the curvature of the characteristic may make itself felt when strong signals are being received and the operating point is moved too far to the left by the automatic grid bias. Consequently it has been found desirable to limit the ratio of minimum to maximum amplification for any one stage to 1 : 10.

It has been previously stated that the amplification is controlled by the amplitude of the carrier wave. In the three-electrode rectifier, which has an approximately square-law characteristic, the rectified voltage is proportional to the total power of carrier and side bands; the

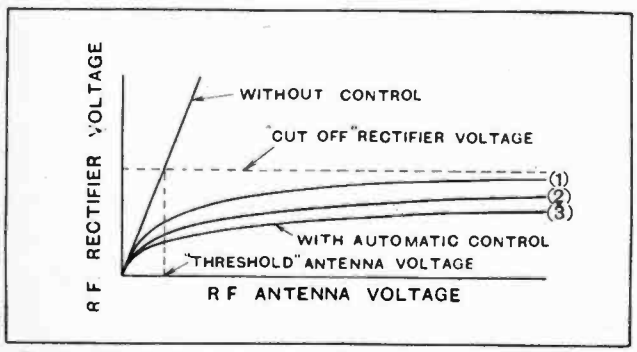

Fig. 3.—Graphical representation of performance with and without automatic control. The numerals at the end of the curves indicate the number of H.F. valves to which the automatic bias is applied.

two-electrode rectifier, on the other hand, has a practically linear characteristic, and the average rectified voltage is equal to the rectified carrier voltage. The characteristics of the two systems of rectification are shown in Fig. 4.

Performance.

A maximum variation of signal voltage in the ratio 1 : 1,000 produces a variation in the rectified carrier voltage of only 1 : 3. This variation, and others due to differences in percentage modulation, can be compensated for by means of the manual volume control.

Due to the time constant of the filter circuits, there is a slight lag between the change in amplitude of the signal and the application of the appropriate grid bias; but this is negligible on normal broadcast wavelengths, where fading periods are usually of the order of minutes. With the values given in Fig. 2 the time constant is 1-40th sec., and the time taken to reach equilibrium approximately 1-20th sec. This time can be further reduced, but at the cost of reducing the amplification of the lowest audio frequencies.

A special problem is presented by this circuit in connection with the anode current supply. When the controlled H.F. valves are operating with low anode current, the signal carrier wave is modulated by any small fluctuations of anode voltage such as may be produced by the varying load of the audio-frequency amplifier. In the presence of a strong carrier these two effects may combine to set up sustained low-frequency oscillation. This trouble may be obviated (1) by decreasing the internal output impedance of the rectifier-filter; (2) by decreasing the amplification at low frequencies in the A.F. amplifier; and (3) by using separate rectifier filter systems to supply the anode currents of the radio- and audio-frequency amplifiers respectively.

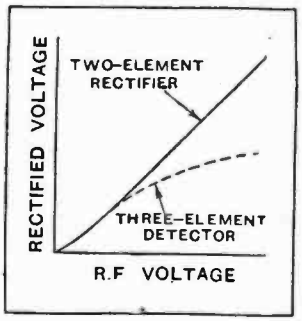

Fig. 4.—Characteristics of two- and three-element rectifiers.

Finally, there is the problem of tuning-in. As resonance is approached and volume tends to increase it is automatically reduced by the grid bias, so that it is difficult to judge by ear when exact resonance is reached. Correct tuning may be observed visually, however, by connecting a milliammeter in the anode circuit of the first H.F. amplifier. Resonance is indicated by minimum anode current, and the values of the various minima serve as an indication of relative signal strength.

Attention is directed in the original paper to British Patent No. 259,664 (Western Electric Co., July 14th, 1925), which covers a similar system applied to superheterodyne receivers.

TRADE NOTES.

A Wireless Circuit Handbook.

A useful handbook of wireless circuits has been issued under the well-known trade mark "Becol." From a general description of tuning coils and their uses the booklet proceeds to give details of special coils and circuits, including superheterodyne oscillator coils, centre tapped aerial and anode tapped coils, and those wound astatically. The handbook is obtainable, price 6d., from the British Ebonite Co., Ltd., Hanwell, W.7.

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In the Shadow of 2LO.

The fact that Messrs. Selfridge and Co.'s Wireless Department carry on their labours within 200 yards of the aerial of 2LO would seem to militate against the reception of any other station. It is therefore remarkable that they are able to report reception during daylight hours, even when 2LO is working, of 5GB, Langenberg, Hilversum, Radio-Paris, and Daventry at full loud-speaker strength without any sign of interference from 2LO. The set used is the Gecophone 6-valve stabilised receiver.

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From the United States.

"Getting the Most Out of Radio" is the arresting title of a catalogue issued by Messrs. Claude Lyons, Ltd., 76, Old Hall Street, Liverpool, and dealing with the products of the General Radio Co., Cambridge, Mass., U.S.A. In its 72 pages the catalogue covers practically every type of U.S. wireless component from superheterodyne transformers to "sockets for American tubes."

CATALOGUES RECEIVED.

The Bowyer-Lowe Co., Ltd., Radio Works, Letchworth, Herts. Publication No. 62, catalogue of radio components and apparatus. Publication No. 63, catalogue of radio receivers and accessories.

C. A. Vandervell and Co., Ltd., Acton, London, W.3. Publication No. 7, dealing with the range of C.A.V. receivers, loud-speakers, and accessories. Also catalogue of C.A.V. H.T. and L.T. radio accumulators.

Benjamin Electric, Ltd., Brantwood Works, Tottenham, London, N.17. Leaflet 1003, dealing with the Benjamin anti-microphonic valve holder, self-contained rheostat, "Majestic" H.T. battery eliminator, and other accessories.

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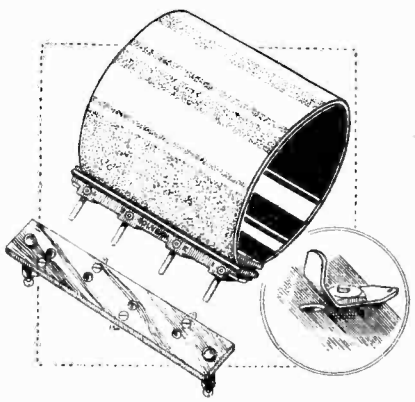
A Review of the Latest Products of the Manufacturers.

TWO H.F. EVERYMAN FORMERS.

Since the publication in recent issues of the article showing the construction of a receiving set incorporating two H.F. stages, a specimen former has come to hand from Collinson's Precision Screw Co., Ltd., Provost Works, Macdonald Road, Walthamstow, London, E.17, intended for use in the construction of the H.F. intervalve couplings. It will be remembered that spaces were left on the former at the ends of the windings to accommodate pin connectors, which were inserted through the Paxolin and arranged close together in line so as to engage on a base mounting piece. The new former is supplied with a brown bakelite moulding and Paxolin strip, which serves as a clamp for gripping the former. Pins are conveniently spaced along the mounting piece so as to provide short connections to the leads from the windings. Pin connectors arranged in line, unless accurately located, will be found troublesome to engage in the sockets. This difficulty is avoided by the



The new Colvern H.F. former for constructing H.F. couplings.

use of hard spring clips in the place of sockets, which, being arranged alternately on opposite sides of the pins, provide sure connection. The base piece is cut from Paxolin and supplied with tapped ebonite spacers and screws ready for securing to the baseboard.

It will be remembered that this form of mount was used in the *Wireless World* Short Wave II and Short Wave III receivers, and this former is therefore equally suited for supporting a winding so as to adapt the short wave sets for broadcast reception. In this case the aerial coil is removed and a tapping point provided some half way along the grid coil, to which the aerial is attached.

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MULLARD GRID LEAKS.

For baseboard mounting to carry a grid leak resistance a bakelite moulding with spring clips is now available from the Mullard Radio Valve Co, Ltd. Being ribbed it will not bend under the strain of gripping the leak between the spring contacts, whilst a recess on the under-

The new type Mullard grid leak resistance.

Mounting piece for Mullard grid leak.

side lifts the contact screws well away and separates them by an air gap from the baseboard.

Leak resistances are also available covering the usual range of values. Tests applied to two specimens verified their accuracy to the stated values while passing a current far in excess of that which can be reached under receiving set conditions.

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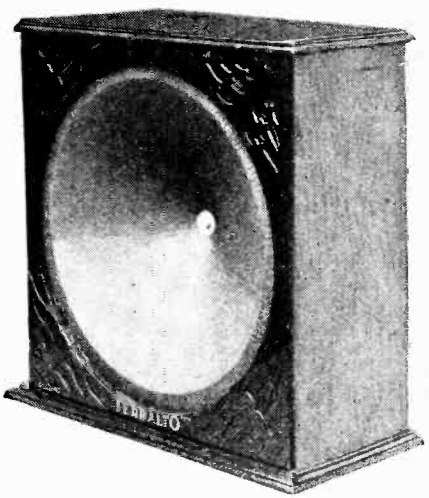
TERRALTO LOUD-SPEAKER.

As hard and fast rules relating to the underlying principles of cone loud-speaker design cannot be rigidly followed in practice, each instrument must needs be carefully developed mostly by observance of actual results. Reed, diaphragm, and box resonances are referred to in a pamphlet setting out the points of design of the Terralto loud-speaker, a product of R. Custerson, 11, Kingsville Gardens, Eastern Avenue, Ilford, Essex, showing that the manufacturer is aware of the need for damping out resonances, and that resonance introduced by one part of the apparatus must not coincide with that of another.

The loud-speaker is of the supple edge type and the conical diaphragm moves with moderate freedom. It is driven at its centre by a reed movement adjustable by a screw at the back, the screw giving a good control of the diaphragm setting. The loud-speaker can be brought to a sensitive condition when the reed is near to the magnet poles without difficulty and the adjustment remains. Satisfactory response in the base register must be obtained by creating a slight base resonance. Although a good response is given in the base, resonance is not sharply defined, and there is no tendency towards the "woolly" effect which sometimes results from a sharply defined base resonance.

The instrument is sensitive and will give a loud signal on small input, such as might be obtained from a two-valve set at 15 miles from a main station. On liberal input the loud-speaker may become overloaded, though for ordinary home conditions excessively loud reproduction may not be required. Its tone is pleasing and speech is crisp. Unlike many other cone type loud-speakers no grille is fitted, the manufacturer considering an unobstructed diaphragm to be advantageous.



A new cone type loud-speaker, the Terralto. The diaphragm is of the exposed form instead of the more usual arrangement where the diaphragm is accommodated behind a grille.

Contained in an oak cabinet in the style shown, the instrument is offered at £3 17s. 6d., and the satisfactory performance, together with the good appearance and finish of this loud-speaker, compares favourably with many others of more expensive design. Another model is available of the same general dimensions finished in Chippendale style with quartered mahogany veneer.

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"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.

Increasing the Output of the H.T. Trickle Charger.

Can you tell me in what way to increase the output of the "H.T. Trickle Charger" described in your August 3rd issue? The output stated in the article is 20 milliamperes, but I wish to have an output of 100 milliamperes. L. T. R.

The output, of course, can be increased by lowering the value of the external plate circuit resistance and increasing the filament temperature, but this is not recommended, as it will speedily ruin the rectifying valve. The only manner in which you could obtain the output required would be to use several of these valves in parallel, but of course you could no longer use the original type of filament transformer, and would have to obtain one giving a secondary output of about 5 amperes at 6 volts. This would be a very uneconomical way of accomplishing your object, however, and it would be far better to abandon the idea of using this charger and invest in a charger using an "arc" rectifying valve.

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Adding Reaction to the "Everyman Four."

Can you tell me in what manner to add reaction to the "Everyman Four" receiver? N. G. L.

If you mean that you require reaction on the normal broadcast wavelengths, this can be obtained by slightly deneutralising as explained by the author on page 19 of the "Everyman Four" book. If, however, your desire is to add reaction on the long wavelengths, you should turn to page 289 of the August 31st issue, where a diagram and full instructions are given.

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Counterpoise for Reducing Interference.

I find that reception of the local broadcast station is badly interfered with by the electric tramways which pass near my house. Can you suggest any means of overcoming this difficulty, please? G H.

It is not possible to eliminate entirely this type of interference at the receiving end, but it can be reduced by employing a counterpoise in place of the usual earth. The counterpoise should consist of a number of wires stretching below the aerial and at about 6ft. or so from the ground. It will be necessary to pay the same attention to the insulation of these wires as would be given to an aerial, and a well-insulated lead should be taken from one end, where the wires should be joined together, to the earth terminal of the receiver.

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Valves for the "Exhibition Five."

I should be obliged if you would inform me which of the Marconi 6-volt valves would give the best results in the "Exhibition Five" receiver. R. W

In the two H.F. positions you could not do better than use the D.E.L.610 valves, but for the detector a high-impedance valve is recommended, such as the D.E.H.610. The first L.F. valve is transformer coupled to the last stage, so that in the fourth position a medium impedance valve, such as the D.E.L.610, should be employed. In the last stage a good power or super power valve is recommended, and either the D.E.5A, with about 150 volts H.T., or the L.S.5A, with 200 volts or more, must be used.

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Using Telephones with a Gramophone "Pick-up."

I have purchased a gramophone "pick-up" which, used in conjunction with the amplifier of my wireless receiver, gives me excellent results on the loud-speaker. I desire, however, to try the effect of listening to gramophone music by means of headphones, but am not sure in what manner to do this, since I find that the volume on the telephones is overpowering even when using one valve only. M. A. R.

In the case of most gramophone pick-ups it will be found that no amplifier of any description is needed in order to obtain good signals on the headphones, it being only necessary to connect them to the two terminals on the pick-up device. You will find that in most cases the strength will be equal to that generally known as "good crystal" strength, or even in some cases it will be equal to "one-valve" strength.

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"The Wireless World" Regional Receiver.

I desire to build a receiver which will bring in a very large number of Continental stations on the headphones, it being essential that the receiver be selective, capable of bringing in both long- and short-wave stations, at the same time productive of good quality. F. M.

We advise you, under the circumstances, to construct *The Wireless World* Regional Receiver, described in the issues of August 11th and 24th. This receiver employs one efficient H.F. stage, optional loose coupling, anode bend detector, and one L.F. stage which is resistance coupled, and should therefore be quite suitable. It would, of course, receive several stations at loud-speaker strength, but if telephones only are desired use could be made of the volume control. On no account must the L.F. stage be cut out.

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

IDENTIFYING STATIONS.

WE have on many occasions drawn attention to the difficulty of identifying the various Continental broadcast transmitting stations and have recommended that each station should transmit some identifying signal at frequent intervals between the items of its programme. There was a time when British stations gave their names and call-signs far more frequently than they do at present. In some cases, in fact, no announcement of the kind comes through except at the beginning of a programme or a definite section of a programme.

Futility of Present Signals.

Many of the Continental stations have adopted some form of identification signal, but in nearly all cases this is employed either at the commencement of the evening's programme or at the conclusion of it, and one may listen in vain for some means other than wavelength to identify a station whilst the programme is being put out. Wavelengths are now agreed upon internationally, and it seems very desirable in the interests of all listeners that some ready means of identifying every transmitter should be introduced. At present there seems to be no system of any kind adopted, but each station appears to choose haphazard some identifying signal which may or may not be very similar and easily confused with that of another station. Thus we find that many of the stations in Germany use the ticking of a metronome, apparently with the idea of providing a signal of identification, but since so many stations use it, it is almost useless for this purpose. A gong is popular with several other stations, and chimes and bells also take their place indiscriminately in the selection of a suitable signal. Many people have complained that the tuning-in signal used by our own stations is so painful to listen to that by the time the programme comes on they have lost their sympathy with broadcasting for the rest of the evening.

What we should like to see, or perhaps more correctly we should say hear, would be a distinctive signal for every broadcasting station in Europe which came on automatically during the intervals between items of the programme.

A New System Suggested.

Probably all stations now adopt a method whereby, when an item has been completed in the studio, the microphone is switched off until the next item is ready to be broadcast. It would be a very simple matter to arrange that when this switch is actuated it brings into operation automatically an announcement which would identify the transmitter. Those who have used the ordinary telephone service in Paris will recollect that where instructions are to be given to the user to the effect, say, that a subscriber with whom it is desired to be connected has changed his telephone number, this information is not given over the 'phone by the telephone operator herself, but the operator switches on to an automatic transmitter which transmits the instructions continuously.

With this same system applied to broadcasting, we would have an automatic transmitter saying continuously "This is 2LO, the London station," or some similar phrase, and this would be repeated continuously between items. If some such system could be adopted by international agreement amongst all the European broadcasting stations it would add very much to the interest of the listener and would be far more in keeping with the general progress towards uniformity which the International European Broadcasting Conferences of the past have already done so much to bring about.

It is impossible to deny that the interest of listening to foreign programmes is steadily growing. There is an increasing demand for selective receivers, and the introduction of the Regional Scheme here will certainly add to the choice of programmes available to those with such sets, whilst it is hoped that the scheme will also clear the ether to a certain extent, so as to facilitate reception of the Continental stations. To most people foreign stations to-day are only an alternative programme, and to be able to identify the origin of the transmissions would add enormously to the interest in them.

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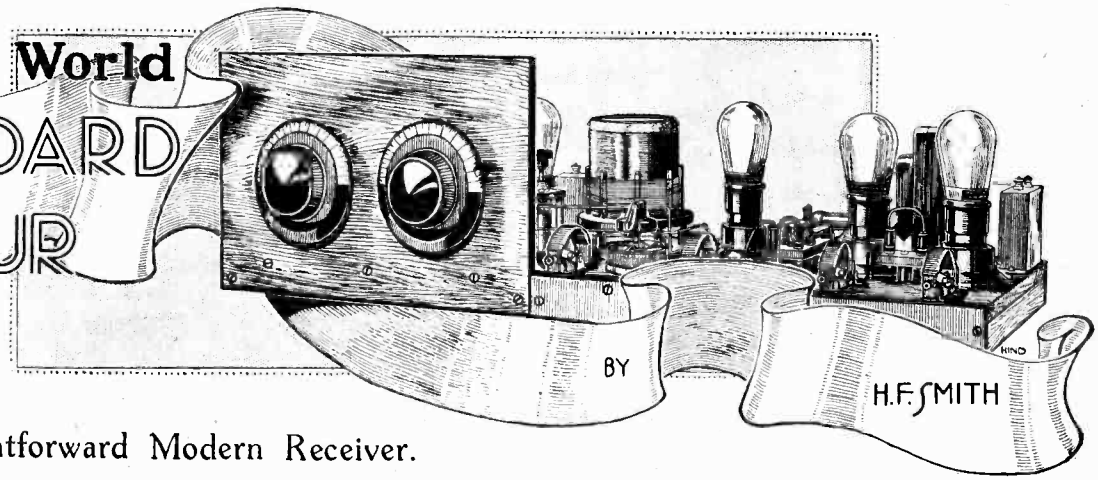
Wireless World STANDARD FOUR



BY H. F. SMITH

A Straightforward Modern Receiver.

IT is significant that the popularity of the "Everyman Four" receiver at the time of writing (some 16 months after the original publication of its description) shows no sign of waning; on the contrary, it is certain that a larger number of these sets is being built to-day than at the corresponding period of last year. One may well ask why this set occupies a position which is probably unique among those presented to home constructors; the answer to the question is undoubtedly summed up in the words "H.F. amplification." Never before has a design been offered where definite figures of performance in this respect were given, and it is safe to say that the set has introduced many amateurs to real high-frequency magnification, as opposed to that obtained by reaction, for the first time. The transformers used in the original receiver were, however, of such exceptional design that there was a natural reluctance to run any risk of impairing their efficiency by making provision for interchangeability; consequently, long waves could only be received by eliminating the high-frequency amplifier and inserting a loading coil in the detector valve grid circuit. Thus, as far as these long waves are concerned, neither sensitivity nor selectivity were of a high order.

Unfortunately, there is a very real need for a receiver which is equally effective on long as well as on medium waves, more particularly around our Morse-infested coasts; the writer has been at some pains to devise couplings to meet this need, and at the same time to retain the efficiency of the "Everyman Four" transformer on the normal broadcasting waveband. He is satisfied that the H.F. transformers designed by him for the "Regional Receiver" [1] fulfil this requirement; any falling-off that there may be is not aurally appreciable.

It is hoped that the present article will serve a two-fold purpose. In the first place, it is intended that it may show how an efficient 4-valve receiver in keeping with the best modern practice may, by careful choice of components, be constructed at low cost and with a minimum of trouble. Secondly, the design may well serve as a basis both for those wishing to use up an existing stock of components, and for those having their own ideas on

[1] *The Wireless World.* Aug. 17th and 24th, 1927.

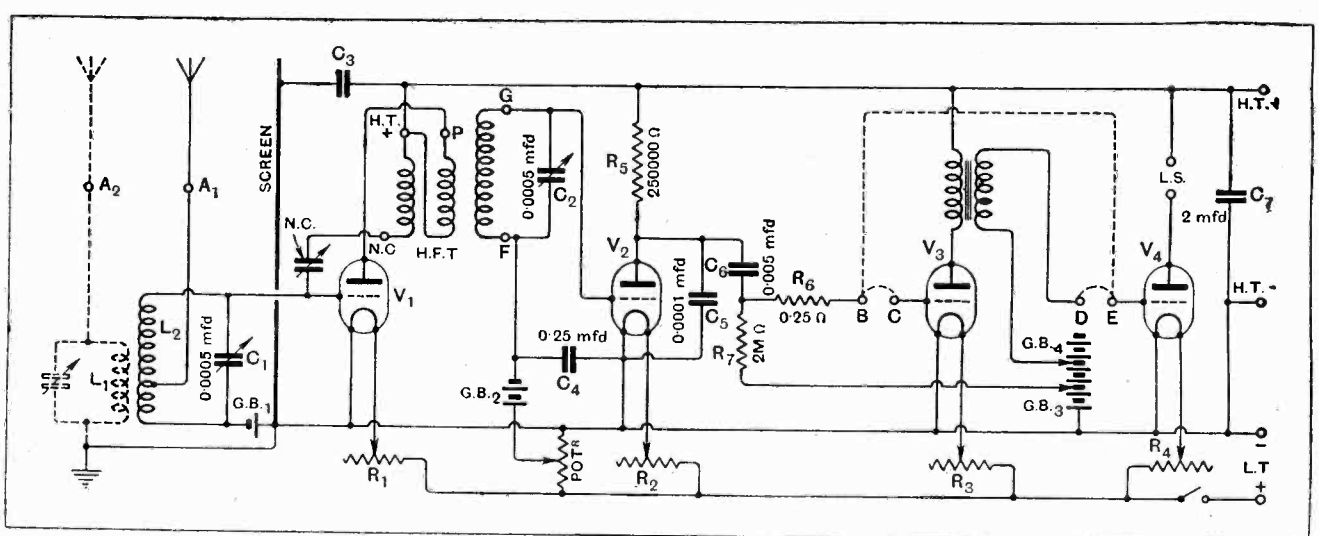


Fig. 1.—The circuit diagram, showing optional tuned aerial circuit in dotted lines. The lettering of components corresponds with that on the practical wiring plan and in the text.

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Wireless World Standard Four.—

set construction to whom expense is not of first importance.

A description of the receiver may well be preceded by a brief description of its capabilities and limitations. The question of selectivity is all-important, and it should be definitely stated that at a distance of less than three miles it must be expected that signals from a powerful station will " spread " over a sufficiently wide waveband to restrict considerably the number of stations receivable without interference. This holds good for any " single H.F." set, and the only remedy is to take advantage of the filtering effect of a second H.F. amplifier. However, the " spreading " of the local transmission falls off rapidly with increase of distance, and under average conditions at five miles or over the selectivity may be considered as sufficient; in any case it is not practicable to increase it appreciably without introducing various undesirable complications.

A " Standard " Circuit.

The sensitivity is such that under average conditions any transmission which is sufficiently free of " mush," atmospherics, or Morse interference to be worth while hearing may be received at loud-speaker strength. Admittedly, conditions do sometimes exist when advantage may be taken of almost unlimited sensitivity, but such occasions are infrequent. Furthermore, when local conditions are really bad, perhaps by reason of an indifferent aerial-earth system, a big " bag " of stations must not be expected unless the unfortunate enthusiast thus situated is willing to provide himself with something much more ambitious than a four-valve receiver.

The circuit is the well-tried combination of H.F. amplifier, anode bend detector, and resistance- and transformer-coupled L.F. amplifiers (in that order), and is given in Fig. 1. It is intended that the aerial shall normally be tapped to a point on the first grid coil near its low-potential end to form an " untuned " coupling, thus keeping the number of tuning controls down to two. For those who do not object to a third control, provision is made for a separately tuned aerial circuit by mounting a holder for a coil (L_1) which may be variably coupled to the grid inductance (L_2) and tuned by an external condenser. It is realised that this arrangement has a limited appeal, but it has distinct advantages, particularly on the long waves.

The high-frequency transformer has already been discussed, and will be referred to again later. Following the usual practice, it is shielded from the grid coil by a vertical metal screen. Detector grid bias may be accurately adjusted by means of a potentiometer in conjunction with two dry cells; this valve is coupled to the first L.F. amplifier by a resistance of a value giving what appears to be the best possible amplification combined with good quality reproduction. Similarly, an anode by-pass condenser (C_5) of 0.0001 mfd. has been chosen as providing an H.F. path of sufficiently low reactance for good detection without appreciably lowering response on the upper register, although with certain loud-speakers it may be found desirable to reduce this capacity to 0.00005 mfd.

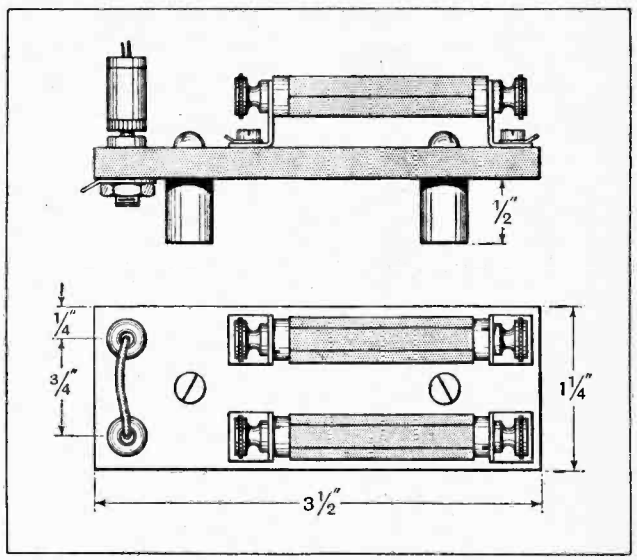
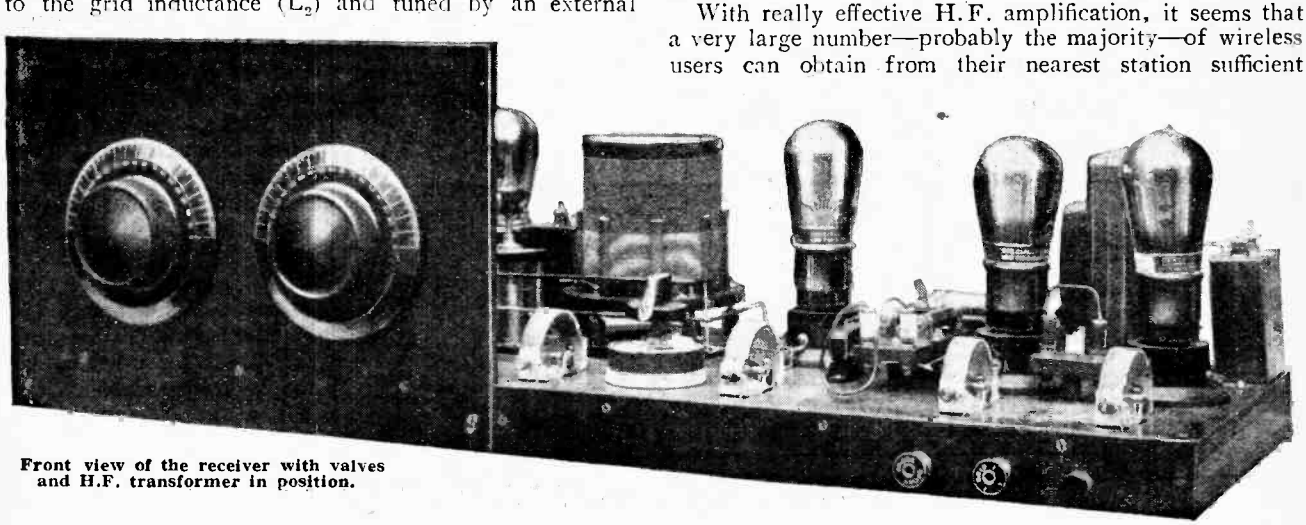


Fig. 2.—Details of the ebonite mount for grid resistances and plug sockets.

With really effective H.F. amplification, it seems that a very large number—probably the majority—of wireless users can obtain from their nearest station sufficient



Front view of the receiver with valves and H.F. transformer in position.

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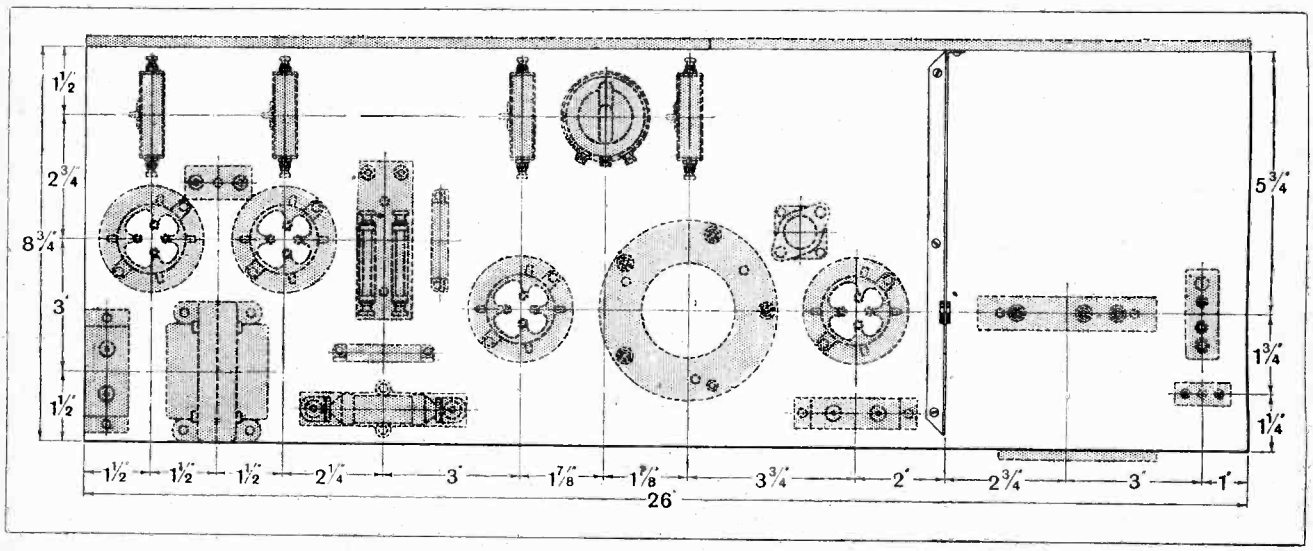

Fig. 3.—Layout of components on the baseboard.

volume, or, at any rate, all the volume with which their output valves are capable of dealing, by the use of a single L.F. stage, although such an arrangement is unsuitable for loud-speaker reproduction of distant stations. It was therefore obvious that some means of eliminating the second L.F. valve was desirable. The writer, realising that L.F. oscillation is an all-too-prevalent trouble at the present time, was unwilling to introduce any complicated switching device which might provoke this condition, and compromised on a simple plug-and-socket arrangement which introduces no undesirable inter-stage couplings. Its operation will be understood without difficulty; when bridging connectors are joined between sockets B, C, and D, E, all four valves are in circuit, while to eliminate the first L.F. amplifier these links are removed, and B and E are connected together. It will be observed that the last valve V_4, presumably specially suited for the output, remains in this position, while its grid is now biassed through the lead marked G.B.3, which must accordingly be moved to the tapping point on the grid battery normally occupied by the G.B.4 plug when all valves are in use. The grid bias battery must therefore be in an accessible position.

Separate filament rheostats are fitted for each valve, but are not, generally speaking, necessary with many modern valves, except, perhaps, for the H.F. amplifier, where adjustment of L.T. current affords a good volume control. If they are omitted, a separate switch must be fitted for V_3, in order that its filament may be extinguished when it is out of circuit. An L.T. on-off switch is already included.

Constructional Details.

A common H.T. voltage for all valves is regarded as suitable where the user intends to limit himself to some 120 volts, but where a greater pressure is to be applied to the output valve an extra connection should be added.

The baseboard, of dimensions as shown in Fig. 3, is fitted on its underside with three transverse battens measuring 1in. square, and the open space at the front is covered in with a strip of ebonite (details in Fig. 4) which carries the loud-speaker terminals and switch. Another small ebonite panel is screwed to the rear edge, and on it are mounted the three "Eelex" terminals for alternative aerial and earth connections. These terminals have a socket fitting, and so lend themselves particularly well to use in these positions, as the external aerial tuning condenser (when adopted) may be fitted with flexible leads and plugs for insertion into the sockets marked A_2 and E.

The panel, on which are mounted the variable condensers, is cut from three-

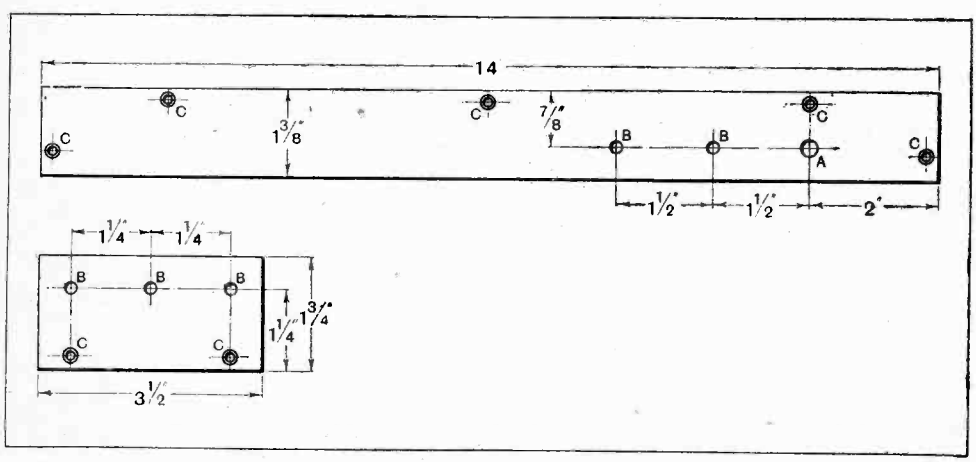

Fig. 4.—Drilling details of ebonite terminal panels. A, 1/4in. dia.; B, 3/16in. dia.; C, 1/8in. dia.; countersunk for No. 4 wood screws.

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Wirele s World Standard Four.—ply wood ¼in. in thickness to dimensions given in Fig. 5. It is supported by screws passing into the front edge of the baseboard and also by the screen, which is a rectangular sheet of No. 18 gauge aluminium with front and lower edges bent over at right angles for screwing to panel and baseboard.

The construction of the ebonite base carrying the grid leak (R_7), the damping resistance (R_6), and the sockets B, C, is shown in Fig. 2. It is raised above the baseboard by two ebonite tube distance pieces through which the securing screws are passed. The other base for sockets D, E, in the output valve grid circuit, measures 1½in. by ¾in., and is mounted on a single distance piece.

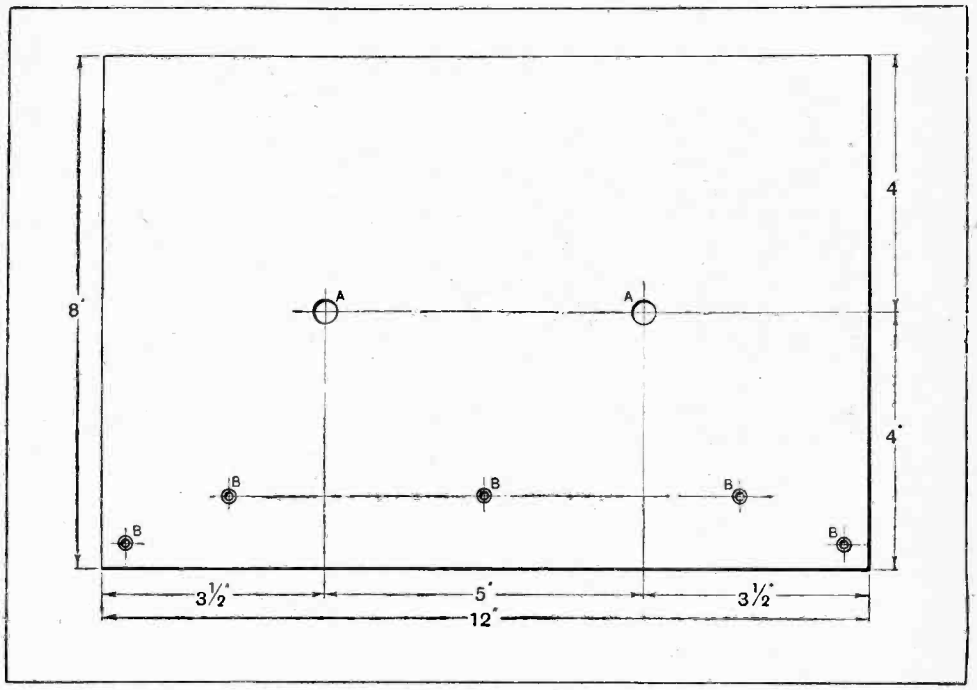


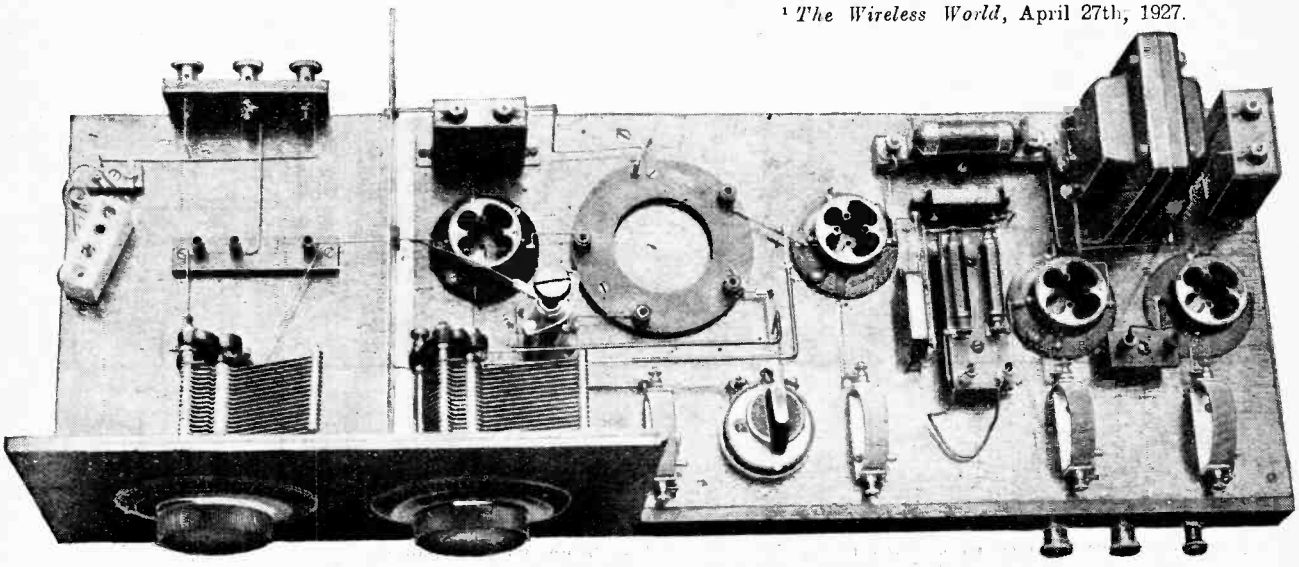
Fig. 5.—Drilling details of the wooden front panel. A, 3/8in. dia.; B, 1/8in. dia., countersunk for No. 4. wood screws.

An examination of Fig. 7 will show that three ebonite blocks fitted with double-ended soldering tags for connection to the battery leads are screwed to the underside of the baseboard. Although their use makes for a neater finish, they are not essential, as the external leads may be joined to appropriate points on the wiring. It should be noted that the grid bias lead for the output valve is passed from the transformer secondary through the baseboard and thence out tc the battery; it is not joined to a soldering tag.

The mounting of components on the underside of the baseboard will be evident from Fig. 7. The grid bias cells are secured by means of loops of wire fitted with eyes through which screws are passed into the wood.

There is considerable latitude in the choice of coils, although naturally results will depend largely on their efficiency. From the designs which have appeared recently in this journal, those for the "Regional Receiver" already mentioned are specially recommended. These are now made by a number of firms, the actual specimens illustrated and used in tests being products of Messrs. Wright and Weaire. The H.F. transformers described by the present writer, in collaboration with N. P. Vincer-Minter, in connection with the "All Wave Four" [1] would also be suitable. Winding details of

[1] *The Wireless World*, April 27th, 1927.



Plan view showing lay out of components.

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LIST OF PARTS.

1 Grid leak 2 megs. (Graham Farish, 17, Mason's Hill, Bromley, Kent).
1 Resistance, 0.25 meg. (Graham Farish).
1 Condenser, 0.0001 mfd. (Graham Farish).
1 Condenser. 0.005 mfd. (Graham Farish).
1 L.F. transformer (R.I.-Varley).
1 Single coil holder (Athol).
4 "Aermonic" valve holders (Christie).
1 Condenser, 2 mfd. (T.C.C.)
1 Condenser, 0.25 mfd. (T.C.C.).
1 Condenser, 0.5 mfd. (T.C.C.).
1 Condenser, neutralising (Jackson Bros.).
2 Filament rheostats, 6 ohms "Varistor" (Bedford Elec. & Radio Co., Campbell Road, Bedford).
2 Filament rheostats, 20 ohms "Varistor" (Bedford Elec. & Radio Co.).
1 Baseboard mounting porcelain potentiometer (Igranic).
1 Anode resistance, 250,000 ohms, wire wound, with base (Mullard).
3 Dry cells, U.9 type (Ever Ready).
2 Variable condensers, 0.0005 (Burton).
1 On-off switch (Wright & Weaire).
5 "Eelex" indicating terminals (J. J. Eastick & Sons, 118, Bunhill Row, London E.C. 1).
4 Sockets and plugs (Eastick).

Approximate price, excluding coils and accessories, £4 5s. 0d.

all these coils will be reprinted in next week's issue. It is felt that the essentials of H.F. transformer construction have been dealt with so extensively that many readers, even when lacking adequate workshop facilities, but desirous of making their own components, will be able to devise a method of construction to suit the means at their disposal. As a guide, the descriptions of the coils already mentioned should be studied. It may be added that the aerial-grid inductance should be of reasonably low H.F. resistance, and may be wound in any convenient manner. For both long and short waves the aerial tapping should be made at a point which will include about one-sixth of the total number of turns between this junction and the earthed end. Referring to the "Regional" long-wave coils, it is useful to know that expense may be reduced considerably, without any very great sacrifice in efficiency, by winding the secondaries with No. 30 D.C.C. wire in place of Litz; construction is simplified by reducing the number of slots to 10, each containing 25 turns.

The choice of valves is always an important matter which should receive careful attention if best results are to be obtained. As an H.F. amplifier, a 20,000-ohm valve (this impedance will be accompanied by a voltage factor of about 20) is the best for all-round work. In this class we have the Cossor 610 H.F., Mullard P.M.5X, Six Sixty S.S.12, etc. In the immediate neighbourhood of a powerful station much better selec-

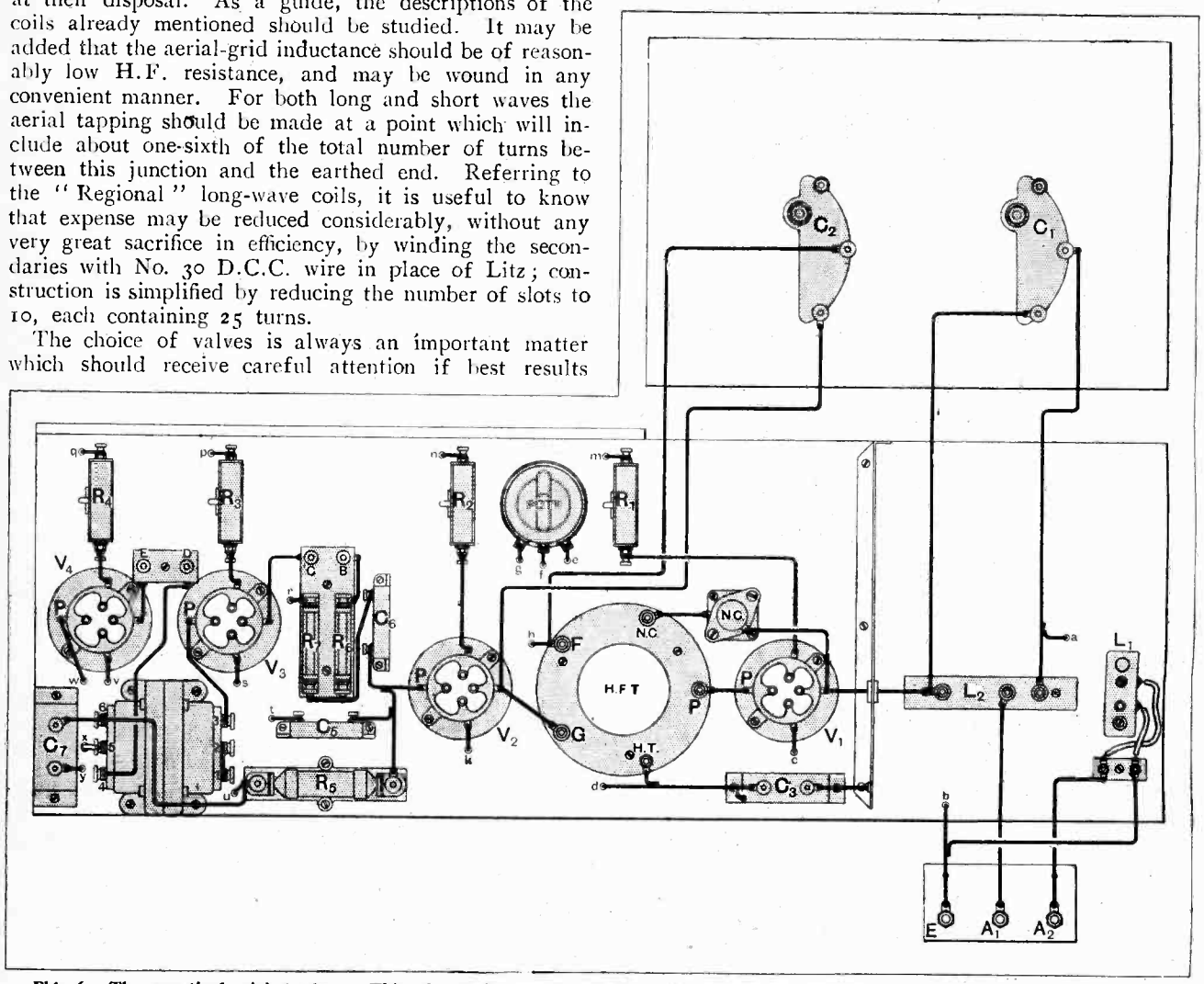

Fig. 6.—The practical wiring plan. This should be considered in conjunction with Fig. 7, which shows the underside of the baseboard. The lettering a, b, c, etc., on leads passing through the board corresponds with that in the latter diagram.

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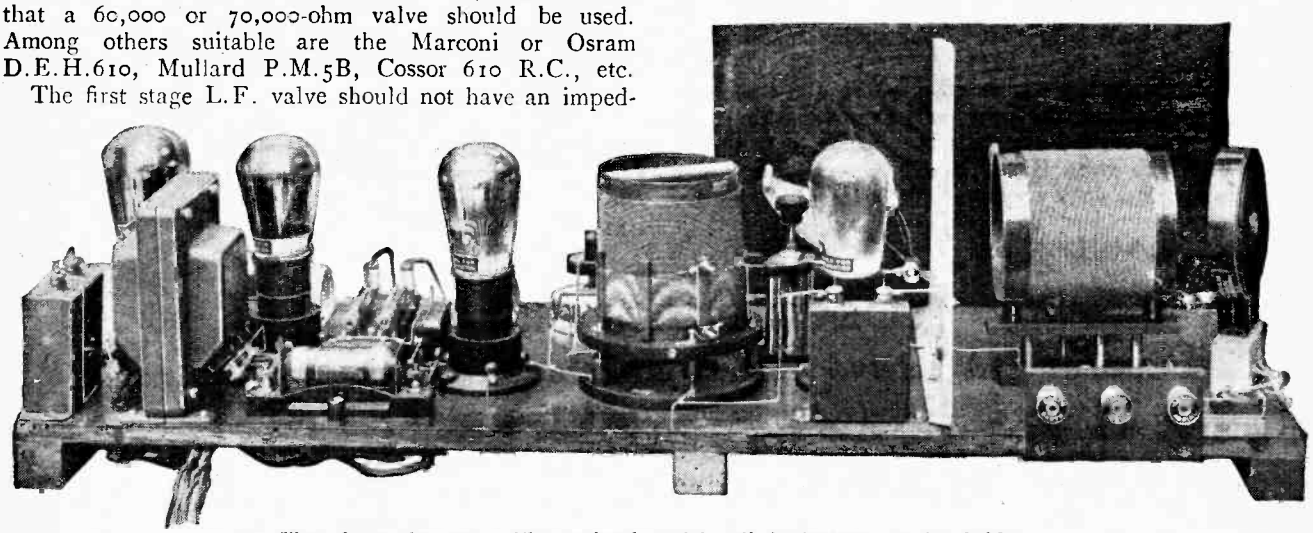
Wireless World Standard Four.—

tivity is obtainable from a 50,000 "R.C." type; the Cosmos S.P.50B, with no grid bias, works particularly well under these conditions. As a detector, it is intended that a 60,000 or 70,000-ohm valve should be used. Among others suitable are the Marconi or Osram D.E.H.610, Mullard P.M.5B, Cossor 610 R.C., etc.

The first stage L.F. valve should not have an impedance greatly in excess of 20,000 ohms; most of the valves mentioned as H.F. amplifiers fulfil this requirement, with the addition of the Marconi or Osram D.E.L.610. The choice of an output valve will, as usual, be a matter to be decided by the user's facilities for supplying anode current, and his requirements as to volume.

Preliminary adjustments may well be made with only one L.F. stage; it should not be forgotten that, as already stated, the G.B.3 plug should be moved to a suitable negative tapping on the battery for biassing the output valve. Where a really large input from a near-by station is available, the H.F. stage may be balanced by switching out the first valve and, with neutralising condenser set at minimum, tuning in signals to maximum loudness. The balancing capacity should now be adjusted till signals disappear, or, at any rate, are reduced to a minimum, after which both circuits are retuned, and a further neutralising adjustment is made, if necessary, to eliminate any signals which may be heard. Alternatively, the set may be balanced with the H.F. valve in operation (*not* on signals from the local station, and preferably out of broadcasting hours, please!). Again, with zero neutralising capacity, a transmission should be tuned in, when, if everything is in order, uncontrollable oscillation will normally be produced. N.C. should now be rotated till apparent stability is obtained, after which the tuning operation should be repeated, following this by a further slight adjustment of the balancing condenser; incidentally, it will be observed that this is mounted in such a position that it is most easily operated with the help of a screwdriver, the blade of which is inserted in a slot cut in its controlling knob.



View from the rear. The optional aerial coil is inserted in its holder.

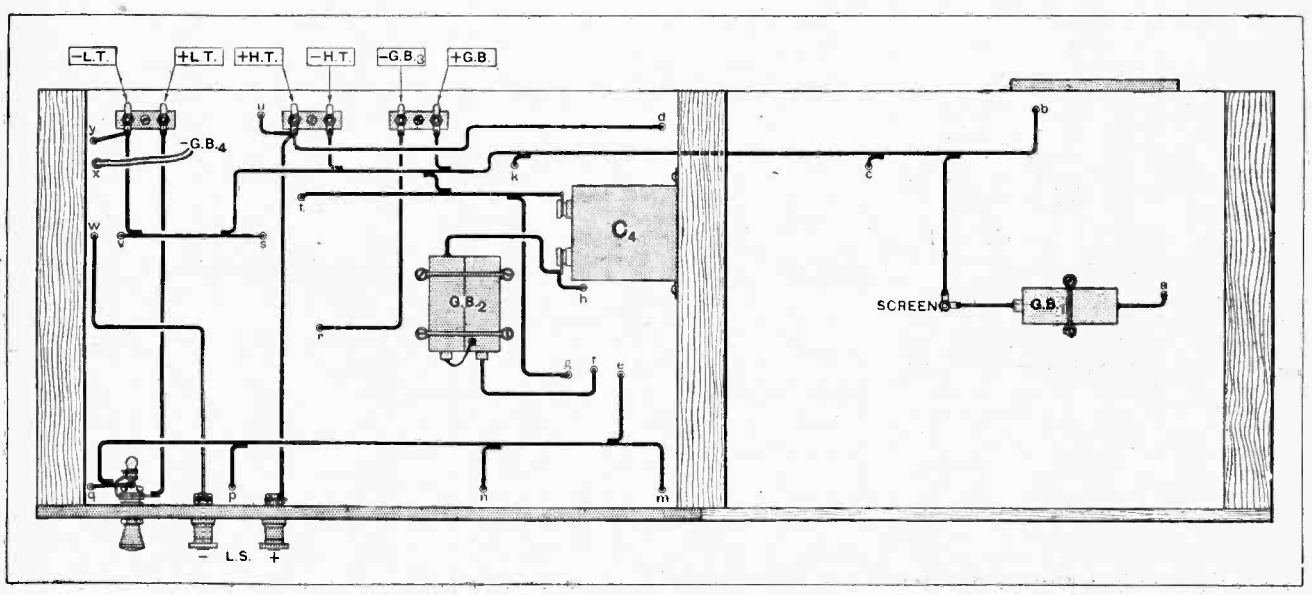


Fig. 7.—Wiring on the underside of the baseboard.

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Wireless World Standard Four.—

"Searching" is carried out by rotating the two condenser dials simultaneously so that the circuits remain more or less in tune with each other; normally it will be found that the dial readings are approximately "in step" over the greater part of the tuning scales of the condensers.

Before attempting to receive distant stations, it is necessary to adjust the grid potentiometer; this operation should be carried out while listening to weak signals, and, with 120 volts H.T., it will generally be found that nearly two volts negative will be required for best detection.

The modifications necessary when it is desired to build up the receiver in the conventional manner in an American type of cabinet will be fairly obvious. A panel measuring 26in. by 8in. will be required, and in addition to the two variable condensers (which will occupy the same positions as at present) the potentiometer and H.F. filament rheostat R_1 may be moved on to it from the baseboard.

By slightly altering the positions of R_3 and R_4 it is possible to accommodate a choke-condenser filter or output transformer; some device of this kind is generally recommended nowadays, particularly when the output valve is of low impedance.

IDENTIFICATION SIGNALS.

Opening and Interval Signals of European Broadcasting Stations.

Below is published a list of identification signals transmitted by a number of the European stations. Identifying stations forms the subject of editorial comment elsewhere in this issue, where it is pointed out that there is a need for international agreement on the type of identifying signal, and that the signal should be transmitted far more frequently than at present. Many of the stations are now using identification signals so similar in character that confusion arises as to identity.

Berlin. Witzleben, 483.9 metres, 4 kW. Interval signal: A clock chimes the hour.

Berne. 411 metres, 1.5 kW. Opening signal: Notes on a post-horn or tuning note. Interval signal: Each item preceded by two strokes and concluded with one stroke of a gong.

Bratislava (Pressburg), Czechoslovakia. 263.2 metres, ½ kW. Interval signal: Four bells (F A C C).

Breslau. 322.6 metres, 4 kW. Interval signal: (Occasional) metronome.

Brussels. Radio Belgique, 508.5 metres, 1.5 kW. Opening signal: Whistle.

Budapest, Hungary. 555.6 metres, 2 kW. Opening signal: — . — . — . on two notes (the dots being on a slightly higher note).

Cadiz. EAJ3, 400 metres, ½ kW. Opening signal: Metronome.

Copenhagen. 337 metres, ¾ kW. Opening signal: Three strokes on a gong.

Dublin. 2RN, 319.1 metres, 1½ kW. Opening signal: Tuning note.

Frankfort-on-Main. 428.6 metres, 4 kW. Opening signal: Three strokes on gong. Interval signal: Metronome.

Geneva. 760 metres, ½ kW. Opening signal: A long whistle repeated three times.

Graz, Austria. 357.1 metres, ½ kW. Opening signal: Series of Vs (. . . —) in Morse. Interval signal: Metronome or K (— . —) in Morse.

Hamburg. 394.7 metres, 4 kW. Opening signal: HA (. . . . — .) in Morse. Interval signals: Strokes on gong to indicate length of interval in minutes, followed by metronome.

Hanover. 297 metres, ¾ kW. Interval signals: Strokes on gong to indicate length of interval in minutes, followed by HR (. . . . — . .) in Morse.

Innsbruck, Austria. 294.1 metres, ½ kW Interval signal: Metronome.

Kiel. 254.2 metres. ¾ kW. Interval signal: KL (— . — . — . .) in Morse. Gong between the items.

Klagenfurt, Austria. 272.7 metres, ¾ kW. Interval signal: Metronome.

Königsberg. 329.7 metres, 1 kW. Interval signal: Metronome.

Königswusterhausen. 1,250 metres. 8 kW. Opening signal: Metronome and call. Interval signal: Metronome and call.

Kovno, Lithuania. 2,000 metres, 15 kW. Interval signal: Strokes on a gong.

Langenberg, Germany. 466.8 metres, 25 kW. Opening signal: Chimes, four bells. Interval signal: U (. . —) in Morse.

Lausanne. 680 metres, ½ kW. Opening signal: Chimes, followed by carillon.

Leipzig. 365 metres, 4 kW. Interval signal: Metronome or, when relaying Dresden, DR (— . — .) in Morse.

Leningrad. RA42, 1,000 metres, 10 kW. Opening signal: Gong or chimes.

Lyons. PTT, 476.2 metres, 1 kW. Interval signal: (Occasionally) a bell.

Madrid. EAJ7 (Union Radio), 375 metres, 3 kW. Opening signal: A bugle-like call of three or four notes or a few chords on a piano.

Marseilles. 309.3 metres, ½ kW. Opening signal: A few bars of old folk song.

Milan. 1 MI, 315.8 metres, 1½ kW. Opening signal: Tuning note.

Munich. 535.7 metres, 4 kW. Opening signal: MUNG (— — . . — — . — — — .) in Morse, followed by three notes (A, F sharp, D). Interval signal: The same.

Münster. 241.9 metres, 1½ kW. Opening signal: Gong and MS (— — . . .) in Morse, at intervals of five seconds. Interval signal: U (. . —) in Morse when relaying Langenberg.

Naples. 1NA, 333.3 metres, 1½ kW. Opening signal: Oscillating valve. Interval signal: Metronome.

Paris. Eiffel Tower, 2,650 metres, 5 kW. Opening signal: A series of seconds counted in French.

Paris. Radio Paris, 1,750 metres, 8 kW. Opening signal: Electric gong at 12.30 and 8.30 p.m. and studio clock chimes at the full hour.

Rome. 1 RO, 450 metres, 3 kW. Opening signal: Oscillating valve, followed by "Pronto." Interval signal: Trumpet call and "Radio Roma."

Stockholm. 454.5 metres, 1½ kW. Opening signal: Swedish folk-songs played on a spinet. Interval signal: Rapid ringing of a bell.

Stuttgart. 379.7 metres, 4 kW. Opening signal: Three notes (C, D, G) and metronome. Interval signal: The same.

Toulouse. 391 metres, 3 kW. Interval signal: Metronome.

Vienna. Stubenring, 577 metres, ¾ kW.; Rosenhuegel, 517.2 metres, 5 kW. Opening signal: V (. . . —) in Morse. Interval signal: Metronome.

Warsaw. 1,111.1 metres, 10 kW. Opening signal: W (. — —) in Morse. Interval signal: The same.

Zagreb, Yugo-Slavia. 310 metres, ½ kW. Opening signal: Metronome. Interval signal: Two strokes on bell.

Zurich. 588.2 metres, 1½ kW. Interval signal: Gong.

CATALOGUES RECEIVED.

C. S. Dunham, Elm Works, Brixton Hill, London, S.W.2. Catalogue of wireless instruments (ninth edition) for season 1927-28.

W. G. Pye and Co., Granta Works, Cambridge. Catalogue of Pye valve receivers.

Carborundum Co., Ltd., Trafford Park, Manchester. Illustrated leaflet dealing with the carborundum stabilising detector unit.

M.P.A. Wireless, 62, Conduit Street, London, W.1. Coloured folders descriptive of the M.P.A. reproducers and broadcast receivers.

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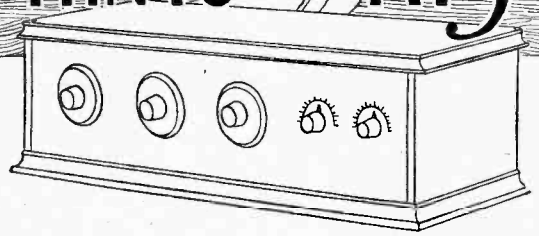
PRACTICAL HINTS AND TIPS



Aids to Better Reception.

Simple Circuit Theory.

A PLEA FOR WORKMANSHIP.

IT is probably sound advice to beginners to suggest that the need for good workmanship increases with lack of knowledge and experience. We see photographs of successful apparatus (sometimes even transmitters) assembled in a rough and apparently haphazard manner, and are perhaps inclined to doubt the correctness of this advice, but a little consideration will show that it is justified. The expert or experienced amateur may tie together his components with string, but close examination will probably reveal the fact that this indifferent insulator is so arranged that points at equal low potential are bridged by it. If the beginner attempts to proceed in this manner difficulties are almost invariably encountered, because his lack of experience does not allow him to exercise discrimination as to where liberties may be taken.

Similarly, the expert is in a position to know where it is possible to use cheap and poorly designed components without running the risk of introducing serious losses and general inefficiency; these economies are likely to lead to disappointment for the beginner, who would be wise to confine himself—until he has acquired experience—to comparatively simple circuits, using only components of reliable manufacture.

oooo

ANOTHER VOLUME CONTROL.

IT is not generally realised that volume can be reduced by increasing the bias of an anode bend detector valve by the application of an excess negative voltage over and above that required for best rectification. Provided that the L.F. part of the set is correctly designed, so that it is normally not overloaded by an H.F. input sufficient to give good detection, there is no reason why this method should introduce appreciable distortion.

When potentiometer control is fitted a record should be kept of the dial reading corresponding with the position for best rectification, and the negative end of the scale should also be marked in order to prevent the possibility of accidentally applying a positive potential, which will impair quality.

The method in question may easily be applied to the control of volume from a distant point; provided that a large by-pass condenser is inserted between the low-potential end of the tuned circuit and negative filament,

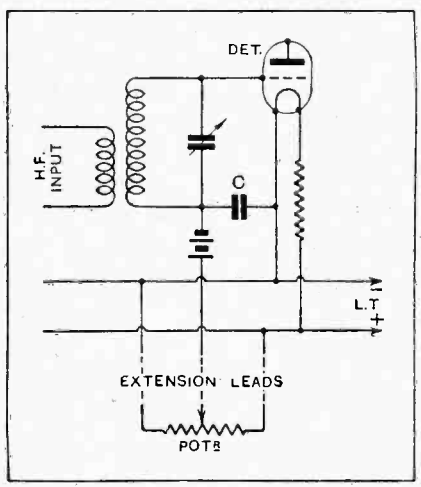


Fig. 1.—Distant control of volume by varying the detector valve bias.

there is no objection to extending the potentiometer leads. The connections are shown in Fig. 1, in which the by-pass condenser mentioned above is shown at C; it may have a capacity of some 0.25 mfd.

It may be added that when the method suggested is adopted it is often desirable to add another cell to the number specified in constructional articles for the detector grid circuit, in order that sufficient negative voltage may be applied for adequate reduction in the rectified output of very strong signals.

oooo

CHOOSING A VALVE.

EXPERIMENTERS and amateurs in this country are fortunate in having a wide choice of valves—probably wider than in any other country. Almost every manufacturer produces a type particularly suited for some special function which in many cases has more or less exclusive characteristics. Users should accordingly not hesitate to mix the products of various makers if by doing so they may more nearly approach the ideals laid down in the various constructional articles.

oooo

ANODE BEND FOR VOLUME.

THERE can be no doubt that, considered purely from the point of view of detection, the leaky-grid-condenser detector is more sensitive than the rival anode-bend rectifier. This latter, however, imposes no damping on the circuits with which it is associated, and, if reaction is ruled out—there is a distinct tendency to do so in modern receivers—it is probably correct to say that it is as sensitive when judged by results. However, it is not the purpose of this paragraph to discuss the relative merits of the two systems, but to point out that when there is superabundant H.F. input from the aerial (this condition will generally obtain in the immediate vicinity of a broadcasting station) it

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is certain that the anode bend detector will be better capable of handling this input, and, assuming a two-valve set with detector and L.F. amplifier, it will actually deliver greater volume.

oooo

SWITCH CHANGE-OVER.

THE Hartley circuit has so many advantages from the point of view of easy wave-band change that it cannot be ignored in the design of a receiver in which it is desired to change from one wave-band to another, or even from one station to another, by the movement of a switch. The fundamental circuit of

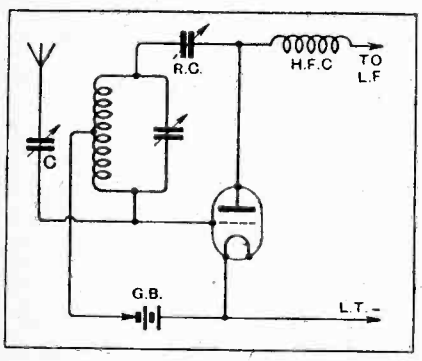

Fig. 2.—Skeleton diagram showing essentials of the Hartley detector circuit with anode rectification.

a Hartley detector is shown in Fig. 2, from which it will be seen that a single centre-tapped coil serves the dual purpose of tuning and reaction inductances. Although the whole coil is shunted by a variable condenser, only one half of it is connected between grid and filament of the detector valve; the other half may be considered as the reaction winding. Regeneration is controlled by means of a variable condenser, which should have a small capacity. If aerial damping is low, some 50 micro-mfds. (0.00005 mfd.) will be sufficient, but to be on the safe side it is suggested that a maximum capacity of 0.0001 mfd. should be used. A condenser with a low minimum may be chosen with advantage. The condenser C, although it has an effect on tuning, should be regarded rather as a control of aerial coupling; it will be found that the amount of capacity necessary to produce reaction will decrease with the reductions of capacity of condenser C.

The circuit diagram of a complete three-valve receiver which is recommended for good-quality loud-speaker reproduction in localities where medium sensitivity combined with no very high degree of selectivity is necessary is shown in Fig. 3, in which are marked suggested values for the majority of the components. The detector operates as an anode-bend detector, but it must be admitted that the Hartley circuit is hardly at its best with this form of rectification, as the full H.F. potential developed across the tuning inductance is not applied to the grid. However, this method of rectification has other advantages, which are probably sufficient to warrant its inclusion, and, in any case, it will be found an easy matter to add a grid condenser and leak in the normal manner when this modification is desired.

Volume control is effected by the use of a tapped anode resistance, which is used as a potentiometer; when the lead connecting to the grid of the first L.F. valve is joined to the tapping nearest to the detector plate, signal strength is at a maximum. A reduction in intensity is made by moving this contact towards the low-potential end of the resistance.

The tuning inductances will be chosen with regard to the wave-bands to be received. Generally speaking, for the normal wave-band and Daventry, commercial centre-tapped coils having respectively 75 and 250 turns will be found suitable. It will be obvious that this arrangement as shown, while changing wave-bands, will not permit of a simple change-over from one station to another, as it is extremely unlikely that a common setting of the tuning condenser will apply to each of the desired transmissions. If a receiver to comply with this condition is required, it will be necessary to fit separate tuning condensers for each coil.

It will be noticed that a separate switch for the filament circuits is included. This may be eliminated by obtaining a three-pole change-over switch, with a centre "neutral" position, wired in such a way that the filaments are lighted when either of the tuning coils are thrown in the circuit.

The H.F. choke may be of any good commercial pattern with an inductance of some 50 millihenries.

Incidentally, this component is a possible source of instability, as far as the long waves are concerned, through choke resonance. This is due to the possibility that the choke winding, in conjunction with incidental capacities present, may tune approximately to the wavelength to be received; the trouble manifests itself as uncontrollable oscillation which cannot be stopped by setting the reaction condenser at zero. A cure may be effected by connecting a second choke in series.

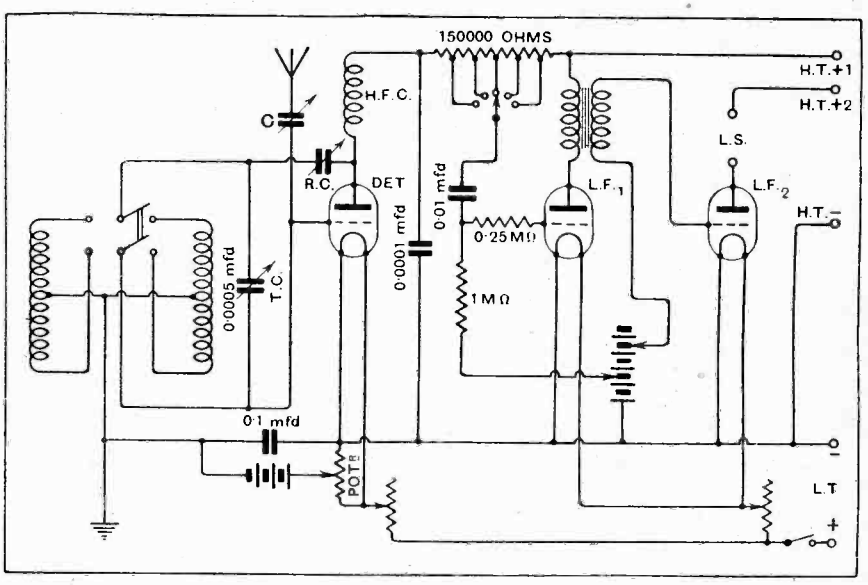

Fig. 3.—Long and short waves by moving a switch; a simple receiver arranged for easy change-over.

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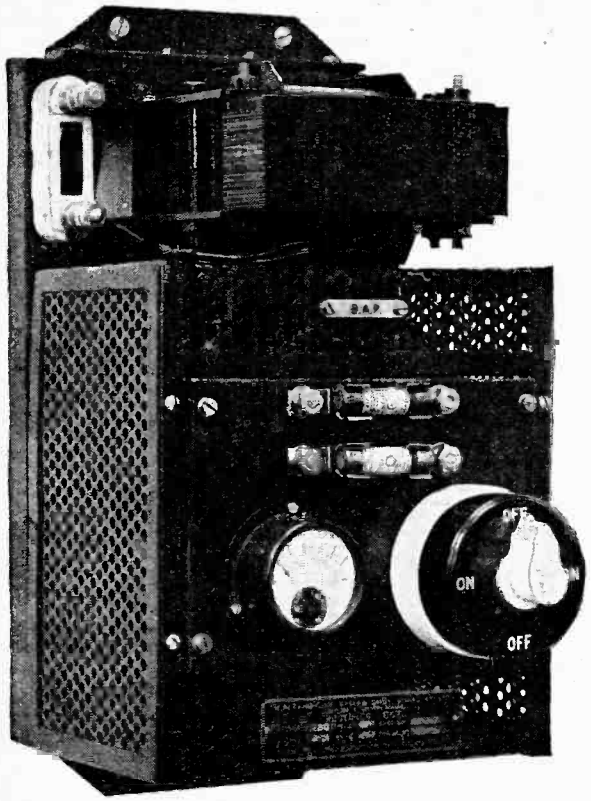
METAL RECTIFIERS.

Important New Type of Battery Charging Rectifier.

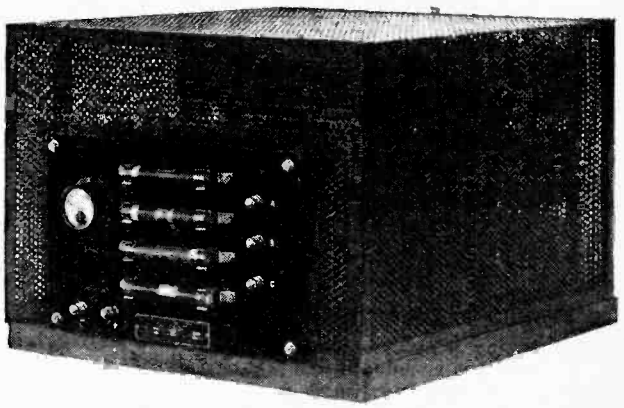
BRIEF reference has already been made in these pages to A.C. battery charging sets embodying the Westinghouse "metal" rectifying elements, and as an entirely new principle of rectification is involved much interest has been shown. Information is now available concerning the several commercial forms of battery chargers to be manufactured by the Westinghouse Brake and Saxby Signal Co., Ltd., and from



Battery charging rectifier incorporating the new dry "metal" rectifier. This model gives an output of 12 to 14 volts at 3 amperes.

technical considerations of performance it is likely that the metal rectifier has come to stay.

The rectifier is described as an electronic device depending for its operation upon the unidirectional conductivity effect which is obtained across a contact of copper and copper oxide. The plates in the form of discs are clamped up hard together upon an assembly bolt, and owing to the slight temperature rise which occurs cooling fins are inserted. Full-wave rectification is produced by connecting four sets of cells in bridge formation, each arm of the bridge consisting of cells in series or parallel, according to whether a high potential or a heavy current is required in the output circuit. It is interesting to learn that the ratio of resistance from the copper to the oxide-coated plate is extremely high



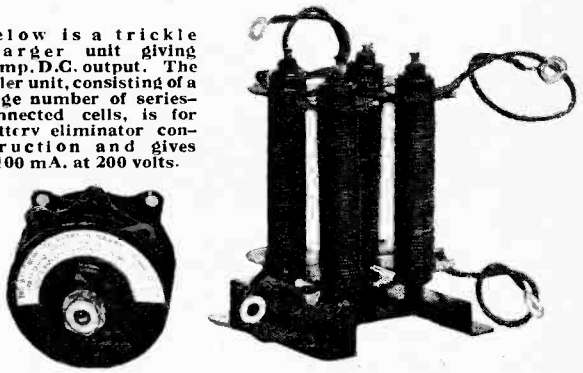
Another form of rectifier designed for three-phase input and giving a D.C. output of 6 amperes at 110 volts.

compared with the resistance from the oxide coating to the copper. The ratio of these two resistances is of the order of 1,000, thus, if a rectifying unit passes 1.0 amp. with 2 volts applied from oxide to copper, then only 1 mA. will be obtained when 2 volts is applied in a reverse direction. The reverse current does not actually occur when a full-wave rectifier is charging a battery. If a rectifier is left connected to a battery after the A.C. supply is cut off a small reverse current will, of course, be taken from the battery, but owing to the exceedingly high resistance of the rectifier in the direction that would tend to discharge the battery, this effect can be neglected.

Although little authoritative data is available concerning the efficiency of the various forms of A.C. rectifiers, it is probable that for the electrolytic, thermionic, and vibrating types efficiency ranges from about 4 to 45 per cent. It is claimed, however, that the efficiency of this new form of rectifier is over 60 per cent., the overall efficiency of the complete rectifying set being approximately 52 per cent. In the small rectifiers the efficiency is probably lower, though still comparing favourably with other rectifiers of corresponding output.

Another application is the use of the rectifying cell in a smoothing circuit following an A.C. rectifier. When the pulsating voltage of the output rises above the mean D.C. potential, the resistance of the rectifying unit, which is non-linear, decreases rapidly. By this means the peaks of the pulsating potentials are removed.

Below is a trickle charger unit giving ½ amp. D.C. output. The taller unit, consisting of a large number of series-connected cells, is for battery eliminator construction and gives 100 mA. at 200 volts.



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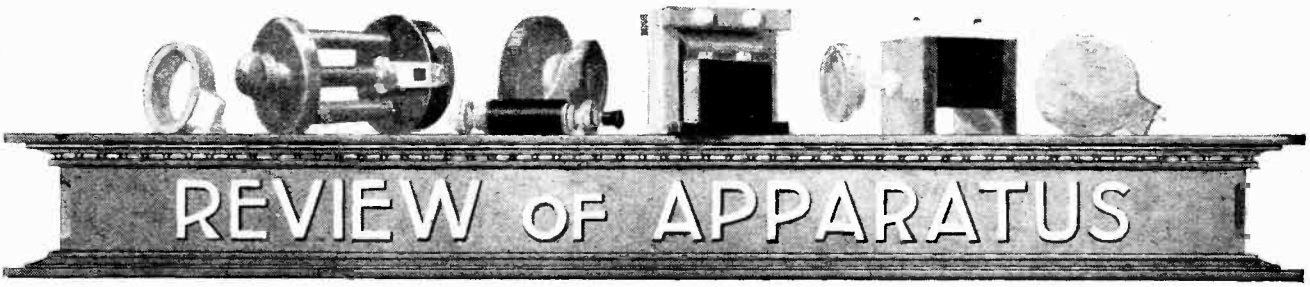
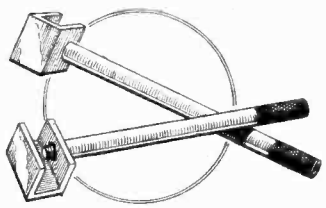


Latest Products of the Manufacturers.

USEFUL PANEL SUPPORTS.

When testing a newly constructed receiver before it is mounted in the cabinet difficulty is often experienced in lifting the panel and its components away from the table. Sets of clamps useful for this purpose are obtainable from the South Wales Wireless Installation Co., Ltd., 21-22, Edward Terrace, Cardiff.



Substantial brass clamps for supporting instrument panels during the process of wiring and testing.

The clamps take the form of rods with angle metal end pieces. Four of these supports can be clamped around a panel to grip the edges. They will not only prove helpful when testing, but have many useful applications during the process of building and wiring.

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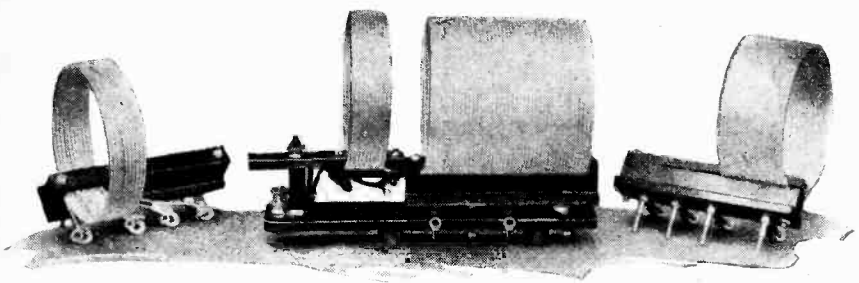
ROTHERMEL SHORT-WAVE COILS.

Readers are reminded that many of the American sets of short-wave coils are suitable for use in the construction of the Short-wave II and Short-wave III sets recently described in the pages of this journal. Coils of the plug-in type fitted with four-pin connectors are now generally used for simultaneously interchanging both closed circuit and reaction coils, while a single coil is used on all wavelengths. A set of robustly constructed short-wave coils in which the turns of wire are secured in grooves on the face of thin celluloid are produced by the Twin Coupler Company and obtainable in this country from the Rothermel Radio Corporation of Great Britain, Ltd., 24-26, Maddox Street, Regent Street, London, W.1. Ribbed section ebonite pieces support the coils and their pin connectors, and a base piece is supplied fitted with spacers so that it can be conveniently screwed down to the top of the receiving set. A set of three interchangeable coils is supplied to cover a wave band of 20 to 200 metres.

Among the many types of short-wave tuning coils manufactured in the United States the Aero inductances designed for covering a wave range of 15 to 130 metres are exceedingly popular. These coils are practically air supported, the turns being spaced and clamped at four points between ebonite strips. A single aerial coil is used over the entire range and is attached permanently to an insulating plate which carries the four sockets for the interchangeable coils. A good feature is the use of the "banana" form of connecting plug, giving a reliable contact. The arrangement of the reaction turns is of particular interest, being arranged as a fine wire winding set up at the aerial end of the grid circuit. This is a good feature because it permits of the grid end of the grid circuit coil being remote from the aerial coil, whilst at the same time the proximity of the aerial winding to the reaction inductance may tend to produce greater range by reducing the losses in the aerial circuit.

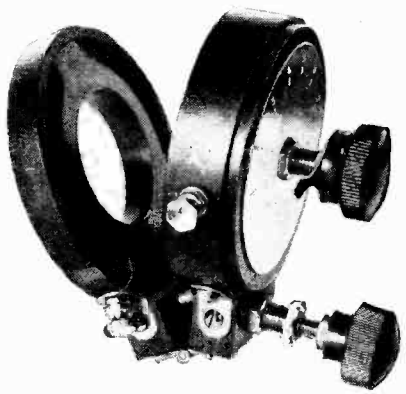


Set of Rothermel short-wave coils covering a tuning range of 20 to 200 metres.

Transmitting inductances are also available with a similar form of mounting, though the windings are of a suitable heavy gauge enamelled wire.

THE "EXACT" AERIAL TUNER.

The two-valve receiver with regenerative aerial tuning is exceedingly popular and moderately easy to construct. Wiring of the aerial reaction circuits may be further simplified by the use of the "Exact" aerial tuner, a product of The Exact Manufacturing Co., Croft Works, Priory Street, Coventry.



The "Exact" aerial tuner. It is easy to fit and the windings are totally enclosed.

Although moderate in price—it sells at 14s.—this tuner is constructed from turned ebonite discs and tubes which completely enclose the windings as well as the contacts of the seven-point aerial switch. The aerial coil in conjunction with the parallel condenser of a capacity of 0.0005 mfd. covers a tuning range of from 250 to well over 1,600 metres. Ample range of reaction coupling is provided, so that regeneration can be obtained with the single reaction coil over this wide band of wavelengths.

To fit the tuner to the instrument panel only two holes are required, one of which is used also to secure a nickel-plated brass indicating scale carrying engraved figures. The plane of this indicating plate is, of course, parallel with the face of the aerial coil, an arrangement which might be thought to have a detrimental effect upon the aerial winding. It is, however, liberally spaced from the winding, so that any damping which may be introduced is of small significance compared with the considerable damping which is always present in an aerial circuit.

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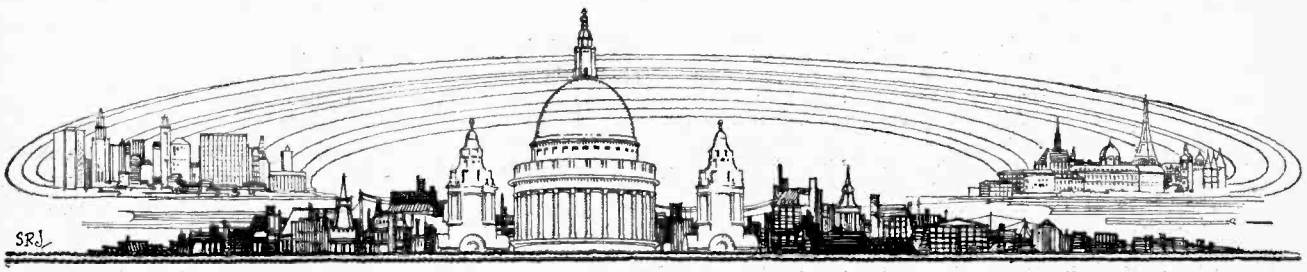

CURRENT TOPICS

Events of the Week in Brief Review.

WEST HAM'S LOUD-SPEAKERS.

The Town Council of West Ham has issued a notification that the by-law is now in force prohibiting the use of loud-speakers in public streets.

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RISING STEADILY.

The number of wireless receiving licences issued by the Post Office this year up to the end of October was 2,337,733. Free licences granted to the blind numbered 10,125.

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TELEGRAPH PICTURE SERVICE.

A service for the telegraphic transmission of pictures between Berlin and Vienna is to be officially inaugurated tomorrow (Thursday), according to a Berlin announcement. The Carolus system will be used.

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"ON THE AIR" AND IN IT.

"Flying Broadcasters, Inc.," is, as one would readily surmise, an American organisation. It has just been granted a licence by the U.S. Federal Radio Commission for the purpose of operating a transmitter in an airplane on the broadcast wavelength band. Its object is said to be experimental.

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WIRELESS-CONTROLLED 'PLANE.

The pilotless 'plane so beloved of the novelists has become a reality. A Bréguet biplane, flying under wireless control without a pilot, has been tested successfully at Istres, says *The Engineer*. It has made several pilotless flights and has taken off and landed eleven times without mishap. The French Government Air Official Trials Committee has decided to accept the device and the machine will be brought to Paris shortly.

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WAS THE MAGISTRATE RIGHT?

An interesting pronouncement upon the receiving licence question was made last week by the Chairman of the Rotherham magistrates when fining a number of offenders against the Wireless Act.

"We have come to the conclusion," he said, "that penalties must be imposed, but at the same time we think it is not generally known that the people who keep these sets must take out licences before they get the set."

WHY PEOPLE MOVE.

Mrs. Smith: "So you're moving to Daventry?"

Mrs. Jones: "Yes, John swore he'd get 5GB on his valve set."

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MOVING-COIL LOUD-SPEAKERS.

Moving-coil loud-speakers will be demonstrated this evening (Wednesday) by Mr. F. H. Haynes, Assistant Editor of *The Wireless World*, at a meeting of the Tottenham Wireless Society.

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SETTLING INTERNATIONAL WIRELESS DISPUTES.

The principle of compulsory arbitration on wireless matters was approved by the International Radio Telegraph Conference on Saturday, November 19th, after the proposal had been strenuously opposed by Great Britain and Japan.

Great Britain took up the attitude that radio controversies were not analogous to the political kind, where resort to force was a possible alternative, and put forward an amendment favouring optional arbitration. This was defeated by 48 votes to 7, the compulsory proposal being adopted by 28 votes to 10.

WHY NOT EMIGRATE?

Australian listeners may shortly be able to obtain an annual receiving licence for 3s. 6d. if the new Wireless Bill is passed.

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TOWN WITH EIGHT RELAY STATIONS.

There are now at least thirty-five relay broadcasting stations in the United States. Most of these pick up programmes from the nearest big station, though some are intended for relaying short-wave transmission from abroad. Los Angeles alone boasts eight relay stations!

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WIRELESS COURSE FOR BEGINNERS.

A course of wireless instruction for beginners has been opened under the direction of Captain Jack Frost at the Peckham Literary Institute, County Secondary School, Peckham Road, S.E.15. Meetings are held every Friday at 7.30 p.m. Full particulars can be obtained from the Principal of the Institute at the above address.

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AUSTRALIA'S WIRELESS PROBLEMS.

Mr. Bruce, the Commonwealth Prime Minister, in the House of Representatives on November 17th announced the

EMPIRE BROADCAST RECEPTION. Although Mr. Gerald Marcuse, seen in the photograph, is mainly concerned with transmission from his well-known station 2NM, he finds time to maintain an efficient receiving equipment. The receiver above is a short-wave superheterodyne which brings in Australian stations on the loud-speaker.

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Ministry's proposals for the future control of wireless, says *The Times*. He said it was considered that reversion to Post Office control would be a fatal blunder, and it was intended to renew the agreement with Amalgamated Wireless (Australasia), Ltd., for five years, with reservations which would strengthen the Government's position and enable the Commonwealth to fix the rates for commercial wireless.

It will be remembered that Amalgamated Wireless (Australasia), Ltd., was strongly criticised in the report recently made by the Royal Commission appointed to inquire into the control and development of wireless in the Commonwealth.

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COURT DECISION BY WIRELESS.

Wireless assisted in overcoming the difficulties of litigation at a distance a few days ago, when the judge in the Court of Equity at Sydney, Australia, ordered that the decision of the Court be served upon the defendant by wireless. The case referred to the sale of shares in a coconut plantation, but the defendant was far away in New Guinea. Our correspondent omits to state whether the defendant registered pleasure or pain on receipt of the message.

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HAVE YOU HEARD ICELAND ?

A new broadcasting station is now testing at Akureyri, Iceland, with a wavelength of 192 metres and a nominal power in the aerial of 1½ kW. The power will probably be increased very considerably. Tests take place every Saturday evening from 7 to 8 p.m. G.M.T. and consist of organ music, news, weather reports, etc. Announcements are made in Icelandic and English.

The owner of the station is an English missionary, Mr. Arthur Cook, but we understand that the present tests are under the direction of Mr. F. L. Hogg, who is using the temporary call-sign NI 2SH until December 15th.

Amateurs' reports on the transmissions will be warmly welcomed.

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STORM WARNINGS 48 HOURS AHEAD.

Professor William Hobbs, head of the Michigan University expedition to Greenland, hopes that the meteorological wireless stations which he has established in Greenland will soon be able to give storm warnings to ships in the Atlantic 48 hours before the storms arrive.

Three stations have been installed in the heart of Greenland, 100 miles apart, including one on the summit of Mount Evans. As most of the Atlantic storms have their origin in this icy neighbourhood, it seems likely that the new stations may be of real value to shipping.

NEWS FROM THE CLUBS.

I.E.E. Wireless Section.

"The Attenuation of Wireless Waves over Land" is the title of a lecture to be given by Mr. R. H. Barfield, M.Sc. (Eng.), at a meeting of the Wireless Section of the Institution of Electrical Engineers to be held at 6 p.m. at the Institution on Wednesday, December 7th.

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Leyton and Leytonstone Radio Society.

One of the newest London clubs is the Leyton and Leytonstone Radio Society. Weekly meetings are held on Thursdays at 8 p.m. at the Haydn House, Fairlop Rd., E.11, and a cordial invitation is extended to all those in the district who are interested in wireless and broadcasting generally.

The Hon. Secretary, to whom enquiries should be addressed, is Mr. G. S. Garner, 82, Oakdale Rd., E.11.

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The Wireless World Prize-winning Set Demonstrated.

The opening lecture of the Kensington Radio Society's winter session was given recently by Mr. Maurice Child, who dealt with short-wave direction finding. Mr. Child gave a lucid description of his frame aerial receiver and how he used it on the occasion of his winning *The Wireless World* three-guinea prize in the open competition held by the Golders Green and Hendon Radio Society.

Visitors and new members are heartily welcomed to the Society's meetings. Hon. Secretary, Mr. G. T. Hoyes, 71a, Elsham Rd., W.14.

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D.C. Mains for Wireless.

The use of D.C mains for operating a broadcast receiver was dealt with in an interesting lecture given on November 10th by Mr. Dennis at a meeting of the Ilford and District Radio Society. One of the points emphasised was that in cases where hum is noticeable considerable improvement would be achieved if the trouble were dealt with at the point where the current actually comes into the house. Naturally only an electrician would be able to insert the necessary chokes.

A discussion on short-wave work followed, and several members described their experiences in using two-volt valves, which, it was claimed, functioned quite well down to 20 metres.

Hon. Secretary, Mr. H. H. Carr, 39, Lynford Gardens, Goodmayes, Essex.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 30th.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Demonstration of Moving-coil Loud-speakers by Mr. F. H. Haynes, Asst Editor of "The Wireless World."

THURSDAY, DECEMBER 1st.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way. Lecture: "Direction Finding—Hints and Tips," by Dr. R. L. Smith-Rose, of the National Physical Laboratory.

Stratford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. Lecture: "Cabinets and how not to make them." by Mr. Binks.

FRIDAY, DECEMBER 2nd.

Radio Society of Great Britain.—At 6 p.m. (Tea at 5.30.) At the Institution of Electrical Engineers, Savoy Place, W.C.2. General Meeting, T. and R. Section. Demonstration of Moving-coil Loud-speakers, by Mr. F. H. Haynes.

South Manchester Radio Society.—At the Co-operative Hall, Wilmslow Road, Didsbury. Auction of Members' Surplus Apparatus.

Leeds Radio Society.—At Leeds University. Lantern Lecture: "Lead Storage Batteries," by the D.P Accumulator Co.

Radio Experimental Society of Manchester.—Lecture by Mr. A. K Bentley, of the Manchester Technical College.

MONDAY, DECEMBER 5th.

Southport and District Radio Society.—At St. John Hall, Scarisbrick Street. Lecture: "Gramophone Pick-ups," by Messrs. S. G. Brown, Ltd.

TUESDAY, DECEMBER 6th.

Tottenham Wireless Society.—First Annual Dinner, at the Chanticleer Restaurant, Frith Street, Soho.

WEDNESDAY, DECEMBER 7th.

nstitution of Electrical Engineers.—Wireless Section.—At 6 p.m. At the Institution, Savoy Place, W.C.2. Lecture: "The Attenuation of Wireless Waves over Land," by Mr. R. H. Barfield, M.Sc. (Eng.), A.M.I.E.E.

Popping the Question.

"Questions and Answers" can generally be relied upon to provide a profitable evening, assuming that someone with the necessary qualifications is present to furnish replies. An interesting evening of this kind was spent by members of the Croydon Wireless and Physical Society on November 7th.

Visitors are heartily welcomed at the Society's meetings. Particulars may be obtained from the Hon. Secretary, Mr. H. T. P. Gee, Staple House, 51-52, Chancery Lane, London, W.C.2.

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Direction Finding.

Next year the Golders Green and Hendon Radio Society intends to repeat the D.F. competitions which were such a popular feature last summer. Various radio societies will be asked to co-operate, and it is hoped that the scope of operations will be considerably enlarged.

With this in view it has been decided to invite all who are interested in the topic to attend the Society's meeting tomorrow, Thursday, at 8 p.m., when Dr. R. L. Smith-Rose, of the National Physical Laboratory, will lecture on "Direction Finding." The Society meets at the Club House, Willifield Way, Golders Green.

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Wireless Society for Wigan.

The formation of a wireless society in Wigan is under consideration. As the result of an appeal for the names of those who would join the membership of such a society, about 100 names were handed in at an exhibition of wireless apparatus held in the Mining and Technical College, Wigan, on Nov 12th. Demonstrations were carried out by the Department of Physics to illustrate the principles of wireless transmission, reception and allied phenomena, including television. Local amateurs came forward with some interesting short-wave sets, gramophone pick-ups, remote control devices, etc. Those interested in the formation of the wireless society are asked to communicate with the Principal, Mining and Technical College, Wigan.

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5SW, CHELMSFORD.

Twenty-kilowatt Experimental Short-wave Transmitter.

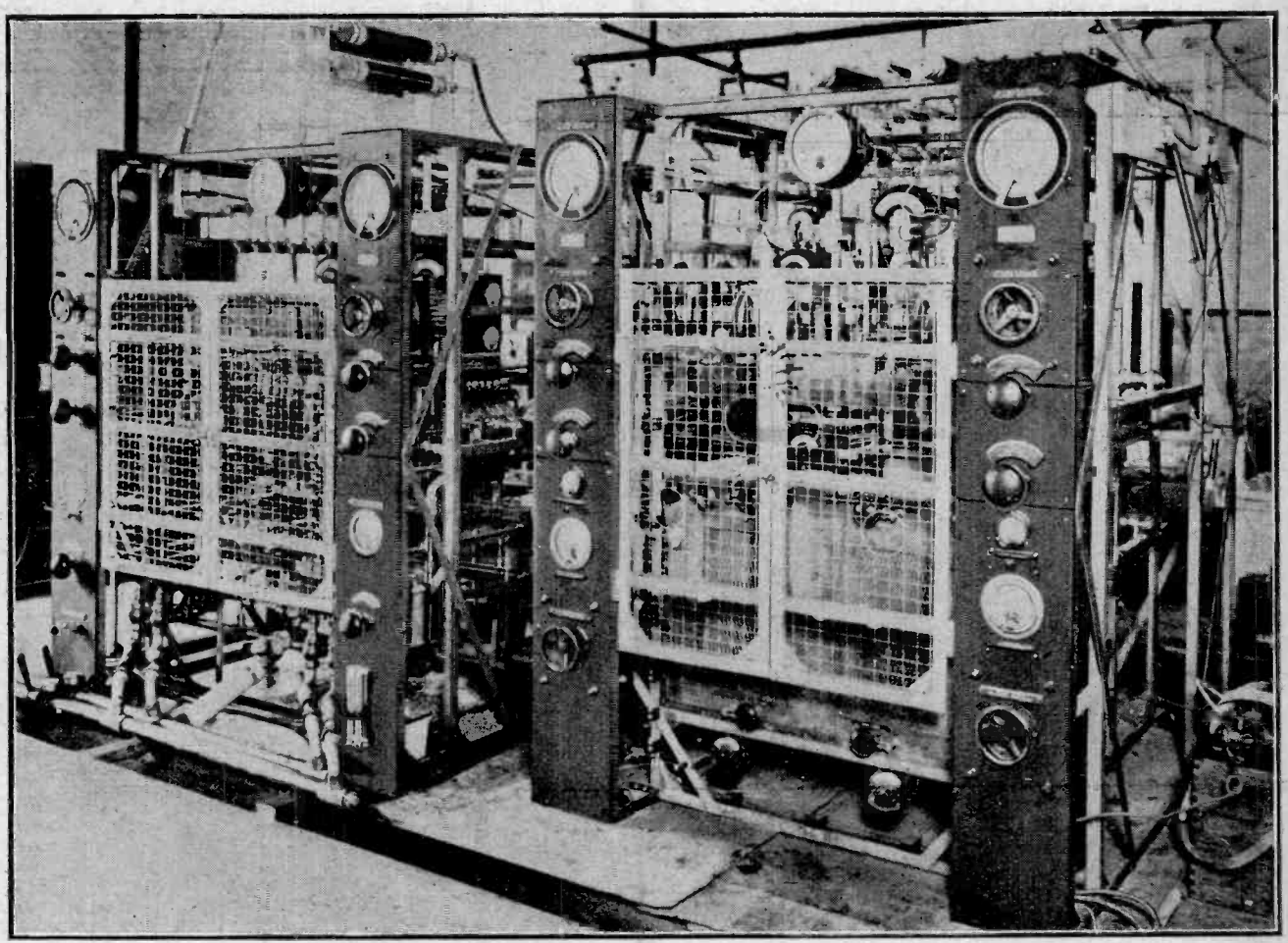
THROUGH the courtesy of the Marconi Company a representative of this journal was permitted to visit their works at Chelmsford, where the new short-wave transmitter 5SW is erected. It will be remembered that this installation was used for broadcasting to the world the speech of H.R.H. the Prince of Wales on Armistice Day last, thus laying the foundation stone of an Empire broadcast service.

The experimental transmitter is erected in the research laboratories which have many historical associations, as it was under this same roof that the first long-wave broadcast transmitter was installed and tested before the Daventry site was chosen. Here also 5GB had its genesis.

The present occupier of this historical room transmits on a wavelength of 24 metres, and has the appropriate call sign of 5SW. Power is obtained from a three-phase A.C. supply, which is generated on the premises, rectified and smoothed, after which it is passed to the main amplifier at a pressure of 8,000 volts.

The equipment is an interesting mixture of standard apparatus and experimental gear, but everything is laid out with a view to efficiency, as will be seen from the accompanying illustrations.

The experimental transmitter consists of two panels of a Marconi short-wave beam transmitter, with the addition of three modulating panels, and, of course, the necessary rectifying valves for the various anode supplies. The main amplifier is fitted with two special oil-cooled valves, and this can be located quite easily in the illustrations by the presence of the oil circulating pipes. To the right of the main amplifier is the second beam transmitter panel fitted with two amplifying valves in the top section, and below this the drive or master oscillator totally enclosed in a copper screening box. Each power amplifier consists of two 10-kilowatt valves. It is necessary accurately to balance the supply to both valves, so that meters are included in the filament and anode circuits of each valve to facilitate this adjustment. These instru-



Two panels of the short-wave transmitter. On the left is the main amplifier and to the right the drive circuit.

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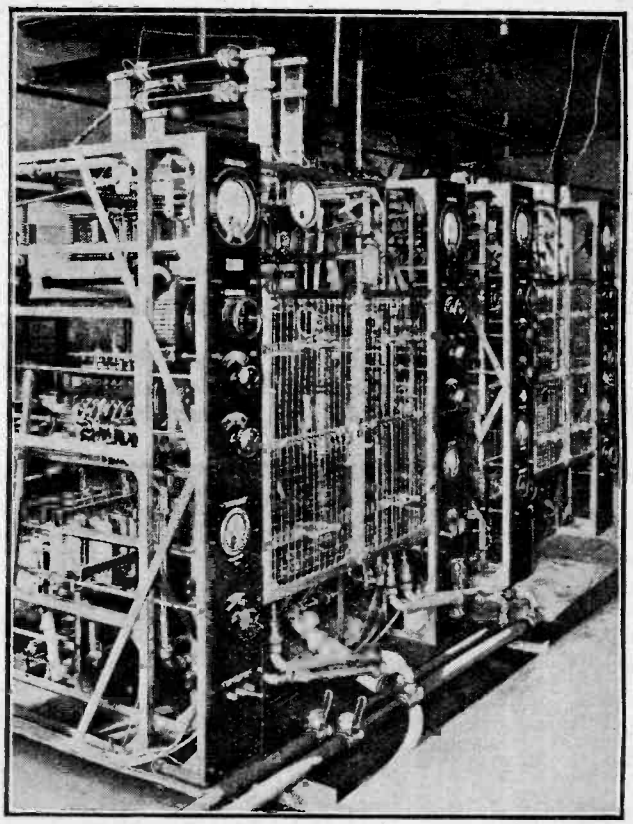
5SW, Chelmsford.—

ments and the various tuning controls are mounted on insulating panels on the front of each unit of the beam transmitter. The three modulating panels are mounted in a temporary wooden framework, and are situated to the right of the oscillators and connected thereto by a speech transformer which, however, cannot be seen in the illustrations, as it is situated behind the beam transmitter.

The modulating panels are each fitted with two 7.5 kilowatt cooled anode valves, these being connected in parallel and forming the main modulator. This is preceded by a smaller panel carrying two air-cooled valves forming the sub-modulator, the function of which is to amplify the signal current received from the land line, or local microphone circuit, before passing them to the main modulator.

The Aerial System.

The output from the main amplifier is fed to the aerial by means of a current feeder encased in a copper tube connected to earth. The purpose of this is to prevent interference from external sources. At the transmitter end the feeder terminates in a coupling coil and balancing circuits, and the far end is connected to the base of the aerial. Ammeters are arranged at either end of the feeder, and the circuits are adjusted so that the current is the same value at both the input and output ends of the feeder. Slight variation in the wavelength of the aerial will have no effect on the closed oscillatory circuit, as the feeder can be considered a resistance. The radiating system used is a Franklin aerial, and this incorporates a number of unique features based on the experience gained from experiments with beam transmitters. The Chelmsford aerial takes the form of five half-wave aerials, in series with non-radiating portions, connected between each radiating section. The whole system is suspended from a wire, but insulated therefrom, attached to the tops of two 450ft. masts. It is claimed that by the use of this arrangement every foot of vertical wire radiates energy, and the radiation resistance of the system is of a very high order.

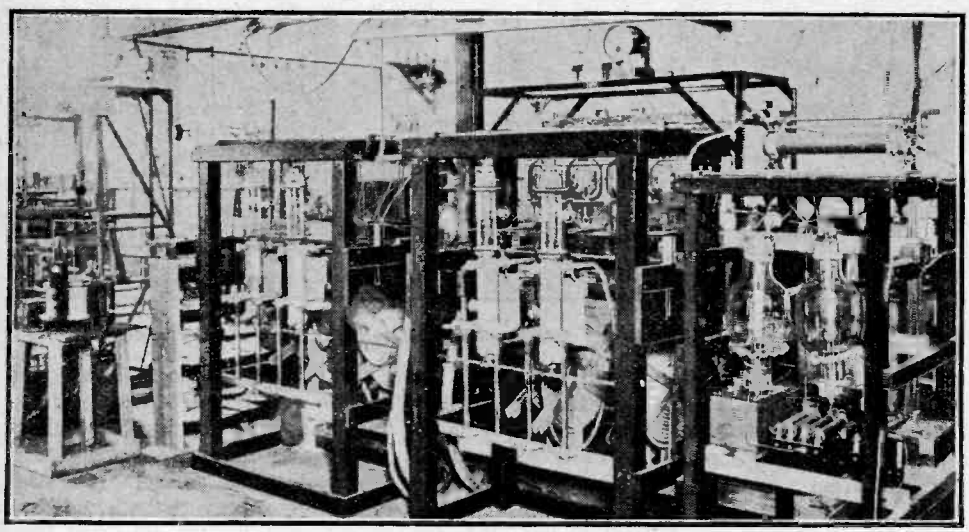


The main amplifier showing the oil circulating pipes and the closed circuit inductance.

This completes the main equipment, and the writer was then conducted to a small hut which was used as the "studio" during the recent 36-hour test undertaken with a view to ascertaining what degree of reliability could be expected from a short-wave broadcast service. This room contained a miniature switchboard with direct lines to the local telephone exchange, a Reisz microphone and amplifier and a special amplifier for use with a gramophone pick-up device; this provided the matter for broadcast during the tests.

Reports have been received from many parts of the world, but it seems that the most consistent reception was experienced in Canada, although on those occasions when the Antipodes received 5SW the results left nothing to be desired. Good reception has also been reported by short-wave enthusiasts in all parts of Great Britain.

H. B. D.



The three modulator panels showing the sub-modulator on the right.

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THE LAST STAGE.

Some Observations on the Need for Power in Order to Secure Quality. The Relative Merits of Super-power Valves, Valves in Parallel, and Valves in Push-pull.

THE wireless receiver used to be regarded as conveniently divisible into two parts represented by its high- and low-frequency sections, but it has now advanced to a point at which a more profitable division of technical interest is to consider the last stage and the loud-speaker together as the reproducing side and the rest of the apparatus as the receiver. The last stage, including the loud-speaker, can thus be regarded as a musical instrument, and it is the first purpose of this article to emphasise the fact that adequate power in the last stage is essential to the realisation of any good qualities which the loud-speaker may possess. Power is the rate at which work is done, and, primarily, adequate power means doing adequate work on the mechanism of the loud-speaker in order to ensure that its movements shall be sharply defined and controlled so that it emits clear speech and music. Muffled effects, for instance, usually imply inadequate power. This aspect of power in the last stage, however, is mainly related to the functioning of the loud-speaker itself, whereas the purpose of this article is to consider some aspects of the last stage as represented by the valve and its circuit.

Distortion due to overloading the last valve of a receiver is very prevalent; readers who are not versed in the potentialities of valves in parallel and valves in push-pull would be well advised to consider carefully the points brought out in this article.

Valves in the last stage may be so arranged that they can handle stronger signals without distortion or that a bigger power output is obtained without increasing the capacity to handle stronger signals. Care must be exercised to differentiate between these two functions.

Power Essential.

In its relation to this part of the last stage, the statement that good quality involves high power has a rather special significance. It means that the valve and its circuit must be capable of transmitting to the loud-speaker a *range* of signals which render audible the softer passages of music and follow the loud passages without distortion. The range of volume of sound from soft to loud in most pieces of music is very wide—far too wide, in fact, to be accommodated without distortion in the last stage that has been designed primarily for economy of plate current in order to save high tension battery renewals.

It is important at this point to realise why the plate current is the symbol of power in the last stage. It is not the steady plate current which operates the loud-speaker, but the fluctuations of that current, and these may be large or small, according to the amplitude of the signal at the moment; on the other hand, it is obvious that their maximum value is limited by the magnitude of the steady plate current itself (because, for example, a signal which decreases that current obviously cannot do more than bring it to zero), and thus the steady plate current itself becomes a symbol of the output *capacity* of the valve. In passing, it may be remarked that the steady plate current is sufficient indication of output capacity without reference to plate voltage, because this latter is only a means to the desired end, and two valves may require widely different plate voltages for the same plate current in the same external circuit. The external circuit being the same, the *useful* work done on it will be the same for the same current flowing in it, and, therefore, the higher plate voltage can only be regarded as a necessary evil associated with the valve that, by reason of its characteristic, needs it.

In an article which was recently published by the Chief Engineer of the B.B.C., he stated that he was using a set in which he was dissipating 10 watts in the plate circuit of the last valve and that he advocated a minimum of 5 watts output in any set designed primarily for quality. Interpreting the above figures in the light of existing valves, an output of 10 watts implies about 300 volts and 33 milliamps, which is the sort of output that can be obtained from a valve like the LS5. This magnitude of voltage is not very easily obtainable, and, therefore, there is distinct merit in a valve or combination of valves which will maintain the same current in the plate circuit at a lower voltage, for, although the nominal power rating would be less, the useful rate of doing work would be the same. We come back, therefore, to the plate current itself as being the significant index to the output capacity of the valve, and from this point of view it is regrettable that valve makers do not give more prominence to appropriate figures on the subject in the tabulated information about their power valves. During the past year or so the publication of characteristic graphs has become common, and these give the requisite information very fully, but the significant *figures* are omitted from most tables. What is needed is the plate current at the recommended grid bias for the recommended voltage. The higher the plate current the greater the grid bias, and the lower the voltage the better is the valve for use in the last stage. There is not much doubt that the omission of this information from valve tables is partly due to the fact that it is only significant in power valves and partly to the feeling that any mention of a generous plate current may prejudice sales among those who are primarily interested in H.T. battery economy. Now it may as well be recognised from the first that, so far as the last stage is concerned, quality is, at present, incompatible with economy of plate current, which leads immediately to the conclusion that, inasmuch as a heavy plate current is very costly from a dry battery, the future development of quality in radio reproduction depends largely on popularising the use of power from the mains.

With a "mains drive" there is no difficulty at all in providing up to 50 milliamps, if necessary, for the output circuit, but this ability to supply the current economically

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does not render a small power valve capable of using it, and so we come to the second purpose of this article, which is to compare alternative methods of increasing the output capacity of the valve or valves in the last stage.

The owner of a set having a single small power valve in the last stage of his set and being desirous of improving the quality (i.e., *the range of volume* which he can reproduce without distortion) will ask himself, "Shall I buy a new super-valve, or shall I parallel my existing small power valve with another of the same kind, and if I use two valves would there be any advantage in arranging them

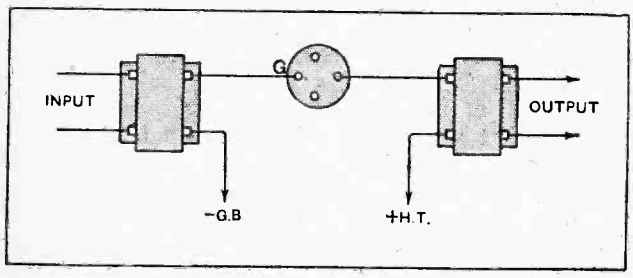

Fig. 1.—A single small power valve with the grid fed from the secondary of an input transformer and the plate feeding the primary of an output transformer. The hypothetical characteristic for this circuit (neglecting bottom bend) is shown by graph 1 (illustration AB) in Fig. 5.

to work on the push-pull circuit?" These questions can best be answered by the aid of a few simple diagrams, and, in order to avoid misunderstanding, it may be as well to begin by illustrating the circuits that are under review. Thus Fig. 1 represents the last stage as a single valve with a transformer feeding the signal to the grid and another receiving it from the plate. In Fig. 2 there are two valves with their grids in parallel and their plates in parallel. In Fig. 3 there are two valves arranged on the push-pull system, and in Fig. 4 the same circuit is applied to four valves arranged in pairs, the valves of each pair being in parallel. These are the four cases which we have to compare, and their comparison is simplified by the chart in Fig. 5. This is intended to represent a set of hypothetical grid-bias : plate-current graphs for the four cases represented by Figs. 1, 2, 3, and 4: the valve connections are pictorially shown. For convenience, the graphs have been made straight from end to end, as this serves more clearly to illustrate the principles and does not invalidate the argument.

Diagrammatic Representation.

It ignores the bottom bend of the curve, but as in practice the operation of the valve must be kept within the straight portion of its characteristic if the output is to be distortionless, the use of straight lines solely for the purpose of illustrating the following principles is justified. The chart has been drawn to an arbitrary scale in order to give it a quasi-practical significance. Thus, for example, graph 1 in Fig. 5 represents the sort of output that is available from the type of valve that is now called a small power valve and of which the well-known B4 was an early and popular example. This class of valve has a mutual conductance [1] in the order of unity, and when 120 volts is applied to the plate the current is about 10 milliamps at zero grid bias. The graph marked 1A illustrates a hypothetical super-power valve having the same mutual conductance as the small power valve, but delivering twice the plate current. The relative plate voltages are immaterial, except as they affect convenience of supply, as it is assumed that the current in the plate circuit is proportional to the values on the chart. Thus, in order to complete the picture, we may assume that the grids of the two valves are biased −5 and −10 volts respectively, and that the respective currents in the plate circuits are 5 and 10 milliamps.

The two points to be borne in mind when comparing these two valves are that :—

1. The same strength of signal on the grid produces the same strength of signal from the plate.
2. The super-valve as represented at 1A will accommodate twice the signal strength on the grid without distortion.

The effect of putting two small power valves in parallel as illustrated in Fig. 2 is to produce the characteristic shown by graph 2, where it will be noticed that mutual conductance of the pair of valves is twice that of the single valve, while the grid base remains unchanged. Comparing this arrangement with the single small power valve and

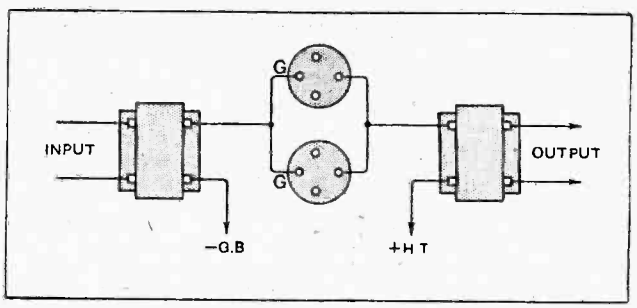

Fig. 2.—Two small power valves in parallel. The capacity of receiving a signal is no more than in Fig. 1, but the output signal is greater. See graph 2 (illustration AD) in Fig. 5.

single super-power valve, the following points stand out :—

3. For the same strength of signal on the grid the two valves in parallel would give twice the strength of signal from the plate but for the effect of the resistance in the plate circuit which reduces this ratio.
4. Two valves in parallel will not reduce distortion if the signal input goes beyond the grid base of one valve alone.

Arranging two small power valves on the push-pull system as illustrated in Fig. 3 produces the pair of graphs represented by 1 and 3 in Fig. 5. Valves arranged in this way divide the incoming signal, and their out-

[1] The mutual conductance of a valve may well be considered as a performance factor, in that it is a measure of the relation between impedance and amplification factor or the slope of the characteristic curve which, measured in units, is the change in milliamperes in the plate circuit for a 1-volt change in the grid circuit.

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going signals are re-combined. The outstanding features of this system are therefore as follows:—

5. For the same strength of signal input as in the previous cases, the signal on the grid of each valve is halved. The two valves thus arranged will thus accommodate twice the strength of input signal without distortion, and from this point of view are equal to the super-power valve. The graphic comparison of this quality of the two valves is more clearly shown by the dotted line 3, which is a "reflection" of the full line in Fig. 5. Graph 1 plus dotted graph 3 is obviously equal to graph 1A in respect to grid base.

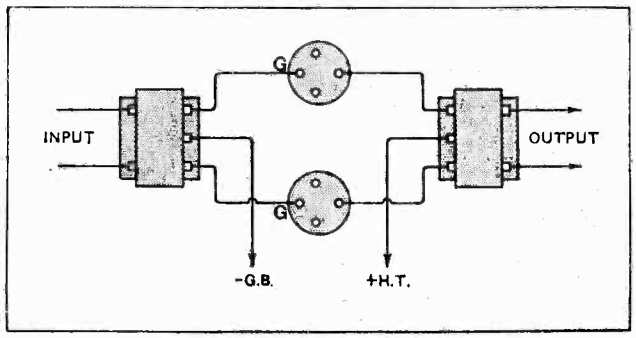

Fig. 3.—Two small power valves in push-pull circuit, which is characterised by centre-tapped transformers. For the same signal strength as in Fig. 1, the grid swing of each valve is halved, but the half signals recombine in the output transformer to give the same strength as Fig. 1, while the capacity to receive a signal is about twice that in Fig. 1. See graph 1 plus 3 (illustration CB) in Fig. 5.

6. The mutual conductance of the pair of valves in the push-pull circuit is the same as either valve singly. That is to say, the combined strength of signal from the two plates is the same as that obtained from one valve alone in a simple circuit for the same strength of signal input.
7. The primary of the output transformer being centre tapped for the H.T., the split current neutralises its magnetic effect, and, therefore, the weight of iron in the core can be less for distortionless transmission of a given signal current. The signal has its full magnetic effect because each valve is 180° out of phase with the other, the simultaneous signal on grid and on filament being equal in strength, but opposite in sign. Another advantage in push-pull is that a slight deviation from linearity of characteristic in the two valves cancels out.

Applying the push-pull system to four valves arranged in pairs, the valves of each pair being in parallel as shown in Fig. 4 produces the double graph 2-4 in Fig. 5, the "reflection" of graph 4 being shown dotted as an extension of 2. This arrangement has the mutual conductivity of Fig. 2 and the grid base of Fig. 3. Thus it will receive without distortion the same strength of signal as the super-power valve represented by 1A, but would produce twice the signal strength therefrom but for the effect of the resistance in the plate circuit which reduces this ratio. The graphs of Fig. 5 serve to illustrate the difference between two very important qualities which are sometimes confused, namely, that distortionless action of the valve depends on the grid base, while the strength of signal from the plate for a given signal on the grid depends on the mutual conductance.

The reason why these two distinct qualities in a valve are liable to confusion is because the desired improvement in quality or signal strength can generally be obtained by either method provided that the receiver is capable of adjusting the signal input to suit the new conditions. Thus, if the problem is to cure distortion, the direct solution is a super-power valve or two valves with a push-pull circuit in order to obtain the wider grid base which will accommodate the existing signal on the straight part of the characteristic. But the same effect can be obtained by using two or more valves in parallel, provided that the receiver can be adjusted to bring the signal input strength within the distortionless range of the single valve and sufficient valves are added to bring up the output signal to the previous strength. The success of this latter method depends entirely upon the extent to which distortion is taking place. Owing to the effect of the resistance in the plate circuit, the actual signal strength of two valves in parallel is not twice that of one valve alone, consequently more than two valves may be necessary in order to obtain adequate volume when the signal applied to the grid is reduced sufficiently to prevent distortion.

Parallel v. Push-Pull.

If the problem is to increase the volume (without, of course, adding another stage), the direct solution is two or more valves in parallel, but the same effect can be obtained by using a super-power valve or two valves on the push-pull system, provided that the receiver is capable of increasing the signal input strength to take advantage of the increased grid base now available. Now, while it is usually feasible to reduce the signal applied to the last valve by slightly de-tuning, by loose coupling, or by less reaction, it is not always so simple to increase the strength of input signal. For this reason valves in parallel, even super-power valves so used, have a very practical value. The addition of another valve or two in parallel adds no complication either to the circuit or

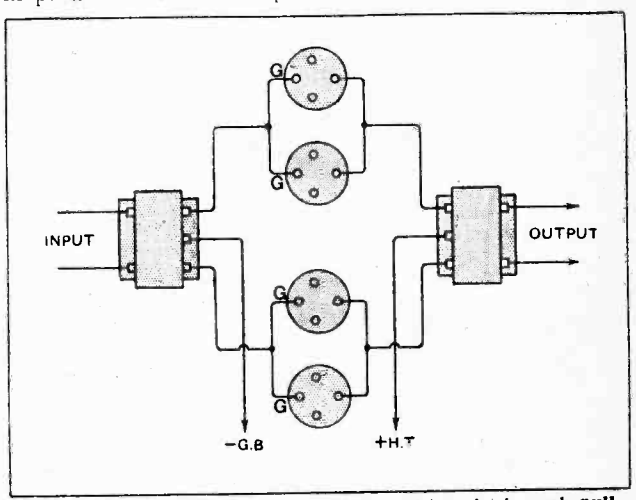

Fig. 4.—Four small power valves arranged in pairs in push-pull, the valves of each pair being in parallel. For relative performance see graphs 2 plus 4 (illustration ED) in Fig. 5.

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to its operation, and this method is, in fact, a safe and sure way of improving quality, the effect being noticeable rather as an increased depth of tone than by any striking increase in volume.

The use of an additional stage is a very drastic way of increasing volume, for the reason that it increases the signal at OS-IS several *times* at least, and can, therefore, be justifiable only when the original signal strength is just strong enough for headphone reception, or the ultimate signal is required to fill a large hall. In the latter case the problem is clearly one for providing a valve or arrangement of valves with an enormous grid base capable of accommodating an enormous grid signal. In the absence of this capacity, distortion is inevitable. The necessary strength of output signal is, so to speak, a secondary consideration which can be easily met by paralleling the valves so as to gain signal strength by increase of mutual conductivity. This aspect of the problem comes back to the main issue which it is the purpose of this article to discuss, namely, how best to gain the percentage increase in volume from an existing last stage in order to secure a higher standard of quality.

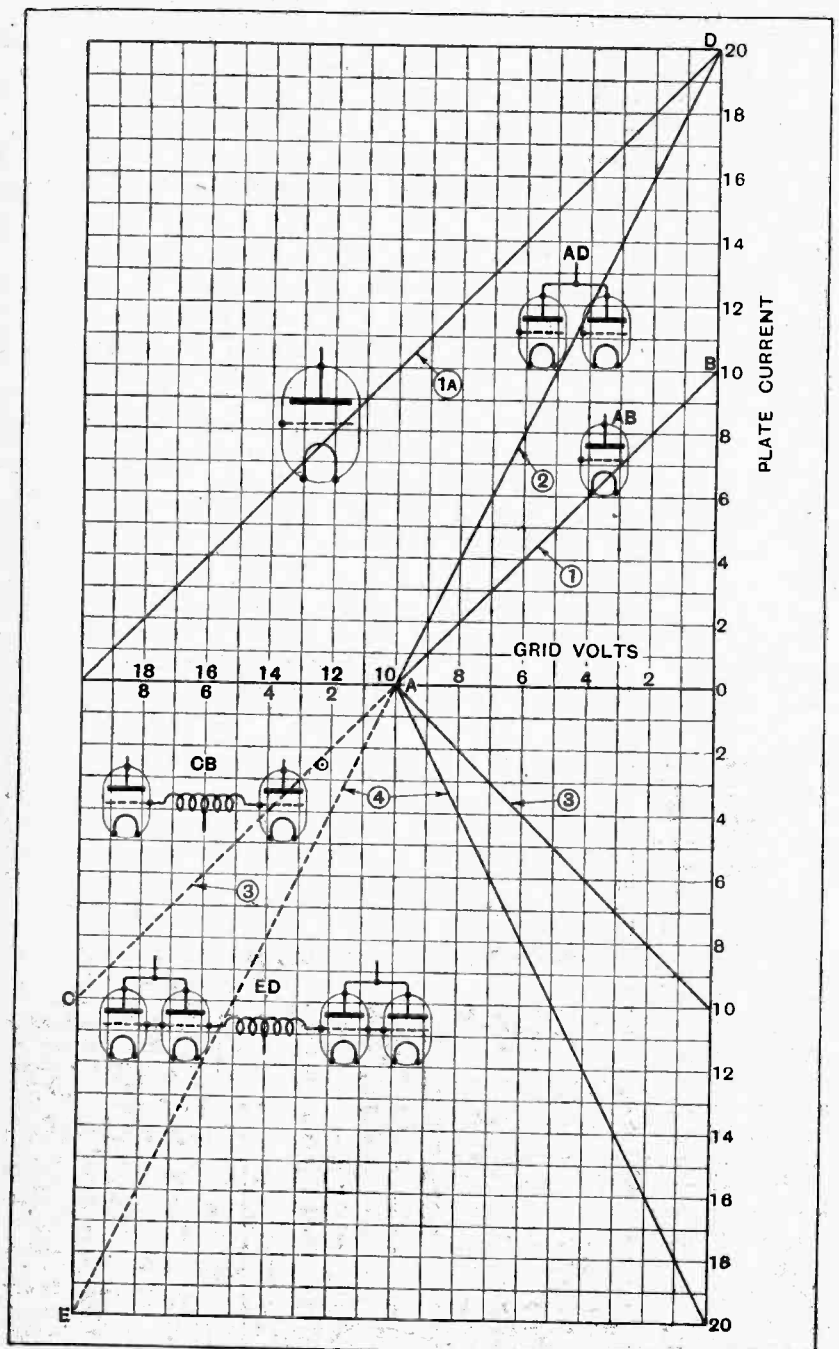

Fig. 5.—Hypothetical graphs comparing relative performances of the valve arrangements illustrated in Figs. 1 to 4. For the sake of simplicity these graphs ignore the bend in the valve characteristic. The dotted lines 3 and 4 are "reflections" of the full lines 3 and 4 in order more clearly to illustrate the widening of the grid base in the push-pull system.

Power Valve or Push-Pull.

An interesting issue which presents itself in Fig. 5 is whether to use two valves on the push-pull system, or one super-power valve of equivalent range. The performance, from the point of view of the valves, is the same. Provided the output transformer is capable of carrying the greater current, the substitution of the super-power valve for an existing small power valve is at present simpler and probably less costly than using an additional small power valve in the push-pull circuit, but if our existing transformers were centre tapped it would be cheaper to adopt the push-pull system.

In those cases where the required performance is beyond the capacity of any single super-power valve, it will probably be found that the performance is also outside the capacity of any single output transformer, and in such cases, therefore, the push-pull system offers itself as a very useful solution to the problem. The fact that it neutralises the magnetising effect of the steady plate current in the output transformer, permits a standard iron core, rewound with a centre tapped primary, to be used to transmit without distortion a much stronger signal than would otherwise be possible. Moreover, it must be remembered that where a very large volume of sound is required, the last stage is generally an additional stage, and, therefore, the main problem is to accommodate a very big grid swing without distortion, and if it should be the case that this range goes beyond the capacity of any existing valve, then the only possible way of accommodating it would be to divide it between two valves on the push-pull system.

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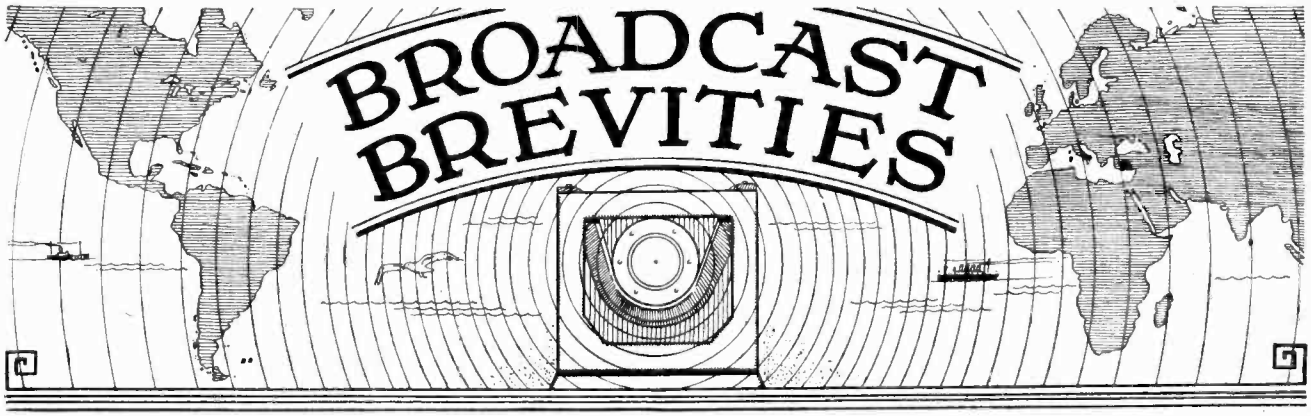

By Our Special Correspondent.

5GB's Power.—Harry Lauder Again.—Melbourne Calling.—Gramophone Broadcasts.—For Our Grandchildren.—Listening in Denmark.

Still Testing at Daventry.

5GB's increase of power from 16 to 24 kilowatts appears to have given pleasure within the "service" area, which covers a radius of about 40 miles. Beyond this distance the change seems to be unnoticed.

Meanwhile, tests are being conducted with different aerials, so there may still be some delay before the present diminutive aerials are dispensed with. I understand that the ultimate power increase to 30 kilowatts will not take place until the new aerial is definitely adopted.

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A Tip for Short-wave Experts.

Messrs. Marcuse, 5SW, and Company may be interested in the view put forward by the wireless officials of the Canadian National Railways at Ottawa, who say that for long-distance broadcasting there is nothing to equal the bagpipes.

Apparently the speech and ordinary music from London on Armistice Day came through indifferently, but the skirl of the bagpipes was heard as though they were being played in a local studio.

Anyone who has attended a Highland Gathering will know that the sound of the pipes is penetrating enough to drown even the popping of corks.

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Harry Lauder Again.

If any one "turn" could be said to come near pleasing high-, mezzo- and low-brow simultaneously it would probably be one of those rare appearances at the microphone of Sir Harry Lauder, who is to have a studio to himself for three-quarters of an hour on Wednesday, December 28th.

The famous little Scotsman is, by common consent, one of the best microphone humorists, his popularity being largely due to the variety of mood and sentiment which he can express by inflexions of the voice. His programme on December 28th will go out from 2LO and will probably be "S.B." to all stations.

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"It's an Ill Wind . . . ."

American slipper manufacturers, says a correspondent, have increased their sales by 3,500,000 pairs during the past year. They attribute this to the home-loving habits inculcated by broadcasting.

There is no truth in the notion that it might be due to Prohibition.

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Picking Up Melbourne.

Now that 3LO Melbourne has begun regular 36-metre transmissions for the benefit of the Empire, short-wave enthusiasts in this country have a good opportunity to test their receiving abilities. The Keston receiving station of the B.B.C. made an attempt to pick up 3LO on Sunday evening, November 20th, but not even the carrier wave was heard. On the other hand, a correspondent in north-west London tells me that he picked up the station direct on that evening between 7.15 and 7.25, using *The Wireless World* "Empire" receiver.

This is not, of course, a serious reflection upon the technical abilities of the B.B.C. It would be quite consistent with the vagaries of the short wave that a signal could come in strongly in London and be inaudible on the outskirts. But in view of this disability I think the B.B.C. would be well advised to employ more than one station for reception from overseas. Chelmsford is fully equipped. What about it?

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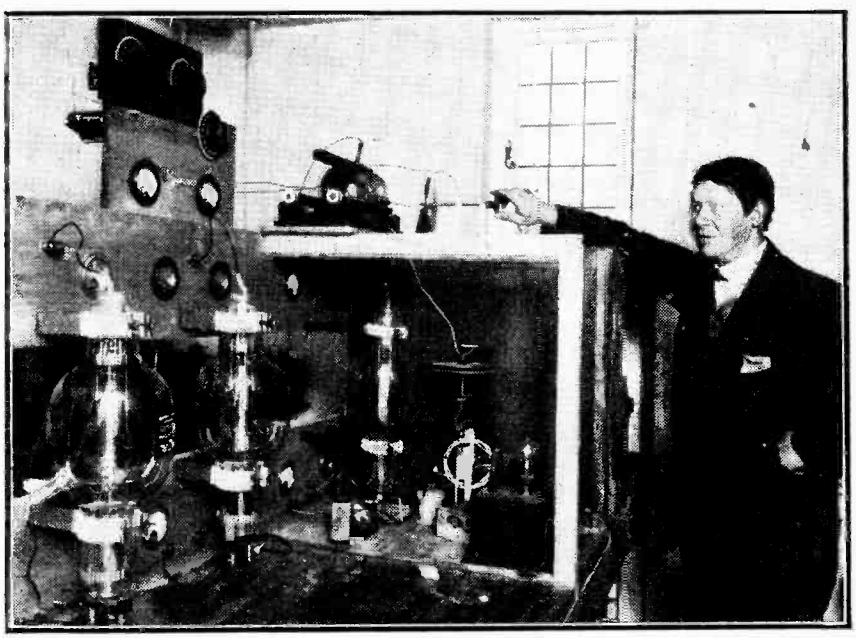
Broadcasting the Gramophone.

Among those who do not object to the broadcasting of gramophone records there



AMATEUR BROADCASTING TO THE EMPIRE. Mr. Gerald Marcuse with his latest transmitter at 2NM, the station which has now become familiar to listeners in most parts of the world. Mr. Marcuse scored a new success on November 11th when his relay of the Albert Hall Armistice Concert was heard in Bombay.

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is a growing tendency towards the view that, to quote a critic, "the gramophone over the wireless cannot be distinguished from the real thing."

This is highly discrediting to the modern wireless receiver, but fortunately it is not true—unless by "the real thing" the writer and his supporters mean "the real gramophone." And if they mean this their remark discredits the modern gramophone, for the microphone does not deal kindly with needle scratch.

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Thin Edge of the Wedge?

There is a sinister side to the newest programme development, in accordance with which parents were asked to leave the room while the children listened to a broadcast lesson in conjuring.

In time this sort of thing may lead to more serious requests. Husbands will be asked to leave the apartment while their wives listen to confidential chat on the latest, and most expensive, headgear—with appalling consequences. Husbands, of course, might get their turn, but under such circumstances what wife would go out of the room?

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Song of the Saw.

A number of musical instruments, long since forgotten, have been disinterred since broadcasting started as a new agency of sound. Ingenious minds, too, have introduced various implements which only become musical instruments when they are heard by the listener on wireless. The Geddes Brothers, at 2LO on December 12th, will demonstrate to listeners that the saw can be made to produce sweet tones instead of the grating noises with which it is associated in the hands of the carpenter. The Geddes will also play banjos, ocarinas, and other instruments.

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A Granville Bantock Event.

Sir Hamilton Harty will conduct the Wireless Symphony Orchestra at 2LO on December 11th, when Bantock's "Song of Songs" is to be broadcast. The soloists are Dorothy Silk, Trefor Jones, and Norman Allin.

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The Prince.

The Prince of Wales' address at the Toc H birthday festival at the Royal Albert Hall on December 3rd will be relayed to 2LO and 5XX.

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Impersonations at 2LO.

Mona Grey, whose impersonations attracted a good deal of attention among listeners when she took part in the broadcast of the Royal Command Variety Performance early this year, will appear before the microphone at 2LO on December 8th.

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Broadcasting Famous Paris Concerts.

It is interesting to learn that the Ecole Supérieure broadcasting station (458 metres) has begun to relay twice weekly the famous "Pasdeloup" concerts from the Theâtre Mogador in Paris. These concerts, which take place every Saturday and Sunday from about 5.15 p.m.-7.30 p.m. (G.M.T.), were founded as popular concerts by Jules Etienne Pasdeloup, the famous French pianist and conductor, in 1861, and since then have been given regularly. They are among the most excellent of the regular Continental concert events.

FUTURE FEATURES.

London and Daventry (5XX).

DEC. 4TH.—Orchestral Concert.
DEC. 5TH.—Variety Programme.
DEC. 6TH.—Military Band Concert.
DEC. 7TH.—Popular Orchestral Concert.
DEC. 8TH.—Ballad Concert.
DEC. 9TH.—Concert by the People's Concert Society.
DEC. 10TH.—"The Show Boat," a revue.

Daventry Exp. (5GB).

DEC. 4TH.—A Programme of Spanish Music.
DEC. 5TH.—Chamber Music.
DEC. 6TH.—"Cinderella Married," a hitherto untold story by Rachel Lyman Field.
DEC. 7TH.—"The Travelling Companion," an opera in four acts.
DEC. 8TH.—"St. Francis d'Assisi," a play in five scenes by J. Vaughan Hamett.
DEC. 9TH.—Variety Programme.
DEC. 10TH.—"Dancing Time."

Cardiff.

DEC. 4TH.—First Concert of the Cardiff Musical Society's Season—1927-1928.
DEC. 7TH.—"The Travelling Companion," an opera in four acts.

Manchester.

DEC. 10TH.—"The Picture that Lied," by Edwin Lewis, and "After the Theatre," a drama in one act, by Michael Morton and Peter Traill.

Newcastle.

DEC. 4TH.—Religious Service from St. Nicholas Cathedral. Address by the Lord Bishop of Newcastle-on-Tyne.

Glasgow.

DEC. 5TH.—A Gaelic Evening, provided by the Glasgow Gaelic Musical Association.

Aberdeen.

DEC. 6TH.—Scottish Variety.

Belfast.

DEC. 5TH.—A Scandinavian Programme.
DEC. 8TH.—A Shakespeare Programme.

For Our Grandchildren.

In A.D. 1977 visitors to the Natural History Museum at South Kensington will take a good-natured interest in a document which has just been deposited in the archives of that institution by the Amplion people. The document, which accompanies a number of gramophone records, describes very minutely the Amplion public address system used in conjunction with these records for the natural history film "Chang" at the Plaza Theatre. The sealed box in which these relics are placed must not be opened for fifty years.

Here is a tip for the B.B.C.. In fifty years' time, when television will have put present-day broadcasting on a par with daguerretypes, sedan chairs, and back-scratchers, a sort of Joanna Southcott box containing B.B.C. relics of 1927 would show our grandchildren that, at all events, our intentions were honourable, even if we did talk a little too much and cull our music from negro kitchens.

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Filling the Box.

What should we put in the box? Not too many things, I hope, but just enough to give a more or less true impression of a day at Savoy Hill. A dozen objects like the following should suffice:—

(*a*) Bit of tape, red, officials, for the use of.
(*b*) Page from Visitors' Book, showing signatures of
  (i.) A man who thought he could interview the Governors.
  (ii.) A person who used the Savoy Hill pen (A.D. 1924);
  (iii.) An artist, if possible.
(*c*) Pipe from old-fashioned organ in No. 7 studio.
(*d*) Portrait of Captain Eckersley.
(*e*) Pianola roll, much used.
(*f*) Letter from satisfied listener, if obtainable.
(*g*) Worn-out gramophone handle.
(*h*) Typescript of typical talk (not more than 25,000 words or 99 pages).
(*i*) Gramophone record of commissionaire saying: "You didn't ought to 'ave come to-day; 'owever, I'll henquire if our Education Department 'as arrived."
(*j*) Another portrait of Captain Eckersley.
(*k*) Photograph of studio audience (if he has not gone home) during poetry reading.
(*l*) Engineer's diary (expurgated).

That ought to make our grandchildren think.

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How Denmark Uses Listeners' Money.

Half of Denmark's listening population reside in Copenhagen, according to a correspondent in that city, who says that the number of licensed sets has now risen to 150,000.

The annual licence fee is 10 kroner (about 11 shillings), and practically the whole of the revenue received goes towards the compilation of broadcasting programmes. If the same could be said regarding the income from licences in this country . . . but this is a dangerous subject. In any case, the present programmes could hardly be improved, could they? (confused cries from the gallery).

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***Truth* and Broadcasting.**

In its Fifty-First Christmas Number, *Truth* has taken up broadcasting and presents, among numerous other attractions, a complete "wireless" programme for Christmas Day, modelled on the B.B.C. published programmes. The programme extends from 6 a.m. till after midnight, and the broadcasters are all people that the public will be glad to hear. There are unlimited openings here all through the day for the good-humoured fun and social and political satire in which *Truth* specialises at Christmas, and both writers and artists have made the most of their openings, with excellent results.

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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.

H.T. ACCUMULATOR CHARGING.

Sir,—I am glad to see that Mr. Bullock has raised the question of the price for charging high-tension accumulators, as there is a danger of restricting the use of these admirable batteries by reason of the exorbitant prices demanded in different districts for charging them. In Harrow one firm ask 5s. for the battery mentioned by your correspondent, whereas an Exide station at Richmond are content with a demand of 2s. 3d. The amount of current used is negligible, but bench space is taken up for some twenty hours if the correct charging current of one-eighth amp. is applied. One must make allowance for this and for the "topping" by distilled water, but, in spite of these factors, the usual charge demanded is out of all proportion to the service rendered. The position should be ventilated if progress is not to be hindered.

Harrow. "WIRELESS."

November 10th, 1927.

Sir,—I have used high-tension accumulators for nearly three years, with very satisfactory results, and should like to put in a word for that rather rare individual, the really conscientious wireless battery charger. I have been informed, and firmly believe, that if the work is done properly it does not pay even at the standard rate of 5s. for 120 volts. Your correspondent, Mr. Bullock, has forgotten the all-important time factor. Many dealers do not trust charging work to subordinates, but attend to it themselves in order to help trade by that very good method—making a satisfied customer. High-tension cells are very often tiny things and may, if of the older type, have tightly fitting rubber caps which have to be lifted to see the acid level. The dealer, to do his work properly, has to check that level in *each cell*, and, if necessary, top up. As often as not, a few of the cells show low specific gravity and have to receive extra individual charging treatment if the battery is going to function as it ought. In addition, the whole battery has to be cleaned and connections examined.

You will, I think, agree that the cost of the current used is not a very important factor in the charge made to the customer for the type of dealer who does not merely put the battery on and take it off again when some of the cells froth a little. MARSHALL J. ROBB.

Aberdeen.

November 10th, 1927.

Sir,—May I be permitted to reply to Mr. Bullock's letter in the November 9th issue, on the subject of "outrageous" charges for recharging high-tension accumulators.

When a high-tension accumulator is brought in for recharging we first remove sixty small vent plugs. We then go round with a small squirt and "top up" sixty cells, many of which are frequently half-empty, so that it would be positively dangerous to charge them without first "topping." The battery is then connected to the charging circuit, and the current is adjusted to the makers' rating. Every two or three hours, for perhaps 24 hours or more, the battery is examined and the current is readjusted to guard against possible overheating. When the battery is taken off charge perhaps a dozen cells taken at random are tested for specific gravity; then sixty small cells are once more topped up to compensate for evaporation during charging, and sixty vents are replaced.

Now comes a most important process which, I fear, is frequently neglected. The tops of the blocks, or the sides of the cells, are brushed over with ammonia, and the units are finally dried off. This is done to neutralise the acid spray, which will otherwise cause very serious leakage of current, due to the high potential and small capacity of the battery.

Now, Mr. Bullock, is 4s. 6d., or even 6s., "outrageous"? If the job is done conscientiously, it is *not*.

There are two sides to every question, and perhaps this letter may help to remove the common misapprehension among those outside the business that accumulator recharging is "a very paying proposition." B. CURTIS ELLIOTT.

London, W.13.

November 12th, 1927.

MORSE INTERFERENCE.

Sir,—In order to clear up certain points which recent correspondence on this subject has elicited, may I summarise briefly my views with special regard to Mr. J. B. Wilson's and "Sea-Going Operator's" letters in your November 16th issue?

(1) The second paragraph of my letter of October 20th is not disputed. If, therefore, a reliable C.W. apparatus for safety purposes is to-day technically possible, it follows that such apparatus should be developed and that international legislation be framed for the furtherance of its use as speedily as possible.

(2) I have *not* claimed that C.W. on 600 metres should be used for "traffic." On the contrary, I claim that so far as ships are concerned there is no necessity for the use of this wavelength at all, when by international agreement an alternative longer wave for the distress signal and call has been allocated. By this means a wider band of useful frequencies will be available for broadcasting, and it is this, I believe, the public desire.

(3) Mr. Wilson agrees with me that once the present Auto-Alarms are installed in large numbers it will be extremely difficult to compel further change. This is such an important phase of the situation that it forms an overwhelming argument against their extended adoption until the final conclusions of the Washington Conference have materialised and frequency bands for the various services throughout the world adjusted.

The gist of "Sea-Going Operator's" letter can be summed up as follows: Present conditions are chaotic, therefore for heaven's sake don't attempt to improve them lest they become worse. There is nothing of a constructive character in their letter. There are many "vapouring theoretical amateurs" in this country who can design C.W. transmitters which will not change their wavelengths when the ship rolls.

There is nothing in my letter which casts a slur on sea-going operators, nor have I anything but praise for the way they "carry on" in spite of the apparatus with which they are provided and other difficult conditions.

My object was rather to show that to-day, as in the past, far too much importance is attached to "commercial expediency" to the detriment of technical efficiency.

I am asked: "Since when has broadcasting been a vital wireless service?" The word "vital" may be open to objection if used in its strict dictionary sense, in which case it logically follows that no wireless service comes under this category. I used the word in its relative sense. We may agree, perhaps, that sometimes there is a little vitality indicated in broadcast transmissions.

Finally, a word or two on the third paragraph of Mr. Wilson's reply. I am one of those who have no faith in leaving matters of *policy* to technical experts. It is for the communities to instruct their Governments as to what they desire and to make sure *that the experts understand the requirements* before proceeding to utilise their "expertness" in working out

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the details. Hence the necessity for reports as to what takes place at conferences and the reasons for proposals submitted.

For instance, supposing one of the experts puts forward the claim that 5XX is to be shut down. The public in this country who have subscribed the money for this station have a right to demand where he obtained his authority for so doing and the reasons underlying the claim.

At present, as might be expected, the public know nothing of what transpired at Washington last month, and therefore, unless it rouses itself to demand full particulars, it must put up with the consequences. MAURICE CHILD.

London, N.W.2.
November 17th, 1927.

Sir,—Might I add a few words to the controversy regarding interference caused by spark telegraphy transmissions?

The majority of complaints are only too well founded, but the charges are largely brought by those who are not sufficiently well informed. On the other hand, those writers who defend the "sea-going operator" assume that they are personally charged.

Spark interference is exceptionally bad even on the "Everyman Four" as far inland as Colchester, and is almost entirely due to French coastal stations and ships communicating with them. The French station FFB, in particular, on a nominal wavelength of 300 metres can be tuned in at deafening strength anywhere between 200 and 600 metres even when four tuned circuits are employed.

On the East Coast severe interference is experienced from the Harwich-Zeebrugge boats, but, apart from this, I feel bound to congratulate the British ship and shore operators on the loose coupling they employ. I should imagine that the interference suffered on the South Coast is almost entirely due to foreign ships, many of whom use their call-letters an unnecessary number of times and transmit an almost unending dash without the slightest apparent provocation.

The nuisance would be considerably mitigated if steps were taken to enforce the international regulations laid down for the conduct of wireless signalling at sea, in which stringent rules are set out regarding the emission of heavily damped waves.

In pre-broadcasting days operators were provided with forms for notifying the P.M.G. of offences of this description irrespective of the offender's nationality, and if this practice were revived it is possible that the harassed listener might feel some benefit. HENRY C. RYLATT.

Colchester.
November 19th, 1927.

Sir,—From correspondence in your columns I gather that the East, South, and West Coasts and part of Scotland all depend solely on Daventry. Why not have two long-wave stations? Present the people at Geneva with (say) Bournemouth's wavelength, and ask for something in the neighbourhood of 1,900 metres. Then all the "out-of-the-way" people who at present have no prospect of any alternative programmes, as long as they are confined to Morse wavelengths, would be appeased. Admittedly the direct wave of a broadcasting station is the only one taken into account, yet nobody seems to want those frequencies which give the best direct wave. If 50 kW. were given to the two Daventry stations on long waves, the "out-of-the-way" people would probably do with 2- or at most 3-valve sets, while everyone else would get a third alternative programme.

Cromer. "EAST COASTER."
November 18th, 1927.

Sir,—While I entirely agree that safety of life at sea must take precedence over amateur wireless and broadcasting, there are other sources of Morse interference which seem unnecessary, inasmuch as the communications concerned could in most cases be established through other media than the ether. In particular I would draw attention to the police transmissions to which you refer in "Current Topics" in the November 16th issue.

Broadcast reception in the Preston district is spoilt by messages continuously sent out by the County Police relating to stolen cars, pullets, cockerels, and other lost property. If messages of this nature *must* be sent by wireless, why cannot C.W. be made use of? At present the interference extends over the broadcast band from 250 to 500 metres, and to a lesser extent on 1,600.

A protest to the postmaster at Preston was sent some time ago; it was acknowledged, and possibly some steps were taken, for the police have jammed it into us more heavily than ever! A large petition to the B.B.C. is now being widely signed.

I therefore offer the Yorkshire listeners my sincere and heartfelt commiseration. "RE MORSE."

Preston, November 17th, 1927.

B.B.C. RECEPTION IN SCOTLAND.

Sir,—With reference to the letter from Mr. Bryan Groom in your issue of November 16th, it is well to remember that Galashiels is situated in the Vale of Gala, low down among the hills, similarly to the position of Hawick. Does the experience of Mr Horne and of Mr. Bryan Groom fairly represent that of the Border district as a whole? The results obtained at an elevation of some 300 feet near Melrose seem to cast the blame on the hilly nature of the country as much as upon the B.B.C.

Some years ago in East Kent it was noticed that Daventry was being received excellently on many loud-speakers in the town of Sandwich in the open marsh country. Reception at River, on the other hand, was very poor indeed on a three-valve set. In the latter case the aerial was high above the sea, but was set in the steep-sided valley which plunges down towards Dover. It was thought that this poor reception was due to screening by the hills, but the set was not examined carefully to determine whether it was efficient.

My own aerial is placed on the side of the valley of the Team. A crystal set attached to it will just make Daventry audible occasionally, while on this identical set, transferred to another aerial a couple of hundred feet higher up the hill, Daventry comes through with regularity and some strength.

Gateshead. GEORGE M. MEYER.
November 16th, 1927.

LOUD-SPEAKER MOVING COILS.

Sir,—With reference to Mr. A. R. Turpin's letter on the above subject in your issue of November 16th, there is, as far as I am aware, no reason why a step-down output transformer cannot be used to feed a loud-speaker moving coil with complete success. I would, in fact, go further and say that I have yet to hear one of these loud-speakers working on a choke-capacity output circuit with a rationally sized choke which had not a serious low tone resonance followed by a sharp low tone cut off, which does not seem to be present in others which are transformer operated.

It is not generally realised that an output transformer is handling several watts, and that therefore the several distortions due to comparatively obscure effects, such as the variation in permeability of the core, which may show up in inter-valve transformers which work on virtually no load, are completely masked.

From the point of view of reasonable flux densities in the core and lack of self-capacities in the windings the transformer is no more difficult to design than the choke; in fact, for certain conditions, such as push-pull amplification, it is easier.

One cannot leave the matter without referring to the kindred subject of the correct relation of the coil impedance to the output impedance of the set at, say, the secondary terminals of the output transformer. I raised this point in these columns some months ago, and, I am sorry to say, did not feel very satisfied or convinced by the answers received. As a result of experience and of conversations with engineers best in a position to know, I feel fairly confident that the effective output impedance of the set will gradually be made relatively higher as the construction of the loud-speakers becomes more perfect. With an output transformer that has been section wound one can alter the ratio (and therefore the output impedance) with ease, and so accommodate a range of loud-speakers varying both in impedance and excellence of construction.

London, S.W.20. D. KINGSBURY.
November 16th, 1927.

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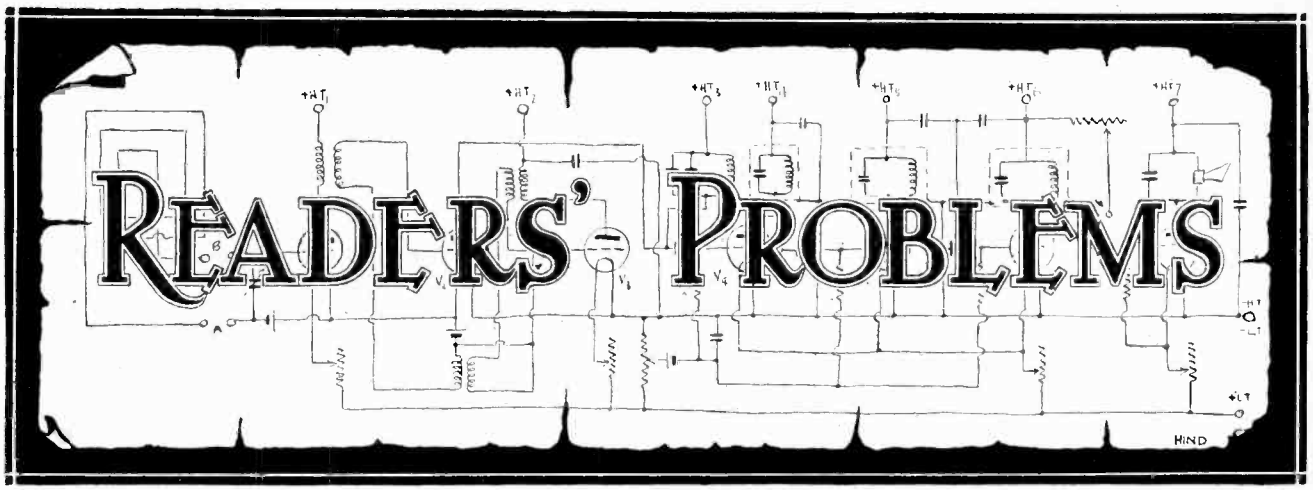

"The Wireless World" Supplies a Free Service of Technical Information.

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.

Converting a Loud-speaker.

I have an old type of horn loud-speaker, and should be glad if you will give me constructional details for converting it to the cone type, as I understand this latter type of loud-speaker gives much better quality.
E. T.

We greatly regret that it is not within the scope of the Information Department to give the constructional details you require. As you will appreciate, very detailed drawings and instructions would be necessary for this purpose. Apart from this, we do not think that it would be a practicable proposition to make the conversion you mention, and, if attempted, results would, in our opinion, be far from satisfactory. Speaking generally, a good type of cone loud-speaker is preferable to an ordinary horn type loud-speaker; but, at the same time, if not constructed in accordance with proper principles, a so-called cone loud-speaker can be productive of very bad distortion.

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The "Roberts Reflex Neutrodyne."

I have your issues dated July 1st, 1925, and June 23rd, 1926, in which are given constructional details of the "Roberts Reflex" receiver. Have you published any further details of this receiver showing the alterations necessary to bring it into line with modern practice? C. V. R.

We have published no further particulars concerning this receiver since the latter date mentioned. This instrument can no longer be said to be up to date, and we should not now advise you to build it. We think that you would obtain far greater satisfaction if you built a receiver not using the reflex principle, as with a "straight" circuit not only will much greater efficiency be obtained from the H.F. point of view, but much better quality also will be had.

RULES.

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

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

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

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

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

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

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

Increasing the Range of a Receiver.

I have a detector and L.F. set, and get several stations, but propose to add a second L.F. stage in order to bring in stations which at present I do not receive. Can you advise me of the form of L.F. coupling to use?
W. C. T.

Little or no extra range will be conferred on your receiver by the addition of an extra L.F. stage. The only effect will be that those stations which you can now hear at weak strength will be brought up to comfortable strength, and it is in this sense only that the range of the receiver is increased. We strongly advise the addition of a good H.F. stage.

Regulating Accumulator Charging Current.

I am using a commercial L.T. battery charger, which gives me a charging current of slightly over 1 ampere, the charger being of the "arc valve" type. I wish to reduce this charging rate to three-quarters of an ampere in order not to charge my small accumulator at a greater rate than that advised by its makers, and propose to cut down the charging current by putting a variable resistance in series with the filament of the arc valve. Is this in order? H. R.

We do not advise you under any circumstances to dim the brightness of your valve filament, as you are likely thereby seriously to impair the life of the valve. In our opinion it would be far better to include a variable resistance in the plate circuit of the valve; this resistance can have a maximum value of about 10 ohms, but, of course, it must be wound with a resistance wire of large enough gauge to pass the charging current without undue heating. The method of doing this is clearly shown in an article published in our October 5th issue.

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Supersonic I.F. Amplifiers.

What is the best wavelength to which the intermediate-frequency amplifier in a superheterodyne should be adjusted?
W. A. C.

The wavelength of the intermediate-frequency amplifier in a supersonic heterodyne receiver can be varied within wide limits without impairing the efficient performance of the receiver. For this reason it is not possible to state that any one wavelength will give better results than another. However, for the reception of the normal broadcast wavelengths, the intermediate-frequency amplifier may be adjusted to any wavelength between 6,000 metres and about 12,000 metres. Generally speaking, it is usual to employ an amplifier adjusted to a wavelength of the order of 8,000 metres.

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Adapting a Set for Gramophone Reproduction.

I have a detector and two L.F. set. The set is fitted with a reaction coil, and I use two stages of transformer-coupled low-frequency amplification. Can you tell me how to connect a gramophone pick-up? G. J. R.

Your best method would be to remove the two wires which go at present to the I.P. and O.P. terminals of the first L.F. transformer in your set (in the case of some makes of transformers these terminals are marked "Plate" and "H.T.+") and then connect two separate wires to the I.P. and O.P. terminals of the transformer, the other end of these two wires being attached to the pick-up.

You could conveniently insert a double-pole switch for changing over from "gramophone" to "wireless." You will merely have to remove the two wires at present running to the I.P. and O.P. terminals, and connect these wires to the pair of terminals at one end of a double-pole, double-throw switch, whilst two wires from the gramophone pick-up would connect from the two terminals to the other end of the D.P.D.T. switch. In addition, two wires will have to be connected from the I.P. and O.P. terminals of the transformer to the two centre contacts of the switch.

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Reception on an Indoor Aerial.

Owing to the absence of facilities for the erection of an outside aerial I have been using an indoor aerial consisting of four wires stretched across the room. The local station is received at very good strength on the "Everyman Four," but distant stations are only telephone strength. Can you suggest any method of improving reception without rebuilding the receiver? A. G.

When a very short aerial is used this should be connected *via* a 0.0002 mfd. fixed condenser to the grid end of the aerial-grid transformer, and not to terminals A, or A_2. Fig. 1 on this page clearly shows the suggested modification. Position 1 is the usual method of connecting the aerial wire, and position 2 the alternative connection.

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Special Types of L.T. Supply.

I propose using a "nickel-iron" type of low-tension cell for lighting the filaments of my valves. I understand that special precautions have to be taken with these cells as compared with the ordinary lead accumulator. If this is so, can you tell me what these precautions are? S. H.

It will be found that the ordinary "lead" accumulator maintains its voltage fairly constantly, almost up to the end of its charge, when the voltage drops comparatively constantly and quickly; one can, therefore, use fixed resistors in the set. The other type of cell you mention, if it is the type we think you refer to, does not maintain its voltage up to the same level throughout practically the whole of the charge, but the voltage drops steadily throughout the charge, somewhat in the manner of an ordinary dry cell. It is obvious, therefore, that there are difficulties in the way of using fixed resistors. One should use a variable resistance, which should be put to the "full in" position at the maximum of the charge, and the resistance gradually cut out during the period of discharge. This precaution is, of course, definitely not required with the ordinary accumulator.

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Pot Magnet Winding for 200 v. D.C.

On page 389 of "The Wireless World" of September 28th last you give a table of pot windings for the coil drive loud-speaker for different supply voltages. I wish to connect this to a 240-volt D.C. main, but require a greater field strength at the "gap" than could be obtained with the 200-volt windings recommended. Can you supply me with the required information? L. R.

A suitable winding for a 200 volts D.C. supply to dissipate a greater wattage than that given in the table could be obtained by winding the bobbin full with No. 36 S.W.G. single silk covered copper wire. This will give a field strength at the "gap" comparable with that obtained with the 6- or 8-volt windings.

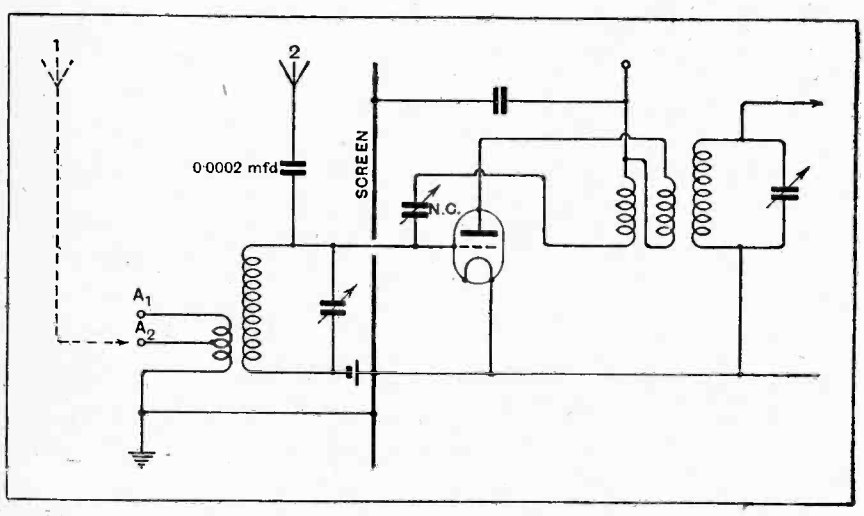

Fig. 1.—Modification of the "Everyman Four" to permit the use of short indoor aerials.

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A Straightforward One-valve Circuit.

I wish to build a single-valve set for the purpose of receiving distant stations on headphones with a minimum of expense, and should be glad if you will advise me of the circuit to adopt. R. G.

We think you could not do better than to construct a simple one-valve regenerative circuit, using the circuit which we show in Fig. 2. Ordinary plug-in coils could be used so that you could cover both the normal and the long B.B.C. stations, and also, if you so desire, use exceptionally large coils to receive the long-wave C.W. stations which may usually be heard at all times on a simple one-valve regenerative receiver.

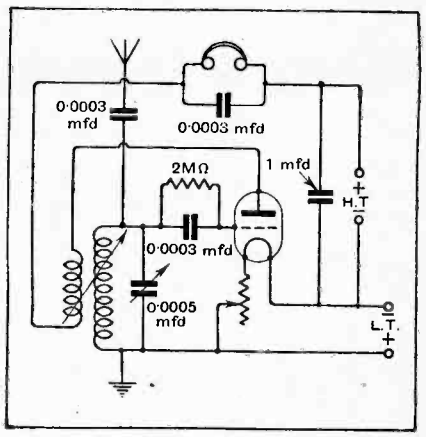

Fig. 2.—Simple single-valve circuits.

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A Question of Distortion.

I am using a two-valve set, detector and L.F. with reaction, but find that quality is very bad. I am using a 30,000-ohm valve as detector, and a proper power valve in the output stage. My high-tension battery is of the 50-volt super-capacity type. Can you tell me what is likely to be the trouble? C. L.

It would appear from your letter that you are only using 50 volts high tension on both valves. Whilst this voltage is ample for the detector valve, it is by no means sufficient for the L.F. valve, and amplitude distortion is bound to occur if you are using this low anode voltage on the output valve. It does not matter in the least that your 50-volt battery is of the super-capacity type, this having no bearing on the H.T. voltage; in fact, if you were using 120 volts supplied by the very small cell type of H.T. battery you would get far better quality than with a 50-volt super-capacity type. Your voltage on the last valve should be at least 100 and preferably greater, and you will therefore have to purchase an additional battery.

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