The Wireless World AND RADIO REVIEW

(16th Year of Publication)

No. 484. WEDNESDAY, DECEMBER 5TH, 1928. VOL. XXIII. No. 23.

Editor: HUGH S. POCOCK.

Assistant Editor: F. H. HAYNES.

Editorial Offices: 116-117, FLEET STREET, LONDON, E.C.4

Editorial Telephone: City 9472 (5 lines).

Advertising and Publishing Offices:

DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: Ethaworld, Fleet, London."

COVENTRY: Hertford Street.

Telegrams: "Cyclist, Coventry." *Telephone:* 5210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street.

Telegrams: "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 260, Deansgate.

Telegrams: "Iliffe, Manchester." *Telephone:* 8970 City (4 lines).

PUBLISHED WEEKLY.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

Entered as Second Class Matter at New York, N.Y.

CONTENTS OF THIS ISSUE.

ALLOCATION OF WAVELENGTHS FOR BROADCASTING.

WHEN broadcasting in Europe started there was practically no machinery of any kind in operation to control, internationally, the choice of wavebands used by the different countries. At first this mattered very little, for in the wavebands available there was plenty of room for a limited number of stations to work, but as more and more stations were put up the question of mutual interference began to take definite shape as one of the most difficult problems requiring to be settled by mutual agreement if broadcasting throughout Europe was to be developed on harmonious lines.

It is not proposed here to offer another to a number of tentative solutions of the difficulty which have already been put forward by those whose business it is to study the problem, but in order that the difficulties may be realised it is, perhaps, of interest to consider what factors must be regarded as governing any general agreement which may be reached as a development of the present basis which was agreed at Geneva as providing a provisional solution. It has been generally conceded that area and population of a country must be the principal factors in deciding upon the power and number of broadcasting stations to which that country is entitled. Then the geographical distribution of the country and a consideration of whether the area over which the transmissions are to be made is mountainous or otherwise, must be taken into account, and it has even been suggested that these factors can be so combined as to provide a simple formula from which the rights of every country can be appraised, and that such a formula will also permit of countries having the choice of a few high-powered stations or many low-powered ones, without upsetting the principle.

Thus far it might be possible to distribute stations without serious difficulties were it not for the fact that we have to consider, in addition, the relative efficiencies of various wavelengths for the purpose of broadcasting. The shorter wavelengths of the normal broadcast band, whilst enabling more stations to be accommodated, are by no means popular because they have not proved to be particularly suitable for the purpose, largely on account of fading. Wavelengths of a higher order, found most suitable for broadcasting purposes, are not sufficiently numerous to be allotted to all countries, although every country may covet them, and when the use of the long wavelengths is considered the difficulty immediately arises that it is not possible to accommodate more than half a dozen or so in Europe without mutual interference, so that here another factor arises which has to be taken into consideration in our formula, and is dependent on the relative efficiencies of different wavelengths for broadcasting purposes.

We have not yet completed the recital of the difficulties, for another consideration has recently been put forward as claiming the attention of those responsible for the distribution of stations. It is that the present system of giving satisfactory broadcast service to urban populations has had the result of neglecting rural communities, and is both unsatisfactory and unfair; it has been put forward by way of argument that the town-dweller already has at his disposal a surfeit of the amenities of civilisation and that his need for broadcast entertainment is far less than that of those who, on account of their location, find broadcasting an important and, perhaps, their sole form of entertainment and contact with the civilised world. Broadcasting means very much more to the isolated units of society than it does to others more favourably situated as far as intercourse with their fellows is concerned, but whether this can be taken into account to the extent of considering it as a prime factor in the distribution of stations has yet to be decided.

An Account of Broadcast Picture Reception with the Fultograph.

By "EMPIRICIST."

THE writer, perhaps as a favoured applicant, has just secured a picture-receiving outfit from the first batch of Fultograph machines to become available. The outfit comprises the picture-receiving machine, the rectifying panel with milliammeter and relay, a P.M.4DX valve, connecting leads and plugs, a quantity of picture-receiving paper, and a bottle of sensitising solution. Being identical in its design and operation to the instrument recently described in these pages,[1] no special instructions were sought from the manufacturers. After more than two years' contact with experimental picture reception little novelty attached to the inception of this new machine. It was not to be appreciated merely as a sensation, but rather by the merit of the results secured.

It is doubtful if many listeners are aware that the B.B.C. are regularly transmitting pictures by the Fultograph system, or if they are so informed, at what hour these transmissions are made. Details of the picture broadcasts are not to be found in the programmes published in the B.B.C. official organ or the columns of the daily Press. These "secret" transmissions are made daily from Daventry 5XX at 2 p.m. Listeners finding this hour inconvenient may have hopes of a week-end midday transmission, but will find that Sundays are excepted. Fortunately, an evening transmission is made up by certain of the Continental stations.

Selectivity an Essential.

On the day on which the first tests were made with the new machine the writer had the opportunity of testing its performance on the inaugural picture transmissions from Konigswusterhausen, which, by the way, uses the Fultograph system. Thus, its pictures can be received on the apparatus available in this country. A very real difficulty was met with in that the wavelength used is 1,649 metres, which almost breaks into the high note modulation of Daventry, and jamming is probable. Not very hopeful, therefore, were the prospects for the first night's test in which a picture transmission was to be received that is normally so completely obliterated by Daventry that its existence is practically unknown in this country.[2] In spite of these adverse conditions of range and selectivity, it is necessary to create a signal that will unfailingly actuate the relay. To use a frame aerial was, therefore, essential, and to this was coupled an H.F. amplifier, an H.L.610 anode bend detector and a single L.F. stage with a P625 valve. Critical manipulation of the frame, the tuning dials, and the volume control reduced the Daventry transmission to extinction so that a talk which was in progress from the German station was just audible on the loud speaker.

Operates with Weak Signals.

To connect up the picture machine was the work of a few minutes, as all the necessary leads are made up and terminated on multi-ended plugs. By throwing its switch to "on" it was noted that the modulated signals of the speech transmission produced an average current in the anode circuit of the additional rectifying valve well in excess of 5 mA., the full scale reading of its meter. It should be noted here that the P.M.4DX has a mutual conductance of approximately 2, which means that were there no resistance into anode circuit a current change of 2 mA. would be produced for every volt change applied to its grid. Actually the output valve of a receiving set may be handling a voltage swing of 30 or more peak volts, which multiplied by its amplification

[1] First published description of the Fultograph. *The Wireless World*, October 24th, 1928.

[2] Not to be confused with the Konigswusterhausen transmission on 1,250 metres.

An Hour with a Picture Receiver.—

factor, probably 5, as well as the ratio of the transformer fitted as an input to the rectifying valve of 6 to 1, gives rise to a current change enormously in excess of requirements. A mean current of some 3 mA. only is required to work the Fultograph, so that two-stage L.F. amplifiers are not wanted as an input, while the signal required to produce audibility from a loud speaker is much in excess of that required for picture reception. With any given combination of valves, therefore, a good picture can be received from a distant station whose signals are too weak for loud speaker reproduction. From these observations it is evident that a critical input is called for which, in turn, demands a good volume control. This control should preferably be independent of the tuning adjustments and might well be fitted to the rectifier panel.

As synchronising is effected by a momentary signal which restarts the cylinder at each rotation, it is obvious that the machine must start in step or its automatic switching cams will not bring the relay into operation at the right moment preceding the transmission of the dot which on each revolution restores rotation. Thus, the cylinder must start right, and the procedure, until it becomes a habit, is a little tricky. To switch in the machine too early means that the relay will be actuated by the tail-end of the preceding announcement or tuning note. To switch in too late, that is after the picture has started, means that the synchronising signal will not be found among the interruptions composing the picture and the machine will run on unchecked.

After the warning "*Achtung! Achtung!*" from the German station a tuning note facilitated the adjustment of signal strength, during which period the moistened paper was prepared and clipped to the cylinder. Then came a period of silence, during which time the clockwork was released, rotation being held by the relay. Next a series of properly spaced synchronising dots let go the cylinder for three or four successive revolutions, indicating everything to be in order. Then followed the picture. On the first attempt, however, synchronising was almost immediately lost as a result of the relay being released by the "mush" that was brought in in a foolish endeavour to augment the signal strength. The effect was that a heavy marking occurred on the left-hand side of the picture.[3] It is here suggested that a check-squared pattern $\frac{1}{8}$in. in width on the edge of every picture would be reassuring to the user that his machine is running correctly, for the detail of the start of a picture usually affords very little clue. Picture No. 1 embodies the experience gained during the former reception, and the black lines which disfigure it are the record of high-pitched notes from the Daventry transmission.

For picture No. 2 signal strength was cut down far

(Left, No. 1) The dark vertical markings are due to interference from 5XX, which has a frequency difference of only 10 kC with Konigswusterhausen.
(Above, No. 2) A less dense picture produced by a weaker signal and in which the Daventry interference has almost disappeared.
(Right, No. 3) A radio picture from Paris. The system employed has a different rate of traverse to that provided on the receiving machine, resulting in an elongation of the image.

[3] Reproduced on page 727, *The Wireless World*, November 28th, 1928.

An Hour with a Picture Receiver.—

below the audibility point, and with no other clue than the picture itself there was a danger of picture reception fading out entirely, as evidenced by the lighter portion which is just discernible half-way across. A "line" image, being a readily readable penned announcement of greeting from Berlin, was the fourth picture transmitted.

Following a now routine procedure from picture to picture, another piece of paper was prepared with great haste and clipped in readiness on the cylinder, pending being set in rotation by an incoming signal. Konigswusterhausen had finished, however, yet a slight movement of the tuning dial set our picture receiver going on a transmission from another source. This time it was Radio Paris giving us a parallel transmission of its celebrities, but unfortunately the conditions at the transmitter did not quite correspond with those to which our receiver was adjusted. As a result picture No. 3 is elongated. Synchronisation was intermittently lost during the recording of two subsequent pictures from the Paris station, the trouble being due to the slight unsuitability of their system. The pictures became marked, and are therefore not reproduced here, but there was no difficulty in identifying the notable personages they represented.

Now that there is an indication that picture-receiving machines are coming into more general use it is hoped that a British transmission, perhaps even on a normal broadcasting wavelength, may be arranged at a time reasonably convenient to the average listener. Quite a low power transmission could serve the whole of this country, and in order not to interrupt the normal service to listeners, may it be suggested that an all picture transmission from a low power station would do much to develop interest.

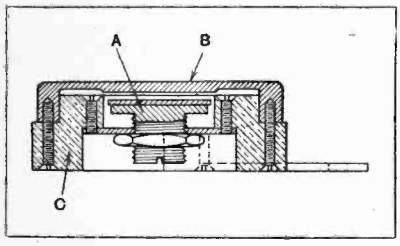
INVENTIONS OF WIRELESS INTEREST.

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.

Piezo Crystal Holder. (No. 277,330.)

Convention date (U.S.A.): September 13th, 1926.

A crystal holder, especially suitable for mounting quartz and other piezo oscillators, consists of a central screw-



A protective holder for crystals. (No. 277,330.)

adjusted electrode A surrounded and protected by a cup-shaped electrode B firmly screwed on to a support C of suitable insulating material. The crystal is mounted upon the central electrode A. The holder protects the crystal from dust and dirt, whilst the effect of temperature variations in altering the electrode spacing, and consequently the effective capacity of the unit, is minimised.

Patent issued to Westinghouse Electric Co.

oooo

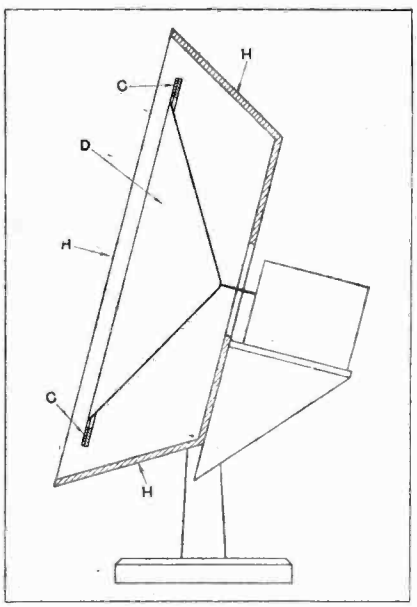
Loud Speakers. (No. 290,344.)

Application date: February 9th, 1927.

A conical diaphragm D is mounted inside a shallow horn H so that the resulting sound waves are propagated directly from the front surface of the diaphragm, and also by reflection from the rear surface. The diaphragm is supported peripherally from a rigid ring C by cutting away the material forming the cone except at three points. This method of suspension is stated to ensure that a substantial portion of the vibration is a direct to-and-fro or piston action, whilst the remainder of the diaphragm vibrates by flexure about the ring support.

The general pitch of the system is controlled by moving the cone D towards or away from the resonator or horn H. The conical diaphragm may be so constructed that its thickness increases gradually from the periphery to the centre. The combination of the cone with the shallow horn resonator is stated to result in a high standard of reproduction.

Patent issued to C. Mahé de Chenal de la Bourdonnais.



Loud speaker so designed that a substantial part of the vibration consists of a piston action. (No 290,344.)

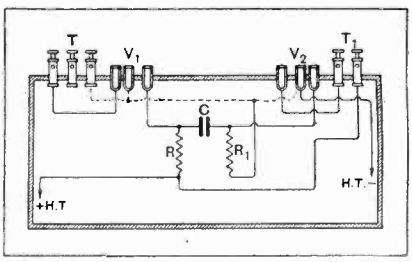
oooo

A Battery-receiver Unit. (No. 290,350.)

Application date: February 10th, 1927.

With a receiver using resistance-capacity coupling, the cost of the coupling unit is relatively small by comparison with that of the H.T. battery. For a small additional charge the H.T. battery can therefore be adapted to serve as the actual receiver, by incorporating in it the necessary coupling unit, a few terminals, and two or more valve holders.

As shown in the illustration, a standard H.T. dry-cell battery is fitted with suitable terminals T, T1, with valve holders V1, V2, and with resistances R, R1, and a coupling condenser C, the latter being embedded in the usual insulating material used to fill up the spaces between the individual cell units. The outfit may

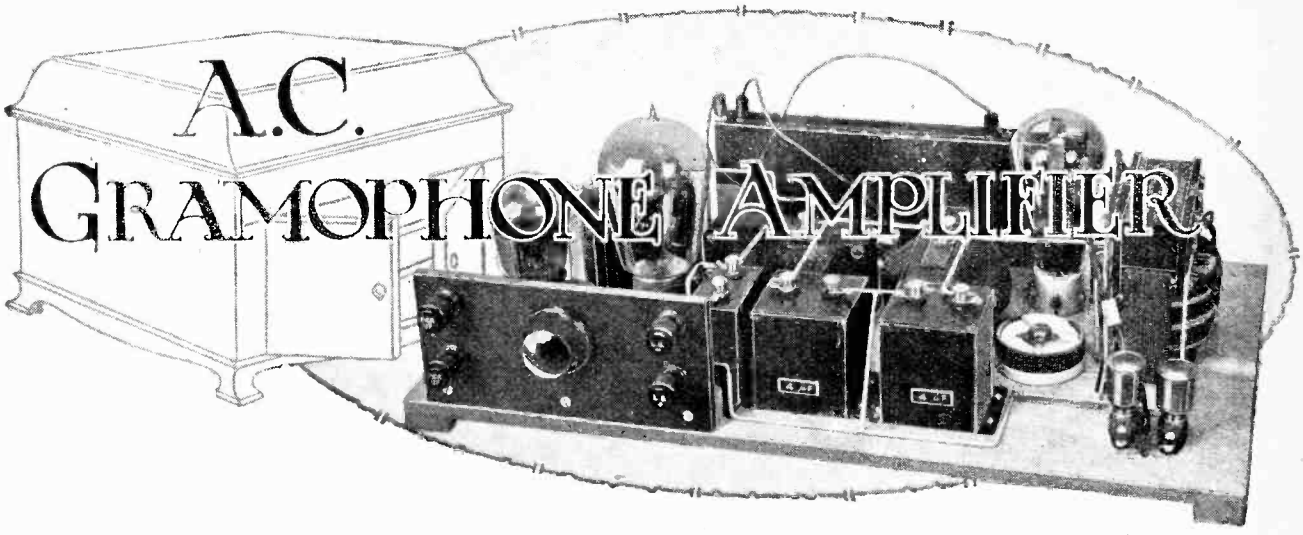


A high tension battery with resistance stage incorporated. (No. 290,350.)

comprise both H.T. and L.T. dry-cell units, the two battery sections being so designed as to last for an approximately equal time when fitted with dull-emitter valves of specified consumption.

Patent issued to the British Thomson Houston Co., Ltd.

A.C. GRAMOPHONE AMPLIFIER



An Interesting Amplifier for Both the Radiophile and the Gramophile.

By N. P. VINCER-MINTER.

SINCE most modern receivers are designed so that their low-frequency portions may be used as a gramophone amplifier, readers may well ask what advantage will they gain by building a separate amplifier. The answer is, of course, that they will gain no advantage whatever, and an amplifier separate from a wireless receiver is only useful under special circumstances. Such a device would be fully justified, however, even if its only good point was that, being solely an amplifier and therefore possessing no rectifier, the chances of obtaining poor quality are greatly lessened, since undoubtedly the detector is by far the weakest link in the wireless receiver from the point of view of quality of reproduction, notwithstanding the diode rectifier, which at the present moment is attracting a good deal of attention

Filament and Plate Current from the Mains.

Now the amplifier with which we are dealing here is designed to operate from A.C. mains of any standard voltage and periodicity, taking both H.T. and L.T. from the mains, grid bias being derived from a grid battery. The reason why no attempt has been made to dispense with the grid battery is that it is cheap to purchase and should last very many months. The provision of an extra power rectifying valve and its concomitant apparatus for the supply of grid bias would increase the initial cost of the amplifier to an absurd

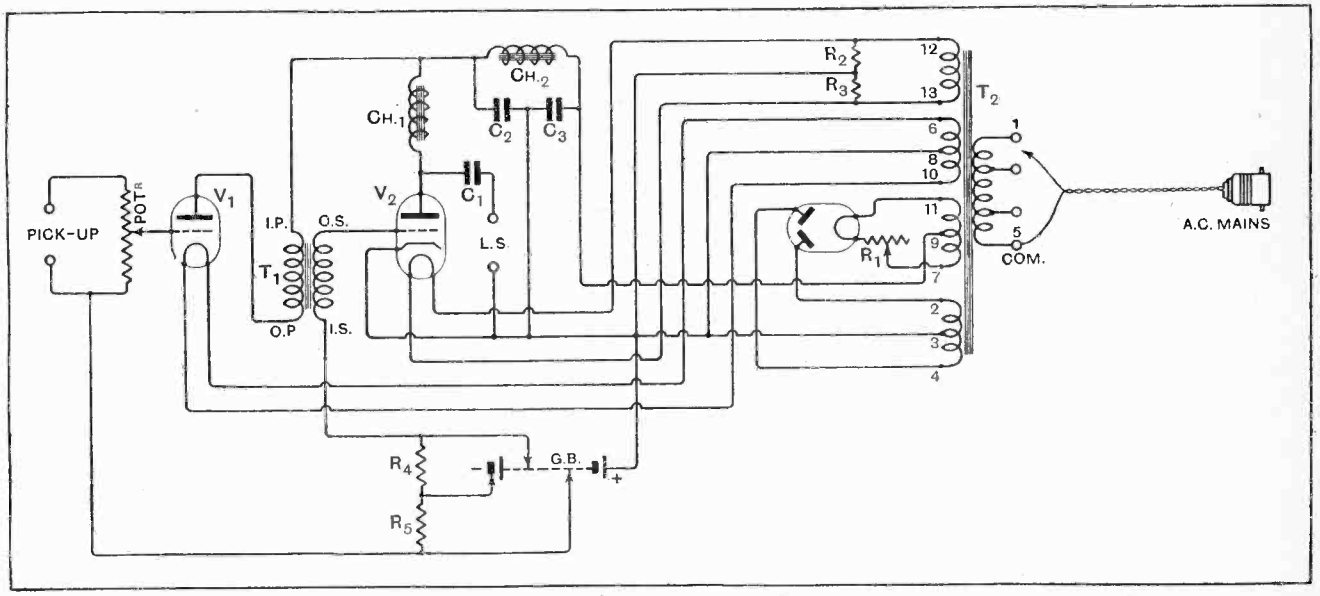


Fig. 1.—The theoretical circuit diagram, CH_1, 32 henrys; CH_2, 20 henrys; R_1, 2 ohms; R_2, R_3, 50 ohms; R_4, R_5, 5 megohms; T_1, intervalve transformer; T_2, mains transformer; C_1, 2 mfds.; C_2, C_3, 4 mfds.

A.C. Gramophone Amplifier.—

figure when the low cost and good service of a grid battery are taken into account, and, of course, no method of batteryless bias, other than the provision of an extra valve or metal oxide rectifier, is worth considering.

Although a practical wiring plan and dimensional layout will be found accompanying this article, it should be pointed out that this layout may be departed from with the utmost confidence as the whole apparatus is absolutely stable and hum-free, and, moreover, does not motorboat, except under very great provocation, such as would cause the best commercial battery eliminator (whichever that may be) to do likewise, at three speeds simultaneously. The whole apparatus may, as a matter of fact, be altered if desired, so that it will fit into a suit case, or into a suitable recess in a console type of gramophone. In this respect it is even better than the "A.C.2" receiver, described by the writer some time ago in this journal, and the actual way it is built up on a baseboard is probably the simplest and most straightforward that could be adopted. If anyone desires to build it up in this form, then the writer would suggest that a wooden cover be made after the fashion of the lid of a sewing machine, a recess being cut out, of course, for the ebonite strip holding the input and output terminals and the volume control. If this were done, suitable holes should be made in the baseboard and in the sides of the cover for ventilation purposes.

It will be noticed that no "on and off" switch is provided. This was left out as it is assumed that readers will simply connect the usual flexible cord to the primary winding of the power transformer as shown in the diagrams. If desired, however, there is ample space for an ordinary tumbler switch to be mounted on the baseboard. The flexible wire could then be anchored down permanently to the baseboard by the usual small ebonite strip so often used for this purpose.

Indirectly-heated A.C. Valve as Detector.

Now we come to the great and burning question of valves. As most readers know, it is customary to employ indirectly-heated cathode valves in any receiver or amplifier designed so that its L.T. supply is obtained from the electric lighting mains through the medium of a step-down power transformer. In a battery-operated receiver, the hot filament and the electron-emitting cathode are one and the same thing, but in the case of A.C. mains it is better for certain reasons and under certain circumstances to use a valve in which the filament is not required to act also as the cathode. It is not the intention of the writer to enter into these reasons again here, since he has already done so at some length in a previous issue of this journal. However, there are circumstances which render the indirectly-heated cathode valve not only unnecessary but undesirable in a certain portion of the receiver.

Now in the first place, even though we are not describing a wireless receiver, let it be asserted by the writer with profound emphasis, that as matters stand to-day no attempt should ever be made to use any but

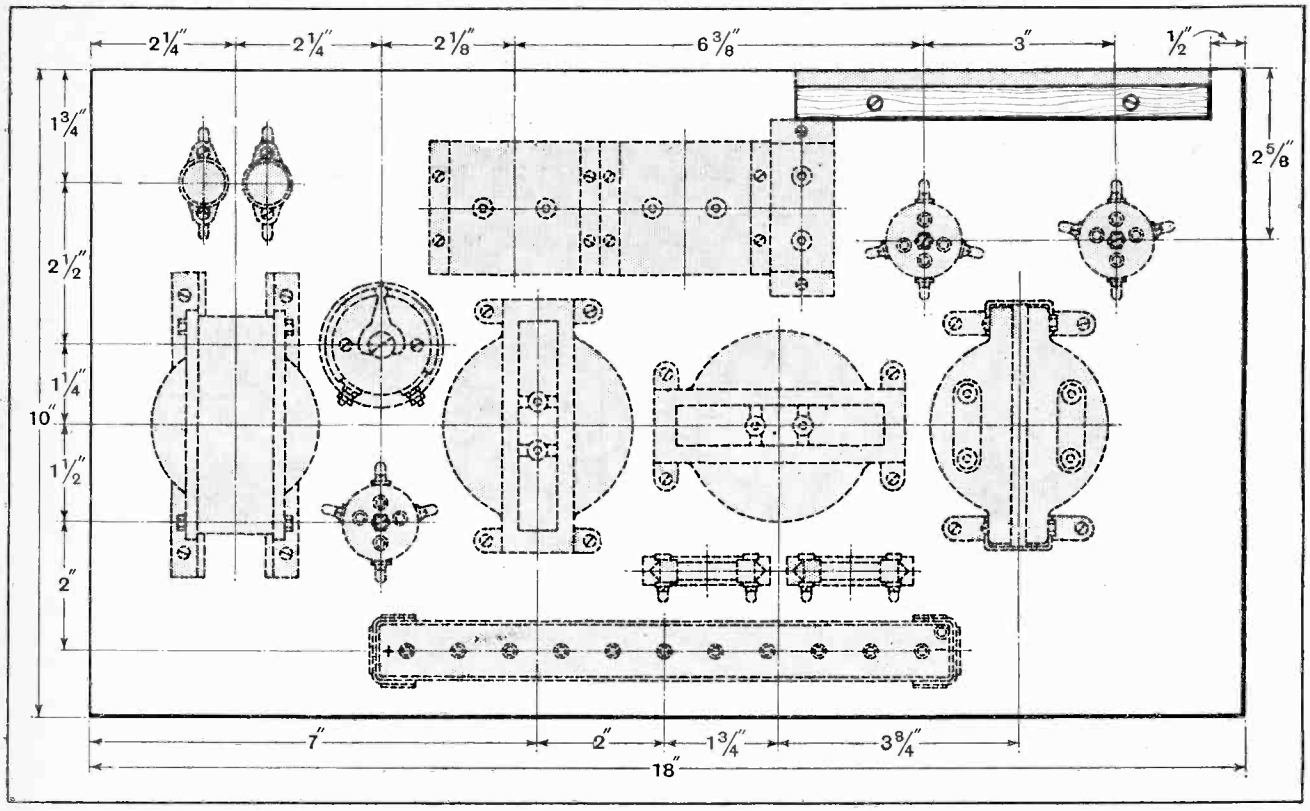
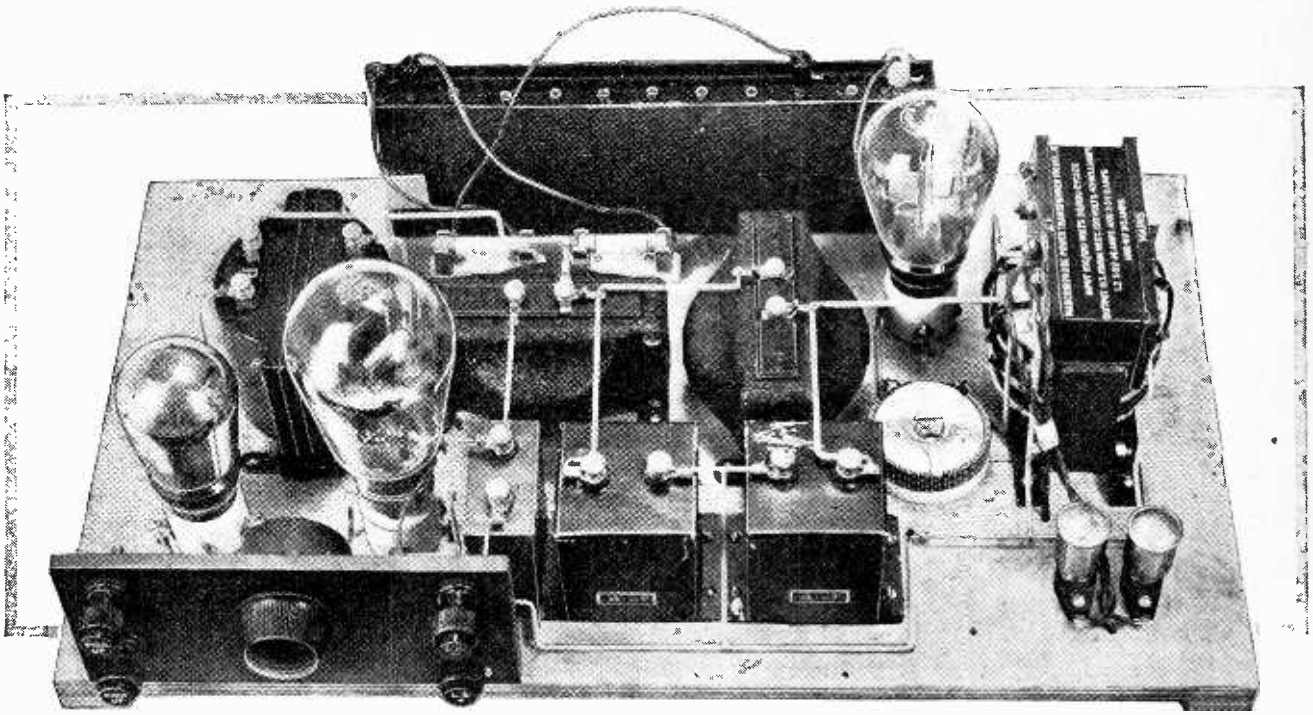


Fig. 2.—The baseboard layout.

A.C. Gramophone Amplifier.—

an indirectly-heated type of A.C. valve as a grid detector. This is a position where any form of directly-heated cathode valve fails miserably as a rule, and if by way of exception it should appear to work satisfactorily, one can confidently anticipate its ceasing to do so at any moment. In an amplifier, however, although the indirectly-heated cathode valve gives excellent results, the possibilities of replacing it by a valve of the directly-heated type must be considered. If the filament of an ordinary 0.1 ampere type of valve were fed from raw A.C. a hum would be heard due, among other things, to the fact that the filament temperature being low, it does not remain constant during one complete A.C. cycle, but tends to vary in temperature in step with the A.C. current passing through. By increasing the thickness of this filament and causing it to take a much heavier current, this disadvantage is greatly reduced. Suppose, therefore, we built the filament to consume 0.8 ampere instead of 0.1 ampere, what happens then?



A general view of the amplifier.

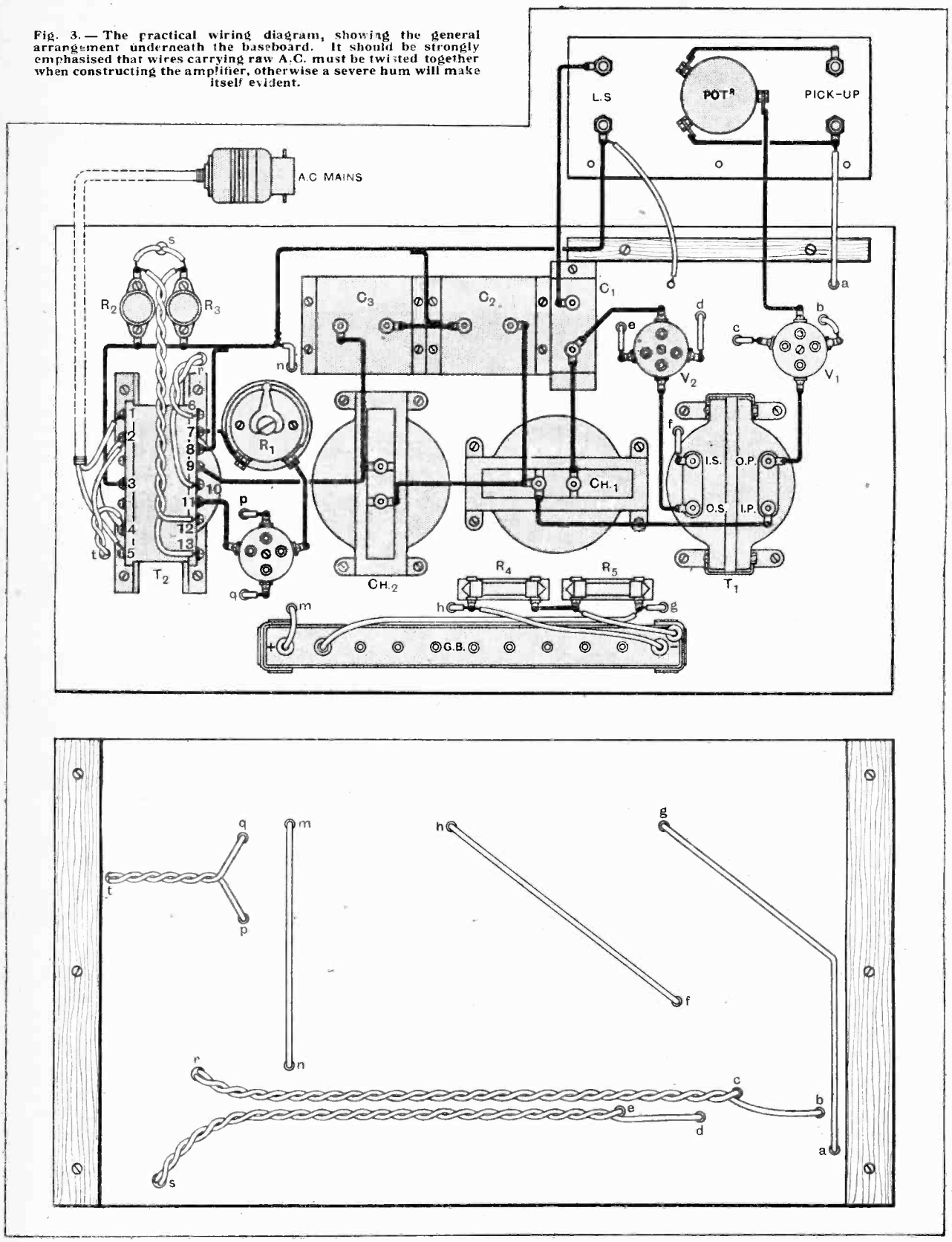
The New "Point Eight" Valves.

We find that the temperature is constant, and the hum tends to disappear, but we have very considerably increased the wattage demanded by our filament. We can easily restore this by dropping the voltage considerably, and by doing this we shall gain other advantages also, due to the resultant short filament. There are other advantageous points which cannot be considered here, however, as they have already been brought out in previous articles. Actually, the new directly-heated cathode A.C. valves that are upon the market consume 0.8 ampere at 0.8 volt, and for this reason they are usually referred to as "Point Eight" valves. There is, however, no magic either in the figure of 0.8 or in the fact that the figure for voltage and current is the same. These valves can be obtained with various characteristics. At the present time power transformers are obtainable which have both a 0.8 and a 3.5 volt winding, so that either these new valves or the older indirectly-heated cathode valves can be used as desired. In this amplifier a "Point Eight" valve is used in the first stage; the writer feels sure that someone will enquire why it is not possible to use an indirectly-heated valve like the K.L.1 in this position. There is, of course, no reason at all against this being done if desired, if the necessary alterations are made in the wiring. The "Point Eight" valve, however, requires less than one-tenth of the filament wattage demanded by the K.L.1 valve, whose consumption is 2 amperes at 3.5 volts.

It should be pointed out at this stage that the voltage amplification given by this valve and transformer stage is quite sufficient to amplify the input signals from average present-day pick-up to a sufficient intensity to cause overloading if presented to the grid of an ordinary super-power valve unless the signal input be reduced by use of the volume control. Moreover, the aforesaid super-power valve will overload before the first valve. This holds good for most pick-ups, with the exception of one or two whose generated E.M.F. is exceedingly small.

We have been assuming that our output valve is of the ordinary super-power valve class, but we must remember that we have to choose an *A.C.* valve for the

Fig. 3.—The practical wiring diagram, showing the general arrangement underneath the baseboard. It should be strongly emphasised that wires carrying raw A.C. must be twisted together when constructing the amplifier, otherwise a severe hum will make itself evident.



LIST OF PARTS.

1 Baseboard, 18 × 10 × ⅜in.
2 Baseboard battens, 10 × 1 × ⅜in.
1 Batten to support terminal strip, 6½ × 11/16 × ½in.
1 Ebonite terminal strip, 6½ × 3 × ¼in.
1 Power transformer (Model "M" Marconiphone).
1 L.F. choke, 20 henrys (Pye).
1 L.F. choke, 32 henrys (Pye).
2 Fixed condensers, 4 mfd. (Type "B.T." Dubilier).
1 Fixed condenser, 2 mfd. (Type "B.T." Dubilier).
1 Transformer 2.7 : 1 ("Ideal" Marconiphone).
1 Volume control ("Voluvernia." Gambrell).
3 Porcelain valve holders (Athol).
1 Fixed resistor, 2 ohms ("Pre-set," Igranic).
2 Grid leak holders (Bulgin).
2 Grid Leaks, 5 megohms (Ediswan).
2 Fixed resistors, 50 ohms (Burndept).
2 Holders for above (Burndept).
1 Pair grid battery clips (Bulgin).
1 Grid battery, 16½ volts (Ever-Ready).
3 Wander plugs (Lisenin).
4 Terminals, 2 Pick-up, 2 L.S. (Belling & Lee).
1 Length of flex.
1 Lamp socket adaptor.
No. 16 Tinned copper wire.
Sleeving for above.
Rubber-covered connecting wire.
Wood screws.

Approximate cost of parts (excluding valves), £6 17s. 6d.

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.

last stage. Looking at particulars supplied by manufacturers we find that an "output" valve of the indirectly heated cathode type is capable of handling a larger permissible grid swing than the "Point Eight" type, and therefore we unhesitatingly choose it. With regard to the output obtainable without overloading this valve, the writer regards it as quite sufficient for ordinary purposes without attempting to use two such valves in any push-pull arrangement. Confession is good for the soul, however, and the writer admits that he was intending to use in the output stage an ordinary 4-volt super-power valve which has a greater permissible grid swing, since he was under the mistaken impression that the transformer delivered four full volts and not 3.5 volts, which is so plainly marked on the instrument. Tests showed that the transformer meant what it said, as the 4-volt valve did not glow with sufficient brilliance to give any results. The writer has no doubt whatever that this arrangement would have worked exceedingly well, because he would mention that he himself uses an amplifier with an ordinary *six*-volt super-power valve in the last stage, his transformer having been constructed for him with a 6-volt winding by a kind-hearted friend possessing much skill in transformer design and construction.

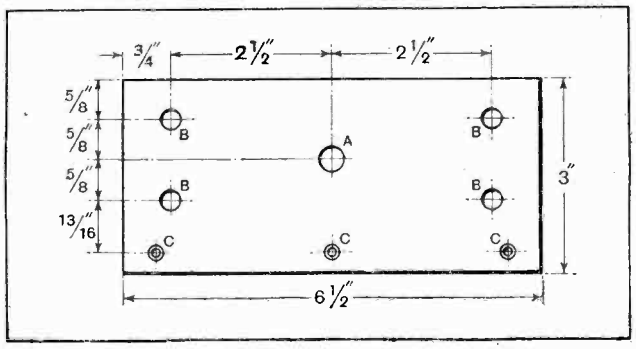


Fig. 4.—Drilling details of the terminal panel. Values are as follows: A, 3/8in. dia.; B, 5/16in. dia.; C, 1.8in. dia., countersunk for No. 4 wood screws.

In spite of theoretical arguments, which might be advanced to the contrary, this arrangement does work faultlessly using either a D.E.5A or a P.625. Both these valves have ¼-ampere filaments, which are quite heavy enough to prevent hum due to temperature variation, which is apparent with 0.1 valves. Although this arrangement can easily be put out of court on several theoretical counts, it works excellently in practice, and the writer often regrets that ordinary commercial A.C. transformers with a 6-volt winding for the purpose of using super-power valves in the output stage are not more generally obtainable upon the market, and would express the opinion that it is a matter to which manufacturers might well turn their attention. Readers are warned against thinking that they possess a ready-made 6-volt winding for this purpose in the one which is supplied for heating a U.5 or other rectifying valve. Obviously the same winding could not be used for both purposes.

No attempt is made to enter into constructional details of this amplifier, since the work entailed merely consists in assembling a few ready-made parts on a baseboard in accordance with the details given in the layout. Wiring up should present no difficulties. It is important, however, that all wires carrying A.C. be twisted together as indicated in the practical wiring diagram or a distressing hum will result. It will be noticed that in the case of the 0.8 winding on the transformer a centre tapping is provided by the makers. None is given on the 3.5-volt winding, but the writer has, as in previous arrangements described by him, picked up the centre tapping electrically by shunting the winding with two 50-ohm fixed resistors in series, the necessary tapping being made at the junction between these two aforesaid resistors. A variable potentiometer of the ordinary wire-wound 400-ohm type may be used if desired, but it is totally unnecessary. The fixed rheostat in series with the filament of the U.5 valve should be adjusted to a position which permits approxi-

A.C. Gramophone Amplifier.—

mately two-thirds of the resistance to be in circuit. Earlier in this article the writer discussed the advantage to be gained from a gramophone amplifier divorced from the wireless receiving set, and was hard pressed to find a reasonable *causa vivendi*. Two important reasons have, however, just suggested themselves; one is that there may exist gramophiles who are desirous of amplifying gramophone programmes only without any thought of wireless reception. The second is the undesirability (in the case of plutocrats possessed of a console type of gramophone in addition to a cabinet wireless receiver) of it being necessary to unite these two instruments by a length of "flex," passing from the pick-up in the gramophone to the amplifier in the wireless receiver. At all times this length of "flex" would be a menace to the peace of the household, since at any moment someone might trip over it and tread on the cat, this resulting in "insulting words and behaviour whereby," as it is usually written on the charge sheet, if the writer's memory does not fail him, "a breach of the peace might be occasioned."

This gramophone amplifier is available for inspection by readers at the Editorial Offices of this journal, 116-117, *Fleet Street, London, E.C.*4.

AMPLIFIER INPUT CONNECTIONS.

Detector Output Circuit should be Built into the Receiver, not the Amplifier.

MANY people like to use more than one receiver, either by keeping both permanently in use for local and distant reception respectively, or by trying different types of detector and high-frequency amplifier. In either case, it is both troublesome and expensive to employ more than one low-frequency amplifier, so that it becomes desirable to possess an amplifier that can be connected to any receiver that is in use at the moment. If this plan is adopted, then any new receiver that may be built need not extend beyond the detector.

The Detector Difficulty.

The chief difficulty in such a case is to arrange the input connections to the amplifier in such a way that it can be used after any receiver.

This difficulty arises because different types of detector require, for best results, different kinds of coupling between them and the first valve of the amplifier, so that no one coupling can be built into the amplifier and used in all cases. It is logical, therefore, to regard this coupling as part of the detector circuit rather than as part of the amplifier, and to build into each receiver the coupling which is most appropriate for the detector contained within it. If this is done, the amplifier may begin with a grid condenser and leak, as indicated in Fig. 1; a 0.005 mfd. condenser and a 2-megohm leak will be suitable for all cases.

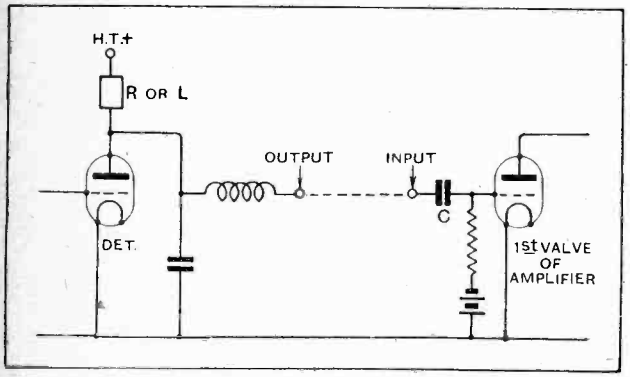


Fig. 1.—General circuit arrangement of detector followed by L.F. amplifier.

Universal Connections.

If a choke or a resistance is connected in the plate circuit of the detector to which this amplifier is to be attached, a single connection between the terminals marked "Output" and "Input" in Fig. 1 is all that is required when common batteries are used, while if a transformer is employed "O.S." is connected to the input terminal of the amplifier, "I.S." being earthed on L.T.−, L.T.+, or H.T.+, whichever is most convenient. The condenser C is retained in all cases, together with the leak through which the grid bias is applied; even though it is not required with a transformer it does no harm, and is retained for the sake of simplicity in the connections, and to avoid the necessity of switching.

Fig. 2 shows an elaboration of this system; here a resistance R of about 20,000 ohms is connected in series with the grid of the first valve of the amplifier to keep out high-frequency voltages, while an iron-core choke of high inductance is connected as indicated for use when it is required to attach the amplifier to a receiver which does not contain within itself any means of coupling the last valve to the amplifier. In such a case the plate circuit of the detector is completed through the choke.

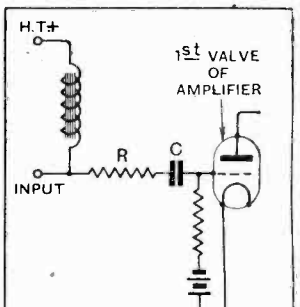


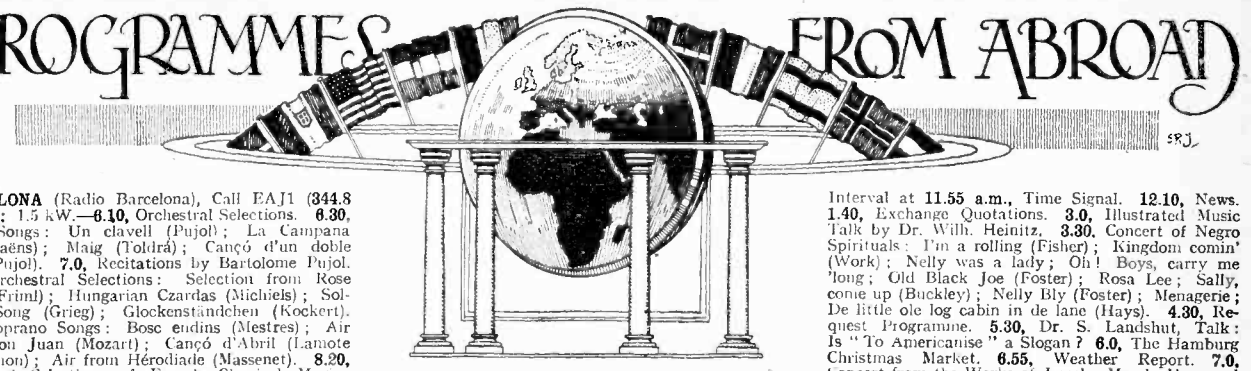
Fig. 2.—Amplifier input connections when detector output circuit is not incorporated in receiver.

A transformer or a resistance might, if desired, replace the choke, but a choke is suggested because of the three it is the only one which gives at least reasonably good results whatever the valve that precedes it.

A. L. M. S.

A 28

PROGRAMMES FROM ABROAD



SATURDAY, DECEMBER 8th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**) ; 1.5 kW.—**6.10,** Orchestral Selections. **6.30,** Tenor Songs: Un clavell (Pujol) ; La Campana (Saint-Saëns) ; Maig (Toldrá) ; Cançó d'un doble amor (Pujol). **7.0,** Recitations by Bartolome Pujol. **7.20,** Orchestral Selections: Selection from Rose Marie (Friml) ; Hungarian Czardas (Michiels) ; Solveig's Song (Grieg) ; Glockenständchen (Kockert). **7.50,** Soprano Songs: Bosc endins (Mestres) ; Air from Don Juan (Mozart) ; Cançó d'Abril (Lamote de Grignon) ; Air from Hérodiade (Massenet). **8.20,** Orchestral Selections of French Classical Music: First Suite from L'Arlésienne (Bizet). **8.40,** Sports Notes. **9.0** (approx.), Close Down.

BERGEN (**370.4 metres**) ; 1.5 kW.—**5.30,** Talk for Girls. **6.0,** Programme for Children. **7.0,** Orchestral Concert. **7.50,** Topical Talk. **8.0,** Mr. A. Paulsen, Talk: The Bergen Dialect. **8.30,** Choral Recital. **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**) ; 40 kW.—**3.30.** Programme from **Hamburg. 4.30,** Herr Uhr, Talk: The Everyday Life of an Official. **5.0,** Industrial Talk by Prof. Woldt. **5.30,** Elementary Spanish Lesson. **5.55,** Dr. K. W. Wagner, Talk: Acoustics. **7.0,** "Agricultural" Concert: Über allen Gipfeln ist Ruh (Kuhlau) ; Heimkehr—Horch, die alten Eichen rauschen (Gelbke) ; Swabian Peasant Dances ; March for Wind Instruments, Hinaus zum Wald (Burman) ; Talk by Heinrich Sohnrey ; Forest and Hunting Songs ; Selection for Wind Instruments, Nun ruhen alle Wälder. **8.0,** Programme from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**) ; 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Programme of Gramophone Records. **10.30 a.m.,** Exchange Quotations. **11.55 a.m.,** Time Signal. **12.30,** Weather Report and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations. **2.30,** Talk by Hans Willibald Tümena. **3.0,** Talk. **3.30,** Reading by Olga Fuchs-Malzmann. **4.0,** Orchestral Concert: Selection from The Girl of the Golden West (Puccini) ; Waltz (Ziehrer) ; Beau Soir (Debussy) ; Valse Romantique (Debussy) ; Grotesque (Lindemann) ; Dance from Rose Marie (Friml) ; Victoria regia, (Künnecke) ; Selections from The Rose of Stamboul (Fall) ; Souvenir (Boulanger) ; Overture to La Belle Hélène (Offenbach) ; in the Interval, Programme Announcements. **5.40,** Dr. Henny Moos, Talk: The Christmas Tree and its Illumination. **5.55,** Prof. Wagner, Talk: Acoustics. **7.0,** Programme from **Königswusterhausen. 8.0,** Concert of Songs and Airs ; Air from Orpheus and Euridice (Gluck) ; Von ewiger Liebe ; Sapphic Ode (Brahms) ; Hallelujah (Mozart) ; Air from Lucrezia Borgia (Donizetti). **8.30,** The Kreutzer Sonata in A Major Op. 47 (Beethoven). **9.30,** News, Weather Report, Time Signal, Sports Notes and Dance Music. **11.30** (approx), Close Down.

BERN (**411 metres**) ; 1.5 kW.—**3.0,** Orchestral Concert. **3.30,** Programme for Children by Fräulein Grety Vogt. **4.0,** Orchestral Concert. **6.29,** Time Signal and Weather Report. **6.30,** Dr. Zurukzoglu, Talk: What are the Aims of Eugenics, and how are they to be realised ? **7.0,** Symphony Concert relayed from **Basle** (1,010 metres). **9.0,** News and Weather Report. **9.15,** Orchestral Concert by the Kursaal Orchestra. **9.40,** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**322.6 metres**) ; 4 kW.—**3.0,** Review of Books by Richard Steinnolt. **3.30,** Concert of Tenor Solos and Quartet Selections. **5.0,** Film Review by Hans Baldung. **5.25,** Esperanto Talk by Alfred Hanuschke. **5.35,** Talk by Herr v. Reinersdorff. **6.20,** Shorthand Lesson. **6.50,** Herbert Brunar, Talk: The Dawning of a New Era—Round the World in a Second by Wireless. **7.15,** Programme of Old and New Dances. **9.0,** News, followed by Dance Music.

BRÜNN (**441.2 metres**) ; 2.5 kW.—**5.0,** German Programme. **6.0,** Concert: Overture to The Czar and the Carpenter (Lortzing) ; The Nutcracker Suite (Tchaikovsky) ; Songs (Grieg) ; Songs (Brahms) ; Songs (Liszt) ; Selection from Lohengrin (Wagner). **6.45,** Programme from **Prague. 8.15,** "The Pearl Necklace"—Comedy (Ed. Bass). **9.0,** Programme from **Prague. 10.25,** Dance Music from the Hotel Rosenbreier.

BRUSSELS (**508.5 metres**) ; 1.5 kW.—**5.0,** Orchestral Concert from the Armenonville Tea Rooms. **6.0,** Elementary English Lesson. **6.25,** English Lesson. **6.45,** Recital of Songs by Mme. Deby, with M. Iliaschenko at the Piano. **7.0,** Gramophone Selections. **7.30,** "Radio-Chronique." **8.15,** Gala Concert. **9.0,** Topical Talk. **9.10,** Concert (continued). **10.10,** News and Esperanto Report. **10.20,** Orchestral Concert from the Palace Hotel. **11.0** (approx.), Close Down.

BUDAPEST (**556.6 metres**) ; 20 kW.—**3.45,** Time Signal, Weather Report and Sports Notes. **4.0,** Orchestral Concert: March of the Gladiators (Fucik) ; Waltz (Waldteufel) ; Potpourri (Komzak) ; Selections (Eulenberg), (a) Musizierende Zigeuner, (b) Schmiedeliedchen, (c) Die Nachtigalle und die Frösche ; The Diplomat (Sousa) ; Spass muss sein (Morena) ; The Phantom Brigade (Middleton) ; Türkische Scharwache (Michaelis). **5.40,** Talk: The Industrial Regeneration of Hungary. **6.15,** Sports Notes. **6.30,** Play from the Studio. **9.15,** Time Signal, Weather Report and News. **9.35,** Concert from the Café Ostende.

CRACOW (**566 metres**) ; 1.5 kW.—**4.20,** Literary Programme. **5.0,** Programme from **Warsaw. 6.0,** Miscellaneous Items. **6.20,** Scandinavian Tales. **6.45,** News. **6.55,** Time Signal. **7.0,** Review of Foreign Politics during the last Week, by Mr. J. Regula. **7.30,** Programme from **Warsaw. 9.0,** Programme from **Warsaw. 9.30,** Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**) ; 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News. **7.30,** Selections by Val Vousden (Entertainer). **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Students' Union: Academy of Music. **8.30,** Pib Uilleann by Seamus MacAonghusa. **8.45,** Star Concert: Overture by the Augmented Station Orchestra ; Baritone Solos by J. Challoner Heaton ; Pianoforte Selections by Maurice Cole ; Dances by the Augmented Station Orchestra: Selections by J. Challoner Heaton ; Violin Solos by Winifred Small ; The Augmented Station Orchestra ; Maurice Cole ; Instrumental Duet by Maurice Cole and Winifred Small ; The Augmented Station Orchestra. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**) ; 4 kW.—**2.5,** Programme for Children. **2.55,** Talk for the Housewife. **3.35,** Concert: Selections (Mascagni), (a) Intermezzo sinfonico from Cavalleria Rusticana, (b) Cherry Duet, from L'Amico Fritz, (c) Ratcliff's Dream from William Ratcliff ; Songs ; Selection from Iris (Mascagni) ; Intermezzo from A basso porto (Spinelli) ; Songs ; Intermezzo from Romeo and Juliet (Zandonai) ; Selection from La Bohème (Leoncavallo) ; In the Interval, Wireless News and Announcements. **5.10,** Reading from the Novel, "On Two Planets" (Lasswitz) by O. W. Studtmann. **5.30,** The Letter Box. **6.0,** Esperanto Lesson by W. Wischhoff. **6.30,** Advertising Talk. **6.45,** Maria Schlee, Talk: A Trip to Switzerland by the Frankfurt League for Adult Education. **7.15,** "The Red Robe"—Drama (Brieux), followed by Dance Music relayed from **Voxhaus.**

HAMBURG, Call HA (in Morse), (**394.7 metres**) ; 4 kW.—**9.15 a.m.,** News. **10.0 a.m.,** Programme of Gramophone Records. **11.10 a.m.,** Weather Report. **11.15 a.m.,** Exchange Quotations. **11.30 a.m.,** Concert relayed from **Hanover** (297 metres) ; In the Interval at **11.55 a.m.,** Time Signal. **12.10,** News. **1.40,** Exchange Quotations. **3.0,** Illustrated Music Talk by Dr. Wilh. Heinitz. **3.30,** Concert of Negro Spirituals: I'm a rolling (Fisher) ; Kingdom comin' (Work) ; Nelly was a lady ; Oh ! Boys, carry me 'long ; Old Black Joe (Foster) ; Rosa Lee ; Sally, come up (Buckley) ; Nelly Bly (Foster) ; Menagerie ; De little ole log cabin in de lane (Hays). **4.30,** Request Programme. **5.30,** Dr. S. Landshut, Talk: Is "To Americanise" a Slogan ? **6.0,** The Hamburg Christmas Market. **6.55,** Weather Report. **7.0,** Concert from the Works of Jessel: March, Herz und Hand fürs Vaterland ; Grand Potpourri from The Maid of the Black Forest ; Duet, Im Postkutschkasten, from Des Königs Nachbarin ; Mexican Legend ; Character Sketch, Spring in Japan ; Es muss ja nicht im Mai gleich sein, from Schwalbenhochzeit ; Das ist der Zauber der Liebe from Schwalbenhochzeit ; Intermezzo Der Rose Hochzeit ; Intermezzo Siciliano ; Man nimmt ein rosa Blatt zur Hand from Schwalbenhochzeit ; Auf zug der Stadtwache ; Am Colorado ; Selection from Des Königs Nachbarin ; Unter afrikanischem Himmel ; Selection from Die Postmeisterin ; Selection from The Maid of the Black Forest ; Flieder und Jasmin ; Serenata di Possilipo ; Selection from The Maid of the Black Forest ; The Parade of the Tin Soldiers. **9.30,** Weather Report, News, Sports Notes and Programme Announcements. **9.45** (approx.) Café Wallhof Concert. **10.50,** North Sea and Baltic Weather Report.

HILVERSUM (**1,071 metres**) ; 5 kW.—**9.40 a.m.,** Time Signal and Daily Service. **11.40 a.m.,** Police Announcements. **11.50 a.m.,** Musical Selections. **1.40,** Musical Programme, relayed from the Tuschinski Theatre, Amsterdam: Orchestral Conductor, Max Tak ; Organist, Pierre Palla. **3.40,** Italian Lesson. **4.40,** German Lesson. **5.40,** Gramophone Selections. **6.25,** French Lesson. **7.25,** Police Announcements. **7.45,** Concert and Talk, arranged by the Workers' Radio Society. **10.10,** Musical Programme, relayed from the Royal Picture House, Amsterdam: Orchestral Conductor, H. de Groot ; Organist, Joh. Joug. **11.15** (approx.), Close Down.

HUIZEN (**340.9 metres**) ; 4 kW.—Transmits on 1,852 metres from 3.40. **12.10,** Concert of Trio Music. **2.40,** Programme for Children. **5.10,** Gramophone Selections. **6.10,** Talk by M. Simons. **6.30,** Catholic Report. **6.40,** English Lesson. **7.10,** Lesson in Dressmaking. **7.40,** Talk by M. Lyppens. **8.0,** Concert from Ammerzoden: Choral, Soprano, Saxophone and Cornet Selections ; Talks by Fr. Is. Trienekens and M. Herckenrath, Mayor of Ammerzoden.

JUAN-LES-PINS (Radio L.L.) (**244 metres**) ; 1.5 kW.—**1.0,** Orchestral Concert. **9.0,** News, Talk for Women by Mme. la Comtesse de Tremenge, and Concert. **10.0,** Dance Music. **10.30** (approx.), Close Down.

KALUNDBORG (**1,153 metres**) ; 7 kW.—Programme also for **Copenhagen** (337 metres).—**6.30 a.m.,** Morning Gymnastics. **10.0 a.m.,** Weather Report. **10.15 a.m.,** Educational Talk. **11.0 a.m.,** Chimes from the Town Hall. **11.5 a.m.,** Orchestral Concert from Wivel's Restaurant. **2.0,** Programme for Children. **2.30,** Concert: Turkish March (Mozart) ; Overture to Tancred ; Valse brunettes (Ganne) ; Selection from A Masked Ball (Verdi) ; Ave Maria (Schubert) ; Mazurka, Columbine (Lumbye) ; Heise og Weyse (Larsen) ; Reading by Clara Schwartz ; Paris March (Ganne) ; Waltz, The Skaters (Waldteufel) ; Selection from Lilac Time (Schubert-Berté) ; Polka, Dina (Lumbye) ; Hungarian Dance, No. 5, Op. 6 (Brahms) ; March, Under the Star-Spangled Banner (Sousa). **4.50,** Talk: The Choice of Seeds for the Garden. **5.20,** Otto Juel Jorgensen Talk: Something About Stoves. **5.50,** Weather Report. **6.0,** News and Exchange Quotations. **6.15,** Time Signal. **6.30,** Camilla Perssen, Talk: Women in the World of Business. **7.0,** Chimes from the Town Hall. **7.2,** Concert of Indian Verse and Music: Introduction ; Selection from Bhagavadgita ; Temple Hymns, (a) Hymn to Indra, (b) Hymn to Agni, (c) Hymn to Ushas ; The Heavenly Messenger (Kalidasa) ; Folk Songs ; Mother India (Dvijendralal Ray) ; Music on Indian Motives ; News. **8.15,** Duet Recital (Hansen) : The Girls of the Town ; Boating ; Minstrels Waltz ; The Land of Song ; Grey-weather Dreams ; Vagabonds ; Amor. **8.45,** Concert of Light Music. **9.45,** Dance Music by the Orchestra of the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

Programmes from Abroad.—

KATTOWITZ (422 metres); 10 kW.—**4.35**, Children's Letter Box. **5.0**, Programme for Children. **6.0**, Announcements. **6.20**, Talk by Mr. K. Zienkiewicz. **6.56**, Time Signal. **7.0**, Mr. K. Rutkowski, Talk: Impressions of a Journey to Constantinople. **7.30**, Programme from **Warsaw**. **9.0**, Weather Report and News. **9.30**, Dance Music.

KAUNAS (2,000 metres); 7 kW.—**3.0**, Concert: Winter Storm (Fucik); Selection (Rebikopf); Winter (Tchaikovsky); Waltz (Waldteufel). **3.35**, "Winter in Poetry." **3.45**, Talk. **4.30**, Announcements. **5.0**, Weather Report and News. **5.15**, Agricultural Report. **5.45**, Mr. Z. Kuzmickis, Talk: Lithuanian Literature. **6.15**, News. **6.30**, Evening Entertainment.

LAHTI (1,522.8 metres); 35 kW.—**4.0**, Vocal and Orchestral Concert: Parola Marche; Selections (Sibelius), (a) Valse triste, (b) Berceuse, (c) Suite Op. 99; Songs (Merikanto). **4.35**, Talk. **5.15**, Finnish Songs (Merikanto); Finnish Songs (arr. Kauppi). **5.40**, Talk. **6.0**, Concert.

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**8.0 a.m.**, Chimes. **8.5 a.m.**, Catholic Morning Recital. **9.35**, Labour Exchange Report. **10.10 a.m.**, Talks: The Choice of Careers. **11.0 a.m.**, Organ Recital by Prof. Hans Bachem. **12.5**, Orchestral Concert: Carnival Overture (Dvorak); Angelus (Micheli); Im Rosengarten Mendelssohn (Urbach); Nordisches Capriccio (Donisch); Waltz, Red Roses (Lehár); Selections from the Works of Suppé (Rhode); Little Grandmother (Langer); Tango, Erinnerung an Neapel (Michael); Boston, Gedicht (Fibich). **2.40**, Herr P. Brüls, Talk on Wireless Technology—Self-Induction in Direct and Alternating Current Circuits. **3.0**, Rev. Phillips, Talk: The Battleground of Life. **3.20**, Talk for Women by Adelbertha Gerhards. **3.40**, Reading from "The Life of Butterflies" (Schnack). **4.0**, Fegeler Felkendorf, Talk: Time, Modes and Man. **4.20**, English Lesson by Prof. F. Hase. **4.45**, Orchestral Concert: Overture to Russlan and Ludmilla (Glinka); Ukrainian Rhapsody for Pianoforte and Orchestra (Liapunoff); Symphonic Poem, Stenka Razin (Glazounoff). **5.30**, Dr. Hans Zbinden, Talk: Intellectual Problems of America. **5.50**, Canaries before the Microphone, on the Occasion of the Canary Show at Düsseldorf. **6.15**, Prof. Honigsheim, Talk: Social Problems of a Large City. **6.40**, Prof. von der Leyen, Talk: Fairy Tales of World Literature. **7.0**, Variety Programme, followed by News, Sports Notes, Orchestral Selections and Dance Music. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (365.8 metres); 4 kW.—**3.30**, Orchestral Concert. **4.45**, Wireless News and Talk. **5.20**, Weather Report, Time Signal and Labour Market Report. **5.30**, Programme from **Königswusterhausen**. **6.0**, Josef Greff, Talk: Psycho-Analysis. **6.30**, Dr. Fritz Reuter, Talk: Music as a Profession. **7.0**, Concert: "Comic Old Ladies in Operetta"; Katisha's Song from The Mikado (Sullivan); Song from Don Cesar (Dellinger); Songs from The Gipsy Baron (Strauss); Duet from As Once in May (Kollo); Olympia's Song from Donna Juanita (Suppé); Song from A Night in Venice (Strauss); Duet from Bub oder Mädel (Granichstaedten): Duet from Gri-Gri (Lincke); Duet from Die gold'ne Meisterin (Eysler); Duet from Der Obersteiger (Zeller): Song from Gasparone (Millöcker). **8.0**, Robert Neumann reads from "Jagd auf Menschen und Gespenster" (Neumann). **9.0**, News, Sunday Programme Announcements, and Sports Notes. **9.30**, Dance Music relayed from **Voxhaus**. **11.30** (approx.), Close Down.

MADRID (Union Radio), Call EAJ 7 (**375 metres**); 3 kW.—**7.0**, Chimes, followed by Sextet Concert: Sinfonía de zarzuelas (Barbieri); Selection from The Mastersingers (Wagner); La Tajadera (Barrera); Interlude by Luis Medina. **8.0**, Dance Music relayed from the Alkázar. **8.25**, News and Announcements. **9.45**, Market Prices Report. **10.0**, Chimes, followed by "La Calesera": Musical Play (del Castillo and Román, Music by Alonso), followed by News and Announcements. **12.30 a.m.** (approx.) (Sunday), Close Down.

MILAN, Call 1MI (**549 metres**); 7 kW.—**7.15**, Talk, News and Time Signal. **7.32**, Variety Concert: Quintet Selections, (a) Overture to The Bohemian Girl (Balfe), (b) Suite from L'Arlésienne (Bizet); Talk: The History and Æsthetics of Music; Soprano Songs; Sonata in E Minor for Violin and Pianoforte (Bazzini); Relay from the Convegno; Reading; Quintet Selections, (a) Serenade to May (Sicde), (b) Serenade to Pierrot (Burgmein); Soprano Songs; Sonata for Violin and Pianoforte (Franck); Quintet Selections, (a) Selections from André Chénier (Giordano), (b) Invitation to the Waltz (Weber). **9.55**, News, followed by Relay of Tzigane Music from the Fiaschetteria Toscana. **10.45** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Böden** (1,190 metres),

Saturday, December 8th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Göteborg (416.5 metres), Malmö (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**4.0**, Orchestral Selections. **5.0**, Programme for Children. **5.30**, Talk: The Shorthand-typist. **5.45**, Cabaret Sketch. **6.30**, "The Messiah": Oratorio (Handel), relayed from a Church. **8.15**, News and Weather Report. **8.45**, Topical Talk. **9.0**, Dance Music. **12.30 a.m.** (approx.) (Sunday), Close Down.

NAPLES, Call 1NA (**333.3 metres**): 1.5 kW.—**7.30**, Wireless Notes. **7.40**, Announcements. **7.50**, News. **7.55**, Harbour Notes. **8.0**, Time Signal. **8.2**, Orchestral Concert, followed by Two Comedies. **9.0**, Review of the Week. **9.50**, News. **9.55**, Calendar and Programme Announcements. **10.0** (approx.), Dance Music from the Trocadero. **10.30** (approx.), Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres).—**5.0**, Programme for Children. **6.0**, Birthday Greetings. **6.15**, Weather Report and News. **6.30**, Readings. **7.0**, Time Signal. **7.2**, Variety Concert. **8.30**, Weather Report and News. **8.45**, Topical Talk. **9.0**, Concert (continued). **10.0**, Dance Music from the Grand Hotel. **11.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (**458 metres**): 0.5 kW.—**6.30**, "Radio Journal de France." **8.0**, Talk by M. Geville. **8.15**, Legal Talk. **8.30**, Concert arranged by the Union des Grandes Association. Followed by News, Time Signal and Weather Report, Dance Music from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**2,650 metres**); 5 kW.—**5.0**, Pasdeloup Concert. **7.10**, Weather Report. **7.30**, "Le Journal Parlé."

PARIS (Petit Parisien) (**340.9 metres**); 0.5 kW.—**8.45**, Gramophone Selections, Talk, News and Announcements. **9.0**, Concert: Overture to The Pearl of Brazil (David), Selection from La Dame Blanche (Boieldieu); Overture to the Suite in D (Bach); Finale from the Eighth Symphony in F (Beethoven); Petite Suite (Büsser); Dance (Debussy); La Reine Fiamette (Leroux); News in the Intervals.

PARIS (Radio-Paris), Call CFR (**1,750 metres**); 6 kW.—**12.30**, Concert of Gramophone Selections: Orchestral Selection from L'apprenti sorcier (Dukas); Orchestral Selection, Le Carnaval des animaux (Saint-Saëns); Tristesse (after a Study by Chopin) Sung in Russian by Mmes. Birse, Ershova and M. Kondratieff; Take in the Sun, Hang out the Moon, by the Singing Sophomores; Portuguese Guitar Duet, Fado Corrido; Chilly Pom Pom Pee by Ray Starita and his Orchestra; Selection from "Good News" by Fred Rich and his Orchestra; Noche de Nieve by the Lucchesi Tango Orchestra; News in the Intervals. **2.0**, Market Prices and Religious Information. **3.45**, Dance Music by the Joss Ghislery Symphonians; News in the Intervals. **7.0**, Agricultural Report. **7.30**, Pianoforte Lesson. **8.0**, Talk: The Sahara, a Marvellous Sanatorium, followed by Market Prices and News. **8.15**, Concert: Dramatic Programme, Melodies, Dance Music by the Joss Ghislery Symphonians; News in the Intervals.

POSEN (344.8 metres); 1.5 kW.—**4.15**, Talk on Scouts. **4.30**, Talk by Mr. Stanislas Stacherski. **5.0**, Chamber Music: Trio for Pianoforte (Haydn); Sonata in A Major, for Violin (Beethoven). **6.0**, Prof. Stephan Papee, Talk: Antoinette Hoffmann. **6.25**, English Lesson by Dr. Arend. **6.50**, Talk for Women by Mme. Swidzinska. **7.10**, Economic Report. **7.30**, Operetta Relay from **Warsaw**. **9.0**, Time Signal and News. **9.30**, Cabaret Programme. **11.0**, Concert arranged by La Maison Philipps. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (348.9 metres); 5 kW.—**3.20**, Talk. **3.30**, Concert. **4.30**, Talk. **4.40**, Talk by Dr. Seracky. **5.0**, Concert of Popular Music. **6.45**, Ing. Svoboda, Talk: The Education of the Public by Wireless. **7.0**, Cabaret Programme. **8.15**, Third Act of "The Pearl Fishers" (Bizet) relayed from **Bratislava** (300 metres). **9.0**, Time Signal and News. **9.25**, Dance Music from the Hotel Rosenbreier, **Brünn**.

ROME, Call 1RO (**447.8 metres**); 3 kW.—**7.10**, Time Signal and Topical Talk. **7.45**, Selections from Opera, (a) "The Huguenots" (Meyerbeer), (b) Act 2 of "The Barber of Seville" (Rossini). **9.50**, News and Close Down.

SCHENECTADY, Call 2XAD and 2XAF (**21.96 and 31.4 metres**); 30 kW.—**12.0** Midnight, Phil Spitalny's Music relayed from **New York**. **12.30 a.m.** (Sunday), Musical Programme from the Eastman Theatre, **Rochester**. **1.0 a.m.**, Musical Programme from the Onondaga Hotel, **Syracuse**. **1.30 to 4.0 a.m.**, **New York** Relay. **1.30 a.m.**, "The Park Bench." **2.0 a.m.**, Selections by the Adler Quartet with Sonia Essin (Contralto). **2.30 a.m.**, Selections by a Male Octet. **3.0 a.m.**, Lucky Strike Programme. **4.0 a.m.**, Time Signal, and Dance Music, relayed from **Buffalo**. **5.0 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**3.30**, Concert **4.30**, Market Prices Report. **5.15**, Concert of Turkish Music. **7.30**, Weather Report and Time Signal. **7.40**, Vocal and Orchestral Concert: Orchestral Selections, (a) Overture to Parsifal (Wagner), (b) Mosaique (Beethoven); Songs; Orchestral Selection, Ballet Suite from Salammbo (Trémisot). **9.0**, News and Announcements. **9.10** (approx.), Close Down.

STUTTGART (379.7 metres); 4 kW.—**3.35**, Programme from **Frankfurt**. **5.0**, Time Signal and Weather Report **5.15**, Herr Schwaebsch, Talk: The Trade Mark as a Commercial Weapon. **5.45**, Talk by Dr. Kümmerlen. **6.15**, Talk by Bernd Isemann. **6.45**, Time Signal and Sports Notes. **7.15**, Folk Song Stories: Kurt Arnold Findeisen (Elocutionist), assisted by Vocal Quartet. **8.15**, Concert: The Rhine; On the Banks of the Rhine, from the Rhineland Suite (Lüling); Wenn über dem Rheintal der Himmel blaut (Lüling); Rheinfahrt (Martin Greif); Mein Heimatland, o du herrlicher Rhein; Frühling am Rhein; Folk Song, Der schönste Bursch am Rhein; Auf dem Rhein (Brentano); So singt man am Rhein (Haseloff); Wein vom Rhein; Im Rheingau (Reyling); Folk Song, Elslein von Caub; Das Herz am Rhein (Hill); Paraphrase, Die Lorelei; Legend, Der Spielmann in Mainz; Ballad, Two Brothers (Heine); Rhenish Humour; Beim Rheinwein (May); Reich' mir den Becher, du Kind am Rhein!; Schunkellied; Folly and Frolics; Ein rheinisches Mädchen; Crossing the Cologne Rhine Bridge by Night, Poem; Vater Rhein, du herrlicher Strom (May); Strömt herbei, ihr Volkerscharen; News, followed by Dance Music from **Voxhaus**.

TOULOUSE (Radiophonie du Midi) (**389.6 metres**); 8 kW.—**12.45**, Concert. **8.0**, Exchange Quotations and News. **8.30**, Instrumental Concert: Selections from Peer Gynt (Grieg); Selections from I Pagliacci (Leoncavallo); Selections from Hérodiade (Massenet) Pianoforte Solo, Turkish March (Mozart); 'Cello Solo, Minuet (Mozart); Selections from The Barber of Seville (Rossini); Mandoline Selections, (a) Les Millions d'Arlequin (Drigo), (b) Songe d'amour après le bal (Czibulka), (c) La vie heureuse (Schrammel), (d) Gavotte Louis XIII; in the Interval, Time Signal. **10.15**, North African News. **10.30** (approx.), Close Down.

VIENNA (517.2 metres); 15 kW.—**2.15**, Phototelegraphy Transmission. **2.45**, "Pechvogel und Glückskind," Play for Children (Blachetta). **3.30**, Orchestral Concert, by the Dostal Orchestra: Prelude from Eva (Lehár); Waltz, Transactionen (Jos. Strauss); Selection from Manon (Massenet); Violin Solo by Herr Willi Boskovsky, Legende (Wieniawsky); Second Hungarian Rhapsody (Liszt); Blumengeflüster (von Blon); Potpourri, Pikante Blätter (Komzák); Schlussmarsch (Ertl). **5.15**, Concert of Chamber Music: Concerto in E Minor (Nardini); Andantino (Martini); Tempo di Menuetto (Pugnani); Sonata for Horn and Pianoforte (Beethoven). **6.15**, Franz Karl Ginzkey in Selections from his own Works. **7.20**, "Auf Befehl der Herzogin," Operetta-Idyll in Three Acts (Granichstaedten); followed by Phototelegraphy Transmission.

VILNA (435 metres); 1.5 kW.—**4.45**, News in Lithuanian. **5.0**, Programme from **Warsaw**. **6.0**, Talk for Women by Mme. Ela Buncler. **6.25**, Art Talk by Prof. J. Klos. **6.50**, News and Time Signal. **7.0**, Programme from **Warsaw**. **7.30**, Programme in Celebration of the First Anniversary of the Vilna Broadcasting Station. **9.0**, Programme from **Warsaw**. **10.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**4.30**, Talk by Prof. Moscicki. **4.45**, Announcements. **5.0**, Programme for Children. **6.0**, Miscellaneous Items. **6.20**, Mr. Kolodziejczyk, Talk: The Bay of Biscay. **6.45**, News. **6.56**, Time Signal. **7.0**, News. **7.5**, "Radio-Chronique," by Mr. M. Stepowski. **7.30**, Relay of an Operetta; in the Interval, Theatre Notes. **9.0**, Aviation Notes and Weather Report. **9.5**, News. **9.20**, Police Announcements and Sports Notes. **9.30**, Dance Music from the Oaza. **10.30** (approx.), Close Down.

ZÜRICH (588 metres); 1 kW.—**3.0**, Concert from the Carlton Elite Hotel. **4.15**, Accordion Selections. **4.45**, Weather Report and Exchange Quotations. **5.0**, Selection from new Gramophone Records. **6.0**, Chimes from the Zürich Churches. **6.15**, Time Signal and Weather Report. **6.20** (approx.), Popular Programme. **7.15**, Variety Concert: Songs, Selections by Tamperli (Entertainer), and Orchestral Music. **9.0**, Weather Report and News. **9.10**, Gramophone Selections of Dance Music.

Programmes from Abroad.—

BARCELONA (Radio-Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**11.0 a.m.**, Cathedral Chimes Transmission. **11.5 a.m.**, Meteorological Report for Europe and Spain. **1.30**, Concert of Trio Music; Gramophone Records in the Intervals. **2.45 to 5.30** (approx.), No Transmission. **5.30** (approx.), Musical Programme; Agricultural Market Prices and Exchange Quotations in the Intervals. **8.0 to 8.20**, Lecture, arranged by the Catalonian Institute of Agriculture at San Isidro. **8.20**, Musical Selections by the Station Orchestra. **8.40**, Sports Notes and Bulletin. **9.0** (approx.), Close Down.

BASLE (**1,010 metres**); 1.5 kW.—Programme relayed from **Bern.**—**7.0**, Concert. **8.45**, Late News and Announcements and Weather Report and Forecast. **9.15** (approx.), Close Down.

BERGEN (**370.4 metres**); 1.5 kW.—**9.30 a.m.**, Relay of Morning Service. **11.30 a.m.**, Weather Report and Forecast and General News Bulletin. **7.0**, Concert by the Bergen Wireless Orchestra. **7.50**, A Chat on Current Events. **8.30**, Musical Recital: Arensky's Trio for Violin, 'Cello and Pianoforte, by Mrs. Bonnevie, Herr Schuster and Herr Müller. **9.0**, Weather Report and Forecast, Late News Bulletin and Time Signal. **9.15**, Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**); 40 kW.—**7.55 a.m.**, Chimes, relayed from the Garrison Church, Potsdam. **8.0 a.m.**, Sacred Recital with Sermon, relayed from **Voxhaus**, followed by Chimes from Berlin Cathedral. **10.30 a.m.** (approx.), Concert Programme from **Voxhaus**. **3.0**, Talk. **3.30**, Relay of Musical Programme from **Voxhaus**. **5.0 to 7.0**, Programme of **Talks**, arranged by the "Deutsche Welle," followed by Relay from another German Station. **9.15**, Late News and Announcements and Sports Notes. **9.30**, Programme of Dance Music. **11.30** (approx.), Close Down.

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**7.55 a.m.**, Relay of Potsdam Garrison Church Chimes. **8.0 a.m.**, Sacred Recital of Choral and Instrumental Music, with Sermon in the Interval, followed by Chimes from Berlin Cathedral. **10.30 a.m.** (approx.), Concert from the Grosse Schauspielhaus. **1.0**, Elementary Morse Lesson. **3.0**, Talk. **3.30**, Concert. **4.0**, Musical or Literary Programme. **6.0**, Talk. **7.0**, Concert Programme. **9.15**, Meteorological Report; Time Signal, Sports Notes, and Late News and Announcements. **9.30**, Programme of Dance Music. **11.30** (approx.), Close Down.

BERN (**411 metres**); 1.5 kW.—**9.30 a.m. to 10.30 a.m.**, Protestant Sermon. **12.0 Noon**, Time Signal and Meteorological Report. **12.5**, Orchestral Concert by the Linder and Meyer Orchestra. **6.29**, Time Signal and Weather Report and Forecast. **6.30**, Reading or Talk. **8.45**, Sports Notes, Late News and Announcements and Weather Report and Forecast. **9.0**, Musical Selections by the Kursaal Orchestra. **9.40** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—Programme relayed by **Gleiwitz** (329.7 metres).—**8.15 a.m.**, Relay of Chimes from Christ Church. **10.0 a.m.** (approx.), Recital of Sacred Music with Sermon. **1.0**, Guessing Competition. **1.10**, Talk or Literary Programme. **1.35**, Notes for Chess Enthusiasts. **2.0**, Children's Programme, Fairy Rales by Friedrich Reinicke. **2.30**, Agricultural Lecture. **7.15**, Evening Entertainment with the collaboration of Mary Wurm-Meysenberg, Hermann Zanke and others. **9.0**, Late News and Announcements. **9.30**, Dance Music. **11.0** (approx.), Close Down.

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0**, Light Music. **6.0**, Children's Corner. **6.30**, Concert of Trio Music. **7.30**, La Radio-Chronique. **8.15**, Orchestral Concert. **10.10**, News from the Press. **11.0** (approx.), Close Down.

BUDAPEST (**556.6 metres**); 20 kW.—**8.0 a.m.**, General News Bulletin and Talk for Women. **9.0 a.m.**, Relay of Sacred Service and Sermon. **11.30 a.m.** (approx.), Musical Programme. **2.30**, Talk for Farmers. **3.15**, Concert. **6.30** (approx.), Concert or Relay of an Opera. **9.45**, Dance Music. **10.30** (approx.), Close Down.

COLOGNE (**283 metres**); 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres) and **Münster** (250 metres).—**6.45 a.m.**, Self Defence Lesson. **7.5 a.m.**, Review of the Programmes of the Week in Esperanto. **7.15 a.m.**, Lute or Guitar Lesson by Olly Wirtz Koort. **7.35 a.m.**, Esperanto Class by Alfred Dormanns. **9.0 a.m.**, Sacred Festival and Address. **12.0 Noon**, Musical Programme. **3.30**, Evening Concert, conducted by Karl Weyler: Entr'acte and Ballet Music from "Rosamunde" (Schubert). **6.45**, Sports Notes. **7.0**, Concert or Opera, followed by Late News and Announcements, Sports Notes and Programme of Light and Dance Music. **11.0** (approx.), Close Down.

SUNDAY, DECEMBER 9th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

CORK, Call 6CK (**400 metres**); 1.5 kW.—**8.30**, Concert of Vocal and Instrumental Music: Nora O'Sullivan (Contralto). **11.0**, National Anthem and Weather Report and Forecast. **11.15** (approx.), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Cathedral Service. **10.56 a.m.**, Relay of the Fanfare from the Church of Notre Dame, followed by Time Signal and Meteorological Report. **11.10 a.m.**, Relay from **Warsaw**. **1.0 and 1.20**, Two Lectures for Farmers. **1.40**, Agricultural Bulletin by Dr. St. Wasniewski. **2.15**, Concert relayed from **Warsaw**. **4.30**, Talk. **5.0**, Programme from **Warsaw**. **7.30**, Evening Concert devoted to Light Music rendered by the Mandoline Orchestra accompanied by Mr. Leon Hoffmann; Vocal Items by Mme. St. Kopff. **9.0**, Transmission from **Warsaw**. **9.30**, Relay of Musical Programme from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**8.30 to 11.15** (approx.), Programme relayed from **Cork**. **8.30**, Concert of Vocal and Instrumental Music, Violin Solos by Winifred Small. **11.0**, National Anthem and Weather Report. **11.15** (approx.). Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—Programme relayed by **Cassel** (252.1 metres).—**7.30 a.m. to 8.30 a.m.** (approx.), Morning Recital and Address. **12.0 Noon**, Transmission, arranged by the Wiesbaden Agricultural Institute. **7.30**, Musical or Literary Programme. **9.30** (approx.), Dance Music. **11.0** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres) and **Kiel** (254.2 metres).—**7.25 a.m.**, Time Signal. **7.30 a.m.**, Weather Report, followed by General News Bulletin. **7.50 a.m.**, Talk on Economic Questions. **10.0 a.m.** (for **Hamburg, Bremen** and **Hanover**), Technical Talk. **11.55 a.m.**, Time Signal, relayed from **Nauen**. **12.5** (for **Hamburg** and **Kiel**), Musical Programme. **12.5** (for **Bremen**), Instrumental Music. **12.5** (for **Hanover**), Gramophone Records. **1.0**, Children's Corner, by Funkheinzelmann. **2.0**, Concert. **3.0**, Musical or Literary Programme. **6.30**, Talk on Sport, arranged by the Hamburg School of Physical Training. **6.40**, Sports News. **6.55**, Weather Report. **7.0**, Concert or Play. **9.30**, Weather Report and Late News Bulletin, followed by Light Music. **10.50** (for **Hamburg, Bremen** and **Kiel**), Weather Report for the North Sea and Baltic. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**); 5 kW.—**12.30** (approx.), Musical Programme. **2.10**, Concert of Orchestral Music, relayed from the Amsterdam Concert Hall. **3.40** Musical Programme. **7.40**, Weather Forecast, News and Sports Notes. **7.50**, Concert, including a Mass by Schubert. **10.40** (approx.), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits from 3.40 on 1,852 metres.—**8.5 a.m.**, Relay of Divine Service and Sermon. **12.10**, Concert by the Katholieke Radio Omroep Trio. **1.10**, Talk. **1.40**, Talk. **2.10**, Concert. **5.30**, Relay of Evening Service from **Bodegraven**; Sermon by the Minister, the Rev. G. A. Pott, on the Text from St. Luke, Chap. 15, Verses 8–10; Voluntaries by the Organist, Mr. v. d Vliet. **7.50** (approx.), Orchestral Concert. **10.25**, Choral Epilogue, conducted by Mr. Jos. H. Pickkers. **10.40** (approx.), Close Down.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**9.0 a.m.**, Divine Service, relayed from **Copenhagen**. **10.30 a.m. to 10.40 a.m.** (**Kalundborg** only), Weather Forecast from the Meteorological Institute. **12.0 Noon to 12.25**, Lesson in German, arranged by "Radiolytteren." **12.30**, Lesson in French, arranged by "Radiolytteren." **1.0**, Divine Service Relay from a church in **Copenhagen**. **2.30**, Orchestral Concert. **4.30**, Programme for Children. **5.0**, Time Signal and Chimes. **5.50** (**Kalundborg** only), Weather Report and Forecast from the Meteorological Institute. **6.0**, Press News and Announcements. **6.15**, Correct Time. **6.30** (approx.), Talk. **7.0**, Town Hall Chimes from **Copenhagen**. **7.5**, "Dyveke," Melodrama in Three Acts, by Hans Werner, Music by Ludolf Nielsen, followed by News and Announcements. **10.0**, Dance Music Programmes by the Palace Hotel Orchestra, conducted by Teddy Petersen; in the Interval at **11.0**, Town Hall Chimes, relayed from **Copenhagen**. **11.30** (approx.), Close Down.

KATTOWITZ (**422 metres**); 10 kW.—**9.15 a.m.**, Relay of Divine Service. **10.58 a.m.**, Time Signal. **11.0 a.m.**, Meteorological Report. **11.15 a.m.**, Concert of Popular Music by the Studio Quartet. **1.0**, Religious Address. **1.20 and 1.40**, Two Agricultural Lectures. **2.0**, Meteorological Report. **2.15**, Transmission of the **Warsaw** Philharmonic Orchestral Concert. **5.0**, Musical Programme. **6.0**, Various Announcements. **6.20**, Half-an-Hour of Humour, by Prof. St. Ligon. **6.56**, Time Signal. **7.0**, Talk. **9.0**, Meteorological Report and Weather Forecast, Press Review and Sports Notes. **9.30**, Dance Music Programme. **10.30** (approx.), Close Down.

KAUNAS (**2,000 metres**); 7 kW.—**2.30**, Children's Corner. **4.0**, Talk by J. Ardickas. **6.30**, Concert or Outside Relay. **9.30** (approx.), Close Down.

KÖNIGSBERG (**303 metres**); 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**8.0 a.m.**, Morning Service with Choral and Instrumental Selections and Address. **10.0 a.m.**, (**Königsberg** only), Weather Report and Forecast. **10.15 a.m.** (approx.), Musical Programme. **11.55 a.m.**, Relay of the Time Signal from **Nauen**, followed by Weather Report and Forecast. **7.0**, "Alpenkönig und Menschenfeind," a Drama of Men and Spirits, by Ferdinand Raimund, adapted for the Wireless by Hans Bodenstedt, Music by Hermann Erdlen. **9.10.** (approx.), Late News Report and Sports Bulletin.

LAHTI (**1,522.8 metres**); 35 kW.—Programme also for **Helsingfors** (375 metres).—**7.0 a.m.**, Relay of Church Service. **9.50 a.m.**, News from the Press. **10.5 a.m.**, Concert. **10.50 a.m.**, Weather Report and Time Signal. **11.0 a.m.**, Relay of Church Service in Swedish. **3.0**, Concert by the Lahti Wireless Orchestra. **4.57**, Time Signal and Weather Report and Forecast. **5.10**, Concert by the Wireless Orchestra: Overture to William Tell (Rossini). **7.15**, Concert by the Station Orchestra with Soloists. **7.45**, General News Bulletin given in Finnish. **8.0**, News Bulletin in Swedish. **8.30** (approx.), Close Down.

LANGENBERG (**468.8 metres**); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**6.45 a.m.**, Boxing Lesson, by Dr. Ludwig Bach. **7.5 a.m.**, Alfred Dormanns: Extracts from the Programme of the Week in Esperanto. **7.15 a.m.**, Music Lesson. **7.35 a.m. to 7.55 a.m.**, Lesson in Esperanto. **8.0 a.m.**, Sacred Recital of Music and Sermon. **12.0 Noon.** Musical Programme. **3.30**, Concert of Orchestral Music. **6.45**, Sports Notes. **7.0**, Evening Concert: "The Marriage of Figaro," Opera (Mozart); Late News and Announcements, Sports Bulletin and Programme of Light Music. **11.0** (approx.), Close Down.

LEIPZIG (**365.8 metres**); 4 kW.—Programme relayed by **Dresden** (275.2 metres).—**7.30 a.m.**, Relay of Organ Recital. **8.0 a.m.**, Vocal and Instrumental Concert. **10.30 a.m.** Talk. **11.0 a.m.**, Concert. **3.0**, Musical or Literary Programme. **4.0**, Concert. **5.30**, Talk. **6.30**, Concert or Play. **8.0** Stories of East Prussia, read by Martina Otto-Morgenstern. **9.0**, Sports Notes. **9.30**, Dance Music, relayed from **Berlin**. **11.30** (approx.), Close Down.

LYONS (Radio Lyon) (**291 metres**); 1.5 kW.—**7.30**, "Le Journal Parlé": News, Press Review, Amusements Chronicle and Announcements. **8.0**, Concert of Instrumental Music, with the collaboration of Mme. Ducharne (Pianist), M. Camand (Violinist), and M. Testanière ('Cellist). **9.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**375 metres**); 3 kW.—Programme relayed by **Salamanca**, EAJ22 (405 metres).—**11.30 a.m.**, Programme by the Municipal Band, conducted by Maestro Villa, relayed from El Retiro. **2.0**, Chimes and Time Signal. **2.5**, Concert Programme of Light Music by the Station Orchestra, with Item by Luis Medina in the Interval. **3.30 to 7.0**, No Transmission. **7.0**, Chimes. **7.5**, Concert of Sextet Music: Selections from La alegria de la huerta (Chueca). **8.0**, Programme of Dance Music by the Palermo Orchestra from the Alkazar. **8.30 to 10.0**, No Transmission. **10.0**, Chimes and Time Signal. **10.5**, Concert by a Regimental Band. **12.0 Midnight**, Chimes, followed by Programme of Dance Music by the Palermo Orchestra, relayed from the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, 1MI (**549 metres**); 7 kW.—**9.0 a.m.**, Opening Signal and English Language Lesson. **9.30 a.m. to 10.0 a.m.** Concert of Religious Music, with Vocal and Instrumental Items. **11.30 a.m.**, Time Signal and Concert of Quartet Music. **12.30 to 3.0**, No Transmission. **3.0**, Opening Signal. **3.5**, Concert by the Wireless Quintet. **4.15**, Concert by the Tzigane Orchestra, relayed from the Fiaschetteria Toscana. **5.0 to 6.55**, No Transmission. **6.55**, Opening Signal and News and Announcements. **7.30**, Time Signal. **7.35**,

Programmes from Abroad.—

Relay of "The Pearlfishers," Opera (Bizet); Sports Notes and News during the Interval. **10.30** (approx.), Close Down.

MOTALA (**1,380 metres**); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.6 metres).—**10.0 a.m.**, Transmission of Morning Service from a **Stockholm** Church. **3.0**, Provincial Musical Programme from **Boras**, including Soprano, Violin and Harp Solos. **4.55**, Chimes from **Stockholm** Town Hall. **8.15**, Late News and Announcements and Weather Report and Forecast. **10.30** (approx.), Close Down.

MUNICH (**535.7 metres**); 4 kW.—Programme, relayed by **Augsburg** (566 metres), **Kaiserslautern** (277.8 metres) and **Nuremburg** (241.9 metres).—**10.0 a.m.**, Chimes from the **Munich** Town Hall. **2.0**, Musical Programme. **7.0**, "The Polish Jew," Opera in Two Acts by Karl Weiss. **9.20**, Late News Bulletin. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333.3 metres**); 1.5 kW.—**9 0 a.m.**, Concert of Sacred Music. **3.45**, Programme for Children. **4.0**, Programme of Vocal and Instrumental Music. **4.30**, Time Signal. **7.30**, Wireless Review. **7.50**, Transmission by the Neapolitan Harbour Authorities. **8.0**, Time Signal. **8.2**, Concert of Theatrical Music by the Station Orchestra, with Soloists: Duet from Act III of Carmen (Bizet), rendered by R. Rotondo (Tenor) and R. Aulicino (Baritone). **9.0**, Sports Results. **9.50**, Calendar and Review of next day's Programmes. **10.0** (approx.), Close Down.

OSLO (**461.5 metres**); 1.5 kW.—Programme relayed by **Fredrikstad** (484.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**9.50 a.m.**, Carillon. **10.0 a.m.**, Service relayed from the Garrison Church. **6.15**, Weather Report and Forecast and Press News. **7.0**, Time Signal. **8.15** (approx.), Concert. **8.30**, Weather Report and News from the Press. **8.45**, Talk on a Current Topic. **9.15** (approx.), Dance Music relayed from the Hotel Bristol. **11.30** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (**458 metres**); 0.5 kW.—Programme relayed at intervals by the following stations:—**Bordeaux PTT** (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres), **Lille** (264 metres), **Limoges** (285 metres), **Lyons PTT** (480 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse PTT** (260 metres).—**8.0 a.m.**, News of the Day and Time Signal. **9.25 a.m.**, International Time Signal and Meteorological Report. **12.0 Noon**, Concert. **1.0**, "Radio Journal de France Economique." **1.30**, Concert of Orchestral Music. **4.0**, Pasdeloup Symphony Concert, conducted by M. Rhené Bâton. **6.30**, "Le Radio Journal de France." **8.15**, Talk by M. J. Noirot, member of the Nautical Committee of the French Touring Club. **8.30**, Concert, followed by late News Report, Time Signal and Weather Forecast. **10.30** (approx.), Programme of Dance Music relayed from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**2,650 metres**); 5 kW.—**7.56 a.m.**, Time Signal on 32.5 m. **9.26 a.m.**, Time Signal on 2,650 metres. **5.0**, Pasdeloup Concert Relay. **7.10 to 7.20**, Meteorological Bulletin. **7.30**, "Le Journal Parlé par T.S.F.," with Lecture on a Health Subject, Police Memoirs, Sports Review, News and Announcements and Racing Results. **7.56**, Time Signal on 32.5 metres. **8.0 to 9.0**, Programme of African and Asiatic Music: Danses arabes (Widor). **10.26**, Time Signal on 2,650 metres. **11.15** (approx.), Close Down.

PARIS (Petit Parisien) (**340.9 metres**); 0.5 kW.—**8.45**, Gramophone Records. **8.50**, Talk. **8.55**, News from the Press. **9.0**, Concert by artistes from the Paris Opera and the Opéra-Comique. **9.25**, General News Bulletin. **9.30**, Symphony Concert under the direction of Professor Estyle of the Paris Conservatoire. **10.0**, Late News Bulletin. **10.15**, Concert of Orchestral Music. **11.0** (approx.), Close Down.

PARIS (Radio L.L.) (**370 and 60 metres**); 1 kW.—**12.30**, Programme arranged by Radio-Liberté, News and Announcements followed by Selections of Music by the Charles Seringes Trio. **1.0**, Carillon de Fontenay. **3.0**, Programme of Dance Music arranged by the Etablissements Radio L.L. **9.0**, Concert of Vocal and Instrumental Music. **10.0**, Carillon de Fontenay. **10.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (**1,750 metres**); 6 kW.—**8.0 a.m.**, General News Bulletin and Press Information. **8.30 a.m.**, Lesson in Physical Training by Dr. Diffre. **12.0 Noon**, Religious Address. **12.30**, News from the Press. **12.45**, Concert by the Albert Locatelli Orchestra with humorous items by Bilboquet in the Interval. **4.30**, Gramophone Records by "L'Industrie Musicale." In the Interval, News from the Press. **7.0**, Agricultural Talk and Press News. **7.45**, The Radio-Paris Guignol. "Le jour du terme" (Dorez), by Bilboquet, Zecca, Brinchetaye and H. Carl. **8.30**, Concert by the Station Orchestra. In the Intervals, News from the Evening Press and Late News Bulletin. **10.30** (approx.), Close Down.

Sunday, December 9th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

PITTSBURGH, Call KDKA (**63 and 27 metres**); 25kW.—**4.0**, Sessions Clock Chimes, followed by Divine Service. **6.30**, Programme arranged by the Whitehouse Coffee Company, relayed from **New York**. **7.0**, "Roxy's Stroll" Programme from WJZ, **New York**. **9.45**, Divine Service relayed from the Shadyside Presbyterian Church and Sermon by the Pastor, the Rev. Hugh Thomson Kerr. **11.0**, Programme of Orchestral Music. **11.30**, Concert by the Whittall Anglo-Persians. **12.0 Midnight**, Session Clock Chimes, followed by Service from the Calvary Episcopal Church, **Pittsburgh**, Sermon by the Pastor, Dr. E. J. Van Etten. **10.0 a.m.** (Monday), National Broadcasting Company's Programme of Music from **New York**. **1.15 a.m.**, Collier's Radio Hour from **New York**. **2.15 a.m.**, The Utica Jubilee Singers from WJZ, **New York**. **2.45, a.m.**, El Tango Romantico relayed from **New York**. **3.15 a.m.**, Longine Time. **3.30 a.m.** (approx.), Close Down.

POSEN (**344.8 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Divine Service. **11.0 a.m.**, Time Signal. **11.05 a.m. and 11.30 a.m.**, Two Agricultural Lectures. **2.15**, Concert of Symphony Music relayed from **Warsaw**. **4.45** (approx.), Talk. **7.30**, Recital of Violin and Pianoforte Music by Mlle. Maric Szrajberowna and Professor François Lukasiewicz; Violin Concerto in D Major (Tchaikovsky). **8.30**, Musical Selections. **9.0**, Time Signal. **9.5**, Variety Programme. **9.20**, Weather Report and News and Announcements. **10.0**, Dance Music. **11.0** (approx.), Close Down.

PRAGUE (**348.9 metres**); 5 kW.—**8.0 a.m.**, Recital of Sacred Music. **10.0 a.m.** (approx.), Concert. **12.5**, Economic Report. **4.30**, Transmission for Workers. **5.0**, Programme for German Listeners. **5.30**, Sports News. **6.0**, Concert or Play. **9.0**, Time Signal and Late News Bulletin. **9.20**, Concert of Light Music. **10.15** (approx.), Close Down.

RIGA (**526.3 metres**); 4 kW.—**8.0 a.m.**, Relay of Morning Service in German. **9.15 a.m.**, Relay of Sacred Service (in Latvian) from the Mara Church. **12.0 Noon**, Musical Entertainment for Children. **3.0**, Concert by the Station Orchestra under the direction of Arved Parups. **4.0**, Programme of Talks. **6.0**, Concert. **8.0**, Weather Report. **9.0**, Concert by the Orchestra at the Café de l'Opéra. **10.0** (approx.), Close Down.

ROME, Call 1RO (**447.8 metres**); 3 kW.—**8.30 a.m.**, Opening Signal followed by German Language Lesson. **9.0 a.m.**, Concert of Vocal and Instrumental Religious Music. **9.45 a.m. to 12.0 Noon**, No Transmission. **12.0 Noon**, Opening Signal. **12.5 to 1.0**, Concert of Trio Music. **1.0 to 4.0**, No Transmission. **4.0**, Opening Signal. **4.5 to 5.30**, Miscellaneous Items. **5.30 to 9.10**, No Transmission. **7.10**, Agricultural Talk. **7.15**, Sports Notes and News and Announcements **7.29**, Time Signal. **7.31**, Talk. **7.45**, Concert by the Grand Symphony Orchestra, conducted by Willy Ferrero: Orchestral Selection, Two Interludes from the Lyrical Poem, "The Two Shepherds," by G. Spagnoli. First Performance in Rome. **9.50**, Late News Bulletin. **10.0** (approx.), Close Down.

SAN SEBASTIAN (Union Radio), Call EAJ8 (**400 metres**); 0.5 kW.—**10.0** Concert of Light Music relayed from the Grand Casino. **12.0 Midnight** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF (**21.96 and 31.4 metres**); 30 kW.—**6.30 to 7.0**, Programme arranged by the United Radio Corporation at **New York**. **8.30**, Organ Recital relayed from the Union College Memorial Chapel at **Schenectady**: Organist, Elmer Tidmarsh. **9.0**, Address to Men by Doctor S. Parkes Cadman, relayed from **New York**. **10.30**, Violin Recital. **11.0**, Stetson Parade Programme relayed from **Boston, Mass.** **11.30**, Programme from **New York**. **12.0 Midnight**, The Old Company's Programme, with Baritone Songs by Reinald Werrenrath, relayed from **New York**. **2.0 a.m.**, Talk on "Our Government," by David Lawrence, relayed from **Washington, D.C.** **2.15 a.m.**, Correct Time. **3.17 a.m.**, Experimental Television Signals. **3.30 a.m** approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (**375 metres**); 2 kW.—**2.0 to 3.0**, Light Music by the Wireless Orchestra and Gramophone Records in the Intervals. **9.30**, Orchestral Concert. **11.0**, Flamenco Songs and Dance Music by the Station Orchestra. **11.30** (approx.), Close Down.

STAMBOUL (**1,200 metres**); 5 kW.—**3.30**, Concert. **4.20**, Exchange Quotations and Grain Prices. **5.15**, Turkish Concert. **7.30**, Weather Report and Forecast followed by Time Signal. **7.40**, Talk on the History of Music. **7.55**, Orchestral Concert. **9.0**, Late News Bulletin. **9.30** (approx.), Close Down.

STUTTGART (**379.7 metres**); 5 kW.—Programme relayed by **Freiburg** (577 metres). **10.15 a.m.** (approx.), Recital of Vocal and Instrumental Music. **11.0 a.m.**, (approx.), Orchestral Concert followed by Gramophone Selections. **1.0**, Children's Corner. **2.0**, Talk. **6.45**, Time Signal and Sports Notes. **7.15** (approx.), Musical or Dramatic Programme followed by Late News Bulletin and Sports News. **10.15** (approx.), Close Down.

TALLINN (**408 metres**); 2.2 kW.—**8.0 a.m.** (approx.), Relay of Morning Service. **12.30** (approx.), Afternoon Concert of Orchestral Music. **2.0**, Agricultural Bulletin. **6.0**, Musical Programme. **9.0** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (**389.6 metres**); 8 kW.—**12.30**, Weather Report and Local Market Prices. **12.45**, Concert of Orchestral Music. **1.0**, Correct Time. **1.45**, News and Announcements. **8.0**, Parisian Market Prices and Stock Exchange Quotations. **8.15**, News from "La Dépêche" and "Le Petit Parisien." **8.30**, Concert of Orchestral Music. **9.0**, Time Signal. **9.6**, Concert arranged by "L'Association des Commerçants Radio-Electriciens du Midi": Selections from "Manon": Opéra-comique in Five Acts (Massenet) founded on the Novel of that name by L'abbé Prevost. **10.15**, "Le Journal sans papier" with Reports from North Africa and Late News and Announcements. **10.30** (approx.), Close Down.

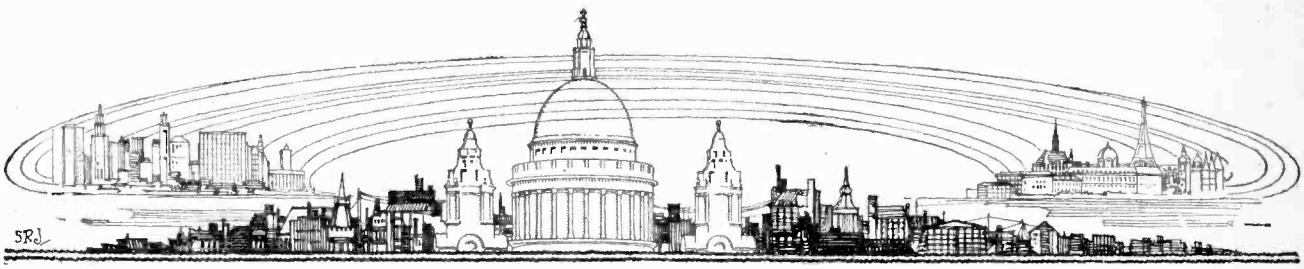
VIENNA (**517.2 metres**); 15 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres).—**9.20 a.m.**, Musical Recital. **10.0 a.m.**, Concert by the Vienna Symphony Orchestra. **2.30**, Experimental Transmission of Pictures. **3.0**, Orchestral Concert. **7.5**, "The Golden Sphinx": Wireless Comedy in three acts by Fritz Gottwald, produced by Hermann Wawra, followed by Light Music and Experimental Transmission of Pictures. **10.15** (approx.), Close Down.

VILNA (**435 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Cathedral Service. **10.56 a.m.**, Time Signal. **11.0 a.m.**, General News Bulletin relayed from **Warsaw**. **1.0 to 6.0**, Programme relayed from **Warsaw**. **1.0 to 2.0**, Three Talks on Agriculture. **2.0**, Meteorological Report. **2.15**, Orchestral Concert. **4.20**, Talk and News. **5.0**, Popular Concert of Polish Music by the Polish Radio Orchestra conducted by J. Ozminski: "La recherche en mariage en Pologne"; Overture by F. Nowowiejcki. **6.0**, Talk in Lithuanian. **6.20 to 10.30**, Programme relayed from **Warsaw**. **6.20**, Talk. **6.45**, General News Bulletin and Time Signal. **7.0**, Talk. **7.30**, Concert. **9.0**, Aviation Route Report and Weather Forecast. **9.5**, News Bulletin from the Polish Telegraphic Agency. **9.20**, Sports News and Police Notes. **9.30**, Dance Music relayed from the "Oaza" Restaurant, **Warsaw**. **10.30** (approx.), Close Down.

WARSAW (**1,111 metres**); 10 kW.—**9.15 a.m. to 10.45 a.m.**, Divine Service Relay. **10.56 a.m.**, Time Signal. **11.0 a.m.**, Aviation Notes and Weather Report and Forecast. **11.10 a.m.**, Symphony Concert arranged by the Educational and Cultural Section of the Magistracy of Warsaw and the Symphony Concerts Directorate and rendered by the Symphony Orchestra, of the Warsaw Philharmonic, conducted by Mr. B. Szulc: Soloists, Mme. M. Bar (Pianist) and Mme. Alma Rose (Violinist), Tasso—Symphonic Poem (Liszt). **1.0 to 2.0**, Three Agricultural Lectures. **2.0**, Weather Report and Forecast. **2.15**, Concert of Symphony Music from the "Philharmonic de Varsovie." **4.45**, Aeronautical Lecture by J. Osinski. **5.0** Popular Concert. **6.20**, Talk. **7.30**, Concert. **9.0**, Aviation News and Weather Report and Forecast. **9.5**, Late News and Announcements. **9.20**, Police and Sports Notes. **9.30**, Dance Music Programme from the "Oaza" Restaurant conducted by W. Roszkowski. **10.30** (approx.), Close Down.

ZAGREB (**309.2 metres**); 0.7 kW.—**10.30 a.m.**, Morning Concert Programme. **4.0**, Programme of Dance Music, relayed from the Club-Cabaret. **6.45**, Wireless Talk. **7.0**, Relay of an Opera from the National Theatre, Zagreb; in the Intervals: News and Announcements and Weather Forecast. **10.0** (approx.), Close Down.

ZÜRICH (**588 metres**); 1 kW.—**10.0 a.m.**, Relay of Concert by the Capitol Theatre Orchestra. **11.0 a.m.**, Meteorological Report. **11.30 a.m.**, Musical Selections by the Wireless Orchestra. **3.0**, Musical Programme from the Carlton Elite Hotel. **6.30**, Time Signal. **6.33**, Protestant Religious Address. **7.0**, Musical Programme. **8.0**, Programme from **Lausanne**. **9.0**, Weather Report, News and Announcements and Press Service from the "Neue Züricher Zeitung." **9.30** (approx.), Close Down.



CURRENT TOPICS

Events of the Week in Brief Review.

BEAM TELEPHONE TO CANADA.

The Marconi Company is understood to be contemplating the establishment of a commercial beam telephone service between Great Britain and Canada.

o o o o

PICTURE RECEPTION AT SEA.

The "Fultograph" pictures transmitted from Daventry on Monday, Tuesday and Wednesday of last week were picked up with success in the *Aquitania* between Southampton and Cherbourg, and after the vessel had left the latter port for New York. The pictures showed little trace of Morse disturbance.

o o o o

FIRE ENGINE WIRELESS.

To Rochdale falls the honour of being the first town in Britain to include wireless transmitters and receivers as permanent equipment on fire engines. Exhaustive tests have been carried out on bad roads, and, according to reports, the apparatus has successfully withstood the worst shocks. The fire brigade intends to employ wireless to enable fire engines to keep in constant touch with headquarters.

o o o o

WIRELESS CONTROL CLAIM.

A system of wireless control of gunfire in the Navy came up for discussion before the Royal Commission of Awards to Inventors last week, when Commander C. H. Rolleston, R.N., claimed an award in respect of a report submitted to the Admiralty. Mr. Swan, counsel for the Crown, submitted that H.M.S. *Vernon* was engaged in wireless control of fire some time before the receipt of Commander Rolleston's report. The claim was heard in camera.

o o o o

LEAGUE OF NATIONS WIRELESS TESTS.

The League of Nations has now collected reports from all over the world on the reception of the short-wave tests recently carried out from Kootwijk (Holland) on a wavelength of 18.4 metres. The total number of reports was 92, classified by the Secretariat as follows: in 38 cases reception was excellent, in 29 cases it was good; it was fair in 18 cases, the remaining seven being regarded as bad. The best reports were received from Indo-China, North-West Frontier of India, Mauritius and Sumatra.

The experiments are to be continued from the same station, which will be connected to a small studio in the Palais des Nations at Geneva. Special efforts are being made to reach North and South America, Japan and Australasia.

o o o o

HOW TOWNS AFFECT WIRELESS WAVES.

A paper entitled "Alternation of Wireless Waves over Towns," by Messrs. R. H. Barfield, M.Sc. (Eng.), and G. H. Munro, will be read and discussed at the meeting this evening (Wednesday) of the Wireless Section of the Institution of Electrical Engineers. The paper will deal with the effect of towns, including buildings, tuned aerials, etc., on wave damping.

o o o o

LOUD SPEAKERS, PUBLIC AND PRIVATE.

The problem of the outdoor loud speaker has again come up for consideration, this time by the General Purposes Committee of the Westminster City Council. The Committee recommends the Council to make a by-law prohibiting the use of a wireless loud speaker or a gramophone so as to cause annoyance in any public place, shop or business premises, under a penalty not exceeding £5.

The Home Secretary has stated that nuisances arising from the use of such instruments in private houses are not, in his opinion, of the sort which could be made the subject of a by-law.

o o o o

SAFEGUARDING AERIALS IN GALES.

The special safety devices included in the aerials of the Marconi beam stations successfully stood the test of the recent gales. Where interruption in the wireless services took place it was due to interruptions in land-lines owing to damage in the storm and not to damage in the wireless stations themselves. The aerial wires at the beam stations, which are normally tightly strained, are so arranged that when the wind reaches hurricane force and undue strain is placed on the masts the tension of the wires is automatically reduced at the lower end.

PCJ CALLING.

PCJJ, the famous Philips short-wave station at Hilversum, is to change its call sign as from January 1st next to PCJ. This is in accordance with the Washington agreement.

o o o o

MORE POWER BY DAY.

The U.S. Federal Radio Commission, in response to requests by broadcasting stations which complained of limited day range under the new regime, has granted permission for the use of three times the night power for use during the daytime until sundown.

o o o o

AMATEUR CUP AWARDS.

Mr. T. P. Allen, M.Sc., has been awarded the "Rotab" Cup for 1929 by the Incorporated Radio Society of Great Britain, being selected as the person who has most assisted private experimenters during the past year. Mr. Allen's energies have been directed towards maintaining "contact" between the hundreds of transmitting amateurs scattered up and down the country.

Another interesting award by the Society is that of the "Wortley-Talbot" Cup, also for 1929, to Mr. J. W. Mathews, 6LL, for distinguished work in the 10-metre band. It will be remembered that Mr. Mathews was the first British amateur to establish communication with the United States on this wavelength. The "Wortley-Talbot" Cup is to be awarded annually to the amateur who does the best work on the short wavebands.

o o o o

A BOOK FOR PHOTOGRAPHERS.

The publication of "Photograms of the Year" is an annual event of great importance to all interested in camera work. The thirty-fourth of the series, just issued by our publishers, contains nearly one hundred reproductions of fine camera pictures, together with critical notes, and its contributors include leading photographers in many parts of the world. The book is edited by F. J. Mortimer, F.R.P.S., Editor of our sister journal, "The Amateur Photographer and Cinematographer."

It is published at 5s. net in stiff paper covers, or 7s. 6d. net in cloth boards, ob-

tainable from all booksellers, etc., throughout the country, or direct from the publishers, Iliffe & Sons Ltd., Dorset House, Tudor Street, London, E.C.4.

○○○○

BROADCAST EQUIPMENT ON NEW SHIP.

The *Lady Rodney*, the new Canadian National West Indies steamer, which was christened at Birkenhead on Friday last by Mrs. J. H. Thomas, is fitted with a six-valve wireless broadcast receiving set for the entertainment of passengers.

Broadcast receivers are a feature of all five ships of the new Canada-West Indies fleet. The sets are of sufficient strength to pick up most of the important stations in Eastern Canada and the United States on the regular West Indies run. Arrangements are being made so that passengers will be able to listen-in to the latest Stock quotations.

○○○○

AMERICAN RADIO PRIZE.

For "his fundamental investigation in piezo-electric phenomena and their application to radio technique," Dr. Walter G. Cady, of the physics department of Wesleyan University, has been awarded the 1928 Morris Liebmann Memorial Prize Medal by the American Institute of Radio Engineers.

The award is made annually to the member of the Institute who in the opinion of the board of directors has made the most important contribution to radio art. Dr. Cady is the author of several important papers on the subject of piezo-electricity.

TRANSMITTERS' NOTES

Short-wave Tests in Manchester.

The Radio Experimental Society of Manchester is now licensed under the new regulations for transmission on all bands from approximately 170 metres to approximately 5 metres, excluding the R.S.G.B. band. The first tests will shortly take place on 41.5 metres with crystal control accurate to 0.1 per cent. The Society's call-sign is 2FZ.

All radio amateurs in the Manchester district who are interested in short-wave work are invited to communicate with the Hon. Secretary, Mr. R. M. Kay, B.Sc. (Tech.), 2, Daisy Bank Road, Victoria Park, Manchester.

○○○○

Among the Belgian Amateurs.

Mr. Louis Era, the district manager for Antwerp of the Réseau Belge, tells us that the Belgian Training Ship *L'Avenir* sailed on November 3rd for Fort de France, Martinique, and Tampa, Florida, equipped with a short-wave transmitter and using the call-sign XEB 4WK. The wavelength is 32.50 metres, the input being derived from accumulators. Three Philips' TB04/10 valves are employed, one as a master oscillator controlling the other two and working on an input of about 20 watts.

This interesting short-wave station is in the charge of Mr. G. Regnier (4WW) and Mr. G. Neelemans (4FT), who at first experienced considerable difficulty owing to the steel wire rigging of the three-masted sailing vessel which caused an unsteadiness of the note. However, by using a master oscillator with power amplifier the signals improved greatly both in quality and steadiness.

XEB 4WK is working regularly at 2300 G.M.T. during the present month. Messrs. Regnier and Neelemans are anxious to get into two-way communication with British amateurs, and reports of signals heard may be sent to them *via* Réseau Belge, 11, Rue du Congrès, Brussels.

○○○○

Antwerp Welcomes Visitors.

Any British amateur visiting Antwerp will be cordially welcomed by the local members of the Réseau Belge. During the summer Mr. R. L. Varney (2ARV) attended one of the "reunions" held in the "Paon Royal" on Tuesdays at 8.30 p.m., and on November 6th the local section entertained the Finnish experimenter, Mr. Bjorklund (ES 2HB), who is in charge of the short-wave station OJBT on board s.s. *Thorburg* during her European cruise. The station is working on the 40-metre waveband, and at the time of writing the steamer was bound for Finland, her next trip being to Cardiff, where she expects to arrive early in December. Mr. Bjorklund is very desirous of getting into touch with British amateurs, and hopes to meet several of those in the West Country with whom he has been in wireless communication.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 5th.

Institution of Electrical Engineers, Wireless Section. At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Paper on "Attenuation of Wireless Waves Over Towns," by Messrs. R. H. Barfield, M.Sc. (Eng.), and G. H. Munro.

North Middlesex Radio Society. At 8 p.m. At St. Paul's Institute, Winchmore Hill. Lecture: "Transformer Amplification," by Mr. Garside, of Messrs. Ferranti, Ltd.

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Business meeting.

Muswell Hill and District Radio Society. At 8 p.m. At Tollington School, Tetherdown. Radio Gramophone Night.

Tottenham Wireless Society. At 8 p.m. At 10, Bruce Grove, N.19. Business meeting, followed by sale and exchange.

THURSDAY, DECEMBER 6th.

Ilford and District Radio Society. Lecture: "The Screened Grid Valves," by the Marconiphone Co., Ltd. (with lantern illustrations).

Slade Radio (Birmingham). Lecture: "Loud Speaker Design and Construction," by a representative of Messrs. S. G. Brown, Ltd.

MONDAY, DECEMBER 10th.

Newcastle-upon-Tyne Radio Society. At 7.30 p.m. At 11, Saville Row. Lecture: "A.C. and D.C. Battery Eliminators," by Mr. C. L. Lyons, M.I.R.E.

Hackney Radio and Physical Society. At 8 p.m. At Hackney Electricity Showrooms, Lower Clapton Road, E.5. Discussion on "New Valves and their Merits," with Pentode demonstration.

EB 4BC to be Crystal-Controlled.

Since his return to Antwerp Mr. Era has been busy reconstructing his station EB 4BC, which is now transmitting on 42.50 metres with a master oscillator and power amplifier, and will very soon be crystal-controlled. He is using a ¼-wave Hertz aerial, and even without the crystal his note has been reported as "T9" from Spain, Russia, Sweden, England, and Ireland.

○○○○

A Bolivian Station.

Mr. Mark Johnson (SO 1AA), Tipuani, Bolivia, is transmitting on 33 metres and wishes to get into communication with British stations.

CLUB NEWS.

The Social Side.

At an enjoyable social and dance evening of the Golders Green and Hendon Radio Society held recently, Col. Vigers, O.B.E., of the 47th Divisional Signals, made a short speech regarding the work of the Signal Division. A film was also shown by Messrs. Kodak, Ltd., depicting some piquant incidents at the Society's last Direction Finding Field Day, held in the neighbourhood of Rickmansworth.

Hon. Secretary: Lt.-Col. H. A. Scarlett, D.S.O., 60, Pattison Road, Childs Hill, N.W.2.

○○○○

The Value of Joint Meetings.

At a joint meeting of the Croydon and Thornton Heath Radio Societies at South Croydon on Tuesday, Nov. 20th, Mr. H. R. Rivers-Moore, B.Sc., President of the South Croydon Society, lectured on and demonstrated "The Latest Screened Grid Valve Set." Capt. Derek McCulloch (of the B.B.C.) occupied the chair. After explaining the internal features of the valve and the importance of the external screening, the lecturer demonstrated his set, which included two screened grid stages. Ample volume was obtained with many distant stations, and the purity of reproduction was fully appreciated by the large and critical audience.

At the conclusion of the meeting, the Hon. Secretary of the Thornton Heath Society stressed the value of holding joint meetings, and said on behalf of his Society that he hoped to reciprocate the invitation in the near future.

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

○○○○

Wireless and Gramophone Reproduction.

A demonstration in which radio reception and electrical gramophone reproduction were compared was the feature of the meeting of Slade Radio (Birmingham) on Nov. 22nd, the demonstrator being Mr. Reuben Heaton. Wireless was represented by an "Everyman Four" receiver and a *Wireless World* moving coil loud speaker. The gramophone was a Panotrope. The lecturer favoured push-pull amplification with a low amplification valve in the first L.F. stage and a tapped anode resistance as volume control. Some interesting contrasts were provided when broadcast reception was followed by a number of records giving a wide range of instruments. A keen discussion followed the demonstration.

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

○○○○

The Rich Man's Set.

A receiving set built regardless of cost with the sole object of obtaining adequate volume with absolute purity of reproduction was demonstrated by a representative of Messrs. Bridge and Sons at a recent meeting of the Southend and District Radio Society. Impressive results were obtained and some interesting comparisons were made on several types of loud speaker.

Hon. Secretary: Mr. F. J. Waller, Lynthorpe, Grange Gardens, Southend-on-Sea.

○○○○

Prizes for Talks.

The hitherto silent members of the Edinburgh and District Radio Society are to have a concrete inducement to share in the discussions. The meeting this evening (Wednesday) will be devoted to "Lecturettes," a new monthly feature in connection with which a prize of one guinea will be awarded for the best paper read during the quarter.

VALVES TESTED

Cossor Screened-Grid Valve S.G.220.

The Cossor screened-grid valve S.G.220 for use with a 2-volt accumulator.

BY this time readers must be familiar with the unique properties of the screened-grid valve. By fitting a fairly close-meshed grid between the anode and the control grid of a valve, its A.C. resistance is greatly increased, but as this is accompanied by a proportional increase in the amplification factor the efficiency of the device is of the same order as that of the average triode. Unfortunately, there is a limit to the amplification that can be obtained from a single stage and this is reached when the feed-back via the valve causes self-oscillation.

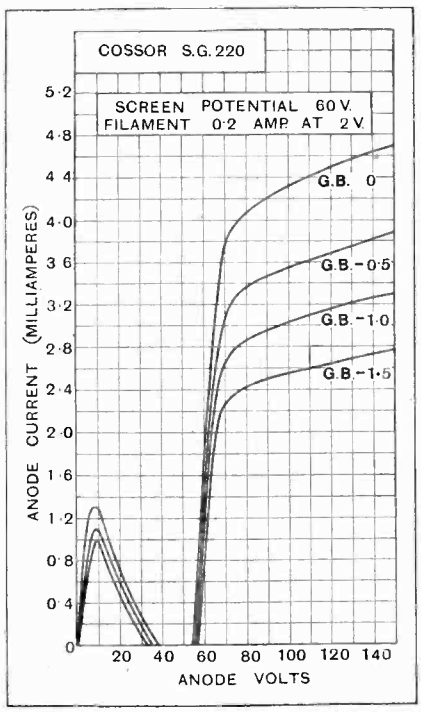
In the Cossor screened-grid valves the anode is connected to a small bakelite shrouded terminal on the top of the glass bulb, and the other electrodes are connected to a standard 4-pin type of base. The control grid and filament pins have the same relative position as on an ordinary 3-electrode valve, but the pin usually connected to the anode is in this case the termination of the screened-grid. One advantage of this arrangement is that the ordinary valve holder can be employed, but the main reason for this method of construction is to keep the inter-electrode capacity reasonably small without leading to an excessive difficulty in manufacture.

Secondary Emission Effects.

The introduction of the screen so alters the characteristics of the valve that it is customary to show these in the form of the relationship between anode voltage and anode current with various grid potentials and a fixed screen voltage rather than as grid voltage—anode current curves. The specimen tested was the 2-volt type—S.G.220—which is rated to pass 0.2 ampere through the filament at this pressure. For the purpose of keeping a check on the filament current during the test, an ammeter with a very low D.C. resistance was included in the filament circuit, but with the exception of this no other resistance was used.

The measured voltage across the valve pins was a fraction under two and the filament current 0.19 ampere. This compares favourably with normal working conditions, as there will be a slight voltage drop in the wiring probably of about the same order.

The potential on the screened-grid was kept at 60 volts and a number of measurements taken with 0, −0.5, −1.0 and −1.5 volts applied to the control grid. It will be seen that the curves are of rather peculiar shape, the anode current rising rapidly with low anode potentials followed by a sharp decline as the voltage is increased and between 40 and 55 volts actually a reversal in direction of flow takes place. This is due to the secondary emission from the plate and must be left at that as the cause and effect is too involved for treatment here.

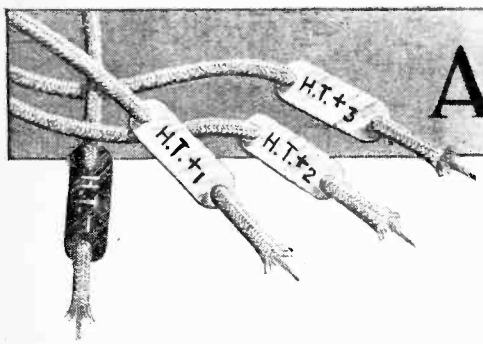


Characteristic curves of the Cossor S.G.220 valve. Average values, A.C. resistance 188,000 ohms, amplification factor 188, mutual conductance 1.0 mA/volt with 130 volts on the anode, and −1.0 volt G.B.

Mutual Conductance of One.

The part of the curve with which we are concerned when using the valve as an H.F. amplifier is the slightly rising portion between 90 and 150 volts, and it will be seen that between these limits the curves are sensibly parallel although at zero grid volts the curve shows a tendency to rise more steeply. The A.C. resistance of the valve will vary with different grid potentials and anode volts, but if we take approximate working conditions, namely, 130 volt H.T., −1.0 volt G.B. and 60 volts screen potential, the A.C. resistance will be 188,000 ohms, and the amplification factor 188, giving a mutual conductance of one. This compares favourably with the makers' figures—200,000 and 200 respectively—and moreover is of the same order, so that it is reasonable to conclude that the specimen tested is a representative sample.

The most suitable voltage values for normal operating conditions would appear to be between 110 and 150 on the anode, and 60 on the screen.



A Safe H.T. Supply

Accumulators, D.C. Mains, and a Charge-Discharge Switch.

WHATEVER may be the position with regard to those having access to A.C. mains, there can be little doubt that amateurs with D.C. supplies are chary of using eliminators. In view of the pitfalls so often encountered when applying this form of supply direct to the receiver, their attitude is reasonable; matters are complicated by the fact that some systems have a positive earth—which means that the majority of the receiver wiring will be above earth potential—and also because one can seldom predict how much smoothing will be necessary in order to correct ripples and irregularities, which are of widely varying intensity. As D.C. current will no longer be supplied for domestic purposes in this country after a few years, one naturally hesitates to face a heavy expenditure for an elaborate eliminator or the parts to make one, and the possibilities of using H.T. accumulators become attractive.

Voltage Dropping Resistances.

If D.C. mains of a sufficiently high voltage are available, the cells can be charged at negligible cost, and provided that a switch is installed in such a way that the operation of charging may be carried out without trouble, there is no excuse for neglecting the battery, and its life will be a long one.

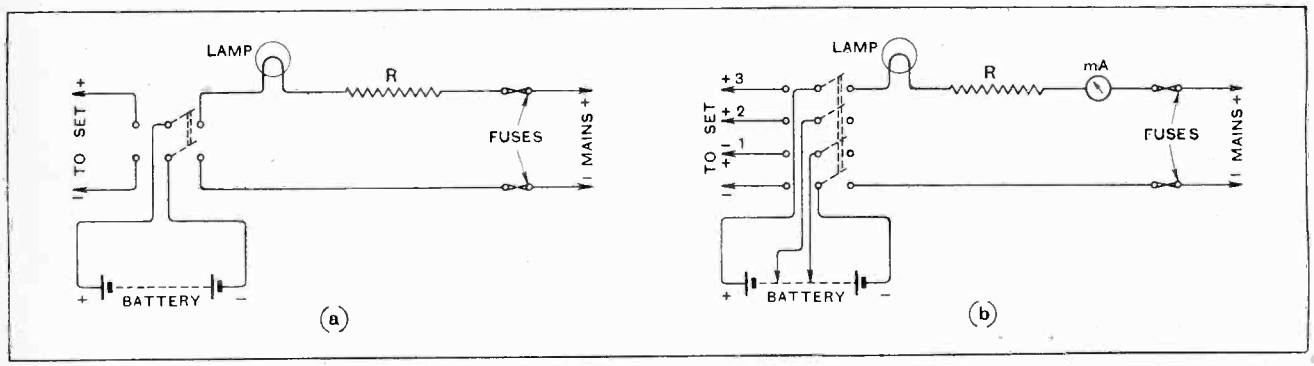
It is to sets in which a common H.T. voltage is applied to all the valves that this kind of switching can be most easily applied; the connections are as shown in the accompanying diagram (a), but it may be pointed out that it is always possible to insert series resistances in the anode circuit of those valves which require less than the maximum pressure available, and thus to retain the simplicity of a double-pole switch. As pointed out on previous occasions, this arrangement has the advantage that all cells of the battery are equally discharged; this is apart from the fact that the series resistances, in conjunction with their by-pass condensers, serve to isolate the various signal-frequency circuits, and to prevent any undesirable interaction.

Even if the set requires a number of different H.T. voltages, no very serious complication will ensue, but it will be necessary, as shown in diagram (b), to fit a switch having a greater number of poles—one for the negative connection and one for each of the positive tappings.

Charging Rates.

The diagrams are almost self-explanatory; to operate the set the switch blades are moved to the left, while to recharge the battery they are placed in the reverse position, so that current from the mains is passed through the battery. In each of the diagrams a resistor R and a lamp are shown; it is not necessary that both of these should be used, as long as there is sufficient resistance in circuit to restrict the flow of current to a value not exceeding the maximum charging rate specified by the manufacturers.

The calculation of this resistance is quite a simple matter; the first operation is to find the voltage available for charging purposes. This is ascertained by subtracting the rated voltage of the battery from that of the mains. We can now work out the resistance necessary by dividing this voltage by the required charging current (in amps.). As an example, let us assume that it is desired to charge a 120-volt battery from 240-volt mains at 100 milliamps (0.1 amp.): in this case the



How an H.T. battery may conveniently be recharged from a D.C. main supply: alternative connections for a charge-discharge switch.

A Safe H.T. Supply.—

voltage available for charging, after subtracting the back-pressure of the battery, will amount to 120 volts, and we can get the necessary value of resistance by dividing 120 by 0.1, the result being 1,200 ohms.

As already suggested, the exact form taken by the limiting resistance is unimportant—provided it will safely pass the desired current—and an ordinary electric lamp is certainly the least expensive and simplest. Its resistance may be ascertained by dividing its rated wattage by rated voltage; this gives the current passed (in amps.). This may be converted to resistance (in ohms) by dividing the figure thus obtained into rated voltage. Unfortunately, however, the resistance thus ascertained will only be effective when the lamp is glowing at full brilliancy, and not when the voltage applied to it is opposed by that of the battery that is being charged. As is well known, the resistance of a lamp decreases as the voltage applied to it is reduced, and to avoid passing an excessive current, a lamp with the next lowest wattage rating to that which would apparently be necessary should be chosen.

If a wire-wound resistor is preferred, its value is, of course, chosen in exactly the same way, but as a reminder that the cells are on charge, it is desirable to insert a milliammeter (in the position shown in diagram (b)) or a small flashlamp bulb, which will also be in series with the charging circuit, as indicated in both diagrams. The resistance of this lamp will be relatively so small that it need not be taken into account.

In cases where the wireless receiving apparatus is in use every day for a number of hours, it will often be found convenient to make it a matter of routine to place the battery on charge when the set is switched off; in these cases the charging rate should be fixed at something considerably less than the maximum specified rate, but sufficiently great to make good the drain on the battery during its working periods. H. F. S.

USEFUL DATA CHARTS. (NOS. 18 & 18A.)

Self-Inductance of Multilayer Coils.

THE self-inductance of a multilayer coil of circular section is given by the formula:—

$$L = L_0.N^2.D,$$

where L is in microhenrys.

N = total turns.

D = mean diameter of coil in inches.[1]

L_0 is a factor depending both on the ratio of axial length to mean diameter and the ratio of radial thickness to mean diameter.

The abac is constructed in exactly the same way as No. 17, but several curves are drawn, one for each value of t/D (ratio of thickness to mean diameter). An inset is provided to show the method of procedure, and a sectional drawing of a coil makes clear the meaning of the quantities l, t and D.

An Example.

A coil of circular section has 316 turns; its external diameter is 4.331ins., while its internal diameter is 3.543ins.; its thickness is 0.394in., and its length 3.937ins. Accordingly $l/D = 1$; $t/D = 0.1$; $N = 316$; $D = 3.937$ins.; and from the abac we should find $L = 6{,}196$ microhenrys, this being the calculated value.

Multilayer Coils of Polygonal Section.

A multilayer coil built up on a former of polygonal section has the same inductance as one of circular section possessing the same length, thickness,[2] and turns provided that the mean diameter of the circular section coil bears a certain relation to that of the coil of polygonal section. This equivalent diameter is given by abac 18*a*, which is self-explanatory. Thus a coil of square section, whose mean turn has a diameter of 3ins. (as measured by calipering across opposite vertices of the square and subtracting the diameter of the wire), is equivalent to a round-section coil of mean diameter 2.43ins.

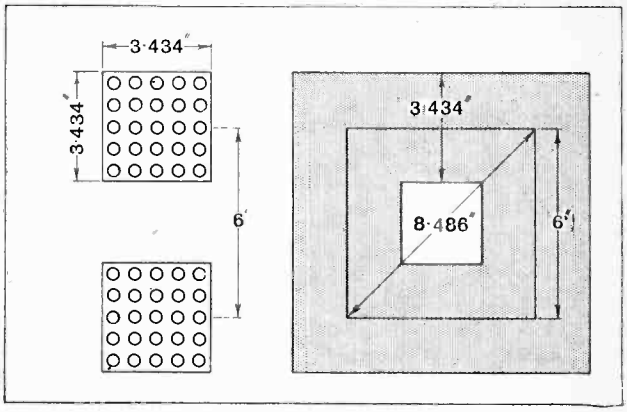


Fig. 1.—An example of a square-section coil with side measuring 6ins. Assuming 200 turns, and by using the abac given this week, the inductance works out at 4,425 microhenrys.

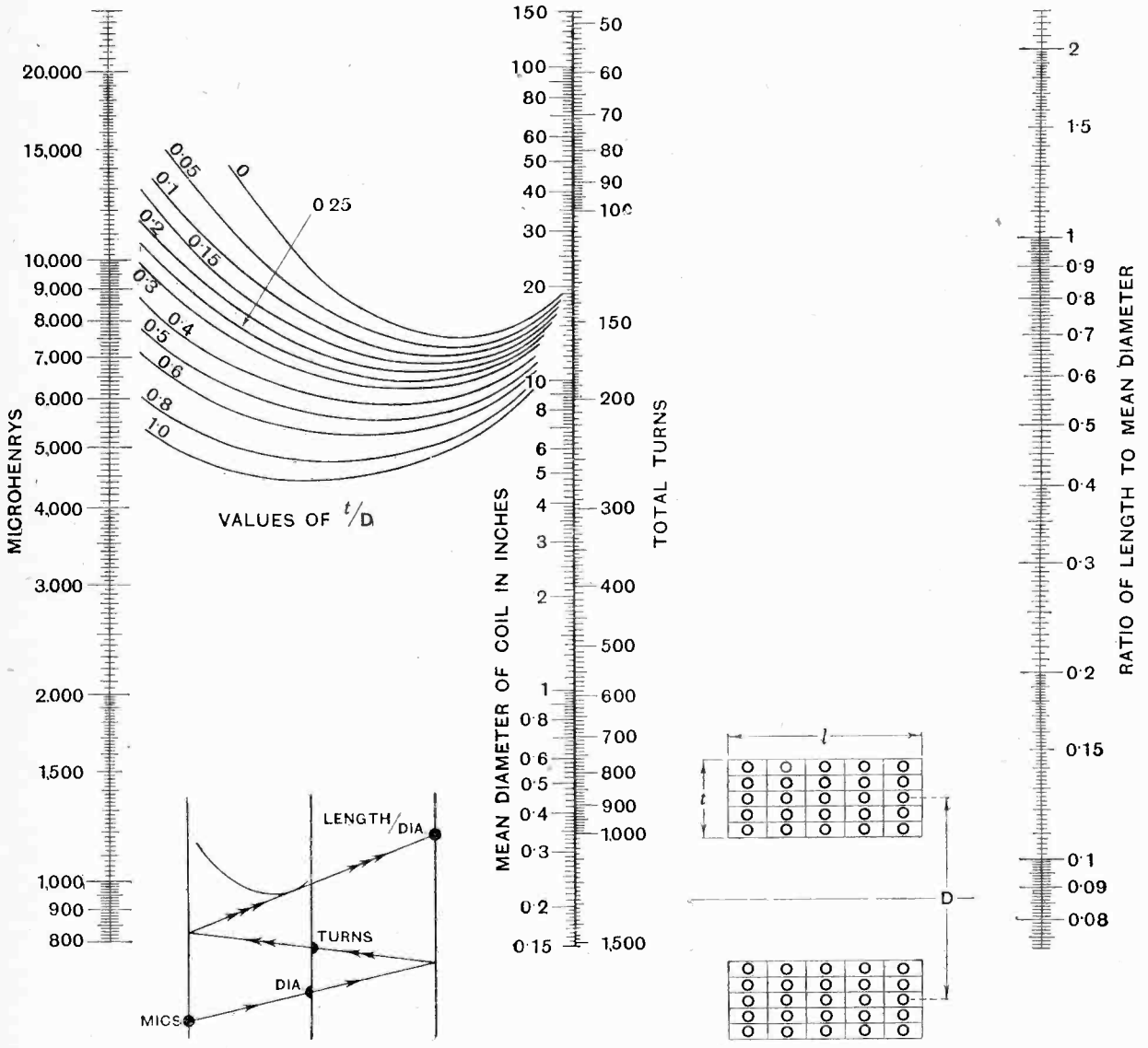
Strictly speaking, the correction factor should vary with the ratio of length to mean diameter, but between the limits 2 and 0.1 of this ratio the variation is less than the probable error in working abac 18.

An Example using a Square-section Coil.

As shown in the figure the mean turn forms a square whose side measures 6ins.; the diameter of its circumcircle is 8.486ins. Abac 18*a* gives the equivalent mean diameter as 6.87ins. Accordingly, the equivalent coil has $t/D = \frac{3.434}{6.87} = 0.5$, and $l/D = \frac{3.434}{6.87} = 0.5$. Hence, assuming 200 turns, abac 18 gives L = 4,425 microhenrys.

[1] Mean diameter = overall diameter of mean turn, less diameter of wire. Length = number of turns in one layer multiplied by axial pitch. Thickness = number of layers multiplied by radial pitch.

[2] By thickness is meant the radial thickness measured along a radius drawn at right angles to the direction of the wire and *not* a radius drawn to a vertex of the polygon.

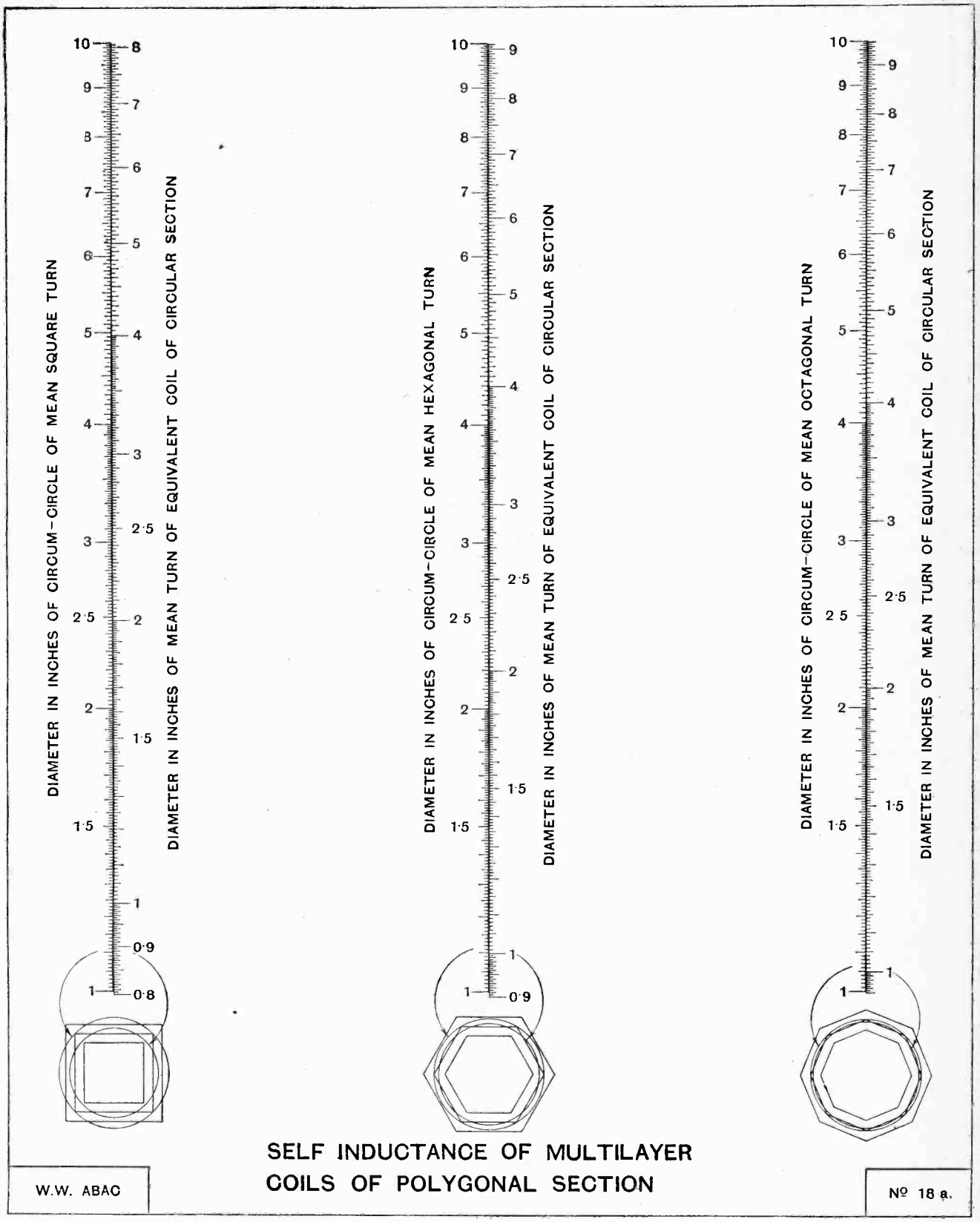


SELF INDUCTANCE OF MULTILAYER COILS OF CIRCULAR SECTION

FOR CORRECTION FACTOR REQUIRED FOR COILS OF POLYGONAL SECTION SEE ABAC Nº 18a.

W.W. ABAC

Nº 18



SELF INDUCTANCE OF MULTILAYER COILS OF POLYGONAL SECTION

W.W. ABAC

Nº 18 a.

BROADCAST BREVITIES

By Our Special Correspondent.

Christmas Broadcasting Arrangements.—Studio Design at "Broadcasting House."—An Imaginative Forecast.—British Stations Heterodyned.—Largest Cathedral Organ Broadcast.

Christmas Broadcasting

One of the first "Christmassy" broadcasts has been arranged for Monday, December 17th, when listeners to 2LO, 5XX, and several other stations will hear Community Carol Singing by the boys of Canford School, Wimborne, Dorset. On the same day there will be a carillon broadcast from Messrs. Atkinson's, Old Bond Street, the recitalist being the noted Belgian carilloneur, Chevalier Jef Denyn.

○○○○

"The Messiah."

A cathedral rendering of "The Messiah" is such a rarity nowadays that special interest attaches to the broadcast on Sunday, December 23rd. This will consist of the full choral and orchestral version of Handel's best-known oratorio from York Minster, beginning at 2.30 p.m. It will be relayed to 2LO and 5XX and to a number of other stations.

○○○○

Wassail.

The Yuletide spirit will find an outlet on Christmas Eve in "Wassail à la Carte," a musical programme to be opened with a Frankau-British overture. Mr. Gilbert Frankau will be present to contribute an item of his own, and will be supported by the Gershom Parkington Quintette with Yvette Darnac and Rex Palmer.

Later in the evening listeners will hear carols from the churchyard of St. Mary's, Whitechapel.

○○○○

On Christmas Day

There will be no dearth of broadcast fare on Christmas Day. Lunch hour music from the Hotel Cecil will be followed by a special Christmas concert in the afternoon, provided by the Wireless Military Orchestra, with Catherine Stewart (contralto) and William Primrose (violin).

Laurence Housman's nativity play, "Bethlehem," will be broadcast from 2LO, 5XX, and other stations at 4.45 p.m. The Children's Hour will be given as usual.

The most seasonable item in the 2LO's evening programme will be a reading by Ian Hay from "The Holly Tree," by Charles Dickens.

Novel Pantomime Idea.

Ernest Longstaffe, who is busy on the script for a pantomime "Dick Whittington," to be broadcast on Boxing Day, tells me that he has "adhered to the story absolutely."

This is something new in a pantomime! From what I can remember of pantomimic entertainment, the story is lucky if it gets a look in. The time is usually monopolised by the principal "boy," the mother-in-law, and the knockabout comedians.

"BROADCASTING HOUSE." The approved design for the B.B.C.'s new building at Portland Place, London, W. The studios will be situated in the central block, the surrounding offices giving protection from street noises.

Alice at the Microphone.

An adaptation of Lewis Carroll's fantasy, "Alice Through the Looking-Glass," which, prepared by Mr. Cecil Lewis, is to be given from 5GB on December 18th, and from 2LO, 5XX, and other stations on December 21st. I hear that the B.B.C. is wondering whether the part of the Leg of Mutton should be played by a man or a woman. This just shows what problems the Corporation is called upon to face.

The Studios in "Broadcasting House."

The recent official announcement concerning the design of the new Broadcasting House in Portland Place confirms much that has already appeared in these columns.

All listeners will be glad to note that the primary consideration will be the design of the studios. To the man at the receiving end it would be small satisfaction, if reception were poor, to know that the music was coming from the most magnificent building in London. He would be in much the same case as the Irish tourist in the Tube who had to get what comfort he could from the announcement that he was passing under some of the most interesting parts of the Metropolis.

○○○○

Studying Acoustics.

Of the nine studios, four will be more than double the size of the largest studio at Savoy Hill, which is 44ft. by 25ft. In addition to these, there will be a super-studio, three storeys high, of approximately 4,000 square feet, which, together with its gallery, will be capable of accommodating an audience of 1,000, as well as a large orchestra.

It is chiefly in connection with the construction of this studio that Capt. West and his assistants are busy developing the acoustic measurement apparatus to which I was able to give exclusive mention last week.

○○○○

Brick Walls as Sound Insulators.

It is noteworthy that the studios in Portland Place will be the first in this country to be built as studios; up till now every studio has been an adaptation of an existing room, and it speaks much for the resourcefulness of those concerned, that there are so few really bad studios in existence at the present time. Luck has played its part, too, for it was not until outside broadcasts were tried that the engineers discovered how fortunate the authorities had been in the choice of the Savoy Hill building, which contains no steelwork and enjoys the sound insulating properties of brick walls.

○○○○

Auxiliary Suites.

In the new building the studios will be insulated from the outer world by

wide corridors and thick brick walls, while a surrounding layer of offices will afford additional protection from street noises.

To each of the four large studios will be attached a suite comprising waiting room, listening room, echo room, and rooms for the band, announcers, and engineers.

o o o o

An Important Item.

I am told that another important apartment will not be forgotten, viz., the canteen. Needless to say, the available refreshment will be perfectly innocuous, as the B.B.C. licence is merely a wireless one.

o o o o

The Financial Side.

The building is to cost between £400,000 and £500,000, the money being furnished by a syndicate from whom the Corporation will lease the premises with an option to purchase if and when this appears desirable.

o o o o

An Imaginative Forecast.

There are more than the immediate financial considerations to account for this cautious attitude of the B.B.C. An official explained to me that the Corporation was looking ten, twenty, and even thirty years ahead. There is no knowing how broadcasting may develop in the next quarter of a century; it is conceivable that present-day conditions may have been entirely superseded. The Corporation turns its imaginative eye on a time when studios may be dispensed with; when television makes it possible for the individual members of an orchestra to perform in their own homes. . . !

Yes, the B.B.C. has imagination.

o o o o

A Useful Accessory.

Extract from a letter which blew into Savoy Hill last week: "My coil has ten tappings at one end and a barometer at the other."

Evidently he hadn't thought of tapping the barometer.

o o o o

Wavelength Muddle Grows.

More and more of the B.B.C. stations are being heterodyned by Continental transmitters.

The sooner the wavemeters necessary for the common wavelength scheme are delivered the sooner will listeners to the relay stations be assured of uninterrupted reception. According to Savoy Hill, every one of the relay stations is now being heterodyned, the worst case being that of Bournemouth, which is jostled nightly by three offenders not yet identified.

Listeners situated more than 150 miles from 5XX are finding that the transmissions are upset both by Königswusterhausen and Lahti (Finland).

o o o o

An Edinburgh "Revel."

The students of the Edinburgh College of Art claim that their annual "Revel" provides the most striking spectacle of its kind outside London. The B.B.C. last year broadcast a running commentary on the spectacle along with dance music. This proved to be so much appreciated that this year they have arranged a more elaborate commentary which will be relayed to all Scottish stations on December 21st, and will consist of short snatches of commentary interspersed with dance music.

FUTURE FEATURES.

London and Daventry.

DECEMBER 10TH.—The Ceremony of the Keys, relayed from the Tower of London.

DECEMBER 12TH.—"Life's Dream," by Calderon.

DECEMBER 14TH.—Symphony Concert, relayed from the Queen's Hall.

Daventry Exp. (5GB).

DECEMBER 9TH.—String Orchestral Concert.

DECEMBER 12TH.—"The Heart of a Clown," by Constance Powell-Anderson.

DECEMBER 13TH.—Hallé Concert, relayed from the Free Trade Hall, Manchester.

DECEMBER 14TH.—"The Stepmother," a farce by Arnold Bennett.

Cardiff.

DECEMBER 9TH.—The first concert of the Cardiff Musical Society, 1928-9 season.

Manchester.

DECEMBER 12TH.—How to Dance, a programme of old-fashioned dances.

DECEMBER 13TH.—Hallé Concert from Free Trade Hall.

Newcastle.

DECEMBER 9TH.—"The Last Judgment" (Spöhr), Part 1, relayed from Durham Cathedral.

Glasgow.

DECEMBER 10TH.—Voice, Violin and Flute Recital.

DECEMBER 13TH.—A Pantoradioptimime.

Aberdeen.

DECEMBER 14TH.—"The Storm," a short story by H. Mortimer Batten.

Belfast.

DECEMBER 11TH.—Programme of Gipsy Music.

Organ Recital from Liverpool Cathedral.

A recital by Mr. H. Goss Custard on the Liverpool Cathedral organ—the largest cathedral organ in the world—will be relayed to 2LO and 5XX on Friday next, December 7th. The organ has five manuals and 168 speaking stops.

o o o o

Enter: A Brass Septet.

A new instrumental combination is to face the Belfast microphone for the first time on December 11th. This is the Station Brass Septet, composed of the brass players from the Station Orchestra, which will play specially arranged selections. They are supported by that popular duo, Grace Ivell and Vivian Worth.

o o o o

Mr Percy Scholes.

Although Mr. Percy Scholes relinquished his position as music critic of the B.B.C. to go and live and work in Switzerland, he has not severed his connection entirely with the microphone. On December 15th he is coming to England to broadcast another of his popular "New Friends in Music" recitals from 5GB. The illustrations on this occasion will be from Gustav Holst's "The Planets."

o o o o

A Wagner Night.

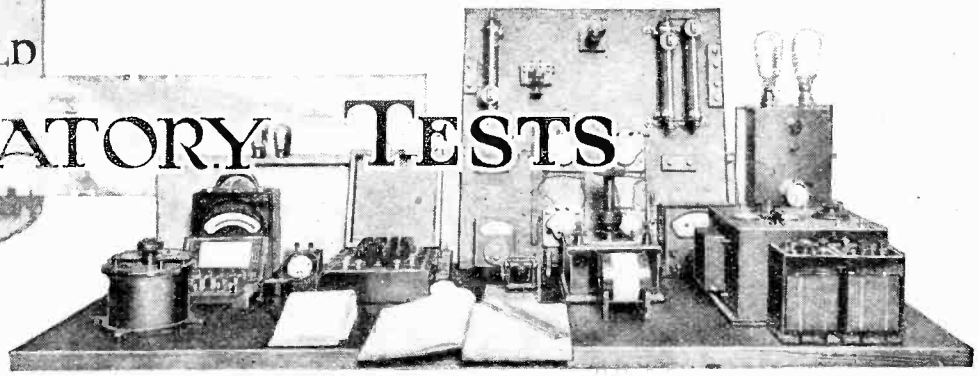
The Festival Theatre at Bayreuth, the home of Wagner's music, has as its present conductor Franz von Hoesslin. He is coming to London on December 14th to conduct the fifth of the B.B.C. symphony concerts at the Queen's Hall.

As might be expected, the programme will consist to a large extent of Wagnerian music—the Siegfried Idyll, the Good Friday Music, and the overtures to "Tannhauser" and "The Mastersingers."

WIRELESS WHILE YOU WAIT. A scene at a station on the Hungarian State Railways, which provide intending travellers with broadcast entertainment while waiting for trains. Note the radio attendant on the left.

WIRELESS WORLD

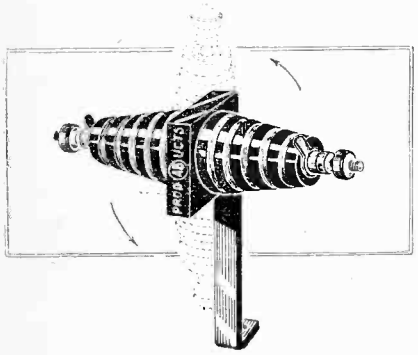
LABORATORY TESTS



A Review of Manufacturers' Recent Products.

A.B. PRODUCTS H.F. CHOKE.

The inductance of this choke is considerable, and resonance is not reached even at a wavelength of 3,300 metres.



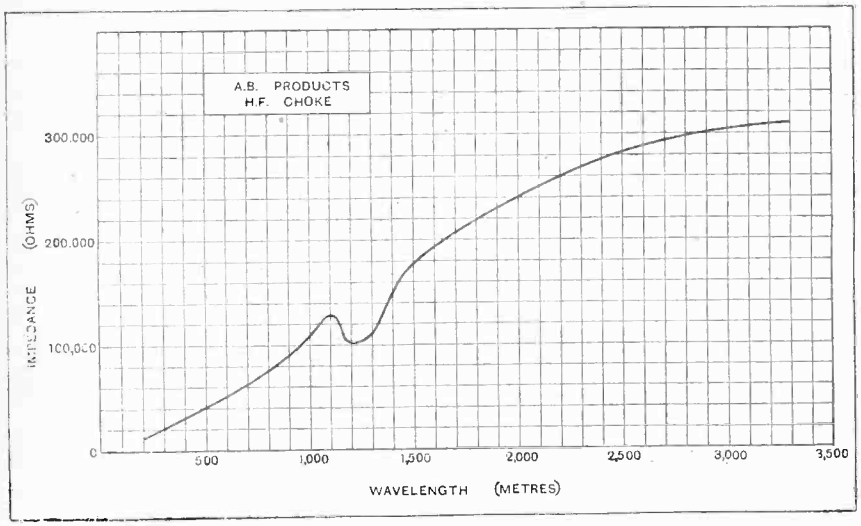
A.B. Products H.F. choke; D.C. resistance 1,420 ohms.

Enamelled wire of fine gauge is used and the high D.C. resistance of 1,420 ohms indicates that the number of turns used is above the average. The windings are carried on a double-ended taper former, and, as the distance between the two cones is greater than the distance between the sub-sections of the winding, the choke is divided into two closed circuits and behaves as two chokes in series. This causes the kink in the impedance curve at 1,200 metres which may cause trouble through self-oscillation between 1,100 and 1,200 metres in a receiver designed to cover the 1,000-2,000 metre waveband. Between 200 and 500 metres and at 1,600 metres the performance will be perfectly satisfactory, and the impedance values at these wavelengths will be as follows :—

Wavelength (metres).	Impedance (ohms).
200	11,000
500	41,000
1,600	192,000

The choke is mounted on a vertical bracket and may be swivelled for wiring in a horizontal or vertical position.

The makers are Messrs. Accessories (Birmingham), 40, Weaman Street, Birmingham.

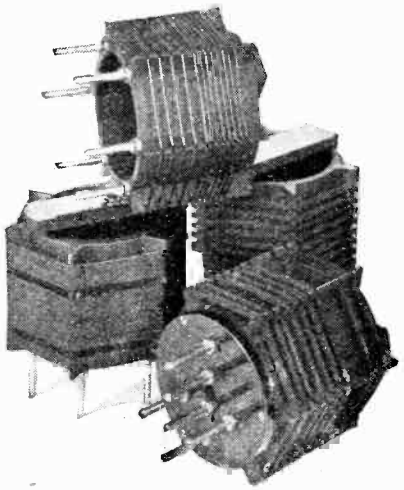


Impedance curve of A.B. Products H.F. choke; external capacity 8 micro-mfd.

POSTLETHWAITE COILS

These coils are wound on ribbed formers, and each consist of an aerial coil, grid coil, and reaction winding. The coils for the medium wave band are layer wound with turns touching, and as the winding length to diameter ratio is considerably less than unity, they should be quite efficient coils.

The short wave coil, which covers a wave band of from 18 to 40 metres, is wound with spaced turns, enamel covered



A range of six pin aerial-grid coils. Note the special long wave coil in the foreground.

wire of generous cross-sectional diameter being employed for the grid coil, and a slightly smaller gauge for the reaction winding. In this particular coil the aerial is tapped to a point on the grid coil so that half a turn only is in the aerial circuit. The grid coil has 4½ complete turns and the reaction six.

A long-wave aerial-grid transformer on the same general lines as the medium-wave coil completes the range. In this case, however, sectional windings are adopted, the two lower grooves carrying the aerial coil, the next five grooves the grid coil, and the top pair the reaction.

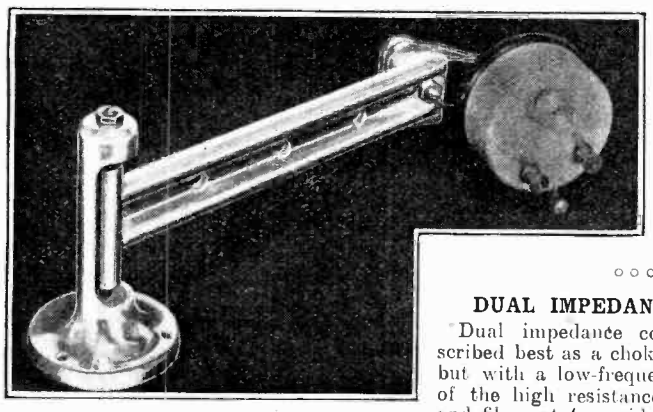
Of more particular interest is a long-

wave aerial-grid coil designed to give improved selectivity on the long waves. Selectivity is governed by the degree of coupling between the aperiodic aerial coil and the tuned grid coil, but with the optimum number of turns the aerial circuit often resonates well below 600 metres, with the result that signals from a powerful broadcast station of medium wavelength will force their way through even though the grid circuit is tuned to about 1,000 metres. To overcome this undesirable state of affairs, the special long-wave transformer type MM3/LS is fitted with a large primary (or aerial) coil, but to maintain the required loose coupling a part only of this coil is coupled to the grid winding. The remainder is wound in two grooves well spaced from the grid coil, this portion being astatically wound. The turns on one section are wound in the opposite direction to the turns in the other, thereby reducing the external magnetic field, and hence the coupling. The designers, Messrs. Postlethwaite Bros., Church Hill, Kinver, Stourbridge, are to be congratulated on the ingenuity displayed in overcoming a rather difficult situation. The price of the special long-wave coil is 10s. 6d., and of the ordinary type 8s. 6d. each.

○○○○

WATMEL PICK-UP CARRIER.

Although light in weight, the construction of this component is massive. Polished aluminium castings are used throughout, and the adjustable single-ball pivot bearings give a practically frictionless movement without side play. The main arm is allowed lateral movement only, and in no way adds to the pressure of the needle on the record. The pick-up is clamped in a small aluminium rocker arm of negligible weight, so that the pressure on the needle is little more than that due to the weight of the pick-up itself. A set-screw is provided for fixing the pick-up, and the diameter of the hole is ¾in.



Watmel pick-up arm with cast aluminium members and adjustable ball bearing.

Simplicity is the keynote of the design, and no device is included for correcting for track error. An alignment card is provided, however, by means of which the track error can be evenly distributed over the range of movement of the arm.

The price of this component, which is made by the Watmel Wireless Co., Ltd., Imperial Works, High Street, Edgware, is 7s. 6d.

○○○○

A PEDESTAL CABINET FOR THE "MEGAVOX THREE."

The design of this cabinet is quite original, and the dimensions are such that it can be used also as a small table for various purposes. The polished oak top measures 18in. × 25in., and the middle section slides out revealing ample space in the interior for batteries as well as the receiver. A special three-ply partition is supplied to separate the set from the batteries.

"Aconicab" pedestal cabinet for the "Megavox Three." The dimensions are such that the cabinet serves also as an occasional table.

The overall height is 30¾in., and the controls fall conveniently to the hand when operating the set from an armchair.

The maker is A. V. Clarke, 22, Old Montague Street, London, E.1, and the price is £3 10s. in polished oak.

○○○○

DUAL IMPEDANCE COUPLING.

Dual impedance coupling can be described best as a choke-capacity coupling, but with a low-frequency choke in place of the high resistance between the grid and filament (or grid bias) of the following valve. The advantages of this method may not at first be apparent, but in all systems depending on a condenser linkage the reactance, or resistance, of the capacity plays no mean part in the amplification obtained. The reactance of the condenser varies with the frequency, this increasing as the frequency is reduced. By choosing suitable values for the chokes and condenser it can be arranged that the network resonates low down on the audio scale, thereby maintaining a high amplification over a large portion of the scale. The Igranic dual impedance coupler consists of two iron-cored inductances wound on separate cores and mounted side by side with a condenser built in. The connections between the chokes and condenser are made internally and four terminals are provided for the required outside connections.

From a curve which accompanied the sample sent to us, we notice that when used with valves of suitable impedance an amplification of 7 is obtained at frequencies in the region of 40 cycles, and this rises to 8 at 60 cycles. As the frequency is increased there is a slight falling off in amplification to about 7 between 100 and 200 cycles, and from 300 to 6,000 cycles the amplification is fairly constant, about 7.75, and this is followed by a slow decline between 6,000 and 10,000 cycles where the amplification drops again to 7. It would appear, therefore, that, with the particular valves used, the mean amplification between the two limits given, namely, 40 to 10,000 cycles, is about 7.5. The maximum variation over the whole band is a fraction over 10 per cent. or barely sufficient to be detected by the ear. This curve was taken using two stages of dual impedance coupling.

The Igranic dual impedance coupling unit.

The makers are the Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, and the price is 30s.

○○○○

TRADE NOTE.

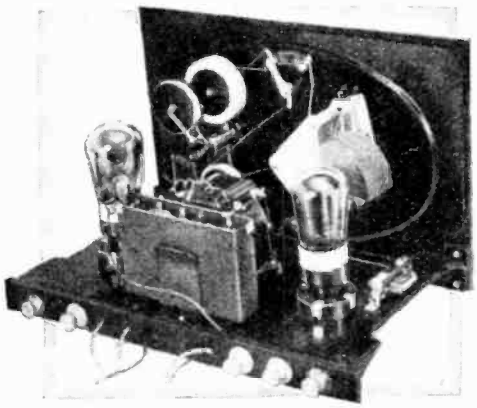
The business of Messrs. Frank Kay and Co., 40, Clifton Street, Lytham St. Annes, has now been taken over by Messrs. Wilkinson's Wireless Service Co., 47-48, Cannon Street, Preston. All goods and correspondence should therefore be forwarded to the Cannon Street address in future and not to Lytham.

BROADCAST RECEIVERS

GRAVES "VULCAN" TWO

Interesting Improvements and Modification in the New Model.

THE Graves two-valve set needs no introduction to our readers. In its original form it was reviewed in the issue of July 27th, 1927, and in the new design the basic features which contributed so much to the success of the first set have been retained. The tuner is essentially the same, and consists of two coils, one for long and one for medium waves, connected in series with a switch for cutting out the long-wave coil when receiving on the medium B.B.C. waveband. A reaction coil swinging through an angle of 180 degrees couples with either coil according to the waveband in use. The coils are wave-wound on ebonite centres, shellacked and baked, and the complete unit presents a particularly neat and compact appearance. The "Utility" condenser is retained for tuning, but instead of using a fixed series condenser for improving selectivity and, if necessary, reducing wavelength, the alternative aerial terminal is connected to a tapping point on the tuning inductance. Otherwise the circuit remains as before, and the leaky grid detector is followed by a transformer-coupled L.F. amplifier feeding direct into the loud speaker.



Interior of the Graves "Vulcan" receiver showing moulded bakelite baseboard and terminal strip.

Modified Layout.

The layout has, however, been slightly modified; the tuning dial is now on the left and reaction on the right, all the terminals are fitted at the back of the set, and the L.F. transformer (now a B.T.H.) is situated between the two Aermonic anti-microphonic valve-holders with the grid bias battery immediately behind it.

The appearance has been greatly enhanced by a moulded bakelite front panel with large-diameter engraved bevel dials set in an oval recess. For the sake of uniformity both scales are engraved in degrees from 0 to 180, so that the zero of the right-hand reaction dial is really at 90° with maxima for long waves and medium waves at 0° and 180° respectively. When the wave-range switch is at "Long," reaction increases from 90° to zero, and at "Short" from 90° to 180°.

The original wood baseboard has been replaced by a special moulding with corner webs which are screwed to the front panel and make angle brackets superfluous. The terminal strip is moulded integral with the baseboard and carries the loud speaker terminals as well as the earth and alternative terminals for the aerial. The battery leads are brought out through holes in the terminal strip and are already fitted with spade terminals and wander plugs.

Improved Quality.

Other points of interest in the specification of the receiver are the redesigned filament and wave-change switches and the substitution of a P.M.2 for the original P.M.1 valve in the output stage.

With the exception of the loud speaker the accessories remain much as before. The new horn-type loud speaker is of massive design and construction, the goose-neck being a heavy iron casting. The flare is of spun metal, and is fixed to the neck by three screws. The joint is well fitted and there is no trace of jarring. An adjusting screw for the movement is situated under the base.

The quality of reproduction has been improved by the use of the P.M.2 output valve, and is more than sufficient for the average living room. The selectivity is much the same as in the original design, and is sufficient to separate 5GB from 2LO in London—no mean performance for a

Broadcast Receivers. Graves "Vulcan" Two.—

two-valve set at only 1¾ miles from the latter station. The selectivity is not quite sufficient to enable Continental stations to be received in the London area, but during intervals in the transmission from 2LO several German stations can be heard on the loud speaker.

The price of the new model, including royalty and complete with aerial equipment and all accessories, remains at £7 17s. 6d., a figure which represents extraordinary value when the quality and performance of the outfit are taken into account. Further, the makers, Messrs. J. G. Graves, Ltd., Sheffield, are prepared to send the set on approval and also on very favourable deferred terms.

LETTERS TO THE EDITOR.

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

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

SHORT-WAVE ECHOES AND THE AURORA BOREALIS.

Sir,—In connection with the discovery of the abnormally long retardations of short-wave signals discovered by Engineer Hals and so interestingly discussed by Dr. Beatty in your issue of to-day, it seems of interest to enquire whether such phenomena might be explained by purely terrestrial agencies. Everyone must find Professor Störmer's theory delightfully attractive, but I think that other possibilities must be considered as well.

Abnormally long retardations of short-wave signals returned from the upper atmosphere were first described by A. H. Taylor and L. C. Young (Proc. Inst. Rad. Eng., Vol. 16, Nr. 5, 1928), who, in experiments carried out between Rocky Point and Washington, obtained retardations corresponding to a distance of transit of from 2,900 km. to 10,000 km., whereas the great circle distance was only 420 km. In other words, retardations over 20 times greater than we should expect were observed. In discussing these experiments in a paper read before the Union Radio Scientifique Internationale in Brussels on September 13th, 1928, I pointed out that waves travelling vertically upwards into the ionised layer would be "reflected" at a point where the group velocity was reduced to zero, and that, if the gradient in this region was not large, the signal would be very appreciably retarded there.

Now, the retardations observed by Engineer Hals and Professor Störmer are much longer than those observed by Taylor and Young, and the question arises whether waves of 30 metres can remain travelling in the ionised layer for such a period of 10 seconds and yet be of appreciable intensity when they reach the ground again. (There is certainly no difficulty in picturing a path in the ionised layer along which it would take 10 seconds for a signal to make a journey round the earth.) Some calculations I have made show that if there is sufficient ionisation *at very great heights*, large retardations with only moderate absorption may be explained.

There is also another possibility. If we think of the ionised layer as forming a kind of reflecting shell round the earth the waves sent out from a station may go round many times before they focus to produce a large signal in a particular place. We know, from Quäck's records, that the attenuation for a single circumferential journey may be surprisingly low.

E. V. APPLETON.

Wheatstone Laboratory, King's College.
November 28th, 1928.

TRANSMISSION QUALITY.

Sir,—With reference to the letter dated October 26th, 1928, from Mr. A. K. Gordon in the November 14th issue of your paper, the same variation can be observed in the transmission from 5XX and 5GB.

Those from 5GB are received here in Salisbury pretty well perfectly on a good set using two L.S.5a valves in a stage of push-pull power amplification with 300 volts H.T. and moving-coil speaker, being crisp, clear and natural.

Those from 5XX, on the other hand, are low pitched, woolly, and if any output is desired speech is almost impossible to understand. I have to detune considerably to raise the pitch so that the higher frequencies are given more chance, as it were, although this is never necessary with 5GB's transmissions, which can be tuned in as sharp as you like and are still crisp.

After standing it as long as I could I wrote to the Chief Engineer of the B.B.C., and received a very courteous letter from him in reply, which I am sure he will not mind you publishing, and for that purpose I quote from it as follows:—

"We think that the difference between the quality of the transmissions of Daventry, 5XX and 5GB, which you notice, is due to the latter station being of a more recent design. Daventry 5GB has a better frequency volume response than 5XX, with the result that the overtones are transmitted in their correct proportions. The curve of musical frequency response from 30 to 8,000 cycles in the case of 5GB is practically a straight line; that of 5XX, while not as good, is nevertheless reasonably satisfactory. We would not, however, characterise the transmissions of 5XX as "woolly," though admittedly this performance is not as good as 5GB. However, the difference is hardly discernible, except on apparatus that is extremely susceptible to good quality."

As a matter of fact he is quite correct in stating that it is only on a good set that any difference can be observed, and, of course, many of the foreign stations exhibit just as bad a frequency curve, and this is unfortunately only too noticeable on a good set.

Have any of your readers who take the Bournemouth transmissions noticed that this station has recently very much improved the quality of its transmission?

On my set, although I am only about thirty miles from it, I could not get any good results unless it was transmitting from the Bournemouth Studio, or one of the cafés, owing to very bad cut-off of the higher frequencies, but in the last month or so it has considerably improved, and is now quite a good alternative to 5GB on the lower waveband.

J. B. KELLAR.

Salisbury.
November 14th, 1928.

Sir,—Mr. Gordon's letter on the question of transmission quality raises again the point which I have raised in your columns on two occasions. When is that nice reticence on the part of the B.B.C. to be broken down and some information concerning transmission quality vouchsafed to a long-suffering public? In an address to the wireless section of the I.E.E., Captain Eckersley gave some frequency response curves for 2LO, 5XX, and 5GB, but as yet no information has been given for any of the provincial stations. An inspection of the curves given by Captain Eckersley shows that Mr. Gordon is possibly right when he says that the reproduction of 5XX transmissions is short of the higher audio frequencies. 5GB (when it is not subject to fading and distortion) gives at my position the most pleasing results.

I think that some official statement on the subject is long overdue, so would the B.B.C. mind giving the following information:

(1) Typical frequency response curves for all the provincial stations, both on direct and relayed transmissions.

(2) What degree of control is exercised, and, if this control were removed, what extra margin would have to be allowed in receiver design to take care of the peakloads.

(3) What improvements we might expect as regards transmission quality from the new regional high power stations.

(4) Do the B.B.C. consider that frequency response curves and a measure of the degree of control exercised represent the whole story as regards measuring distortion in broadcast transmissions?

W. S.

Manchester.
November 14th, 1928.

READERS' PROBLEMS

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

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

Energising Current.

I have an A.C. mains supply at 240 volts. Which is, in your opinion, the most convenient method of using this to energise the pot magnet of a moving-coil loud speaker? L. P. S.

We think you will find it difficult to beat the arrangement which makes use of a small 6-volt accumulator battery connected across the winding, and charged by means of one of the many devices which are now available. The charger should be able to deliver a current at least equal to that consumed by the winding.

○○○○

An Overloaded Eliminator.

My set gave good results with batteries, but since obtaining an eliminator signals are weak and badly distorted. Does this indicate that the set is unsuitable for use with a mains supply? The eliminator is beyond suspicion, as I have tried it with a friend's two-valve set with entirely satisfactory results. R. J.

You do not give details of your set, or any information as to total anode current consumed by it, but we are inclined to think the trouble must be due to the fact that the eliminator is designed for a small output, and that its voltage falls very considerably when connected to your receiver. The fact that your friend's set works well with the H.T. unit would suggest that this is the true explanation.

○○○○

The "Everyman Portable" Circuit.

Is it possible to use the throttle control reaction circuit of the "Everyman Portable" (on a full-sized aerial) with an auto-transformer type of aerial coupling, and, if so, where should the tapping connections be made? I wish to retain the waveband switch. L. F. M.

Your proposed modifications can be put into effect if you use a three-pole double-throw switch for waveband changing. The connections will be as in Fig. 1, from which you will see that the third arm of the switch is arranged to change over the aerial connection to appropriate points on long or short wave coils. These tappings should be made at approximately the positions indicated; you will observe that the aerial is joined in such a way that the coupling turns are situated at the low-potential end of the grid sections of the coils.

The actual number of turns will depend on the degree of selectivity required and the constants of your aerial system, etc.; the best position for the aerial tap can best be found by trial and error.

○○○○

An Inexpensive Receiver

Is there any reason why the "Pentode Two" receiver should not be used with an ordinary valve in the output position? W. M.

Provided that you do not require the high magnification and large output obtainable from a pentode valve, there is no reason why an ordinary triode should not be substituted. You will, of course, omit the connection to the screen grid terminal.

○○○○

The Pictures.

I am thinking of using some of my spare components in the construction of a special set for operation with a picture receiver. Will you outline briefly some of the requirements? I am particularly keen on receiving the foreign transmission. S. T. J.

The most important attributes of a set for long-distance picture reception are high selectivity and good sensitivity. The latter quality is desirable, not because a very strong signal is needed, but because it is desirable to have a wide margin of safety in order to compensate for fading. A smooth control of magnification may be regarded as almost essential. We doubt if you could better two H.F. stages with a detector and one L.F. amplifier, and would add that for your purpose "quality" reproduction as it is usually understood is of no importance, although there must, of course, be no marked tendency towards self-oscillation in either H.F. or L.F. amplifiers.

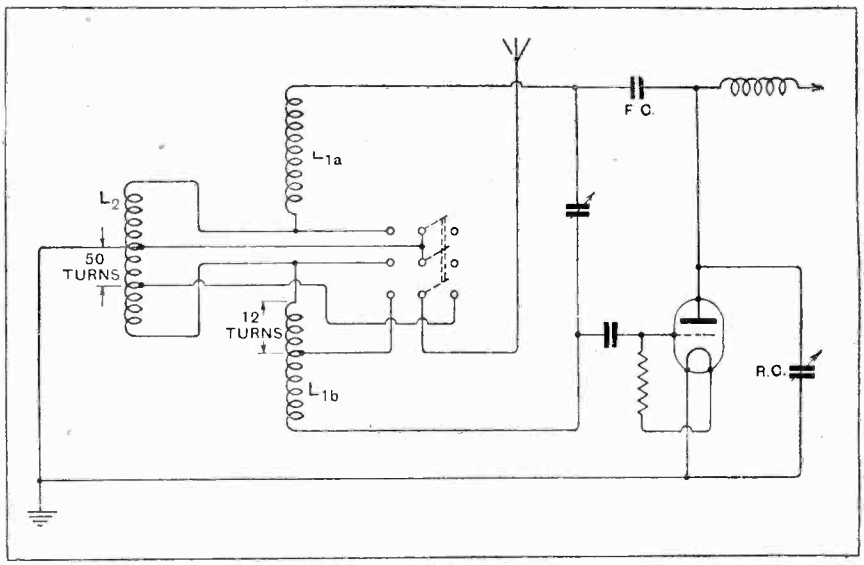


Fig. 1.—A throttle-controlled Hartley circuit with auto-coupled aerial and waveband switching. L_{1a} and L_{1b} represent the divided medium-wave inductance; L_2 is the long-wave coil.

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.

The Wireless World AND RADIO REVIEW

(16th Year of Publication)

No. 485. WEDNESDAY, DECEMBER 12TH, 1928. VOL. XXIII. No. 24.

Editor: HUGH S. POCOCK.

Assistant Editor: F. H. HAYNES.

Editorial Offices: 116-117, FLEET STREET, LONDON, E.C.4

Editorial Telephone: City 9472 (5 lines).

Advertising and Publishing Offices:

DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street.

Telegrams: "Cyclist, Coventry." *Telephone:* 5210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street.

Telegrams: "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 260, Deansgate.

Telegrams: "Iliffe, Manchester." *Telephone:* 8970 City (4 lines).

PUBLISHED WEEKLY.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

Entered as Second Class Matter at New York, N.Y.

CONTENTS OF THIS ISSUE.

CHRISTMAS AND RADIO.

CHRISTMAS comes round once again, and the question of how far wireless can help us in our problems of the choice of gifts for our friends and for Christmas-time entertainment is with us. In "Radio Gifts for Christmas" in this issue we endeavour to suggest in the minds of our readers ideas for the choice of Christmas presents from amongst the products for which broadcasting is responsible. There is much that is new and an immense variety of gifts at all prices, so that we think readers will find that their difficulties in the choice of Christmas presents can largely be solved by consideration of the possibilities which wireless offers.

○○○○

TALKING FILMS.

THE scope of the wireless engineer is no longer limited to the technical development of wireless transmission and reception of telegraphy and broadcasting, because new branches of electrical engineering are continually presenting fresh problems which require the experience of the wireless engineer for solution.

Some little while back came the application of the principles of electrical sound reproduction to the gramophone, and this has now developed to a point where the standard of reproduction of the modern gramophone is set by the performance of electrical reproduction.

Another direction in which the principles of sound reproduction have been applied to assist in the development of the new industry is exemplified in the talking film, for which it will be generally conceded there are very great possibilities. Since the technical problems of the development of the speaking film are allied to wireless, we may perhaps be permitted to make reference to the subject of the speaking film generally.

A New Technique Needed.

In spite of the apparent possibilities, it does not seem to us that the speaking film is achieving the popularity to which its potentialities entitle it, and our own experience, after having seen and heard examples of speaking films in various theatres in this country is that, whilst the technical problems, such as synchronisation and quality of reproduction, are more or less taking care of themselves, and are bound to develop along the present lines to a state of comparative perfection within a short time, yet the part played by the producers of the films leaves much to be desired.

In our opinion, before justice can be done to the principle of the talking film, the present ideas of producers of films must, in a large measure, give place to a new technique, and instead of approaching the new principle from the idea of adding speech to a film, which has been taken very much on the lines of a silent film, the speaking film should be developed, using the stage and spoken plays as the basis but utilising to the fullest extent the advantages which the photographic film offers, as a means of improving upon the scenery and effects.

The handicap of the theatre is that scenery and general effects are cramped within the limits and the possibilities of stage scenery; the silent film depends largely for its effect upon the fact that it is not restricted in this respect.

If the two could be combined, therefore, with the scenery and effects as secondary to the spoken words of the play, and utilised to enhance the realism of the whole, instead of merely adding the spoken word and sounds to what is otherwise a silent film of a type to which we have hitherto been accustomed, then in this combination we foresee a much greater possibility of the development of a new art.

Suggestions for Every Purse and Purpose.

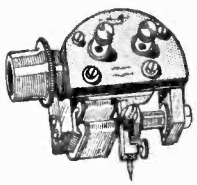
AT this season we are permitted the privilege of giving presents to our friends and relations as tokens of esteem and affection. The giving of presents, if undertaken in the right spirit, can be made an even greater pleasure than receiving, for the choice of suitable gifts provides unlimited scope for the exercise of ingenuity and thought, and in its highest form is worthy to rank as an art.

The wireless enthusiast will want to approach the problem of Christmas gifts in a logical and scientific manner, and he will first make sure that he understands the fundamental principles underlying the choice of the ideal gift.

It goes without saying that the present should satisfy a want. The element of surprise is also important, and the pleasure experienced by the recipient will be increased tenfold if the gift satisfies a need of which he was hitherto only subconsciously aware. It is for this reason that all enquiries as to possible requirements should be made unobtrusively and without putting direct questions.

Permanence and Utility.

The article chosen should, if possible, be useful and of a permanent character in order that it may serve to perpetuate the feeling of goodwill of which it is a token. No present could more completely satisfy this requirement than a wireless set, which is certain to be in daily use now that broadcasting is permanently established as a public service.



Another very sound reason for giving wireless is that one will be on familiar ground and therefore much more likely to choose an article of intrinsic value than if one attempted, say, to buy an etching for a collector of old prints, or a book for a literary friend. It is a sound principle in buying presents to confine oneself to subjects with which one is fairly well acquainted, provided the recipient shares to a certain extent the same interest. Here, again, we are on pretty safe ground in choosing wireless, for if our friends are not interested in the technical side of the hobby, they cannot fail to be interested in some part of the daily programme transmitted by the B.B.C.

"Superlative reproduction and simplicity of control are the qualities most likely to win the appreciation of a musician."

Complete Receivers.

According to statistics only one house in four is equipped with wireless, and there would appear to be ample scope for complete receivers as Christmas gifts. In choosing the type of receiver the temperament of the person to whom it is to be given must be taken into account. Superlative reproduction and simplicity of control are the qualities most likely to win the appreciation of a musician.

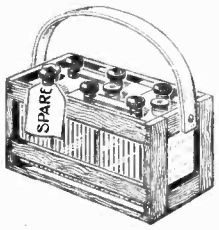
B 10

Radio Gifts for Christmas.—Long-distance reception can be safely ruled out and, in the interests of quality, the selectivity need be sufficient only to separate the alternative programme stations. If possible the loud speaker should be the only visible part of the equipment, the receiver being installed in another part of the house with remote control.

A sensitive long-distance receiver cannot fail to fire the enthusiasm and imagination of youth. As it will be in constant use at all hours of the day, and possibly of the night, headphones rather than a loud speaker would seem to be indicated in the interests of the remainder of the household. High quality of reproduction is not essential, but knife-edge selectivity is a *sine qua non*.

"A sensitive long-distance receiver cannot fail to fire the enthusiasm and imagination of youth."

Between these two extremes will be found the requirements of the average family, namely, the ability to receive at all times two alternative programmes at sufficient volume for the living room, together with the possibility of picking up one or two Continental stations as a matter of interest when circumstances are favourable. A wide selection of receiving sets satisfying these requirements will be found at prices ranging from £7 to £10. Before making a final choice, it would be as well to enquire into the probable cost of upkeep in order that the recipient may not be involved in an expense beyond his means. In this respect mains-driven receivers show to distinct advantage, but the nature of the mains supply must be ascertained with meticulous care before placing an order. Some details of the type of aerial it would be possible to erect and the distance of the nearest B.B.C. station should also be noted for the information of the dealer to whom the order is entrusted.



To make quite certain of successful results and to be independent of problems relating to aerial systems and power supply, the self-contained portable set should be seriously considered. The upkeep cost in the matter of H.T. batteries is naturally higher than a permanent mains-driven set, but against this the advantages of portability are obvious. It makes the ideal present for the outdoor type of person.

Finally, a hint to those with relatives and friends in distant parts of the Empire. What finer present than a short-wave set with which to get in touch with the Home Country through 5SW? But before ordering be sure to get advice regarding the best type of cabinet, insulating materials, and batteries for H.T. and L.T. from someone acquainted with tropical conditions. In general, a metal cabinet, porcelain or bakelite insulation, and inert cells to be filled on the spot will fulfil these conditions.

Accessories.

So far we have been working on the assumption that our friends have not as yet enjoyed the possession of a wireless receiver. If it should happen that they have already installed a set, one's choice is limited to accessories. On second thoughts, "limited" seems hardly the correct word to use, for the number of "gadgets" suitable for addition to existing receivers is well-nigh unlimited. A visit to your friend's house and an unobtrusive examination of the set will suggest many possibilities. It may happen that the set is not functioning. You enquire the reason. The accumulator is away being charged. Item Number One, a spare accumulator for use while the big one is being charged. The capacity should be such that the maximum discharge rate is equal to the current required by the set, and the plates should preferably be of the "mass" type, for it will be called upon to hold its charge for long periods. Make sure that the voltage corresponds with the type of valves in the set, or the gift may do more damage than it is worth. A question as to whether 2-, 4- or 6-volt valves are being used is very frequently asked as a matter of interest, and will not arouse suspicion.

While on the subject of batteries, may we suggest a hydrometer as a means of keeping cells in good condition, and so obtaining the maximum service?

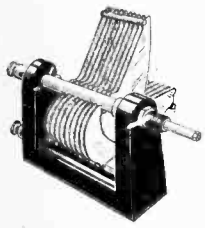
Then there are accessories which extend the usefulness of a receiver beyond the reception of broadcasting. An electrical gramophone pick-up, for instance, or—yes, why not?—a complete picture receiver.

If dry cell H.T. batteries are known to be an expensive item in the upkeep

Radio Gifts for Christmas.

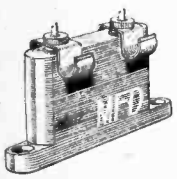
of a quality receiver using power valves, an H.T. mains eliminator is certain of grateful acceptance. The choice of a suitable type, however, can hardly be undertaken without a consultation with the owner of the set, for the fullest particulars of the receiver as well as the nature of the supply must be given when ordering.

If you already possess a detailed knowledge of the receiver in question and to your certain knowledge it has remediable faults, the gift of a suitable accessory is a tactful way of pointing out the deficiency. A loud speaker whose performance is being marred by an excessive direct current through the windings will be assisted in functioning properly by a filter-feed unit or output transformer. Selectivity can often be improved by the use of a well-designed unit connected in the lead-in wire. Recent improvements in valve characteristics suggest another possibility, but new and more powerful output valves should only be given where the source of H.T. current is the supply mains.



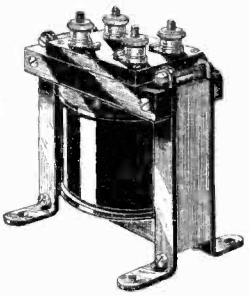
Aids to Better Reception.

A triple-range measuring instrument will give pleasure to the man who takes an interest in watching over the performance of his set. The ideal instrument for modern circuits would have the following ranges: 0-200 volts, 0-7.5 volts, and 0-35 milliamperes, but the ranges could be modified to the requirements of the receiver in use. Numerous applications for an instrument of this type will be found in an article which appeared in the issue of this journal for March 28th, 1928. Incidentally, may we remind our readers that *The Wireless World* is an indispensable accessory to the full enjoyment of any branch of wireless activity, and that a year's prepaid subscription will be acceptable alike to the novice and the expert. There is also the comprehensive range of text books and the "Wireless World Diary" from which to make a choice.



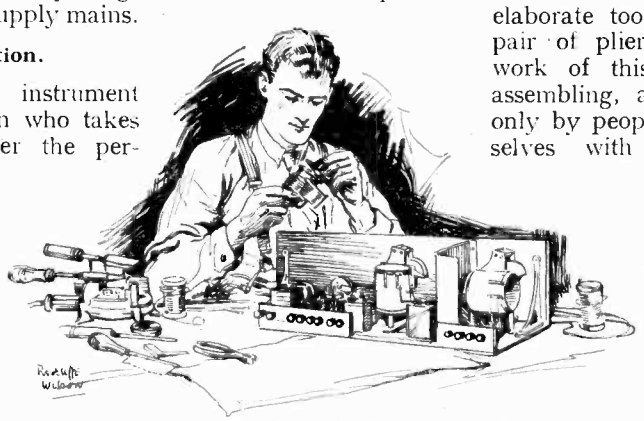
The Experimenter.

Those of your friends who are experimenters and make a hobby of building their own sets will no doubt appreciate components as Christmas gifts. These must be chosen with the utmost care if they are to be of any use, for the experimenter is an experienced critic, and to win his approval components must conform exactly to specification. If possible try to obtain full particulars of the additional components required for his next set, but if this is impracticable there are many components to choose from which are of general utility and are certain, sooner or later, to fill a want. Amongst other things we would suggest a pair of slow-motion dials made to fit ¼in. spindles, variable condensers of well-known make, either of 0.0003 or 0.0005 mfd. capacity, a good audio-frequency transformer, ratio about 3.5 : 1, a set of non-microphonic valve holders, and large by-pass condensers of, say, 2 mfd. capacity.



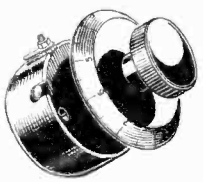
Many home-constructed sets do not get much farther than the panel and baseboard layout stage, but when one is made which looks like taking permanent form, the present of a suitable cabinet will add the finishing touch.

It is possible to construct a complete wireless set with no more elaborate tools than a soldering iron, a pair of pliers, and a screwdriver, but work of this kind is little more than assembling, and is generally undertaken only by people who wish to equip themselves with wireless at the lowest possible cost.

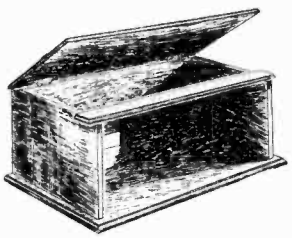


"The experimenter is an experienced critic, and to win his approval components must conform exactly to specification."

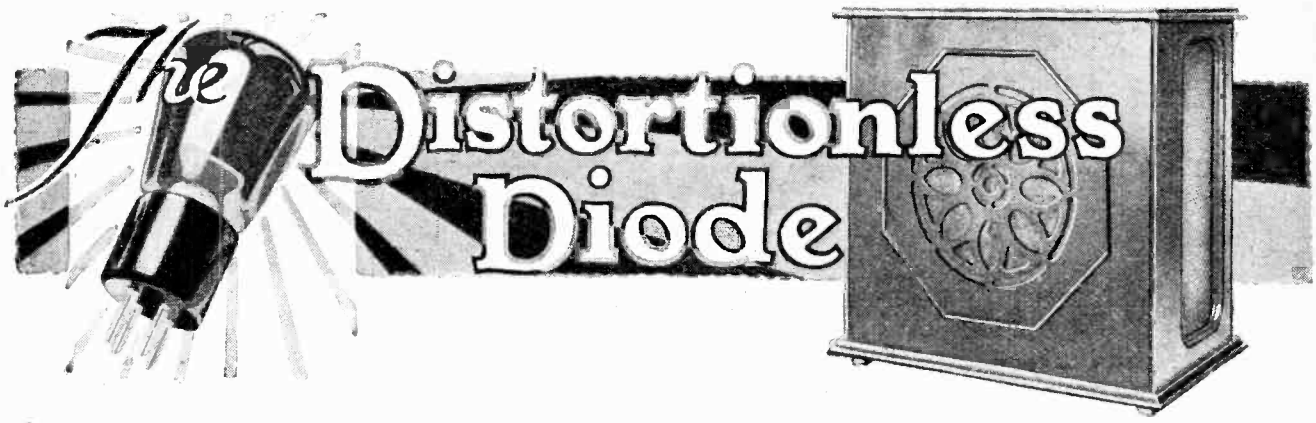
The man who takes a pride in his hobby is prepared to go to any length in building his sets according to his own ideas. This will mean that he will have to construct many parts from raw material, and his equipment of tools will expand accordingly. Many useful tools specially designed for wireless work are available and these, in addition to such standard appliances as hand drills and electric soldering irons, provide ample variety for choice.



In conclusion, may we remind readers that time is now getting short, and to make certain of delivery before Christmas orders should be placed at the earliest possible moment. The more popular the receiver or component the greater the need for prompt action; the demand for these articles will increase enormously as Christmas draws near, and although the rate production may be adequate to meet the demand the packing and despatching departments will be overtaxed. These departments are the bottle-neck through which production flows, and any help which the public can give to relieve the last minute strain will be greatly appreciated by manufacturers.



B 12



Practical Applications of the Two-electrode Rectifier.

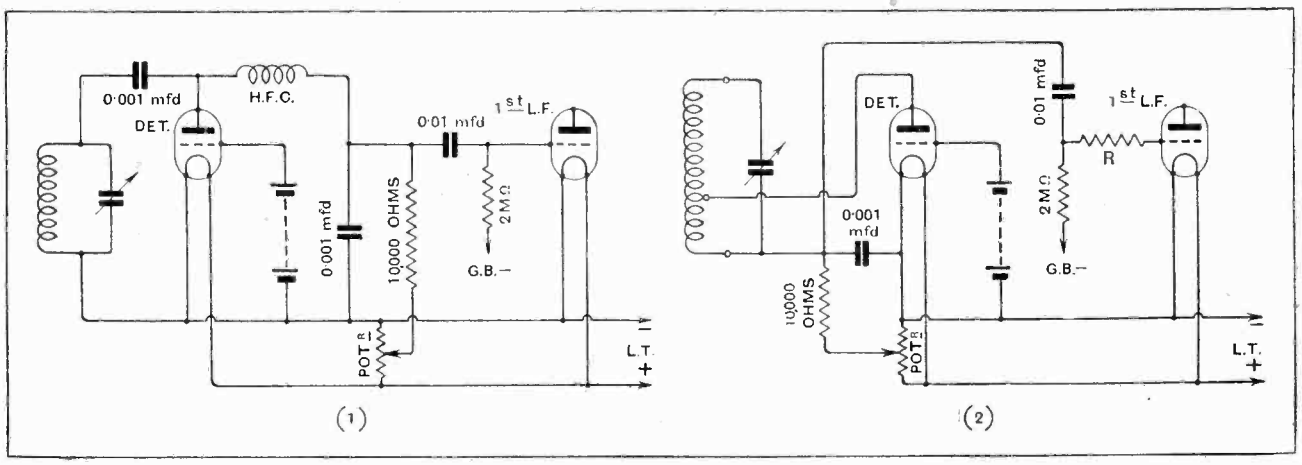
By H. F. SMITH.

IT is more than doubtful if the ear can detect distortion due to a properly arranged anode bend rectifier, even when it is followed by the best amplifier and loud speaker, although it must be admitted that the defects of this method of rectification might become noticeable with a considerable increase in the depth of modulation at the transmitting station. The diode detector in its best form gives a rectified output strictly proportional to input voltage over a wide range, but in spite of this advantage it would appear to have an application only in cases where academic perfection is required, were it not for the fact that it has, apart from its excellence as a rectifier pure and simple, another property which is even more important under present-day conditions. It requires no high-tension voltage, and, indeed, is completely isolated from the anode circuits of the L.F. amplifying valves in the receiver; consequently its circuits are free from interaction, and the possibility of low-frequency reaction—which, if present, is certain to introduce serious distortion, if not actual "motor boating," or oscillation—is very considerably reduced. This is especially true where anode current is derived from an eliminator; although signal impulses can be diverted from resistances and impedances common to a number of circuits, thus preventing interaction, this end is attained only at the cost of complication and considerable expense. On these grounds alone a good case could be made out for the diode, and it should not be neglected by users of two-stage L.F. amplifiers, who depend for anode current on a mains supply, or even on an H.T. battery of high internal resistance.

Distortionless; damped; decoupled; in these three words may be summed up the more important advantages and disadvantages of the modern version of the two-electrode detector, for which an ordinary three-electrode valve is used.

In many cases diode rectification confers benefits that more than outweigh its shortcomings, and its usefulness is by no means confined to the more ambitious type of receiver.

It cannot be denied that the sensitivity of the diode is low, and it is therefore most likely to appeal to those



Figs. 1 and 2.—The conventional parallel-connected rectifier circuit, and (Fig. 2) the series arrangement. In either, the anode may be joined to a tapping point on the coil, thus increasing both selectivity and volume.

The Distortionless Diode.—whose main object is good reproduction from the local station. However, it must not be imagined that it is totally unsuitable for long-distance reception; provided suitable precautions—which will be described later—are taken, there is no reason why it should not be included in a long-range receiver.

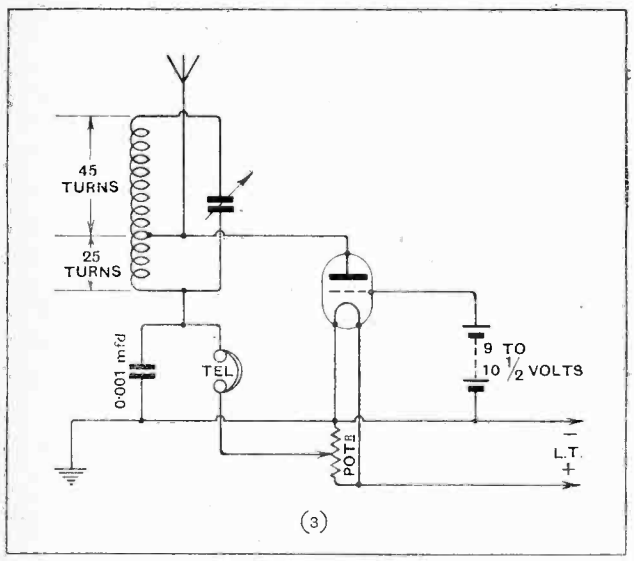


Fig. 3.—A test circuit for diode rectification, without H.F. or L.F. amplication.

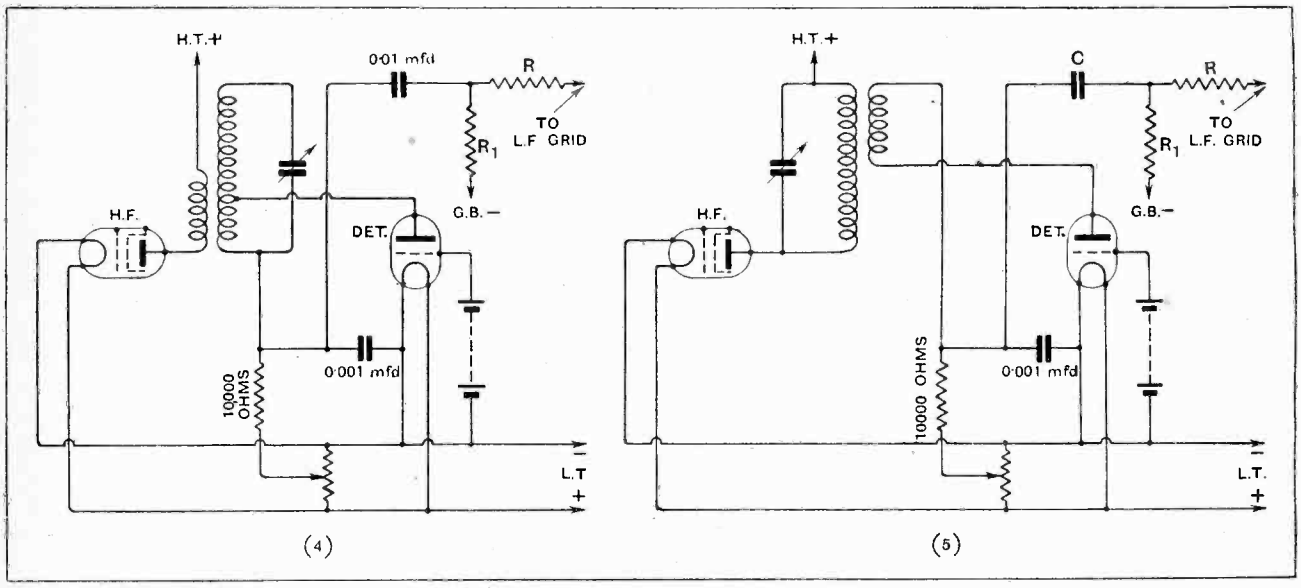
There are several methods of using a modern three-electrode valve as a two-electrode rectifier, but in every case it is usual to neutralise the space charge by the application of a steady positive potential (derived from dry cells or an accumulator battery) of some 9 or 10 volts to the grid. Signal voltages are impressed between anode and filament. As is well known, a valve passes anode current when its plate is made positive with respect to the filament; there is no current flow when polarity is reversed. In exactly the same way, when oscillatory currents are applied, the positive half-cycle is passed, and the negative is suppressed.

The method of connection shown in Fig. 1 is probably the most popular at the present time; it is that used in the demonstration receiver at the South Kensington Museum, and is generally referred to as the "Kirkifier." In this arrangement input and output circuits are in parallel.

Coupling Resistance in Series.

Another and somewhat simpler form of connection, which has about the same sensitivity, is shown in Fig. 2; here the coupling resistance is in series with the rectifying circuit, and low-frequency impulses built up across it are applied to the grid of the first L.F. valve through a stopping condenser fitted with the usual grid leak. It is also recommended that precautions should be taken to restrict the development of H.F. potentials across the L.F. input circuit; this can conveniently be done by connecting a resistance of not less than 100,000 ohms in the manner shown. Alternatively, an H.F. choke can be inserted in the same position. A rectifier of this kind is not quite so perfect over a wide range of inputs as is the first-mentioned, but if it is followed by an efficient 20,000-ohm valve, coupled in its turn to the output valve by means of a good transformer, it will be distortionless on H.F. inputs, which, after detection and amplification, will fully load up any ordinary output valve with the H.T. voltage customarily applied.

A diode detector, like a galena crystal, imposes a very heavy load on the tuned circuit which precedes it, and it is partly for this reason that it has such a bad reputation for sensitivity. Its shortcomings in this respect can be overcome to a great extent by using



Figs. 4 and 5.—Rectifier preceded by screened-grid H.F. stage with step-up transformer: Fig. 5 shows a step-down coupling with tuned primary. In these and the following circuits. C is the coupling condenser; R, H.F. stopping resistance: R_1, grid leak. These components may have conventional values.

The Distortionless Diode.—

specially designed tuning circuits with a higher ratio of capacity to inductance than is customary, but this expedient is hardly likely to be widely popular, and it will generally be considered preferable to use transformers, etc., of conventional design, and to join the anode of the detector to a tapping point on the coil at such a position that approximately one-third of the total number of turns are included in circuit. It is not possible to lay down a hard-and-fast rule, but if a tuning condenser of 0.0003 or 0.0005 mfd. is used, this connection will generally be sufficiently near to the optimum point for all practical purposes.

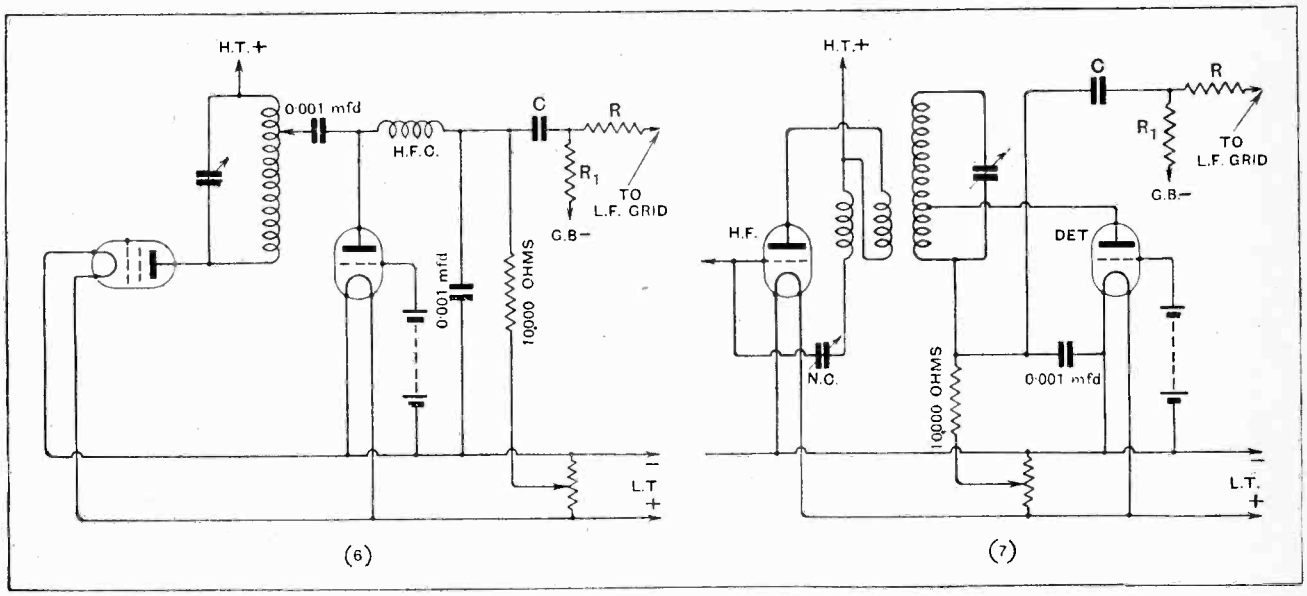
Almost any ordinary valve will work well as a rectifier, but a "general purpose" type, with—very roughly—a rated impedance of 20,000 ohms, and a voltage factor of 20, is the safest and best, particularly for the circuit of Fig. 2.

To improve the performance of the rectifier it is desirable to apply a slight positive bias—of something less than a volt—to the anode of the valve. This can

existing conditions. To make the experiment, a coil with seventy turns of No. 26 D.C.C. should be wound on a 3in. former with a tapping at the twenty-fifth turn from the earthed end. This is joined up in the manner shown, and if really loud phone signals are obtained the experimenter can rest assured that the rectified current obtainable, applied to an amplifier as described in an earlier paragraph, will fully load up a normal output valve, even if it is of the super-power variety with an anode voltage of 130 or so. Under these conditions the detector will be working distortionlessly, but where more ambitious requirements are to be satisfied it will be necessary to precede the detector by a stage of H.F., and preferably to use the rectifier circuit given in Fig. 1.

Adding H.F. Amplification.

With regard to sets for long-distance work, we must face the fact that, as compared with an anode bend or grid circuit rectifier, the diode does reduce both sensitivity and selectivity. The position is not hopeless,



Figs. 6 and 7.—The parallel-connected diode following an H.F. stage with tuned anode coupling, and (Fig. 7) the series arrangement connected to a neutralised transformer of conventional design.

most conveniently be done, as shown in the diagrams, by joining the low-potential end of the plate-filament circuit to the slider of a potentiometer, the windings of which are connected across the L.T. battery. The adjustment is best made when listening to signals artificially weakened by detuning or otherwise.

A Trouble-free Domestic Set.

The most obvious, and certainly the most attractive, application of the diode is to a simple short-range set. High-frequency amplification is by no means essential at distances of a few miles from the transmitter, unless requirements as to volume are above the average. By setting up the circuit shown in Fig. 3 it is an easy matter to decide whether the rectifier, without H.F. amplification, will give the required performance under

as quite fair results are obtainable with a single H.F. stage if it is really efficient. We must not forget, however, that reaction from the detector anode circuit is no longer obtainable, and that this valve does nothing towards magnifying the applied signal voltages. Consequently, we must regard the addition of a second H.F. stage as almost essential when long-range reception is our aim.

In Fig. 4 is given the connection of the simpler form of rectifier when used in conjunction with a screened grid H.F. amplifier. The coupling transformer may be of conventional design, but, as before, damping should be reduced by joining the detector anode to a point on the secondary which will result in the inclusion of about one-third of the total number of turns.

Another device for coupling the rectifier to an S.G.

The Distortionless Diode.—

amplifying valve is shown in Fig. 5; this consists of a transformer with a tuned primary and a step-down ratio of about 3: 1. This arrangement is rather less selective than that discussed in the previous paragraph, but it has the advantage that the number of connections brought out from the transformer is reduced by one—an appreciable gain where waveband switching is to be included.

The "Kirkifier" detector circuit may be linked to an H.F. valve through the couplings shown in Fig. 4 and Fig. 5, or, if preferred, it may be used in conjunction with a tuned anode arrangement as shown in Fig. 6. Unfortunately, this scheme of connection does not completely isolate the L.F. grid from the H.T. supply, and the use of an H.F. transformer, in spite of its slightly increased complication, is considered to be preferable to prevent the possibility of interaction. There is no reason why a diode detector should not be preceded by a stage of neutralised H.F. amplification in conjunction with an ordinary valve. Its connections are given in Fig. 7, from which it will be seen that, as usual, the rectifier anode is joined to a tapping on the coil. Due to the damping which must inevitably be present in spite of this precaution, there is little point in using a transformer with a Litz-wire secondary.

In conclusion, it may be pointed out that in circuits such as those shown, it is possible to control volume over a reasonably wide range by dimming the detector filament; measurements show that a reduction of emission does not cause any real change in the linear relationships between input H.F. voltage and rectified current when the valve is operated under conditions as already stated.

CLUB REPORTS AND TOPICS

New Society at Swindon.

The inaugural meeting of the Swindon and District Radio Society was held on November 27 at Maxwell Street Schools. Following the election of office bearers the evening was devoted to the comparison of various moving coil loud speakers demonstrated on a simple and inexpensive three-valve receiver.

The Society meets every Tuesday at 7 p.m. New members will be welcomed.

Hon. Secretary, Mr. Pidgeon, 130, Princes Street, Swindon.

○○○○

Song and Dance.

A Radio-Gramophone Concert and Dance, open to the public, is being organised by the Bec Radio Society, Bec School, Beechcroft Road, Balham, S.W.17. This interesting event will be held on Saturday next, December 15, at 7.30 p.m. at the School. Loud speakers and amplifiers, kindly loaned by Messrs. S. G. Brown, Ltd., will be used together with an H.M.V. automatic gramophone and records. Tickets, 1s. 3d. each (reserved 1s. 6d.), are obtainable from the Hon. Secretary, Mr. A. L. Odell, 171, Trannere Road, S.W.18.

○○○○

Quartz Crystals.

Mr. A. Hinderlich recently lectured before the Golders Green and Hendon Radio Society on "Quartz Crystals and Their Application to Wireless." The lecturer described the oscillating properties of quartz when placed between two plates subject to an electrical discharge, and explained how this property was utilised in the calibration of wavemeters.

Hon. Secretary, Lt.-Col. H. A. Scarlett, D.S.O., 60, Pattison Road, N.W.2.

○○○○

Ultra Selectivity.

The question of selectivity occupied the attention of members at the last meeting of the North Middlesex Radio Society. The discussion was opened by Mr. E. H. Laister, who showed how the growth in the number of wireless stations in the last few years had emphasised the need for greater selectivity in wireless reception. The effect on quality of highly selective circuits was discussed, and the use of several stages of H.F., each of moderate selectivity, was advocated with the object of obtaining a flat-topped resonance curve. Mr. T. Tagent mentioned the effect of grid and anode rectification respectively on selectivity, pointing out the disadvantages of the former method.

Mr. A. J. Webb, M.A., B.Sc., a visitor from the Croydon Wireless Society, described a receiver embodying no fewer than six tuned circuits. The selectivity was such that the tuning in of even the local station was a considerable problem!

Hon. Secretary, Mr. E. H. Laister, "Endcliffe," 7a, Station Road, Winchmore Hill, N.21.

Picture Broadcasting Described.

Mr. F. H. Haynes, Assistant Editor of *The Wireless World*, lectured on "Picture Broadcasting" at the meeting of the Tottenham Wireless Society on November 21. The lecture was of great topical interest and showed how an entirely new field had been opened up to the experimenter. Several pictures were shown, and the apparatus was described in detail. There was an enthusiastic discussion.

Hon. Secretary, Mr. R. C. A. Haynes, 159, Lordship Lane, N.22.

○○○○

Wrong Methods Demonstrated.

The *Wireless World Five* was demonstrated in a novel manner by Mr. E. L. Cumbers, Hon. Secretary of the South Croydon and District Radio Society at the last meeting. Mr. Cumbers showed how easy it was to operate the set in the wrong way, explaining how various maladjustments produced distortion and similar results. Subsequently the set was given a fair trial, and Continental stations were received in plenty. An interesting five-valve portable set was demonstrated by Mr. Fairweather, who entered the clubroom carrying what looked like an ordinary attaché case. 2LO was received at excellent strength, and more than one European station could be tuned in without any delay.

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

○○○○

A Good Record.

At the first annual general meeting of the Slade Radio (Birmingham) on November 29, the Secretary's report disclosed that the numbers on the membership roll had grown from sixteen to eighty-seven in one year. The number of lectures and demonstrations given during the year totalled thirty-four, of which more than half were contributed by members of the Society. A number of social events had also been held. The Society is engaged in forming a valuable collection of apparatus and Precision instruments, and not the least important activity is attending to sets belonging to blind listeners. The ensuing year is looked forward to with every confidence, and a hearty welcome is extended to new members. Particulars can be obtained from the Hon. Secretary, Mr. H. Clews, 52, St. Thomas Road, Erdington, Birmingham.

○○○○

Simplicity in Control.

When, recently, the South Woodford and District Radio Society obtained the loan of a Music Magnet receiver from the General Electric Co. it was demonstrated by Mr. H. O. Crisp, who had never seen the assembled instrument before. Its simplicity of construction and control were no handicap to performance, as the demonstration proved. Distant transmissions were tuned in with good quality, and the reaction was handled with ease.

Hon. Secretary, Mr. E. J. Turbyfield, "The Nook," Alexandra Road, South Woodford, E.18.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 12th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Demonstration of Radio and Electrical Novelties, by Mr. Leonard Hartley, B.Sc.

Wigan Technical College Radio Society.—Social evening.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.19. Lecture: "Quality in Reproduction," by Mr. S. Smith.

Edinburgh Radio Society.—At 8 p.m. At 117, George St. Demonstration of "A Complete Electric Radio-Gramophone Equipment," by Mr. H. W. Gambrell (of the B.T.H. Co., Ltd.).

Royal Society of Arts.—At 8 p.m. At John Street, Adelphi, W.C.2. Lecture: "Applications of Electricity to Medical Practice," by Mr. G. G. Blake, M.I.E.E., F.Inst.P. Chairman: Sir Oliver Lodge, M.A., LL.D., D.Sc., F.R.S.

THURSDAY, DECEMBER 13th.

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. Demonstration of Moving Coil Loud Speakers, by the Star Engineering Co.

Kensington Radio Society.—At 8.30 p.m. At 136, Holland Park Avenue. Demonstration of a Straightforward Broadcast Receiver, by Mr. Maurice Child.

Slade Radio (Birmingham).—At 6 p.m. At the Parochial Hall, Broomfield Road, Erdington. Members' Night.

FRIDAY, DECEMBER 14th.

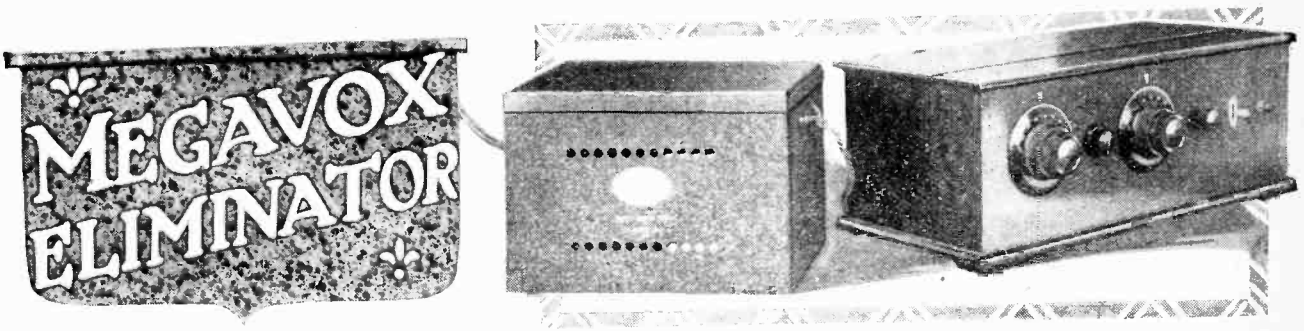
South Manchester Radio Society.—At the Co-operative Hall, Wilmslow Road, Didsbury. Demonstation of a Gramophone Pick-up, by Mr. F. W. Bissett.

SATURDAY, DECEMBER 15th.

Golders Green and Hendon Radio Society.—Visit to the National Physical Laboratory, Teddington.

MONDAY, DECEMBER 17th.

Hackney Radio and Physical Society.—At 8 p.m. At the Electricity Showrooms, Lower Clapton Road, E.5. Evening Devoted to "Improving your Moving Coil Loud Speaker."



An H.T. Eliminator for A.C. Mains with Metal Oxide Rectifier of Universal Application to Receivers with Three and Four Valves.

By W. I. G. PAGE, B.Sc.

IT is a somewhat disquieting fact that the most faithful rendering of speech and music in wireless is closely associated with special valves whose greed for anode current does not seem to diminish as time goes on. The principles of power output are such that the signal should produce a large *change* in anode current, but it is patent that the current cannot swing to a value below zero. The inference, therefore, is that the current must be large before any signal arrives so as to accommodate the fluctuations within the limits of the valve's characteristic.

Thus, satisfactory loud speaker reproduction and a generous H.T. supply appear to be inseparable. The case for mains operation, where such is possible, becomes clear when it is appreciated that 20 milliamperes at a pressure of 200 volts for 250 hours represents a Board of Trade unit costing perhaps but 6d., whilst dry batteries giving the same output would cost over 30s. True, the mains equipment will waste a small fraction of the energy, but the comparison still remains very striking. The eliminator, after a short period, should thus pay for itself in spite of its rather high cost, which we must now attempt to justify. Liberties cannot be taken with apparatus connected to lighting mains, and, to prevent breakdown due to poor insulation, all components have to be chosen which have the makers' guarantee that they have been tested at voltages far above that to which they will be subjected in the eliminator.

Although designed specially for the MEGAVOX-THREE receiver, which on account of its remarkable performance has achieved such popularity, the eliminator described in this article with very small modification can be used with almost any receiver. Motor-boating, distortion and hum are entirely absent and a generous output of 100 mA. at 200 volts is obtainable.

High Voltage Surges and Test Pressures.

At the moment of switching the H.T. supply on or off there will be, due to the presence of smoothing equipment, voltage surges[1] which may at "make" rise to a value not exceeding twice that of the working voltage, whilst at "break" a pressure may be reached which is even three times greater than the working voltage. Condensers which have been tested with surge voltages of 1,000 cannot be manufactured cheaply, and chokes which must under given D.C. load conditions retain the necessary high inductance to impede the low-frequency ripple current are likewise expensive. The resistances used must also have a large margin of safety to ensure that they do not heat up with the watts consumed.

To prevent shock, which can be quite unpleasant at voltages well over 200, the whole equipment has been mounted inside an ingenious earthed all-metal safety box by means of which when the lid is opened the mains supply is broken at both poles by a switch, thus leaving all the exposed contacts "dead." Fuses blowing at one ampere are provided in each main's lead in the lid of the box, and afford a protection against short-circuit or serious overload. Thus the equipment as a whole can be said to conform to the I.E.E. regulations, and should satisfy the most stringent requirements of any lighting company. The total expenditure has been considerably increased by the adoption of a Westinghouse metal-oxide bridge rectifier with eighty cells per arm, which has some striking properties, and can be regarded as a sound investment of practically unlimited life with no upkeep costs.

As a rectifier it has the high efficiency of nearly 70 per cent., and its extremely low internal resistance, as compared with that of other forms of rectifier, provides a most satisfactory voltage regulation curve. The voltage drop is practically proportional to the load, so that the curve approximates to a straight line. The bridge formation prevents any reverse current whatsoever, and provides full-wave rectification. When the latter form of rectification is obtained from a valve, a bridge arrangement cannot conveniently be used, and a centre-tapped transformer is employed, the outers of which may have the large potential difference of some 480 volts, whereas the R.M.S. volts across the untapped secondary of a transformer designed to precede a metal rectifier are not more than a few per cent. above the primary voltage. A word of warning is here necessary concerning any attempt to dissemble the rectifier. The bolts holding the treated copper discs have been carefully adjusted to give a correct pressure for opti-

[1] See *Experimental Wireless*, November, 1928. Surges in Eliminator Smoothing Circuits," by A. G. Warren.

Megavox Eliminator.—

mum performance, and should not be touched. A slight temperature rise takes place during operation; therefore, ventilation is necessary, precluding the mounting of any components actually touching the sides or top of the apparatus.

With a complement of eighty cells in each of the four arms of the bridge, the voltage rise which occurs on open circuit is not of sufficient magnitude to harm the rectifier, while damage from short-circuit or overload is prevented by interposing a sensitive flash lamp fuse between the transformer and the rectifier. The lamp used is rated for 6 volts, 100 mA., and fuses at about 180 mA. (see photograph). Not the least attractive feature of the transformer-rectifier combination selected is the fact that the present eliminator is capable of feeding almost any set containing up to four valves, the requirements of which are not more than 100 mA. at 200 volts. Very few experimenters are content with one receiver for any length of time, so that the ample latitude of this battery substitute to accommodate the anode requirements of almost any valve should have considerable appeal. The reader will be able to judge from the foregoing that it is almost impossible to design a highly efficient A.C. H.T. eliminator of almost unlimited life conforming to

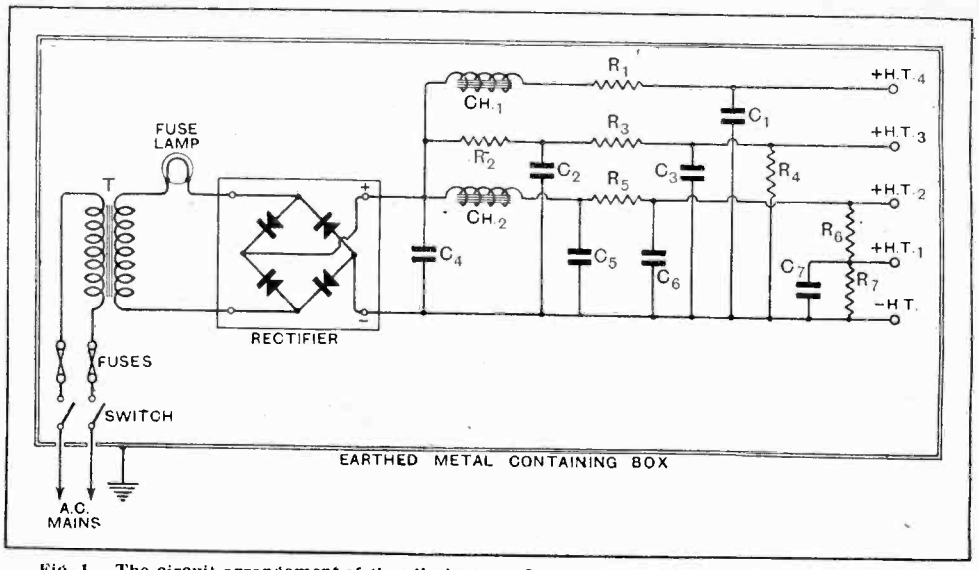


Fig. 1.—The circuit arrangement of the eliminator. One-ampere fuses are fitted to the lid of the metal safety-box and a sensitive fuse lamp blowing at about 180 mA. is connected in one lead between the transformer and rectifier. Value of components are as follows: CH_1, 20 henrys; CH_2, 32 henrys; C_1, C_5 2 mfd. condensers, 1000 volt test; C_4, two 2 mfd. condensers in parallel, 1000 volt test; C_2, C_3, C_6, C_7, 2 mfd. condensers, 500 volt test; R_1, 5000 ohms; R_2, 10,000 ohms; R_3, 10,000; R_4, 30,000 ohms; R_5, 20,000 ohms; R_6, 20,000 ohms; R_7, 30,000 ohms.

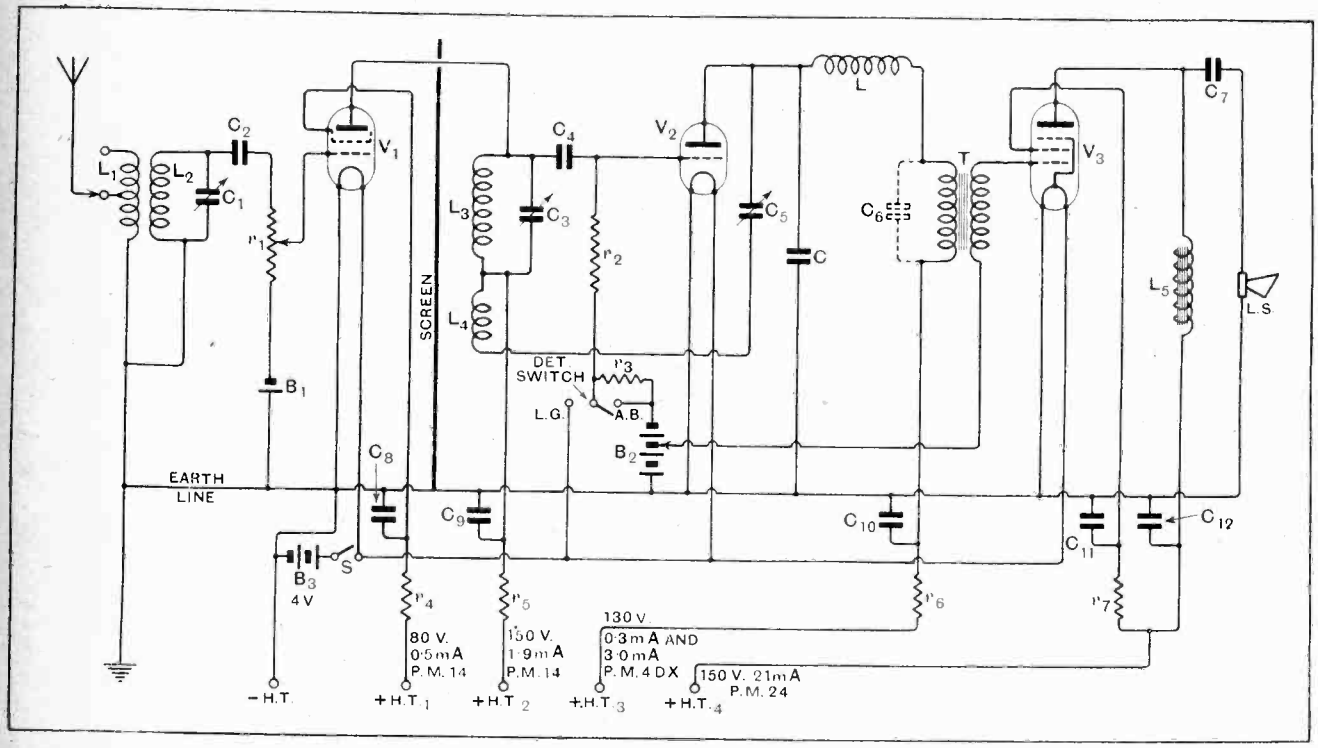
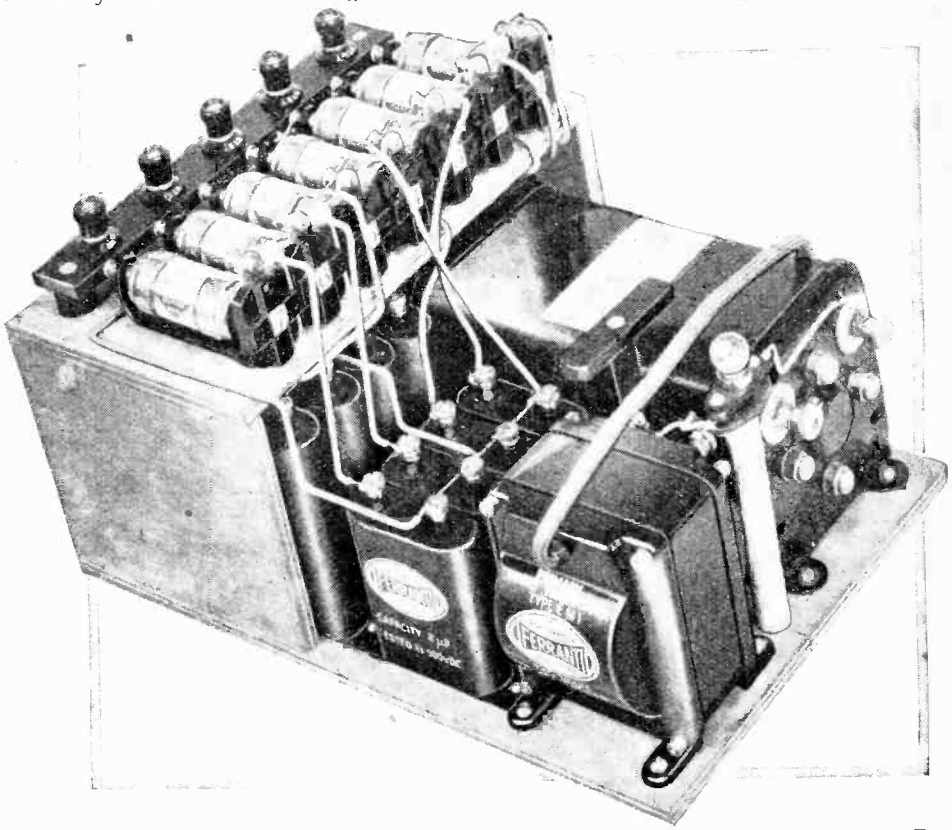


Fig. 2.—The circuit diagram of the *Megavox-Three*. A separate H.T. lead to the detector plate (H.T. + 3) is necessary. To simplify the calculation of resistances in the mains equipment the valve currents and voltages have been marked against their respective terminals. The pentode feed is now H.T. + 4.

Megavox Eliminator.—

regulations and suitable for almost any receiver without an expensive outlay.

It is difficult in an article of limited length to give the *raison d'être* for every component and every circuit detail, and the writer must reluctantly resort to what another author has been pleased to call "Bradshavian Acrobatics." This article should be read in conjunction with two other articles,[2] firstly, to see why it is essential to use the series anode feed scheme (and not a common potential divider across the mains) to prevent motor boating or back-coupling, distortion, and loss of amplification; and, secondly, why separate local potential dividers are necessary when it is required to drop volts for the feed to the screen of a screened grid valve and an anode bend detector. The eliminator circuit about to be described (Fig. 1) has resistances values and a slightly modified smoothing equipment to suit the *Megavox-Three* receiver (constructional details of this receiver were given on September 19th), but by one or two simple changes, not in any way affecting the chassis dimensions or layout, the equipment can be altered to suit almost any receiver, as will be shown in the concluding instalment of this article in next week's issue.



View of the components and complete eliminator chassis removed from the metal safety-box. The flash lamp fuse can be seen at the top of a small wooden pillar. Note the numbered resistance holders.

Due to the separation of every H.T. feed and to the liberal smoothing equipment embodied, neither motor boating, distortion, loss of amplification, nor hum were discernible even when using a moving coil loud speaker, one of the great attributes of which is response to low frequencies. By courtesy of the Westinghouse Brake and Saxby Signal Company, the eliminator was tested on an Ondograph machine, and found to have in the detector output feed a ripple voltage of a small fraction of a volt R.M.S., so small, indeed, as to be comparable with the slight fluctuations that occur in H.T. batteries.[3] The circuit of the *Megavox-Three* is again given in Fig. 2, and is identical with the original, with the exception that the anode feed of the detector is brought out to a separate terminal on the terminal strip and labelled H.T.+3. The pentode feed now becomes H.T.+4. The reason for this slight alteration is due to the difficulty of preventing back-coupling with a lead common to the plates of the H.F. valve and the detector. No other modifications whatsoever are needed in the receiver; the resistances r_4, r_5, r_6, and r_7 remain, as also do the condensers C_8 to C_{12}. The resistance r_8, shown in dotted lines in the original diagram, is not needed.

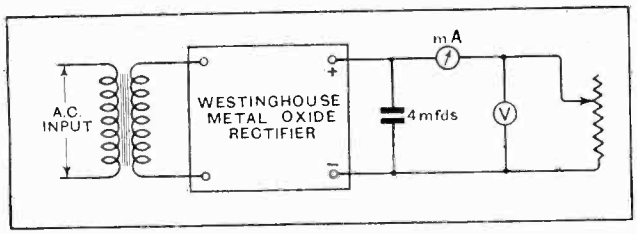


Fig. 3.—The circuit arrangement used for the preparation of the voltage regulation curve.

Tuned Anode and Difficulty in Smoothing.

Against the H.T. positive terminals of the receiver (Fig. 2) are marked the names of the valves used, together with the anode currents taken at the optimum H.T. voltages, assuming that the grid biases applied are in accordance with those advised in the original article. The terminals on the eliminator are marked to correspond with the terminals on the receiver, *i.e.*, H.T+4 is connected to H.T.+4, etc., and the values

[2] "Back Coupling in Eliminators." *The Wireless World*, September 26th, 1928. "Dropping Volts." *The Wireless World*, November 28th, 1928.

[3] A straight line amplifier is used to amplify the ripple component before an Ondograph reading is obtained.

Megavox Eliminator—

LIST OF PARTS.

1 Safety-box with fuses and double-pole switch (Ferranti).
1 Mains transformer (state mains voltage and frequency when ordering) (Type E.M.1. Ferranti.)
1 Metal oxide rectifier; (Type "H.T.1." Westinghouse Brake & Saxby Signal Co.)
1 32-henry choke (Type 658 Pye).
1 20-henry choke (Type 664 Pye).
7 Wire-wound resistances bi-duplex with clips; 5,000, 10,000, 10,000, 20,000, 20,000, 30,000, 30,000 ohms. (R. I. & Varley).
8 2 mfd. condensers, 4 type C_1, 1,000 volt test; 4 type C_2, 500 volt test (Ferranti).
1 Resistor holder for fuse lamp (Burndept).
1 Flashlamp bulb, 6 volts 100 mA. (Bulgin).
5 Shrouded terminals; H.T.−; H.T.+1; H.T.+2; H.T.+3; H.T.+4 (Igranic).
5 Spade ends (insulated) 4 red, 1 black (Lisenin).
5 Ivorine flex wire labels; H.T.−; H.T.+1; H.T.+2; H.T.+3; H.T.+4 (Bulgin).
1 Ebonite terminal strip 8" × 1" × ¼".
Wire, systoflex, ⅜" plywood 24" × 10", lampholder adaptor or wall plug, etc.

Approximate cost of all parts, £12.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer and illustrated in the photographs of the 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.

of the voltage-dropping resistances have been so chosen that the H.T. currents are correct to each valve.

The pentode feed is passed through the smoothing choke CH_1, which has an inductance of about 14 henrys at 21 mA., but has the advantage of the low D.C. resistance of 300 ohms. The resistance R_1 augments the smoothing in conjunction with C_1 and drops the necessary volts. The pentode screened grid circuit is isolated by the de-coupling resistance and condenser already in the receiver. In order to cope with the two anode currents of 0.3 mA. and 3.0 mA., respectively, for anode bend and leaky grid detection, the potential divider R_2, R_3, R_4 in the H.T. +3 lead has been given rather a low total value, so that the current passed is comparatively large, which was explained as essential in the article entitled "Dropping Volts." One limb (i.e., the series limb) of this potential divider has been split into two portions with a condenser C_2 at the junction point to assist smoothing. Another condenser C_3 between the two limbs of the potential divider gives a sufficient filtering to dispense with a choke in the detector feed.

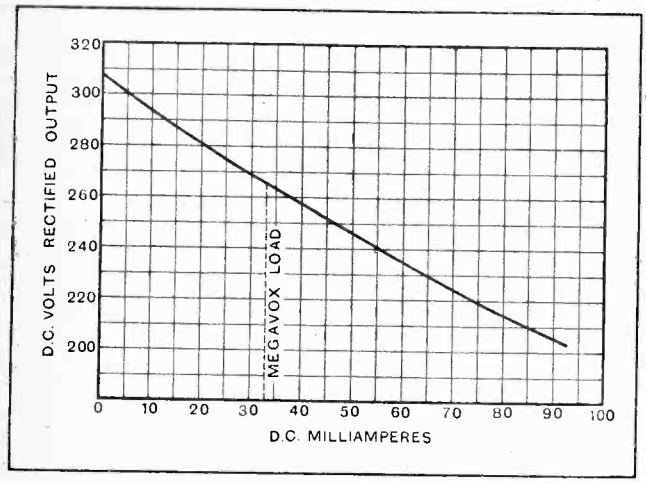


Fig. 4.—The voltage regulation curve obtained from the transformer-rectifier combination used in the eliminator. The H.T. current for the Megavox is about 26 mA., but together with the potential divider losses the total load is about 33 mA., at which a voltage of approximately 265 is obtained.

The tuned anode coupling in the *Megavox* provides a path for ripple current from the plate of the screened grid valve to the most vulnerable part of the receiver—namely, the grid of the detector—and special precautions have to be taken to prevent any ripple from reaching the terminal H.T. +2 of the eliminator. The choke CH_2 has an inductance of 32 henrys when the specified D.C. current is passing through it, and together with the combination C_5, R_5, and C_6, adequate smoothing is obtained. Because of the elaborate smoothing required preceding tuned anode coupling, it is possible that there will be a general tendency towards the use of tuned transformers with screened grid valves. For the sake of cheapness, more satisfactory filtering, and because there is no question of L.F. coupling at this point, the plate of the screened grid valve, as well as the screen of the same valve, is fed from one potential divider of three sections—R_5, R_6, R_7, whose junction points are connected to C_6 and C_7.

Obtaining the Regulation Curve.

It now remains to describe the method of ascertaining the D.C. volts developed across the 4 mfd. condenser C_4, which have to be broken down to the values shown against the terminals in Fig. 2. The rectifier produces a pulsating uni-directional current which can be regarded as a pure D.C. current with an oscillating component symmetrically superimposed, but as the rectifier has internal resistance it is quite clear that a load will cause a drop in volts. A condenser by passing part of the oscillating component can act as a load and reduce the voltage output just as a resistance can do the same thing. In order to obtain a reasonably true reading with a moving coil D.C. meter of the average D.C. output available at the input of the filter, it is necessary to subdue as far as possible the oscillating or ripple current by including the meter after the 4 mfd. condenser, which incidentally acts as a reservoir. If an attempt be made to damp out more thoroughly the ripple current at C_4 by increasing the capacity above 4 mfds., it will act as a short circuit to ripple and damage the rectifier by overloading it.

The curve showing the relation between total current consumed by the set and voltage available at the filter

Megavox Eliminator.—

input is known as a voltage regulation curve of the filter, and is obtained by connecting a milliammeter, a high resistance voltmeter, and a variable resistance as shown in Fig. 3. The milliammeter should have a resistance of under 1 ohm and read from 0 to 100 mA., whilst the voltmeter should read up to 300 volts and not pass more than, say, 10 mA. at full scale reading. The milliammeter, of course, reads the load due to the resistance as well as that of the voltmeter. The resistance can have a minimum of 3,000 ohms. Fig. 4 is the voltage regulation curve obtained from the present eliminator when the meters are inserted after the 4 mfd. condenser across the rectifier, as shown in Fig. 3. From Fig. 2 it will be seen that the total H.T. current required for the receiver is just over 26 mA. (using leaky grid detection), but the potential dividers in the eliminator bring this figure up to about 33 mA., with which load it will be seen from Fig. 4 that a voltage of about 265 is available. The values of the resistances required to reduce this potential to the requirements of each valve will be given in the concluding instalment of this article, as will also the modifications necessary for adapting the eliminator to almost any multi-valve set.

A schematic diagram showing the successive changes in waveform which result from passing a sine wave (A.C. lighting mains) through the various components of the mains equipment is given in Fig. 5. At A a 50-cycle alternating current is applied to the primary of the transformer; at B a slight increase in amplitude is shown. Full-wave rectification (C) gives 100 peaks per second, and the average D.C. component is shown as a horizontal line located so that the two shaded portions are equal in area. After the 4 mfd. condenser the magnitude of ripple is less (D). The average D.C. output available, as read by a moving coil, is indicated by X. A further choke and condenser (E) reduce the ripple considerably—likewise the rest of the filter (F) absorbs the fluctuating components to a degree which it is considered fair, in view of the Ondograph test, to depict as satisfying Euclid's definition concerning the shortest path between two points. (*To be concluded.*)

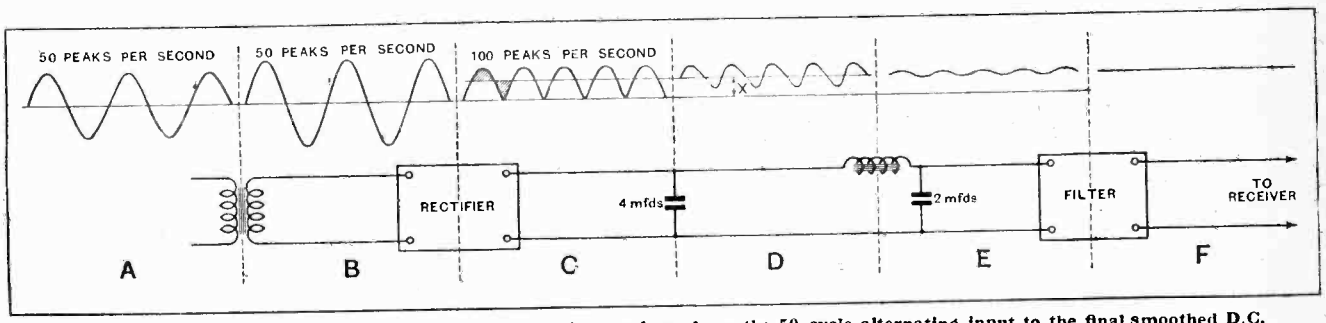


Fig. 5.—A schematic diagram of the successive changes in waveform from the 50-cycle alternating input to the final smoothed D.C. output which can be considered as a straight line in view of the successful test on the Ondograph machine.

THE USE OF HIGH ANODE VOLTAGES.

IN the matter of the choice of anode voltage there are at present two conflicting influences. On the one hand, one knows very well that any valve will deal with stronger signals without overloading, and will in most cases yield a greater degree of amplification if the anode voltage used is high than if it is low. This is especially noticeable when the output valve is in question, for the raising of the anode voltage allows of a considerable increase in the volume of undistorted sound that can be obtained from the loud speaker. We are strongly tempted, then, to run up the high-tension voltage to some 200 volts as a minimum, to the great improvement of the results obtained.

We are, however, discouraged from doing this by observing that upon the containing box of every valve we buy, apart from those of the L.S.5 class, there is inscribed in large print the words, "Maximum anode voltage 120"; and, in addition, there is often a definite statement to the effect that the makers will not guarantee their valves to have a reasonable life if this voltage is appreciably exceeded. Sometimes the limit of voltage is set even lower than this, and 100 volts is the permitted maximum; in a few cases, mostly found among the valves of higher impedance, 150 volts is allowed.

In practice it is found in most cases that, provided the correct grid bias is used, no noticeable harm is done to the valve by using an anode voltage up to about 160 volts; in fact, this voltage is that most usually supplied by the "Power" tapping of commercial battery eliminators. It is most essential to remember, particularly with valves of low impedance such as are used for operating the loud speaker (the so-called "super-power" valves), that serious damage may be done to the valve if it is allowed to run, even for a few moments only, without sufficient grid bias to keep the anode current down to a reasonable value. With this in mind, it will be realised that either the H.T. supply or the filament current should be switched off before making any change in grid bias, for during the change from one voltage to another the valve is temporarily left with no grid bias at all.

In the earlier stages of the receiver similar precautions must be taken if, as is becoming more and more usual, all valves are operated with the same anode voltage. The high-frequency amplifiers, which have to deal with only a very small grid swing, can be given an even greater grid bias than that required to operate them at the middle of the straight part of the curve; they can, in fact, be biased almost down to the bottom bend. Low-frequency amplifiers in the plate circuit of which there is a transformer, may be similarly treated, or, if the anode current is taken from the mains, a resistance-capacity filter may be used to decrease the voltage that is actually applied to the plate of the valve at the same time that it fulfils its primary function of checking any tendency to instability through L.F. oscillation.

Resistance-coupled, low-frequency amplifiers require no precautions, as they are protected by their anode resistances from too high a current. Provided that they are biased to the middle point of their dynamic curve it is possible to take great liberties with such valves; owing to the strict limitation of plate current they do not appear to be harmed by the continuous application of even 350 volts outside the resistance, even though this may imply some 220 volts on the anode of the valve itself.

A. L. M. S.

Talking Films

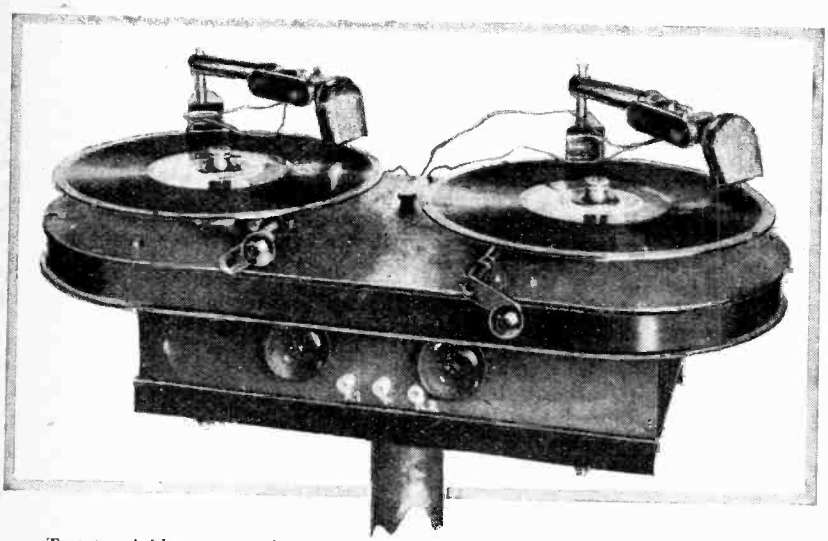
No. I.—The British Phototone System.

THE gramophone is a few years senior to the cinematograph. The former became popular nearly thirty years ago and the latter just over twenty. The idea of combining the one with the other has been obvious from the onset, and one might well demand the reason for the delay in its accomplishment. A common assumption was probably that the problems of synchronising the visual and acoustic reproduction were practically insurmountable. This, definitely, was not the reason for the delay. Quite simple mechanical devices are now used to achieve synchronising, while the process by which the speech is light recorded on the edge of the film had long been known, yet still the talking film did not take its place in the cinema.

Those who have followed the growth of the talking film are well aware of the difficulty that has delayed its introduction. It is not the problem of synchronising but rather that speech and musical reproduction has been far too defective to be associated with the reality of the moving picture. During the past eighteen months several firms have sprung into being for the purpose of devoting their energies exclusively to the supply of talking film equipment, and there are already more than twelve theatres in this country exhibiting talking films. The period of this advancement precisely coincides with the development of improved loud speakers, the moving coil type now being exclusively used in the several systems. The wireless enthusiast is, therefore, the most severe critic of the talking film, and its close link with amplifier and loud speaker design has given rise to the inclusion of articles on the subject from time to time in the pages of this journal.

How Film and Record are Synchronised.

Turning our attention now in particular to the British Phototone system, we are chiefly interested in the process of synchronising picture and loud speaker or, going back to the source, the film and the gramophone record. As everyone knows, the film is driven through the projector by a sprocket wheel, the small pins of which engage in the perforated holes running along the two edges of the film. This sprocket drive must be positively coupled through suitable gearing with the gramophone turntable, the relationship between the record and film being the same during recording as when reproducing. It is surprising that synchronising is so simple, it being merely necessary to introduce such mechanical requirements as will ensure smooth running.



Two turntables are employed in order to give continuous speech reproduction throughout the progress of the film. The turntables are started spontaneously by means of small metal contacts attached to the edge of the film. The drive of the turntables is coupled to the mechanism which propels the film.

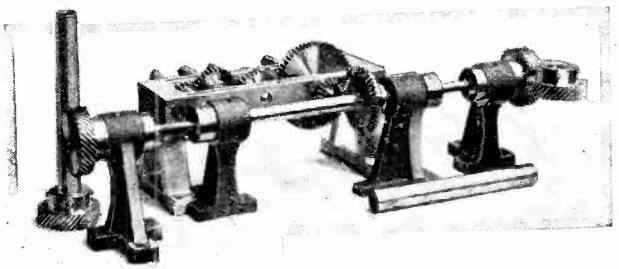
To better appreciate the detailed requirements the reader might set himself the problem of running film and record in step. Nothing could be easier than that of marking the gramophone record at a particular point on its first groove and setting a certain marked portion of the film in the shutter. Both would

Talking Films.—

start away together, and being driven from a common source of motion would continue exactly in step just as they did during recording. Thus, for a few minutes the arrangement would be satisfactory.

Changing Records.

Provision must be made, however, for changing over from one record to another, without delay, as the film progresses. This change-over can conveniently be made either during a display of caption or at a time of momentary silence. A feature of the Phototone system is that a record is started by a small electrical contact attached to the film. Clipped on to the film is a small piece of silver foil for contacting, and on passing a given point the record is thrown into rotation beneath the

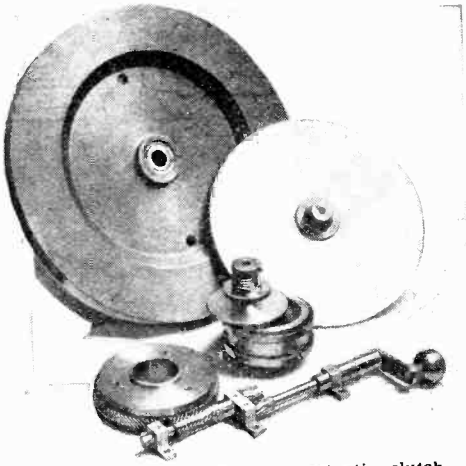


The geared cross shaft and vertical spindles used for driving the two turntables.

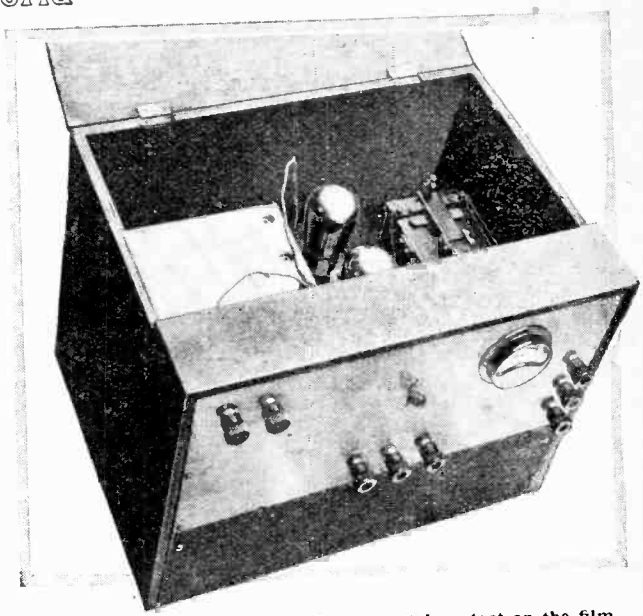
needle spontaneously. Associated with the silver contact is a single stage valve amplifier, in the anode circuit of which is a relay fitted with a double set of contacts. One set closes a local circuit through a battery and an additional winding on the relay by which means a brief pulling-up of the armature causes it to hold. The other pair of contacts energise a magnetic clutch of similar form to that recently described in association with the wireless picture receiver. This clutch sets the turntable carrying the gramophone record in rotation. It might be thought that the duty of the magnetic clutch is to slip, but actually when energised it gives a very positive drive.

To overcome the inertia present when setting the record in rotation a heavy cast iron flywheel is employed running at the correct speed by being directly coupled to the sprocket wheel of the projector. Flywheel and turntable have, of course, concentric shafts, and the magnetic clutch couples them together. As instantaneous starting of the record is impossible, a spiral spring device is interposed between the clutch and turntable shaft. Resistance offered by the turntable on starting is temporarily taken up by this spring, but this does not cause loss of synchronisation, as it later releases to the original setting while rotating.

To facilitate engaging the elec-



Flywheel, turntable and magnetic clutch, together with the adjusting mechanism, used to bring the pick-up to the correct position on the record.



The current impulse given by the metal contact on the film is amplified and energises a relay which closes the contacts of the magnetic clutch.

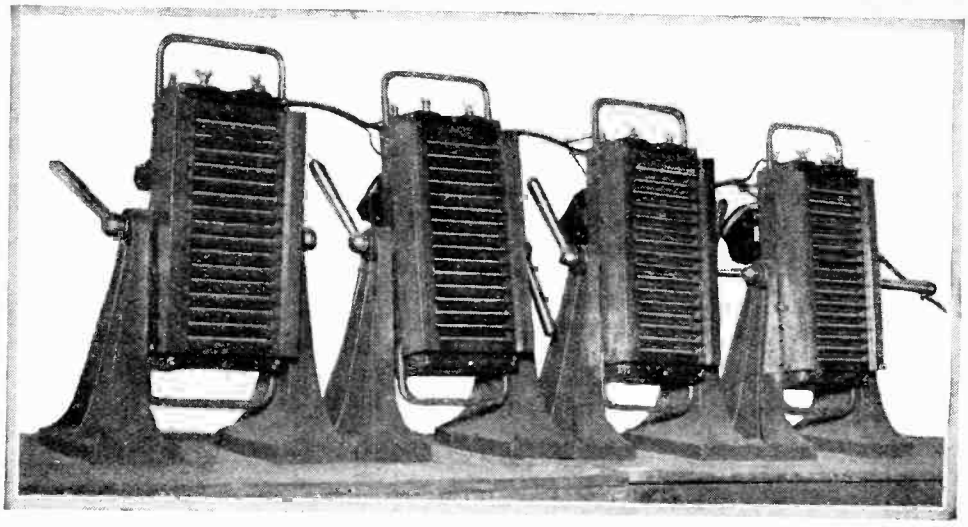
trical pick-up with the first groove on the record a wide groove pitch is allowed, and an indicating arrow marks the starting point. Should record and film inadvertently run out of step, the pick-up arm is rotated about the centre spindle so as to either overtake or fall back until the passage of the record accompanies the movement of the film. The correction is made without interruption. A second flywheel is also in synchronous rotation alongside the first, and is likewise arranged to give immediate rotation to a second record when an impulse is received from the tiny contact attached to the side of the running film. By this means successive records are brought into operation, changing over alternately from one turntable to the other.

Thus the quality of reproduction is dependent upon the merits of the recording and amplifying equipment, and the type and arrangement of the loud speakers. Little is left for description in this connection, as the Phototone system is fortunate in that it adopts in its entirety the public address equipment of Siemens Schuckert. This equipment has already been referred to, its chief distinction being the Blatthaller loud speaker which it uses. Instead of a pair of magnetic poles as are provided with the annular ring form of moving coil loud speaker the Blatthaller is composed of a grid consisting of a large number of alternate poles interlaced with a ribbon conductor carrying the speech currents. To this conductor is attached the diaphragm which, moving as an entirety, gives a considerable air displacement, and possesses in a large measure the

Talking Films.—theoretical ideals desirable in loud speaker diaphragms.

A battery of these loud speakers is arranged behind the screen, the volume output being adjusted to suit the acoustic conditions of the hall. Power for amplifiers and field excitation is derived from a direct-coupled motor generator.

The non-directional properties of the loud speaker are in its favour, for they give a naturalness of effect when reproducing a full orchestra, while not revealing the precise point from which the voice is emitted when giving speech to the screen artist.



Battery of Siemens Schuckert (Blatthaller) loud speakers as placed behind the screen in the British Phototone system.

LETTERS TO THE EDITOR.

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

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

STANDARDISATION—SCREEN-GRID VALVES.

Sir,—I have recently had cause to notice the different methods being adopted by valve manufacturers in the connections to screen-grid valves.

Most makers now appear to have adopted the vertical type of valve with the terminal on the top, but there is apparently no agreement between them as to the method of connecting the various electrodes. For instance, the Mullard valve has the connection for the anode brought out to the extra terminal, whilst the usual anode pin is utilised for the screen connection. I believe this also applies to the Osram and Ediswan makes. In the B.T.H. valve, however, the control grid is brought out to the top terminal, and the screen grid connection is by means of the usual "grid" pin on the base of the valve.

I do not know what are the factors governing the arrangement of these connections, but I do think (unless there is definite reason for this variation) that it should be possible for the various makers to adopt some standard method.

Some of your readers may care to indicate their views, or perhaps the makers themselves would like to set out their reasons for the various methods in use. S. WEBSTER.

Enfield, Middlesex.

Sir,—Mr. Rowett's letter on the subject of standardisation raises an interesting point with regard to screen-grid valves. I have always considered the double-ended type to be a distinct advance on the ordinary single-ended valve; making, as it does, for maximum separation of the electrode leads and great convenience in external screening. I was very sorry, therefore, when British valve manufacturers went back to the single-ended type (with anode fixed to the top), thus copying the Americans. I am quite aware that the latter type is more efficient than the older double-ended type, but I do not imagine this extra efficiency has any inherent connection with the shape of the valve.

Let us by all means have standardisation where it does not interfere with efficiency and convenience, but I would strongly condemn any attempt at standardisation which might act as a check on progress. ROGER NORTH.

Buckingham Gate, S.W.1.

LOUD SPEAKER "ATTACK."

Sir,—It is a curious fact that a discussion departs sooner or later from matters of fact and becomes matters of opinion. The letter of "Curious" in your issue of November 7th is a case in point. Your blue pencil forbids us dealing with this letter in detail, but we crave space to query one sentence, which reads as follows:—

"In the case of the Reed drive low frequency transients have no chance at all because there is no bass." We take it that the writer includes balanced armature movements. Perhaps he would therefore amplify his bold statement by replying to the following queries:—

(*a*) Has he tested every movement that is commercially available?

(*b*) What apparatus he used to produce, say, half a dozen pure notes in the lower register two octaves below middle C, and what was the value of those notes?

(*c*) What was the connecting link between the pure note apparatus and the input side of the unit?

(*d*) What type of apparatus was fed by the output side of the unit?

As we are curious on all these points perhaps we may be permitted to sign ourselves "CURIOUS SECUNDUS."

London, W.C.2.

November 7th, 1928.

DIODE RECTIFICATION.

Sir,—I have been very interested in the recent correspondence on the diode rectifier.

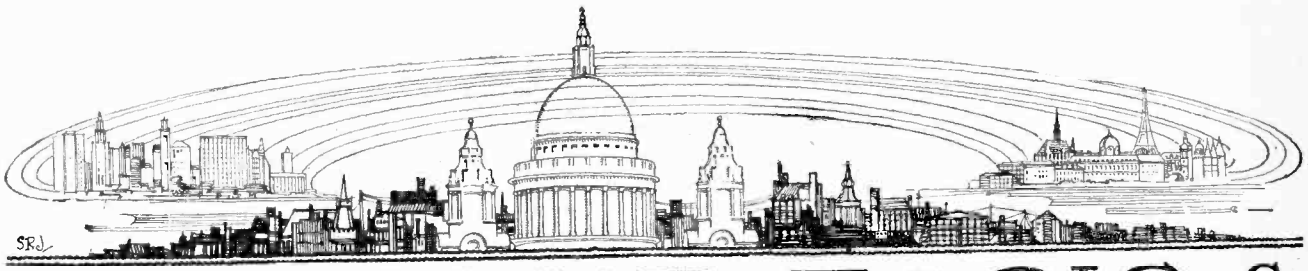
Although I would consider this detector justified on the score of quality alone, there is one other point which has not been stressed, and should appeal to mains users.

The fact that the detector valve does not take an H.T. supply at once removes a possible source of hum and motor-boating.

I changed from anode bend to this arrangement about a year ago, and find two L.F. stages are ample if there is some preceding H.F. magnification. W. R. PARKINSON.

Streetly, Staffs.

November 15th, 1928.



CURRENT TOPICS

Events of the Week in Brief Review.

FIRST COME, FIRST SERVED.

Christmas, 1928, promises to be a record season for wireless. Those who make their radio purchases early have the best choice. *Verb. sap.*

o o o o

PROVERBS FOR PRESENT CHOOSERS.

A valve in the hand is worth three ties or four pairs of socks.

A soft answer turneth away wrath, but a loud speaker goeth one better.

o o o o

STANDBY WIRELESS FOR P.O.

A Post Office wireless station is to be erected at Fleetwood for use when the cables to Ireland and the Isle of Man are out of action.

o o o o

POWERFUL DUTCH COLONIAL STATION.

The Dutch Parliament is considering a Bill for the installation of a short-wave station in the East Indies with a power of 600 kilowatts. The station would provide five channels for simultaneous telegraphic communication with Europe besides two or three telephone circuits.

o o o o

MARCONI PIONEERS.

Dr. J. A. Fleming, F.R.S., was among the guests at a dinner given by Senatore Marconi on November 29th to those who had been connected with the Marconi companies for twenty-five or more years. Dr. Fleming has been in association with the companies almost from their inception. Another guest was Colonel H. Jameson-Davis, founder of the original Wireless Telegraph and Signal Company in 1897.

o o o o

COMPULSORY WIRELESS ON SHIPS.

As a result of disclosures made during the New York enquiry into the loss of the *Vestris*, the Merchant Navy Reform Society has sent a manifesto to the Government urging that compulsory wireless on all ships should be discussed at the International Conference on Safety of Life at Sea, which will meet in London next April.

The *Vestris* enquiry showed that the small steamer "Montoso" might have reached the scene of the wreck in time to save lives if it had been equipped with wireless.

TRANSATLANTIC WIRELESS HISTORY.

To-day (Wednesday) marks the twenty-seventh anniversary of Senatore Marconi's reception of the first Transatlantic wireless signal.

o o o o

EMPIRE TELEPHONE SERVICE NEXT?

In view of the success of the Transatlantic telephone service, the Post Office is understood to be considering the opening of similar services with different parts of the Empire. It is possible that preliminary tests may shortly be made with Australia.

CHRISTMAS HOLIDAYS.

Earlier Publishing Dates.

OWING to the Christmas Holidays "The Wireless World," dated December 19th will be on sale on the previous day, and the issue dated December 26th, on Monday December 24th.

AUSTRALIAN DUTIES ON WIRELESS SETS.

Australian radio manufacturers are petitioning for increased duties on imported wireless sets. The existing duties are: British preferential, 35 per cent. *ad. valorem*; intermediate, 50 per cent.; and general, 55 per cent. No objection is raised to this scale of duties on components, but an increase is asked for on completed sets.

o o o o

FOREIGN BUYERS OF MARCONI SHARES.

Extensive foreign buying of shares in the Marconi International Marine Communication Co., Ltd., has led the directors to convene an extraordinary meeting of the shareholders on Friday next, December 14th, to consider whether the company's Articles of Association shall be altered to provide that the company shall continue under British control and that not more than 25 per cent. of its issued shares shall be in foreign hands.

MODERN INSTITUTIONS.

In two East Sussex Poor Law institutions wireless installations have superseded gramophones.

o o o o

SHORT WAVES FROM SWEDEN.

At irregular intervals the Swedish high-power station at Motala now broadcasts simultaneously on two wavelengths, viz., 1,363 and 99 metres.

o o o o

WIRELESS-CABLES MERGER.

It is considered that the position of chairman of the new wireless-cables merger company may be offered to Sir Basil Blackett, a former Controller of Finance at the Treasury.

o o o o

GERMAN HIGH POWER CALIBRATION SIGNALS.

Calibration signals, for the benefit of the German broadcasting stations, are regularly transmitted on the 11th and 12th day of each month throughout the year by the high-power Koenigswusterhausen station. The broadcasts are carried out between 5 and 7.15 a.m., G.M.T., but should one of the test days fall on a Sunday the experiment is carried out on the following day.

Times of transmissions are as follows:—

G.M.T.		Morse Letters.	Wavelengths. 1st day.	2nd day.
05.00	05.05	A	1,440	2,750
05.15	05.20	C	1,100	1,965
05.30	05.35	G	1,090	1,785
05.45	05.50	J	1,050	1,650
06.00	06.05	K	1,000	1,565
06.15	06.20	O	900	1,525
06.30	06.35	P	800	1,475
06.45	06.50	X	750	1,400
07.00	07.05	Y	720	1,360
07.15	07.20	Z	700	1,140

o o o o

THE WIRELESS LEAGUE.

At the annual general meeting of the Wireless League held at the Royal Automobile Club an account was given by the chairman, Sir Arthur Stanley, of the League's activities during the past year. Membership includes the insurance of wireless sets and accessories, free technical help, and legal advice on all wireless matters. Through its branches the League has done useful work in presenting hospitals with free wireless sets, the funds being raised by concerts, whist

drives, and the like; whilst blind persons have been helped by receiving at a reduced rate copies of the *Radio Times* printed in Braille. The offices of the League have recently been removed to 19, Berkeley Street, London, W.1, and full particulars of membership may be had from the secretary.

o o o o

CZECHO-SLOVAKIA'S NEW BROADCASTING STATION.

The new Czecho-Slovakian broadcasting station at Bratislava, the transmitter of which is illustrated on page 806 of this issue, will be the largest of five stations comprising that country's broadcasting chain. The transmitter, a product of the British Marconi Company, is constructed on the unit system, each circuit being carefully screened from its neighbour.

Two rectifying panels are employed, each containing three water-cooled valves which are fed by three single-phase transformers, and the rectified unit supplies the intermediate and power amplifiers with direct current at between 8,500 and 10,000 volts. The drive unit uses two type D.E.T.1 valves, the anode voltage being provided by a H.T. D.C. motor generator taking current from an accumulator battery, which is also used to light the filaments. The modulator is resistance-capacity coupled to the sub-modulator, and the sub-modulator is arranged for resistance capacity coupling to the output line amplifier. Three water-cooled valves connected in parallel are used in the power amplifier circuit.

The aerial will be supported on two 300ft. towers about 600ft. apart.

o o o o

P.C.J.J.'s NEW SCHEDULE.

The famous Philips station at Hilversum, working on 30.2 metres (telephony), has opened a new campaign with the object of being heard in places as far apart as British India and Australia. The following weekly schedule (G.M.T.) is now being observed :—

THURSDAY :	From 1800–2000 for British India, Europe and South Africa.
	From 2300–0 for Spain (in Spanish.)
FRIDAY :	From 0–0100 for Brazil (in Portuguese).
	From 0100–0300 for the South American Republics (in Spanish).
	From 1800–2000 for Europe.
SATURDAY :	From 0–0100 for the Dutch West Indies.
	From 0100–0400 for Central American and Antillian Republics, as well as for the British and French Colonies in America (in English, Spanish and French).
	From 0400–0600 for Australia and New Zealand (in English).

o o o o

BELGIAN BROADCASTING.

In a few weeks Brussels will be in the possession of a high-power transmitter from which many readers may already have heard tests at irregular intervals. On one or two evenings it has broadcast the Radio Belgique programmes, but has not yet been brought into regular operation.

Radio Schaerbeek, a privately owned station erected some few months ago, has decided to increase its power from 100 watts to 5 kilowatts.

o o o o

WIRELESS AT WESTMINSTER.

(From our Parliamentary Correspondent.)

Broadcasting and the General Election.

Broadcasting in relation to politics came up for consideration in the House of Commons last week when Sir Nicholas Grattan Doyle asked the Postmaster-General whether during the period of the General Election it was proposed to allow the broadcasting of political speeches.

Viscount Wolmer replied that he could not yet say that political speeches, if any, would be broadcast by the B.B.C. during the General Election.

o o o o

Licences per Thousand of Population.

In reply to a question regarding wireless receiving licences in Wales, the Postmaster-General, Sir William Mitchell-Thomson, stated that the total number of licences in force on October 31st in the whole of Wales was about 80,600, which was equivalent to a rate of 36.5 per thousand of population. The corresponding rate for England was 62.8, for Scotland 37.3, and for Northern Ireland 21.9.

WIRELESS IN WAR OF THE FUTURE.

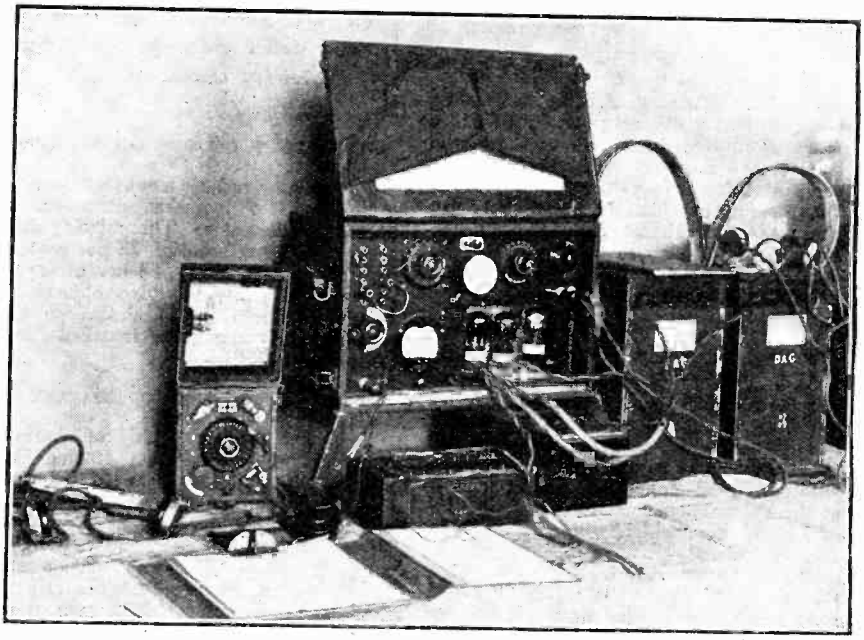
The Work of the Territorial Signals.

The heading of this note may seem sensational, and the 47th (2nd London) Divisional Signals T.A sincerely trusts that it is unlikely of realisation, but, nevertheless, in the present state of world politics, it is an eventuality which must be reckoned with. That is the reason why the Territorial Signals are trying to assist in spare time in the solution of the interesting problems attendant on fitting wireless telephony into vehicles, the design and use of small portable wireless stations for communication between rapidly moving bodies of troops, etc.

Training takes the form of making the force efficient in the use of the various forms of wireless with which the unit is equipped among other means of signalling, but in addition opportunities are given of looking into the future. The authorities controlling army wireless research have adopted the principle of trying new designs "on the dog," namely, Territorial Signals. New designs, as they are produced, can only be tried out adequately by the man who is going to use them in practice under the actual conditions which prevail in war. This is not always easy to stage at short notice, and from time to time Territorials are asked to spend an afternoon or a week-end in trials of new designs and to report as "users." This gives glimpses into the future and is very interesting.

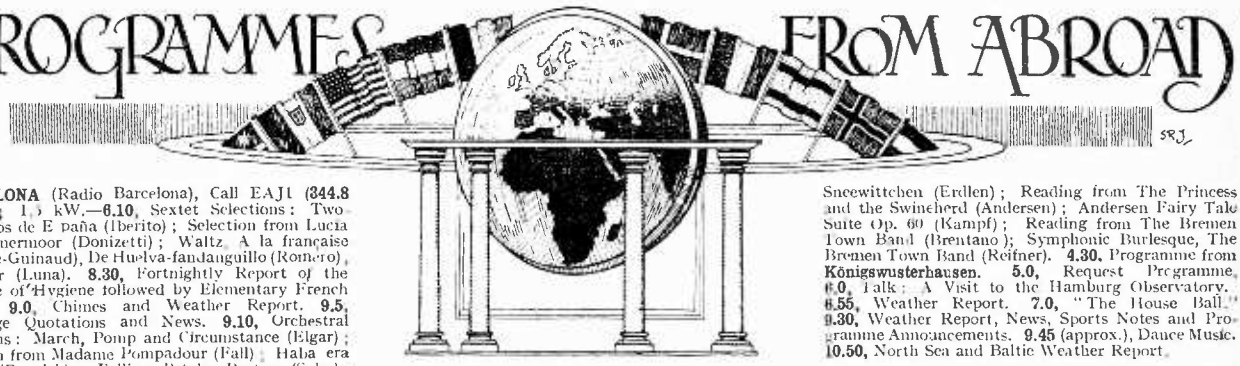
The illustration shows a type of portable telephony and telegraphy set which was designed by the 47th (2nd London) Divisional Signals, who welcome any new members to the unit interested in wireless, whether they have any expert knowledge or still rank as beginners.

Headquarters are at Fulham House, 50 yards from Putney Bridge Station on the Underground.



A TERRITORIAL FIELD SET, for telephony and telegraphy, designed by the 47th (2nd London) Divisional Signals.

PROGRAMMES FROM ABROAD



SATURDAY, DECEMBER 15th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**6.10,** Sextet Selections: Two-Step Ecos de España (Iberito); Selection from Lucia di Lammermoor (Donizetti); Waltz, A la française (Gedalge-Guinaud), De Huelva-fandanguillo (Romero), Benamor (Luna). **8.30,** Fortnightly Report of the Institute of Hygiene followed by Elementary French Lesson. **9.0,** Chimes and Weather Report. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Selections: March, Pomp and Circumstance (Elgar); Selection from Madame Pompadour (Fall); Haba era clásica (Raurich); Falling Petals—Boston (Soler); Sevilla (Albéniz); Overture to Zampa (Herold). **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**5.30,** Programme for Children. **6.0,** Talk for Girls. **7.0,** Orchestral Concert. **7.50,** Topical Talk. **8.0,** "The Soul of a negro described in West-African Tales of Adventure" by Mr. Schroder-Nielsen. **8.30,** Pianoforte and Violin Recital: Sonata in A Major Op. 100 (Brahms). Sonata in F Minor (Francœur). **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**); 40 kW.—**3.30,** Programme from **Hamburg. 4.30,** Herr Potzel, Talk: The Inland Revenue—Anecdotes Grave and Gay. **5.0,** Prof. Woldt, A Discussion with Industrial Workers. **5.30,** Advanced Spanish Lesson. **5.55,** Talk by Dr. J. Nadler. **7.0,** "Agricultural" Programme: Choral Selections, (a) Heimat (Wiesner) (b) East-Mark Peasant Song (Buck), (c) Wer hat dich, du schöner Wald (Mendelssohn). Talk: Peasant Rights and Morals, Choral Selections, (a) Im schönsten Wiesengrunde (Wagner), (b) Wenn ich den Wandrer frage (Hegar), (c) Wem Gott will rechte Gunst erweisen (Mendelssohn), (d) Das Wandern ist des Müllers Lust (Zöllner), (e) Nun ade, du mein lieb Heimatland (Kirchl). **8.10** (approx.), Programme from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Programme of Gramophone Records. **10.30 a.m.,** Exchange Quotations. **11.55 a.m.,** Time Signal. **12.30,** Weather Report and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations, Agricultural Report and Time Signal. **2.30,** Talk by Dr. Rudolf Wegner. **3.0,** Sports Review by Dr. Hans Bollmann. **3.30,** Richard Wilde, Talk and Reading: Gutzkow, on the 50th anniversary of his Death. **4.0,** Recital for Two Pianos: Fantasia and Fugue in G Minor for Organ, Two Pianos (Singer); Duettino conzertano (Mozart); Gavotte (Pirani). **4.30,** Tea Concert from the Hotel Kaiserhof, followed by Advertising Notes. **5.40,** Advertising Talk by Max Hansen. **6.0,** Georg Hausdorf, Talk: Modern Art. **6.30,** Talk. **7.0,** "Uriel Acosta"—Play, with Introductory Talk by Gerhart Pohl, on the Occasion of the Fiftieth Anniversary of the death of Karl Gutzkow, followed by Weather Report, News, Time Signal and Sports Notes. **9.30,** Dancing Instruction by Reinhold Sommer, followed by Dance Music. **11.30** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—**2.0,** Review of Books by Dr. Ernst Boehlich. **3.0,** Orchestral Concert. **4.30,** Programme relayed from **Königswusterhausen. 5.0,** Film Review by Herr M. Lippmann. **5.20,** Programme in Commemoration of Zamenhop, the originator of Esperanto. **5.45,** Travel Talk: Siberia and Mongolia. **6.20,** Shorthand Lesson. **6.50** Reading in English by Douglas Yates, M.A. **7.15,** Variety Programme: Orchestral Selection from Hansel and Gretel (Humperdinck); Tenor Songs; Five German Folk Songs; Orchestral Selection, Silesian Songs (Bilse); Tenor Songs; Songs; Orchestral Selection; Songs (a) Ein Schäfermädchen weidete (Seidler-Winkler), (b) Du, du hegst mir im Herzen, (c) Die Auserwählte; Orchestral Selection, German Dance (Schubert). **9.0,** News. **9.30,** Dance Music. **11.0** (approx.), Close Down.

BRÜNN (**441.2 metres**); 2.5 kW.—**4.30,** Music Talk by Dr. Vetterl. **4.45,** German Programme, News and Concert: Mignon (Thomas); Robert le Diable (Meyerbeer). **5.15,** Weekly Report for Journalists. **6.0,** Dr. Ziska, Talk: Czech History. **6.15,** Talk on Winter Sports by Mr. Koch. **6.30,** Programme, relayed from **Prague. 9.0,** Programme relayed from **Prague.**

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0,** Orchestral Concert from the Armenonville Tea Rooms. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Pianoforte Recital. **7.0,** Gramophone Selections of Dance Music. **7.30,** "Radio-Chronique." **8.0,** Concert from the Liége Conservatoire: Symphonic Suite (Fler. Alpaertz); Spanish Symphony (Lalo); Ivan de Stora Skogarna (Lindberg); Violin and Orchestral Selection, Basque Fantasia (Pierné), Symphonic Poem, Ballata delle gnomidi (Respighi); Topical Talk in the Interval, followed by News, Esperanto Report and Orchestral Concert from the Palace Hotel. **11.0** (approx.), Close Down.

BUDAPEST (**556.6 metres**); 20 kW.—**4.10,** Talk by Koloman Rossahegyi. **5.20,** Hungarian Song Recital by Frau Emma Komlossy. **6.20,** Relay from the Opera House, followed by Weather Report and News at **9.30,** (approx.), and Recital of Songs with Accompaniment on Old Hungarian Wind Instruments. **10.15,** Band Music relayed from the Hotel Hungaria.

CRACOW (**566 metres**); 1.5 kW.—**4.10,** Mr. M. Jedlicki, Talk: The Monarchist Movement in France at the Present Time. **4.35,** Programme from **Warsaw. 5.0,** Programme for Children. **6.0,** Miscellaneous Items and News. **6.25,** English Reading by Mr. J. Stanislawski. **6.55,** Time Signal. **7.0,** Agricultural Report. **7.5,** Mr. J. Regula, Talk: Review of Foreign Politics during the past week. **7.30,** Programme from **Warsaw. 9.0,** Programme from **Warsaw. 9.30,** Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News. **7.30,** Health Talk by Mrs. A. Russell, M.B. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0 to 10.30,** Symphony Concert by the Station Symphony Orchestra and the Phibsboro' Choir. **10.30,** News and Weather Report. **10.45** (approx.), Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**2.5,** Programme for Children. **3.35,** Vocal and Orchestral Concert: Overture to Das Nachtlager in Granada (Kreutzer); Selection from Euryanthe (Weber); Song; Selection from Undine (Lortzing), Overture to Des Falkners Braut (Marschner); Song; Selection from Tannhäuser (Wagner); In the Interval—Wireless News and Announcements. **5.10,** Reading by O. W. Studtmann. **5.30,** Talk: Postal Regulations for Christmas. **5.45,** "The Letter Box." **6.15,** Esperanto Lesson by W Wischhoff. **6.45,** Prof. Hülsen, Talk: The Jewish Cemetery in the Börneplatz as a Memorial to Culture and Art. **7.15,** Variety Concert with Ernst Arnold, Vienna, in some of his own Songs, followed by Dance Music relayed from **Voxhaus. 11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—**9.15 a.m.,** News. **10.0 a.m.,** Programme of Gramophone Records. **11.10 a.m.,** Weather Report. **11.15 a.m.,** Exchange Quotations. **11.30 a.m.,** Concert relayed from **Hanover** (297 metres). In the Interval at **11.55 a.m.,** Time Signal. **12.10,** News. **1.40,** Exchange Quotations. **3.0,** Illustrated Music Talk by Wilh. Heinitz. **3.30,** Concert of Musical Fairy Tales: Reading from Sneewittchen (Grimm); Suite from Sneewittchen (Erdlen); Reading from The Princess and the Swineherd (Andersen); Andersen Fairy Tale Suite Op. 60 (Kampf); Reading from The Bremen Town Band (Brentano); Symphonic Burlesque, The Bremen Town Band (Reifner). **4.30,** Programme from **Königswusterhausen. 5.0,** Request Programme. **6.0,** Talk: A Visit to the Hamburg Observatory. **6.55,** Weather Report. **7.0,** "The House Ball." **9.30,** Weather Report, News, Sports Notes and Programme Announcements. **9.45** (approx.), Dance Music. **10.50,** North Sea and Baltic Weather Report.

HILVERSUM (**1,071 metres**); 5 kW.—**9.40 to 9.55 a.m.,** Time Signal and The Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Trio Concert. **1.40,** Concert from the Tuschinski Theatre, **Amsterdam. 3.40,** Italian Lesson. **4.40,** French Lesson. **5.40,** Concert of Waltzes and Marches: March, El Capitan (Sousa); Waltz, Wiener Blut (Joh. Strauss); March, The Gladiator's Farewell (Blankenburg); Waltz, Mondnacht auf der Alster (Fetras); March, Panache rouge (Orit); Waltz, Soirée d'été (Waldteufel); March, Old Comrades (Teike). **6.25,** German Lesson. **7.25,** Police Announcements. **7.45,** Concert and Talk arranged by the Workers' Radio Society. **11.15** (approx.), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits on 1,852 metres from 5.40 p.m.—**12.10,** Concert of Trio Music. **2.40,** Programme for Children. **5.0,** Gramophone Selections. **6.10,** Talk by M. Gerisch. **6.30,** Catholic Bulletin. **6.40,** English Lesson. **7.10,** Lesson in Dressmaking. **8.0,** Concert of Orchestral and Vocal Music, with Recitations by M. Boezer.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**6.30 a.m.,** Morning Gymnastics. **10.0 a.m.,** Weather Report. **10.15 a.m.,** Educational Talk. **11.0 a.m.,** Chimes from the Town Hall. **11.5 a.m.,** Orchestral Concert from Wivel's Restaurant. **2.0,** Programme for Children. **2.30,** Concert of Orchestral Selections. In the Interval Recitations by Hans Dynesen. **4.50,** Talk by Mr. N. Esbjerg. **5.20,** Mr. F. C. Becker, Talk: Central Heating. **5.50,** Weather Report. **6.0,** News and Exchange Quotations. **6.15,** Time Signal. **6.30** Mr. Iver Gudme, Talk: Modern American Authors. **7.0,** Chimes from the Town Hall. **7.5,** Reading. **7.30,** Selection of New Danish Work Songs, followed by News. **8.15,** Violin Recital by Harald Andersen: Concert Polonaise, Op. 4 (Wieniawsky); Caprice viennois (Kreisler); Scherzo-Tarantella Op. 16 (Wieniawsky); Humoresque (Dvorak, arr. Kreisler); Hungarian Air, Op. 22 (Ernst). **8.45,** Orchestral Concert: March, Advance! (Toift); Selection from Der Bettelstudent (Millöcker); Caecilie Waltz (Lumbye); Sæterjentens Söndag (Ole Bull); Toreador et Andalouse (Rubinstein); Strofe for Strings, Organ and Pianoforte (Bartholdy); Böljeby-Vals (Peterson-Berger); Yelka March (Reesen). **9.45,** Dance Music by the Industry Restaurant Orchestra. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

KATTOWITZ (**422 metres**); 10 kW—**2.45,** Financial Report. **3.0,** Gramophone Selections. **4.10,** Music Lesson by Prof. F. Sachse. **4.35,** Children's Letter Box. **5.0,** Programme for Children. **6.0,** Announcements and News. **6.30,** Talk by Mr. K. Zienkiewicz. **6.56,** Time Signal and Agricultural Report. **7.5,** Mr. K. Rutkowski, Talk: Impressions of a Journey to Constantinople. **7.30,** Programme relayed from **Warsaw. 9.0,** Weather Report and News. **9.30,** Dance Music.

KAUNAS (**2,000 metres**); 7 kW.—**5.0,** Weather Report and News. **5.15,** Agricultural Report **5.45** Announcements. **6.30,** Concert. **7.0** Talk on Neurasthenia. **7.30,** Dzuku Recital. **8.0,** Talk by Mr. K. Berulis. **8.15,** Dzuku Recital (continued).

LAHTI (**1,522.8 metres**); 35 kW.—**5.15,** Orchestral Selections: Kleiner Wienermarsch (Kreisler); Syncopation (Kreisler); Do-Re-La (Lehár); Intermezzo (Nevin); Selection for Two Guitars (Harlick). **5.40,** Talk. **6.0,** Wireless Programme: Couplets, Talk and Dramatic Selections. **7.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (**468.8 metres**); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres), and **Münster** (250 metres).—**9.35 a.m.,** Labour Exchange Report. **10.10 a.m.,** Talks: The Choice

Programmes from Abroad.—

of Careers. **11.10 a.m.**, Gramophone Selections. **12.5**, Orchestral Concert. **1.30**, Hints for the Housewife. **2.40**, Herr P. Brüls, Wireless Talk: The Condenser in Direct and Alternating Current Circuits. **3.0**, Talk for Women by Hertha Maria Funck. **3.30**, Dr. Wilhelm Leyhausen, reads from "Lettres de mon moulin" (Daudet). **4.0**, Fegeler-Felkendorf, Talk: Time, Modes, and Men. **4.20**, English Lesson by Prof. F. Hase. **4.45**, Concert by Lute and Mandoline Orchestra: Mandoline Selections, (a) Er weicht der Sonne nicht (Blankenburg); (b) In a Persian Market (Ketelbey), (c) Overture in B Minor (Wölki); Zither Solos, (a) Herzliches Gedenken (Grünwald), (b) Fantasia on Strauss Waltzes (Kolmaneck); Mandoline Selections, (a) Wolgaklänge (Ritter), (b) An der Weser (Pressel), (c) Lustige Finken (Ritter). **5.30**, Dr. Hans Zbinden, Talk: The International Problems of America. **6.15**, Herr P. Leistenschneider, Talk: For Workers: Insurance against Accident in the Mining Industry. **6.40**, Prof. Leyen, Talk: Fairy Tales of World Literature. **7.0**, Variety Programme. **9.30** (approx.), News, Sports Notes, Business Announcements, Orchestral Selections and Dance Music. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (365.8 metres); 4 kW.—**3.30**, Mandoline Concert: March, Mandolinismo (Coletta); Chimes (Vicari); Under the Cyclamens—Waltz (Debiassi); Invocation (Palti); Popular Potpourri (Vicari); Serenade, Mandolinata (Coletta); Tango, Spring (Vicari); Selection from Faust (Gounod); Intermezzo, The Setting Sun (Cammarano); In the Service of Honour (Coletta). **4.45**, Advertising Notes. **5.20**, Weather Report, Time Signal and Labour Market Report. **5.30**, Programme relayed from **Königswusterhausen. 6.0**, Josef Greff, Talk: Psycho-Analysis. **6.30**, Prof. Georg Witkowski, Talk: Lessing. **7.0**, "Der treue Soldat," Musical Play in Two Acts (Schubert). **8.30**, Cabaret Concert. **9.0**, News, Sunday Programme Announcements and Sports Notes. **10.0**, Dance Music relayed from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 **(434.8 metres)**: 3 kW.—**7.0**, Chimes, followed by Sextet Concert: Los cadetes de la reina (Luna); Fantasia on The Ring (Wagner); El carro del sol (Serrano); Interlude by Luis Medina. **8.0**, Dance Music relayed from the Alkázar. **8.25**, News and Announcements. **9.45**, Market Prices Review. **10.0**, Chimes, followed by "El huésped del Sevillano": Musical Play (Reoyo and Luca de Tena, and Guerrero); followed by News and Announcements. **12.30 a.m.** (approx.) (Sunday), Close Down.

MILAN, Call 1MI **(549 metres)**; 7 kW.—**7.15**, Industrial Notes. **7.25**, News and Time Signal. **7.32**, Variety Concert: Overture to Maritana (Wallace); Selection from Parsifal (Wagner); Andante cantabile for Harp, 'Cello and Organ (Braccesco); Soprano Solos, (a) La barba bianca (Tedesco), (b) Siciliana e Bella Bellina (Sinigaglia); Pianoforte Solos, (a) Piccola vecchia partita (Bas), (b) Au jardin de l'enfance (Grovletz); Quintet Selections (Tchaikovsky), (a) Melody Op. 51, (b) Romance without words; Reading (d'Annunzio); Soprano Solos (Schubert), (a) Jägerlied, (b) Barcarolle: Soprano Song, Einsame Träne and Lorelei (Schumann); Harp Solos (Tedeschi), (a) Chiaraponte, (b) Dramatic Improvisation for Two Harps; Quintet Selections, (a) Selection from Manon Lescaut (Puccini), (b) The Songs of Italy (De Micheli). **9.55**, News, followed by Relay of Tzigane Orchestra from the Fiaschetteria Toscana. **10.45** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Böden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**4.0**, Concert of Gramophone Selections. **4.30**, Programme for Children. **5.15**, Relay of a School Festival from **Jönköping** (201.3 metres). **6.0**, "The Christmas Fair," relayed from the Town Hall. **6.45**, Pianoforte Recital from the Works of Chopin: Nocturne in C Minor; Etude in E Major; Waltz in A Flat; Waltz in C Sharp Minor. **7.0**, Cabaret Programme, including "Bridge": A Sketch by Karl Gerhard. **8.0**, Topical Talk. **8.15**, News and Weather Report. **8.45**, Dance Music. **9.45** (approx.), Close Down.

NAPLES, Call 1NA **(333.3 metres)**; 1.5 kW.—**7.50**, News and Harbour Notes. **8.0**, Time Signal. **8.02**, Schubert Recital. **9.20**, "Il Braccialetto": One Act Comedy (Traversi). **9.40** (approx.), Review of the Week. **9.50**, News. **9.55**, Calendar and Programme Announcements. **10.0**, Dance Music from the Trocadero. **10.30** (approx.), Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres) and **Rjukan** (448 metres).—**6.15**, Weather Report and News. **6.30**, Talk: Hypochondria. **7.0**, Time and

Saturday, December 15th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Orchestral Concert, of Light Music: Comedy Overture (Keler Bela); La Serenata (Tosti); Tzigane Song (Renée); Selection from A Waltz Dream (Oscar Straus); Amoureuse (Gillet); Mon rêve (Waldteufel); Selection (Mouton), Viennese Waltz (Heiber); Alaine and Melody (Schroder); Waltz Potpourri from Die geschiedene Frau (Fall). **8.0**, 'Cello Recital by M. Guillaume Hesse. **8.30**, Weather Report and News. **8.45**, Topical Talk. **9.0**, Cabaret Programme. **10.0**, Dance Music from the Grand Hotel. **11.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT **(458 metres)**; 0.5 kW.—**4.15**, Concert: Selection from I Pagliacci (Leoncavallo); Berceuse (d'Ambrosio), Jubel Overture (Weber); Canzonetta (Filipucci). **6.30**, "Radio Journal de France." **8.0**, Talk by M. G. Geville. **8.15**, Scientific Talk. **8.30**, Concert arranged by the Renaissance Française and Dance Music from the Coliseum de Paris. **12.0 (Midnight)** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(2,650 metres)**; 5 kW.—**5.0**, "Pasdeloup" Concert. **7.10**, Weather Report. **7.30**, "Le Journal Parlé."

PARIS (Petit Parisien) **(340.9 metres)**; 0.5 kW.—**8.45**, Gramophone Selections, Talk, News and Announcements. **9.0**, Concert: Overture to Le Timbre d'argent (Saint-Saëns); Rip (Planquette); Selection for Flute and Orchestra, Tarentella (Saint-Saëns); Violin Solo, Rondo from Serenade No. 7 in D Major (Mozart); Orchestra Suite, The Pearl Fishers (Bizet); Rêverie du soir from the Algerian Suite (Saint-Saëns); Spanish Dance No. 3 (Moszkovsky); In the Intervals, News.

PARIS (Radio Paris), Call CFR **(1,750 metres)**; 6 kW.—**12.30**, Programme of Columbia Gramophone Records: Nostalgia by Lucchesi's South American Orchestra; Waltz, Together, by the Charleston Serenaders; Fox-Trot, Kiss and Make Up, by the Piccadilly Players; Fox-Trot, Rag Doll, by Debroy Somers Band; Felix the Cat, by Paul Whiteman and his Orchestra; Duet, Get out and get under the Moon, by Van and Schenck; Russian Barcarolle by the Choir of La Chauve-Souris; Le Village (Charles Freaine); Slavonic Dances in E Minor (Dvorák) by M. J. Szigeti (Violin); Waltz in A Flat Major (Brahms) by Percy Grainger (Piano); Fugue in G Minor (Bach); La Peri (Dukas); In the Interval, News. **2.0**, Market Prices and Religious Information. **3.45**, Dance Music by the Joss Ghislery Symphonians. In the Intervals, News. **6.30**, Agricultural Report. **7.30**, Pianoforte Lesson by Pierre Lucas. **8.0**, Agricultural Talk, followed by Market Prices and News. **8.15**, Concert arranged by "Le Matin": Programme of Symphony Music and "L'Education manquée" (Chabrier). In the Intervals, News.

POSEN (344.8 metres); P.5 kW.—**6.35**, English Lesson. **6.50**, Talk for Women. **7.10**, Economic Report. **7.30**, Programme from **Warsaw. 9.0**, Time Signal, Miscellaneous Items, News and Announcements. **9.30**, Cabaret Concert. **11.0**, Concert arranged by the Maison Philips. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (348.9 metres): 5 kW.—**6.30**, "The Peasant Jacob" (Nedbal), relayed from the National Theatre, **Prague. 9.0**, Time Signal, News and Theatre Report **9.15**, Dance Music relayed from the Hotel Sramota.

ROME, Call IRO **(447.8 metres)**; 3 kW.—**7.10**, Sports Notes, News, Exchange Quotations and Weather Report. **7.29**, Time Signal, and Report of the International Labour Office at Geneva. **7.45**, "Othello"—Opera (Verdi). In the Intervals, Fashion Review for Women and Review of Art and Literature. **9.50**, News and Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres)**; 30 kW.—**12.0 Midnight**, Phil Spitalny's Musical Programme from **New York. 12.30 a.m.** (Sunday), Musical Selections from the Eastman Theatre, **Rochester. 1.0 a.m.**, Musical Programme from the Onondaga Hotel, **Syracuse. 1.30 a.m.**, "The Bark Bench" Programme from **New York. 2.0 a.m.**, Selections by the Adler Quartet and Contralto Solos by Sonia Essin, from **New York. 2.30 a.m.**, "Bonnie Laddies." **3.0 a.m.**, "Lucky Strike" Programme relayed from **New York. 4.0 a.m.**, Time Signal and Dance Music from the Hotel Van Curler. **5.0 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**3.30**, Concert. **4.30**, Market Report. **5.15**, Concert of Turkish Music. **7.30**, Weather Report and Time Signal. **7.40**, Orchestral Concert: Overture No. 3 from Leonora (Beethoven); Violin Solo; Songs; Suite from L'Arlésienne (Bizet). **9.0**, News and Close Down.

STUTTGART (379.7 metres); 4 kW.—**3.35**, Programme relayed from **Frankfurt. 5.0**, Time Signal and Weather Report. **5.15**, Dr. Kümmerlen, Talk: Army Pensions. **5.45**, Major Carl Lange, Talk: Danzig and German Culture. **6.15**, Legal Talk by Herr L. Leibfried. **6.45**, Friedrich Felger, Talk: Literature of the Great War. **7.15**, Time Signal and Sports Notes. **7.30**, Concert: "On the beautiful blue Danube"; Overture to The Gipsy Baron (Strauss); Poets from Austria (Fortner); Dorfschwalben aus Osterreich (Strauss); Der Ländler (Bartsch); Grüss mir mein Wien (Kálmán); Das war'n Zeiten (Kálmán); Pizz Polka (Strauss); Wiener Bürger (Ziehrer); Modern Austrian Poetry (Fortner); Wien, du Stadt meiner Träume (Sczyinsky); Selections (Ernst Arnold), (a) Das war am alten Glacis, (b) Das Lied von der Pumnerin, (c) Das Wienerlied; Waltz, Künstlerleben (Strauss); "The Farewell Supper": Comedy (Schnitzler); The Blue Danube (Strauss); Viennese Humour (Fortner); Caprice viennois (Kreisler); Auf der Lehmgruben, da steht a alt's Haus (Strecker); Fiakerlied (Gruber); 's Lercherl von Hernals (Oscar Straus); Sei mir gut, schöne Marietta (Ernst Arnold); Das war die Mizzi von der Sandongasse (Ernst Arnold); Liebesfreud, Liebesleid (Kreisler); Duet from Josephine Gallmeyer (Knepler); Viennese Humour (Fortner); Eine Frau wie du, die war' mein Traum (Arnold); Schön ist mein Wien (Arnold); Potpourri, Leháriana (Geiger). Followed by News and Dance Music from the Pavillon Excelsior.

TOULOUSE (Radiophonic du Midi) **(389.6 metres)**; 8 kW.—**12.45**, Concert. **8.0**, Exchange Quotations and News. **8.30**, Recital of Argentine Songs, with Guitar Accompaniment. **8.46**, Musical Selections (Ketelbey), (a) In a Persian Market, (b) In a Monastery Garden. **8.50**, "Werther": Opera Selection (Massenet). **9.45**, Waltz Selections: Donawellen (Ivanovici); Sobre las Olas (Rosas); Gold and Silver (Lehár); Waltz from Faust (Gounod). **10.0**, Waltzes for Accordion, Banjo and Pianoforte: Waltz Boston from Les Millions d'Arlequin (Drigo); Venetian Skies; The Sphinx (Popy); Rêve de Fleurs (Translateur). **10.15**, North African News. **10.30** (approx.), Close Down.

VIENNA (517.2 metres); 15 kW.—**2.15**, Photo-telegraphy Transmission. **3.0**, Orchestral Concert. **4.45**, Reading by Gustav Waldau. **5.30**, Talk by Prof. Willy Schmieger. **5.45**, Dr. H. Michel, Talk: Precious Stones. **6.15**, "Autumn Storms on Land and Sea": Recitative by Dr. Franz Horch and Dora Miklosich; Songs by Robert Almassy. **7.10**, Time Signal, Weather Report and News. **7.15**, "Aequinoctium": Drama in Four Acts (Ivo Vojnovic), Translation by Vida Bravacic, followed by Orchestral Concert: Overture to Die Fledermaus (Joh. Strauss); Concert Waltz (Moszkovsky); Song, Drunt' in der Lobau (Strecker); Selection from Die einzige Nacht (Stolz); Song, In Schönbrunn (Benatzky); Fox-Trot, Love and Kisses (Baker-Silver); Slow Fox-Trot, Sunshine (Irving Berlin): Original Chinese Blues (Moore): Tango, Ich hätte Dich so gerne noch einmal gesehen (Engel-Berger): Fox-Trot, Under the Moon (Snyder): Boston, So Blue (Sylva); Fox-Trot, Sweet Marie (Rose); followed by Phototelegraphy Transmission.

VILNA (435 metres); 1.5 kW.—**6.15**, Poem Recital from the Works of Mme. W. Niedziakkowska-Lobaczewska. **6.20**, Programme from **Warsaw. 7.0**, News. **7.30**, Programme from **Warsaw.**

WARSAW (1,111 metres); 10 kW.—**3.0**, Concert of Gramophone Selections. **4.10**, Talk by Prof. L. Szyszkowsky. **4.35**, Talk by Prof. H. Moscicki. **5.0**, Programme for Children. **6.0**, Miscellaneous Items. **6.30**, "Radio-Chronique," by Dr. M. Stepowski. **6.56**, Time Signal. **7.0**, Agricultural Report. **7.5**, News. **7.30**, Concert; In the Interval, Theatre Notes. **9.0**, Aviation Notes and Weather Report. **9.5**, News. **9.20**, Police Announcements and Sports Notes. **9.30**, Dance Music from the Oaza Restaurant. **10.30** (approx.), Close Down.

ZURICH (588 metres); 1 kW.—**4.45**, Weather Report and Exchange Quotations. **5.0**, Programme of New Gramophone Records. **6.0**, Chimes from the Zurich Churches. **6.17**, Variety Programmes: Accordion Selections, Songs to the Lute and Humorous items. **9.0**, Weather Report and News. **9.10**, Gramophone Selections of Old and New Dance Music.

Programmes from Abroad.—

BARCELONA (Radio Barcelona), Call EA]1 (**344.8 metres**) ; 1.5 kW.—**11.0 a.m.,** Chimes relayed from the Cathedral. **11.5 a.m.,** Weather Report and Forecast. **1.30,** Selections by the Station Trio ; Gramophone Records in the Intervals. **2.45 to 5.30** (approx.), No Transmission. **5.30** (approx.), Relay of an Opera, Agricultural Market Prices and Exchange Quotations in the intervals. **8.0 to 8.20** Talks arranged by the Catalonian Institute of Agriculture at San Isidro. **8.20,** Concert by the Station Orchestra. **8.40,** Sports Notes and Bulletin. **9.0** (approx.), Close Down.

BERGEN (**370.4 metres**) ; 1.5 kW.—**9.30 a.m.,** Relay of Divine Service. **11.30 a.m.,** Weather Report and Forecast and General News Bulletin. **4.0,** Instrumental and Vocal Concert. **7.0,** Concert by the Station Orchestra. **7.50,** Topical Talk. **8.30,** Pianoforte Recital by Margrethe Gleditsch Engebrethsen : Bach's French Suite No. 3 in B Minor, (a) Allemande, (b) Sarabande, (c) First and Second Minuets, (d) Gigue. **9.0,** Weather Report and Forecast, Late News Bulletin, and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen), (**1,250 metres**) ; 40 kW.—**7.55 a.m.,** Relay of Chimes from the Garrison Church at Potsdam. **8.0 a.m.,** Morning Recital and Address relayed from **Voxnaus,** followed by Chimes from Berlin Cathedral. **10.30 a.m.** (approx.), Concert relayed from **Voxhaus. 12.45,** Experimental Transmission of Pictures. **3.0,** Talk. **5.0,** Series of Talks arranged by the "Deutsche Welle," followed by Concert or Opera. **9.15,** Press News. **9.30,** Selections of Dance Music. **11.30** (approx.), Close Down.

BERLIN (Voxhaus), (**484 metres**) ; 4 kW.—**7.55 a.m.** Relay of Church Chimes from Potsdam. **8.0 a.m.,** Morning Concert with Vocal and Instrumental Solos followed by Chimes from Berlin Cathedral. Address in the interval. **10.30** (approx.), Concert. **1.0,** Morse Lesson for Beginners, by Hans W. Priwin. **3.0,** Talk. **3.30,** Recital of Music. **6.0,** Talk. **7.0,** Concert. **8.30** (approx.), Concert, followed by Weather Report, Late News Bulletin and Sports Notes. **9.30,** Dance Music. **11.30** (approx.), Close Down.

BEZIERS (**158 metres**) ; 0.6 kW.—**8.30,** Sports Bulletin. **8.45,** Programme of Light Gramophone Music arranged by the Maison Relin Pathé Records. **10.30** (approx.), Close Down.

BRESLAU (**322.6 metres**) ; 4 kW.—Programme relayed by **Gleiwitz** (329.7 metres).—**8.15 a.m.,** Chimes relayed from Christ Church. **10.0 a.m.,** Catholic Recital of Music with Address in the Interval. **11.0 a.m.,** Musical Programme. **1.0,** Guessing Competition. **1.10,** Talk or Literary Programme. **1.35,** Hints for the Chess Lover. **2.0.** Stories for Children. **2.30,** Talk for Farmers. **7.0,** Christmas Oratorio by J. S. Bach. **9.0,** Late News and Announcements. **9.30,** Dance Music. **11.0** (approx.), Close Down.

BRUSSELS (**508.5 metres**) ; 1.5 kW.—**6.0,** Light Orchestral Music. **6.0,** Children's Programme from Le Théâtre des Enfants. **6.30,** Musical Programme. **7.30,** La Radio-Chronique. **8.15,** Concert of Orchestral Music. **10.15.** Late News and Announcements. **11.0** (approx.), Close Down.

BUDAPEST (**556.6 metres**) ; 20 kW.—**8.0 a.m.** General News Bulletin and Beauty Notes. **9.0 a.m.,** Relay of Morning Service and Sermon. **11.15 a.m.** (approx.), Programme of Music. **2.30,** Talk for Farmers. **3.15,** Concert. **6.30** (approx.), Concert or Operatic Relay. **9.30,** Dance Music. **10.30** (approx.), Close Down.

COLOGNE (**283 metres**) ; 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres) and **Münster** (250 metres).—**6.45 a.m.,** Lesson in Self Defence. **7.5 a.m.,** Précis in Esperanto of the Programmes of the Week. **7.15 a.m.,** Lute and Guitar Instruction by Olly Wirtz Koort. **7.35 a.m.,** Esperanto Lesson. **8.0 a.m.,** Sacred Recital with Address. **10.0 a.m.,** Talk on the German Language by Fritz Worm. **10.35 a.m.** (approx.), Agricultural Talk. **12.0 Noon,** Afternoon Concert. **1.30,** Wireless Literary Talk. **3.30,** Concert of Popular Music. **7.0,** Popular Concert ; In the Intervals : Der Vetter auf Besuch ; Late News and Announcements, Sports Notes and Light Dance Music Programme. **11.0** (approx.), Close Down.

CORK, Call 6CK (**400 metres**) ; 1.5 kW.—**8.30,** Organ Recital by J. T. Horne, relayed from St. Fin Barre's Cathedral, Cork, and followed by Concert with Soloists. **11.0,** National Anthem and Weather Report and Forecast. **11.15** (approx.), Close Down.

CRACOW (**566 metres**) : 1.5 kW.—**9.15 a.m. to 10.45 a.m.,** Morning Service relayed from a Cathedral. **10.56 a.m.,** Relay of Fanfare from the Church of Notre Dame, followed by Time Signal and Weather Report. **11.10 a.m.,** Relay from **Warsaw. 1.0 and 1.20,** Two Agricultural Talks. **1.40,** The Farmer's Chronicle by Dr. St. Wasniewski. **2.0,** Weather Report. **2.15.** Concert relayed from **Warsaw. 4.20,** Talk. **5.0,** Programme from **Warsaw. 6.0 to 7.30,** Transmission

SUNDAY, DECEMBER 16th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

arranged by the Academy of Fine Arts on the occasion of its Fiftieth Anniversary. **7.30,** Concert of Instrumental Music with Vocalists. **9.0,** Relay from **Warsaw. 9.30,** Relay of Light Music from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**) ; 1.5 kW.—**8.30 to 11.15** (approx.).—Programme relayed from **Cork. 8.30.** Organ Recital from St. Fin Barre's Cathedral, Cork, followed by Vocal and Instrumental Programme. **11.0,** National Anthem and Weather Report. **11.15** (approx.), Close Down.

FRANKFURT (**428.6 metres**) ; 4 kW.—Programme relayed by **Cassel** (252.1 metres).—**7.30 a.m. to 8.30 a.m.,** Morning Recital. **12.0 Noon,** Report of the Wiesbaden Agricultural Institute. **7.30,** Programme of Music or Literature. **8.30,** Concert. **9.30** (approx.), Dance Music. **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**) ; 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres), and **Kiel** (254.2 metres).—**7.25 a.m.,** Time Signal. **7.30 a.m.,** Weather Report and Forecast followed by General News Bulletin. **7.50 a.m.,** Economics Talk. **8.0 a.m.,** The Week's Legal Notes. **10.0 a.m.,** Talk. **11.55 a.m.,** Time Signal relayed from **Nauen. 12.5** (For **Hamburg** and **Kiel**) : Concert. **12.5** (For **Bremen**) : Musical Selections. **12.5** (For Hanover) : Popular Gramophone Selections. **1.0,** Funkheinzelmann's Programme for Children. **6.30,** Transmission of the Hamburg School of Physical Culture. **6.40,** Sports News. **6.55,** Weather Report and Forecast. **7.0,** Concert or Play. **9.30,** Weather Report and Late News Bulletin followed by Programme of Light Music. **10.50** (For **Hamburg, Bremen** and **Kiel**), Weather Report for the North Sea and Baltic. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**) ; 5 kW.—**12.10,** Concert by the Station Orchestra. **2.10,** Orchestral Concert. **7.40,** Time Signal, News Bulletin and Sports Results. **7.55,** Operatic Performance, Gounod's "Faust." **10.40** (approx.), Close Down.

HUIZEN (**340.9 metres**) ; 4 kW.—Transmits from 5.40 on 1,852 metres.—**9.30 a.m.,** Morning Service relayed from **Gorincnem** (Hoogstraat), Sermon by the Rev. R. K. M. Hummelen, Minister ; At the Organ : Heer O. van der Kleyn. **12.10,** Musical Selections by the K.R.O. Trio. **1.10,** Talk. **1.40,** Talk. **2.10,** Orchestral Concert. **5.30,** Relay of Church Service (on 1,852 metres). **7.10,** Talk. **7.50** (approx.), Orchestral Concert. **10.25,** Epilogue by "Le Petit Chœur" under the direction of Mr. Jos. H. Pickkers. **10.40** (approx.), Close Down.

JUAN-LES-PINS (Radio L.L.), (**244 metres**) ; 1.5 kW.—**1.0 to 2.0,** Concert by the Casino Municipal Orchestra and Programme for Children. **9.0,** General News Bulletin. **9.15,** Instrumental Concert with Soloists. **10.0,** Dance Music by the Casino Orchestra. **10.30** (approx.). Close Down.

KALUNDBORG (**1,153 metres**) ; 7 kW.—Programme also for **Copenhagen** (337 metres).—**9.0 a.m.,** Divine Service relayed from **Copenhagen. 10.30 a.m. to 10.40 a.m., (Kalundborg** only), Weather Report and Forecast from the Copenhagen Meteorological Institute. **12.0 Noon to 12.25,** German Instruction under the auspices of "Radiolytteren." **12.30,** Lesson in French arranged by "Radiolytteren." **2.15** (approx.), Instrumental Music. **5.50 (Kalundborg** only), Weather Report and Forecast from the Meteorological Institute **6.0,** News from the Press. **6.15,** Time Signal. **6.30,** Talk. **7.0,** Chimes relayed from the Town Hall, **Copenhagen. 7.5,** "Lilac Time," Musical Play in Three Acts by Dr. A. Willner and Heinz Reichert. Music by Schubert. Translated into Danish by Johannes Dam and Paul Sarauw. The Orchestra conducted by Ernst Hye-Kundsen. In the interval between Acts One and Two, Press News. **10.0,** Dance Music relayed from the Palace Hotel, the Orchestra conducted by Teddy Petersen. In the Interval at **11.0,** Town Hall Chimes relayed from **Copenhagen. 11.30** (approx.), Close Down.

KATTOWITZ (**422 metres**) ; 10 kW.—**9.15 a.m.,** Relay of Morning Service. **10.56 a.m.,** Time Signal. **11.0 a.m.,** Weather Report and Forecast. **11.15 a.m.,** Popular Concert by the Station Quartet. **1.0,** Talk, **1.20 and 1.40,** Two Talks for Farmers. **2.0** Weather Report. **2.15,** Popular Symphony Concert relayed from **Warsaw** : Fantasia on Themes from the Opera "Verbum Nobile" (Moniuszko) by the Orchestra of the Warsaw Philharmonie conducted by C. Wilkomirski. **5.0,** Programme of Music. **6.0,** Announcements. **6.20,** Professor St. Ligon in Humorous Selections. **6.56,** Time Signal. **7.0,** Talk. **7.30,** Concert. **9.0,** Weather Report and Forecast, News from the Press and Sports Results. **9.30,** Dance Music. **10.30** (approx.), Close Down.

KAUNAS (**2,000 metres**) ; 7 kW.—**2.30,** Programme for Children. **4.0,** Talk by J. Ardickas on Economics and Life. **7.0,** Concert by the "Aidas" Orchestra. Waltz, "Loin du bal" (Gilbert). **9.30** (approx.). Close Down.

KÖNIGSBERG (**303 metres**) ; 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**8.0 a.m.,** Recital of Music, including Choral and Instrumental Solos and Address. **10.10 a.m.** (approx.), Morning Concert with Soloists. **11.55 a.m.,** Relay of Time Signal from **Nauen,** followed by Weather Report and Forecast. **7.10,** "La Chaste Suzanne," Operetta in Three Acts by Georg Okonkowsky. Music by J. Gilbert. Performance under the direction of Josef Christean Musical Director : Hugo Leyendecker. **9.15,** Late News Bulletin and Sports Results. **9.30,** Dance Music. **11.0** (approx.), Close Down.

LAHTI (**1,522.8 metres**) ; 35 kW.—Programme also for **Helsingfors** (375 metres).—**8.0 a.m.,** Relay of Sacred Service. **9.50 a.m.,** News from the Press. **10.5 a.m.,** Concert. **10.50 a.m.,** Weather Report and Time Signal. **11.0 a.m.,** Relay of Church Service in Swedish. **3.0,** Concert by the Station Orchestra. **4.57,** Time Signal and Weather Report and Forecast. **5.10,** Concert by the Station Orchestra. Songs of Finland by Pahlman. **7.0,** Concert. **7.45** General News Bulletin given in Finnish followed by News in Swedish. **8.30** (approx.), Close Down.

LANGENBERG (**468.8 metres**) ; 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**6.45 a.m.,** Lesson in the Art of Self-Defence by Dr. Ludwig Bach. **7.15, a.m.,** Alfred Dormans : Review in Esperanto of the Programmes of the Week. **7.15 a.m.,** Lute and Guitar Lesson. **7.35 a.m. to 7.55 a.m.,** Esperanto Lesson. **8.0 a.m.,** Trinity Church Chimes. **8.5 a.m.,** Catholic Festival with Musical Items and Address. **10.0 a.m.,** Philological Talk by Fritz Worm. **10.35 a.m.** (approx.), Agricultural Talk. **12.0 Noon,** Afternoon Concert. **1.30,** Talk : Wireless and Literature. **3.30,** Concert of Orchestral Music. **6.35** (approx.), Sports Notes. **7.0,** Popular Concert. Late News Bulletin, Sports Results and Notes and Programme of Light Music. **11.0** (approx.), Close Down.

LEIPZIG (**365.8 metres**) ; 4 kW.—Programme relayed by **Dresden** (275.2 metres).—**7.30 a.m.,** Relay of Organ Recital. **8.0 a.m.,** Vocal and Instrumental Programme **10.0 a.m.,** Talk. **10.30 a.m.,** Talk. **11.0 a.m.,** Instrumental Concert. **12.0 Noon,** and **12.30,** Agricultural Talks. **1.0,** News from the Foreign Press and Review of the Events Abroad. **1.45,** Talk. **3.0,** Musical or Literary Programme. **4.0,** Concert. **5.30.** Talk. **6.30,** Concert or Play. **8.0,** Comedy by Prosper Merimée, produced by Hans Peter Schmiedel. **9.0,** Sports Results. **9.30,** Dance Music relayed from **Berlin. 11.30** (approx.), Close Down.

LYONS (Radio Lyon) (**291 metres**) ; 1.5 kW.—**7.30,** Le Journal Parlé with General News Bulletin, News from the Press and Miscellaneous Announcements. **8.0,** Instrumental Concert : Pianoforte Solos by Madame Ducharne ; Violin Solos by M. Camand ; and 'Cello Solos by M. Testanière ; L'Invitation au Voyage (Charpentier). **9.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**434.8 metres**) ; 1.5 kW.—Programme relayed by **Salamanca** (EAJ 22) (405 metres).—**11.30 a.m.,** Concert by the Municipal Band from El Retiro. Conductor : Maestro Villa. **2.0,** Chimes and Time Signal. **2.5,** Concert of Popular Music by the Station Orchestra with the collaboration of Celso Diaz (violinist) ; Interlude by Luis Medina ; Liebesfreud (Kreisler). **3.30 to 7.0,** No Transmission. **7.0,** Chimes. **7.5,** Selections by the Station Sextet. **8.0,** Dance Music Selections by the Palermo Orchestra from the Alkazar. **8.30, to 10.0,** No Transmission. **10.0,** Chimes and Time Signal. **10.5,** Regimental Band Concert. **12.0 Midnight,** Chimes followed by Dance Music Programme by the Palermo Orchestra relayed from the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, 1MI (**549 metres**) ; 7 kW.—**9.0 a.m.,** Opening Signal and Lesson in English. **9.30 a.m. to 10.15 a.m.,** Vocal and Instrumental Recital of Sacred Music. **11.30 a.m.,** Time Signal. **11.35 a.m.,** Concert by the Station Quartet. **12.30 to 3.0,** No Transmission. **3.0,** Opening Signal. **3.5,** Concert by the Station Quintet. **4.15,** Concert by the Tzigane Orchestra at the Fiaschetteria Toscana. **5.0 to 6.55,** No Transmission. **6.55,** Opening Signal. **7.0,** News and Announcements. **7.15,** Talk by C. A. Blanche. **7.25,** Sports News. **7.30,** Time Signal. **7.35,** "The Pearl-fishers," Opera by Bizet ; At end of Act Two, Sports Notes and News from the Stefani Agency. **10.30** (approx.), Close Down.

Programmes from Abroad.—

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.6 metres).—**10.0 a.m.**, Relay of Divine Service from a **Stockholm** Church. **4.55**, Carillon relayed from the Town Hall at **Stockholm. 6.15**, Talk on "The Poet Viktor Rydberg," followed by Centenary Programme in his memory. **8.15**, Late News Bulletin and Weather Report and Forecast. **10.0** (approx.), Close Down.

MUNICH (535.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (277.8 metres) and **Nuremburg** (241.9 metres).—**10.0 a.m.**, Relay of Chimes from the Münich Town Hall. **10.10 a.m.**, The Bavarian Wireless Weather Chart. **12.0 Noon**, Time Signal, Weather Report and Forecast and Programme Announcements. **2.0**, Musical Programme. **7.0**, Concert. **9.0**, Concert of Orchestral Music. In the Interval at **9.20**, Late News Bulletin. **10.30** (approx.), Close Down.

NAPLES, Call 1NA (333.3 metres); 1.5 kW.—**8.30 a.m.**, Lesson in French. **9.0 a.m.**, Sacred Recital. **3.45**, Children's Corner. **4.0**, Vocal and Instrumental Concert. **4.30**, Time Signal. **7.30**, News. **7.50**, Report of the Naples Harbour Authorities. **8.0**, Time Signal. **8.02**, Concert by the Station Orchestra with Vocalists: "Ambo nati in questa valle," from Linda di Chamounix, by Donizetti, Baritone Solo by Raff. Aulicino, accompanied by the Orchestra. **9.0**, Sports Results. **9.55**, Calendar and Programme Announcements. **10.0** (approx.), Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**9.50 a.m.**, Carillon. **10.0 a.m.**, Divine Service relayed from St. Saviour's Church. **6.15**, Weather Report and Forecast and Press News. **7.0**, Time Signal. **8.15** (approx.), Recital of Music. **8.30**, Weather Report and News from the Press. **8.45**, Topical Talk by a Journalist. **9.15** (approx.), Dance Music relayed from the Hotel Bristol. **11.30** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (458 metres); 0.5 kW.—Programme relayed at intervals by the following stations: **Bordeaux** PTT (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres), **Lille** (264 metres), **Limoges** (285 metres), **Lyons** PTT (480 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse** PTT (260 metres).—**8.0 a.m.**, News Bulletin and Time Signal. **9.25 a.m.**, International Time Signal and Weather Report. **12.0 Noon**, Concert. **1.0**, "Le Journal de France Economique." **1.30**, Concert organised by the General Association of French Wireless Listeners. Ballet Music from "Sylvia" (Delibes). **2.30**, Symphony Concert arranged by the Paris paper "Le Journal." **4.0**, Pasdeloup Symphony Concert by M. Rhené Bâton and relayed from the Champs Elysées. **6.30**, "Le Radio Journal de France." **8.15**, Sports Talk. **8.30**, Orchestral Concert. **10.30** (approx.), Dance Music relayed from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (2,650 metres); 5 kW.—**7.56 a.m.**, Time Signal on 32.5 metres. **9.26 a.m.**, Time Signal on 2,650 metres. **5.0**, Relay of Pasdeloup Concert. **7.10 to 7.20**, Weather Report and Forecast. **7.30**, "Le Journal Parlé par T.S.F." The Day's Sporting News with Racing Results from "Paris Sport." **7.56**, Time Signal on 32.5 metres. **8.0 to 9.0**, Vocal and Instrumental Concert. **10.26**, Time Signal on 2,650 metres. **11.15** (approx.), Close Down.

PARIS (Petit Parisien), (340.9 metres); 0.5 kW.—**8.45**, Popular Gramophone Selections. **8.50**, Talk. **8.55**, News from the Press. **9.0**, Concert with Items by well-known artistes from the Paris Opera and the Opéra-Comique. **9.25**, General News Bulletin. **9.30**, Symphony Concert—Conductor: Professor Estyle, of the Paris Conservatoire: Finale from the Spanish Symphony for Violin and Orchestra (Lalo); Violinist: M. Bellanger, of the "Concerts Colonne" and the Conservatoire Concert Society. **10.0**, Late News Bulletin. **10.15**, Concert of Orchestral Music. **11.0** (approx.), Close Down.

PARIS (Radio L.L.), (370); 1 kW.—**12.30**, Radio Liberté Transmission. General News Bulletin, followed by Concert of Instrumental and Vocal Music by the Charles Seringes Trio. **1.0**, Carillon de Fontenay. **3.0**, Popular Dance Music. **9.0**, Vocal and Instrumental Concert. **10.0**, Carillon de Fontenay. **10.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (1,750 metres); 6 kW.—**8.0 a.m.**, General News Bulletin and Press News. **8.30 a.m.**, Physical Culture Instruction by Dr. Diffre. **12.0 Noon**, Religious Address, followed by Recital of Sacred Music arranged by "La Vie Catholique." **12.30** News from the Press. **12.45**, Concert by the Albert Locatelli Orchestra with selection by Bilboquet in the interval. **4.30** Concert of Gramophone Music arranged by "L'Industrie Musicale." In the interval: Press News. **6.45**, Gramophone Records. **7.30**, Press News. **7.45**, The Radio-Paris Circus. **8.15**, Symphony Concert by the Station Orchestra, conducted by M. Eugène Bigot. In the intervals: News from the Evening Papers and Late News Bulletin. **10.30** (approx.), Close Down.

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—**4.0**, Sessions Clock Chimes, followed by Relay of Church Service. **6.30**, Programme arranged by the Whitehouse Coffee Company, relayed from **New York. 7.0**, "Roxy's Stroll," Programme from WJZ, **New York. 9.45**, Relay of Service from the Shadyside Presbyterian Church, with Sermon by the Minister, the Rev. Hugh Thomson Kerr. **11.0**, Programme of Orchestral Music. **11.30**, Concert by the Whittall Anglo-Persians, from **New York. 12.0 Midnight**, Sessions Clock Chimes, followed by Relay of Service from the Calvary Episcopal Church at **Pittsburgh.** Sermon by the Minister, the Rev. E. J. Van Etten. **1.0 a.m.** (Monday), Musical Programme from the National Broadcasting Company, **New York. 1.15 a.m.**, Collier's Radio Hour from **New York. 2.15 a.m.**, Concert by the Utica Jubilee Singers relayed from WJZ, **New York. 2.45 a.m.**, El Tango Romantico relayed from **New York. 3.15** a.m., Longine Time. **3.30 a.m.** (approx.), Close Down.

POSEN (344.8 metres); 1.5 kW.—**9.15** a.m. to **10.45 a.m.**, Relay of Morning Service and Sermon. **11.0 a.m.**, Time Signal. **11.05 a.m. and 11.30 a.m.**, Two Talks for Farmers. **2.15**, Symphony Concert relayed from **Warsaw. 4.20**, Talk. **4.50**, Talk. **7.30**, Violin Recital by M. Edmond Gizejewski. (At the Piano: Professor François Lukasiewicz): Two Gavottes by Rameau and Martini. **8.30**, Musical Programme. **9.0**, Time Signal. **9.5**, Variety Items. **9.20**, General News Bulletin. **10.0**, Light Music. **11.0** (approx.), Close Down.

PRAGUE (348.9 metres); 5 kW.—**8.0 a.m.**, Sacred Recital. **10.0 a.m.**, Concert. **12.05**, Talk on an Industrial Subject. **3.30**, Concert. **4.30**, Workers' Transmission. **5.0**, Programme for German Listeners. **5.30**, Sports Talk. **6.0**, Concert or Play. **9.0**, Time Signal and Late News Bulletin. **9.20**, Light Musical Selections. **10.15** (approx.), Close Down.

RABAT, Call PTT (416 metres); 2 kW.—**12.30 to 2.0**, The Radio Maroc Orchestra in a Programme of Light Music. **4.0 to 5.0**, Concert by a Military Band. **8.15**, "Le Journal Parlé" for Arab Listeners. **8.20**, News Bulletin and Announcements. **8.30**, Orchestral Concert. **10.30**, Dance Music, relayed from the "Chaumière de Rabat." **11.0** (approx.), Close Down.

RIGA (526.3 metres); 4 kW.—**8.0 a.m.**, Relay of Church Service in German. **9.15 a.m.**, Sacred Service (in Latvian) relayed from the Mara Church. **12.0 Noon**, Songs and Music for Children. **3.0**, Concert by the Riga Wireless Orchestra (Conductor, Arved Parups). **4.0**, Programme of Talks. **6.0**, Concert. **8.0**, Weather Report. **9.0**, Musical Selections, relayed from the Café de l'Opéra. **10.0** (approx.), Close Down.

ROME, Call 1RO (447.8 metres); 3 kW.—**8.30 a.m.**, Opening Signal, followed by Lesson in German. **9.0 a.m.**, Vocal and Instrumental Concert. **9.45 a.m. to 12.0 Noon**, No Transmission. **12.0 Noon**, Opening Signal. **12.5 to 1.0**, Concert by the Station Trio. **1.0 to 4.0**, No Transmission. **4.0**, Opening Signal. **4.5 to 5.30**, Variety Concert. **7.10**, Talk for Farmers. **7.15**, Sports Notes and News from the Stefani Agency. **7.29**, Time Signal. **7.31**, Talk. **7.45**, Concert by the Grand Symphony Orchestra: Concerto in D Major for Violin with Orchestral Accompaniment (Paganini); Violinist, Maria d'Alba. **9.50**, Late News Bulletin. **10.0** (approx.), Close Down.

SAN SEBASTIAN (Union Radio), Call EAJ8 (400 metres); 0.5 kW.—**10.0**, Concert by the Grand Casino Orchestra. **12.0 Midnight** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF (21.96 and 31.4 metres); 30 kW.—**3.30** (approx.), Relay of Church Service. **8.30**, Recital of Organ Music by Elmer A. Tidmarsh, relayed from the Union College Memorial Chapel at **Schenectady, N.Y. 9.0**, Dr. S. Parkes Cadman's Talk for Men, relayed from **New York. 10.30**, Violin Recital by Arcadie Birkenholz, relayed from **New York. 11.0**, The American Legion Band Half Hour, relayed from **Boston, Mass. 11.30**, Acousticon Programme from **New York. 12.0 Midnight**, The Old Company's Programme, relayed from **New York. 12.30** a.m. (Monday), Relay from the Capitol Theatre, **New York. 2.0 a.m.**, Talk on the American Government, relayed from **Washington, D.C. 2.15 a.m.**, Atwater Kent Hour, relayed from **New York. 3.15 a.m.**, Correct Time. **3.17 a.m.**, Relay of Grand Opera from **New York**, followed by Television Signals. **4.30 a.m.** (approx.), Close Down.

SEVILLE (Union Radio). Call EAJ5 (375 metres); 2 kW.—**2.0 to 3.0**, Concert by the Station Orchestra and Gramophone Records. **9.30**, Orchestral Concert of Music by Spanish Composers. **11.0**, Flamenco Songs and Popular Dance Music. **11.30** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**3.30**, Concert. **4.30**, Stock Exchange and Prices of Cereals. **5.15**, Concert of Turkish Music. **7.30**, Weather Report and Forecast, followed by Time Signal. **7.40**, Talk on the History of Music. **8.0**, Concert by the Station Orchestra. **9.0**, Late News Bulletin. **9.30** (approx.), Close Down.

STUTTGART (379.7 metres); 4 kW.—Programme relayed by **Freiburg** (577 metres).—**10.15 a.m.** (approx.), Vocal and Instrumental Concert. **11.0 a.m.**, Orchestral Concert followed by Gramophone Records. **1.0**, Programme for Children. **2.0**, Talk or Reading. **3.0** (approx.), Concert: **7.15** (approx.), Concert or Opera followed by Late News Bulletin and Sports News. **10.30** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (389.6 metres); 8 kW.—**12.30**, Meteorological Report and Local Market Prices. **12.45**, Programme of Instrumental Music. **1.0**, Correct Time. **1.5**, Concert (continued). **1.45**, News Bulletin. **8.0**, Market Prices and Stock Exchange Quotations from Paris. **8.15**, News from the Parisian Newspapers. **8.30**, Concert of Instrumental Music. **9.0**, Time Signal. **9.15**, Concert (continued). **10.5**, Ten Minutes of Dance Music: West End Blues (Oliver). **10.15**, "Le Journal sans papier" with News from North Africa and Late News Bulletin. **10.30** (approx.), Close Down.

VIENNA (517.2 metres); 15 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfart** (272.7 metres), and **Linz** (254.2 metres).—**9.20 a.m.**, Musical Recital. **10.0 a.m.**, Concert by the Vienna Symphony Orchestra and Soloists. **3.0**, Concert of Orchestral Music. **6.30**, Relay from the Opera House, followed by Concert of Orchestral Selections and Experimental Transmission of Pictures. **10.15** (approx.), Close Down.

VILNA (435 metres); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Cathedral Service. **10.56 a.m. to 4.20**, Programme relayed from **Warsaw. 10.56 a.m.**, Time Signal. **11.0 a.m.**, General News Bulletin. **11.10 a.m.**, Symphony Concert of the "Philharmonie de Varsovie," devoted to the Works of French and Italian Composers. Intermezzo from the Opera "Cavalleria Rusticana" (Mascagni) rendered by the Orchestra under the direction of J. Oziminski. **1.0 to 2.0**, Three Talks for Farmers. **2.15**, Orchestral Concert. **5.0**, Musical Selections. **6.45**, General News Bulletin and Time Signal. **7.0 to 10.30**, Programme relayed from **Warsaw. 7.0**, Talk. **7.30**, Concert. **9.0**, Aviation Report and Weather Forecast. **9.5**, General News Bulletin. **9.20**, Sports News and Police Notes. **9.30**, Dance Music relayed from the "Oaza" Restaurant, **Warsaw. 10.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Cathedral Service. **10.56 a.m.**, Time Signal. **11.0 a.m.**, Aviation Route Report and Weather Forecast. **11.10 a.m.**, Symphony Concert from the "Philharmonie de Varsovie." **1.0 to 2.0**, Three Agricultural Talks. **2.0**, Weather Report and Forecast. **2.15**, Symphony Concert. **4.20**, Talk. **4.45**, Aviation Talk. **5.0**, Popular Concert. **6.0**, Variety Items. **6.20**, Talk. **6.45**, General News Bulletin and Time Signal. **7.0**, Talk by C. Jablonowski: Divertissements intellectuals. **7.30**, Concert by the Polskie Radio Orchestra, conducted by J. Oziminski: Overture to the Opera "Ruslan and Ludmila" by Glinka. **9.0**, Aviation Report and Weather Report and Forecast. **9.5**, News from the Polish Telegraph Agency. **9.20**, Police and Sports News. **9.30**, Dance Music by the Orchestra at the "Oaza" Restaurant, Conductor: W. Roszkowski. **10.30** (approx.), Close Down.

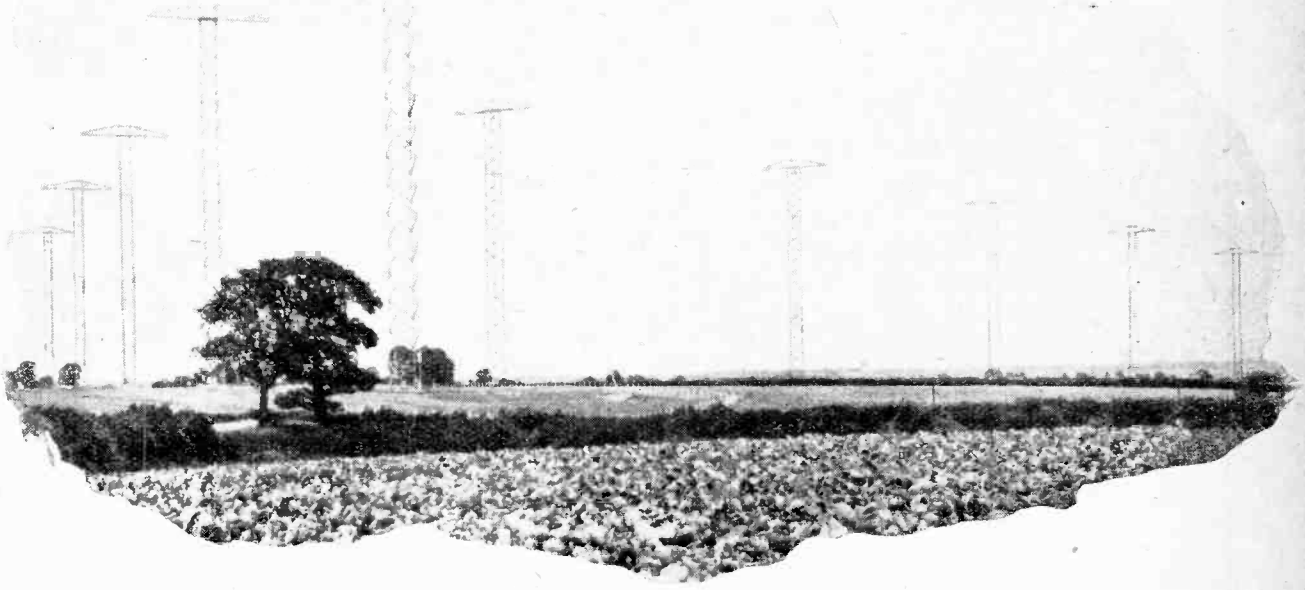
ZAGREB (309.2 metres); 0.7 kW.—**10.0 a.m.**, Symphony Concert by the Croatian Philharmonic Orchestra: Balkansphonia (Josip Slavenski). **4.0**, Dance Music Programme relayed from the Club-Cabaret. **6.45**, Wireless Notes. **7.0**, Opera Relay from the National Theatre, Zagreb. In the Intervals: News and Announcements and Weather Forecast. **10.0** (approx.), Close Down.

ZÜRICH (588 metres); 1 kW.—**10.0 a.m.**, Concert relayed from the Capitol Theatre. **11.0 a.m.**, Weather Report and Forecast. **11.30 a.m.**, Programme by the Zürich Station Orchestra. **3.0**, Concert by the Castellano Orchestra at the Carlton Elite Hotel. **6.30**, Time Signal. **6.33**, Protestant Address. **7.0**, Programme relayed from **Basle.** Recital of Music at St. Martin's Church. **9.0**, Weather Report, Late News Bulletin and News from the Neue Züricher Zeitung. **9.30** (approx.), Close Down.

Sunday, December 16th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

A Year's Progress in Commercial Wireless



Automatic S.O.S., Position Finding, Less Jamming of Broadcast, Beam Telephony.

By LIEUT.-COLONEL CHETWODE CRAWLEY, M.I.E.E.

THE advances made in all branches of wireless communication during the past year have been quite as extensive, though perhaps rather less spectacular, than in recent years. In fact, the technical side of wireless has now reached a stage where it has time to pause a little and consolidate its position. Of course, the days of "hit or miss" are long past, but the advent of short waves three years ago did have the effect of throwing into the melting-pot many problems which then seemed to have been solved, and it is only during this last year that we have sailed into less troubled waters. But the pause will be short-lived, many new avenues of advance are opening up, and it will not be long before the melting-pot is in use again for facsimile transmission and short-wave telephony. Later on, we shall be asked to struggle with television, and even, perhaps, the distribution of power by wireless; but we must check these alluring visions and come to the more prosaic attainments of 1928.

The International Convention.

In the autumn of 1927 an International Radiotelegraph Conference was held in Washington, and the resulting International Convention was promulgated in the early part of last year. This Convention, which came into force on January 1st this year, supplants the Convention of 1912. Usually there is a new Convention every five years, but since 1912 it had been found impracticable to arrange for an international radio conference until 1927, although the urgent need for such a conference was apparent to anyone interested in wireless communications.

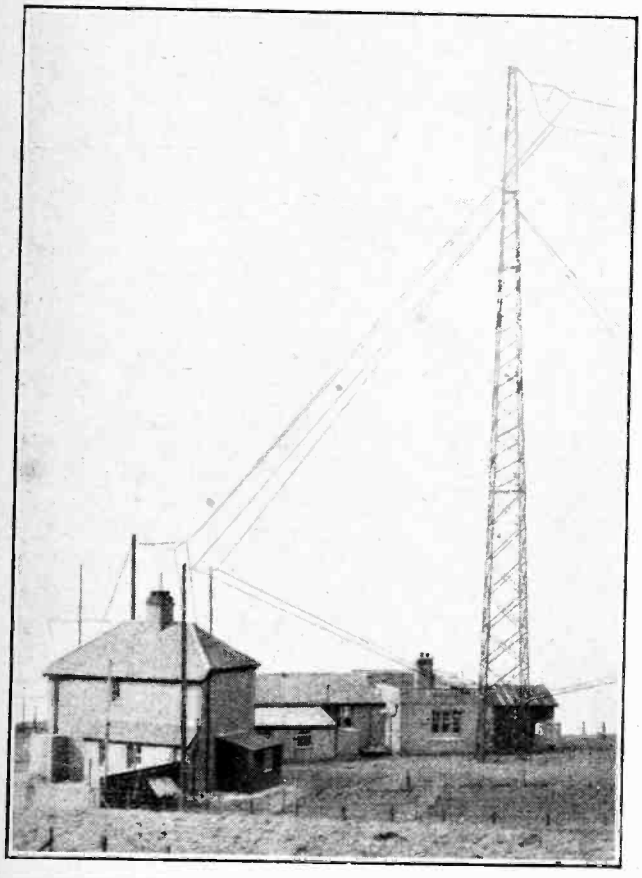
The 1912 Convention had dealt only with regulations governing the communication of ships with one another and with the shore, as at that time the use of wireless was practically confined to such communication. Now, of course, the situation is quite different, and the new Convention, besides overhauling the old ship and shore regulations, lays down regulations for governing point-to-point communications, aircraft services, broadcasting, and amateur working. As all wireless communication is conducted by means of waves in the ether, it is essential, if interference is to be avoided, that the various services should be confined to definite wavelengths, and this international allocation of waves was the most important, and, indeed, the most difficult, work with which the conference had to deal. The Convention now lays down, for all the different services, definite bands of waves, from 5 to 30,000 metres, some of these bands being exclusively confined to a particular service, others being allocated to two or more services in cases where mutual interference is unlikely, or at any rate is not of great importance.

A Year's Progress in Commercial Wireless.—

In actual practice much of the spirit of the new regulations was already in being as a result of the advances made in wireless technique since the 1912 Convention, and during the last year most of the letter of the new regulations has already been put into operation.

Automatic Distress Signal.

The most important advance in maritime signalling during the year has been the fitting of British ships with automatic apparatus for receiving the alarm signal. This



Directional aerial receiving equipment installed at a coast station so that ship direction and location can be determined. (Portpatrick station.)

signal consists of a series of twelve dashes sent in one minute, the duration of each dash being four seconds, and the duration of each space between two dashes, one second. It is used solely to announce that the distress signal is about to follow, and, when received on the special automatic apparatus, it actuates an electric circuit so as to ring a bell which calls the operator to the instruments. British ships are, as a rule, allowed to reduce their operating staff if they are fitted with this apparatus, and there are now nearly 800 ships so fitted. This alarm signal, and the use of automatic receivers, have been recognised in the new International Convention, but up to the present such apparatus has been fitted only in British ships. It has not been laid down internationally that the distress signal must be preceded by the alarm signal, but it is now well known that if the latter is omitted the former may be missed by British ships within range, and in consequence it is becoming general to use both signals.

The advantage of having directional receiving apparatus in ships has become more appreciated by shipowners during the last year. With this apparatus a ship is able to obtain its bearing from any station or ship fitted with wireless, and in addition wireless beacon stations are being erected at various places all over the world for the purpose of allowing ships which are equipped with directional receivers to obtain bearings from these beacons. The percentage of British ships fitted with directional receivers compared with the total number of British ships fitted with wireless has increased during the year to about 17 per cent.

The design of ships' apparatus has tended towards the introduction of interrupted continuous wave apparatus in place of spark apparatus, as it is laid down in the new Convention that ships equipped after the 1st of January, 1930, must be fitted with continuous-wave transmitters, except in the case of very small installations. This regulation will tend to reduce interference in maritime signalling generally, and especially the interference caused by such signalling to the reception of broadcasting programmes in coastal areas, as continuous-wave transmission, being more sharply tuned than spark transmission, causes less interference. Broadcast listeners have indeed been well looked after by the new Convention, as broadcasting stations have been given bands of waves which cannot be used by other services. Two waves which have hitherto been used by ships—the 300-metre wave and the 450-metre wave—are not to be so used in future in regions where they might interfere with the reception of broadcast programmes.

Similar regulations have been laid down for the coast stations which work with ships, and during the year several of our coast stations have had their spark installations replaced by interrupted continuous-wave sets.

The policy of fitting our coast stations with directional receivers, so that they may be able to give a ship its bearing from the station, has been continued, and about 8,000 bearings have been given during the year. But ships which are themselves fitted with directional receivers often require to obtain a bearing for navigational purposes from places where no coast stations are established, and during the year a considerable advance has been made in providing wireless beacon stations for this purpose. Six of these stations are now in operation at suitable points round the coasts of the British Islands, and several more are in hand. In a few cases submarine sound signals are emitted from the station at the same time as the wireless signals, so that ships fitted with the necessary apparatus can obtain, not only a bearing, but also their position, by noting the difference in time between the reception of the wireless and the sound signals.

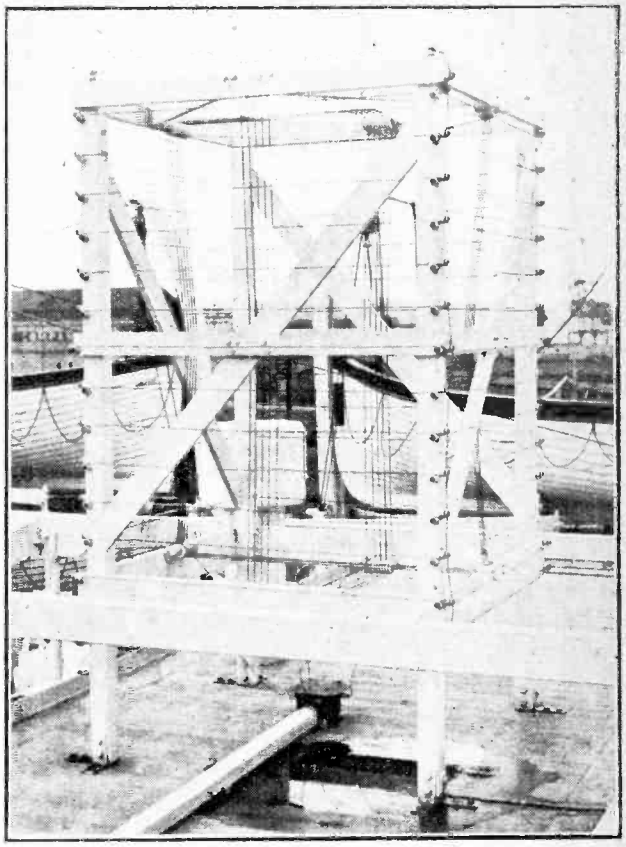
The results of extensive experimental work on directional wireless carried out by the Radio Research Board during the last five years has been published. It was found that the bearings of transmitting stations by day were reliable to an extreme error of four degrees, the great majority of readings being correct to within two

degrees. During darkness results were far more erratic, but, fortunately for ships' navigation, these variable errors were not encountered up to a range of about one hundred miles when the transmission was entirely over sea. These results of the Radio Research Board's experiments are confirmed by observations made in various countries throughout the world.

In addition to the work carried out at the coast stations there is a large volume of telegraph traffic conducted with passenger ships at long ranges through a Post Office medium-power station. A new, up-to-date transmitting station for this purpose was opened during the year at Portishead to replace the one at Devizes which had been in use since the war. The receiving and operating station remains as before at Burnham-on-Sea, but the whole service has been extended, and a long-range, short-wave service is now available in addition to the improved long-wave service. Nearly one and a half million words were dealt with at this station during the year.

Short Waves for Ships.

Technical difficulties have arisen in adapting short-wave installations to ship conditions, and so far only a few ships have been fitted. Great ranges are often obtained; for instance, Portishead is frequently in good communication with ships in the South Atlantic and the Indian Ocean, but the communication cannot yet be considered as reliable. However, the work carried out during the year may be taken as proving that a great future is in store for short-wave communication with ships. When at last this comes to its own, no ship need ever be out of direct touch with any country, but we have some way to go yet before that is a practical proposition.

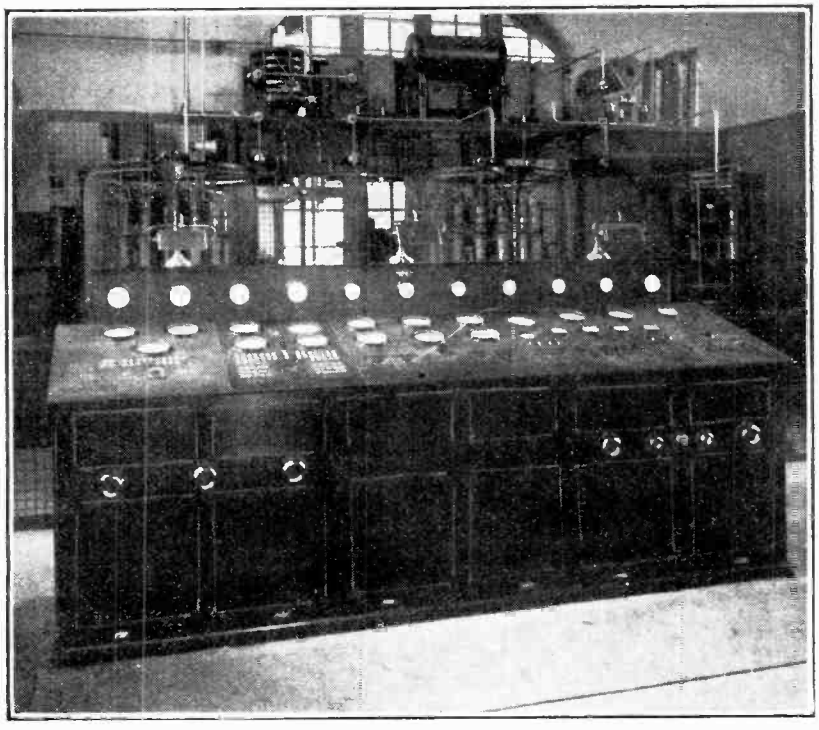


Ship's direction-finding aerial.

During the year, wireless telephony has been fitted in a few fishing fleets, and, as an experiment, in a few large passenger ships. In some of the fishing fleets it has proved useful, but otherwise it has made little advance in maritime signalling. A set for working with ships has been installed in the coast station at the Humber.

Marine Telephony.

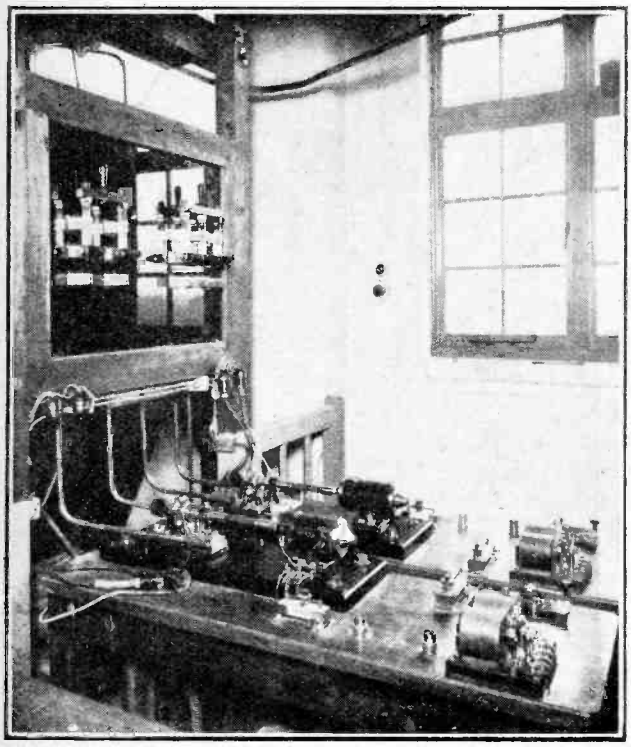
The obstacles in the way of wide adoption are that telephony causes more interference than telegraphy, for equal power the range obtainable is less, the difficulties of technical maintenance are about the same for the two systems, and telephony presents language difficulties which are not present in telegraphy. But, on the other hand, the supreme advantage of conversation between individuals on ship and shore, as compared with telegraphic communication, must eventually overcome the difficulties which at present loom so large.



Control panel of transatlantic telephony equipment at Rugby.

A Year's Progress in Commercial Wireless.—

The advantage of having wireless equipment in aircraft has been made more apparent this last year than ever before, for the simple reason that more aircraft have been flying. The disadvantages remain as before, weight and difficulty of operating, but it is only a matter of time before a way round is found and it becomes acknowledged that wireless equipment is an essential part of the machine.



High-speed signalling keys at the Northolt station.

The new equipment at Croydon aerodrome has been brought into action during the year. The four transmitters are at Mitcham, a couple of miles distant, operation and reception being carried out at the aerodrome at Croydon. Directional apparatus is fitted, and the process of finding the position of an aircraft takes less than a minute. Simultaneous bearings are taken from Croydon, Pulham, and Lympne, the intersection of the bearings giving the position of the machine in flight.

Beam Telephone Possibilities.

Developments in point-to-point wireless communication have centred on short-wave working, but very few long-range commercial services are yet in operation so far as telephony is concerned. The most notable of these telephone services is that opened by the Post Office last summer between this country and America, as an auxiliary to the long-wave service which has been in operation for some time.

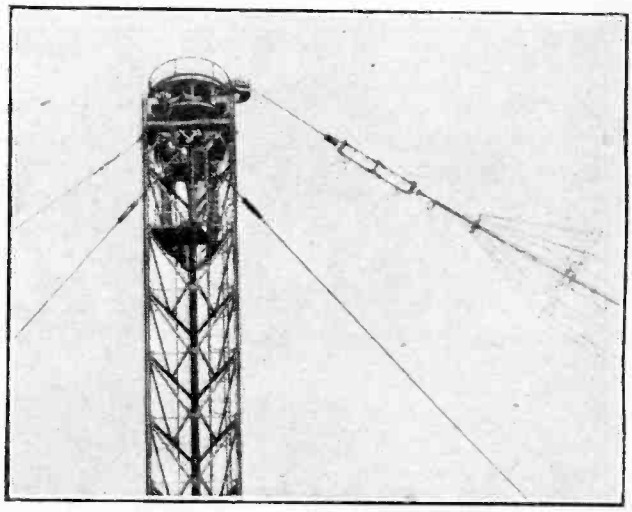
There is no doubt, however, that we are on the eve of full commercial application of short-wave telephony for communication over great distances, but 1928 cannot be registered as the year when this result was achieved.

The main reason why short-wave communication is so desirable is, of course, that for great distances short-wave working is much more economical than long-wave working.

The Cable-Radio Merger.

As regards telegraphy, short-wave services have developed rapidly during the year. Many commercial services over great distances have sprung up all over the world, including a service opened last summer by the Post Office between this country and Kenya Colony.

The amount of traffic sent over the short-wave telegraph circuits between this country and Canada, Australia, South Africa and India has shown a steady increase. These circuits are worked by wireless telegraphy on the beam system. Hitherto they have been operated at this end by the Post Office, but other arrangements are now being made in accordance with the recommendations of the Imperial Wireless and Cable Conference which met during the year. This conference, which was appointed by the Government, included representatives of Great Britain, the Dominions, the Irish Free State, and the colonies and protectorates. The conference recommended that a Communications Company be formed to take over all the communication assets of the cable companies and the Marconi companies concerned in exchange for shares, and to acquire the Government cables and the lease of the Post Office beam stations, the capital of the company not to exceed at its inception £30,000,000. The chairman and one other director are to be persons approved by the Government on the suggestion of the cable campanies, and British control of all the companies must be guaranteed. In addition, there is



Eight hundred feet up. The top of one of Rugby's masts.

to be an advisory committee, including representatives of the Governments concerned, which must be consulted on questions of policy, including any alteration of rates. The external telephone services of Great Britain are, however, to be left in the hands of the Post Office, which will come to terms with the company regarding the right to use the company's wireless stations for telephone purposes.

By Our Special Correspondent.

Relays from Belgium.—How Ireland Fares.—New Year's Eve.—More Worry for Daventry?—B.B.C. and Variety Artistes.—Christmas in Aberdeen.

Landline Triumph.

To the Post Office, as much as to the B.B.C., belongs the credit for the really excellent relay from the Aberdeen studio on Monday, December 3rd. Those of us in London who may have switched on in the middle of the concert might have been forgiven for imagining, at first, that the performance was being given at 2LO.

○○○○

600 Miles.

Naturally there were bad patches, but, considering that the landline was nearly 600 miles in length, we should have forgiven the Post Office if distortion had been far more marked.

In a relay from Aberdeen the lines proceed first to Edinburgh, then to Leeds, on to Manchester, and thence to London.

○○○○

A Belgian Proposal.

The landlines in Belgium, particularly those radiating from Brussels, have been immensely improved of late, which is one reason why the Belgian broadcasting authorities have proposed a new series of relays to this country, beginning possibly with the performances of the Vienna Philharmonic Orchestra. The proposal is that this world-famous orchestra should visit Brussels for a week and that the concerts should be relayed to British, German and Dutch stations, which would thus share in the enormous expense. I hear that it is this part of the proposition which has provoked controversy at Savoy Hill.

○○○○

Counting the Cost.

No one doubts that the landlines could give a fairly good account of the Vienna orchestra's performance; the question is mainly one of cash. Is it worth while to pay several hundred pounds for an orchestral performance of an hour or two, which, to be brutally frank, could hardly be more satisfying than a British orchestra at the Queen's Hall connected to Savoy Hill by a negligible amount of landline?

The best orchestra in the world will suffer a loss of tone and distinctiveness—just the qualities that count—if heard at the end of a long landline, however good that line may be.

○○○○

Belfast's Submarine Cable

When a submarine cable steps into the picture the reproduction of music suffers still more. Anyone who doubts this might ask the opinion of a Belfast listener. (If he puts safety first, it would be better not to!) From time to time Belfast has the bravery to include a London symphony concert in its programme. Hope springs eternal. Although the submarine cable was constructed for speech only, the prayer apparently goes up that it will cope with strings, brass, wood wind and drums, "just for this once."

It is an open secret that several of these efforts have finished up *via* wireless from Daventry.

○○○○

B.B.C. and the Irish Free State.

Dublin (2RN), the I.F.S. station, has been working quite a lot recently in association with the B.B.C., relaying items from Belfast. I hear that the station has been given practically *carte blanche* in the use of Belfast's material, but has not made full use of the opportunity. One reason is that the Belfast evening programme opens at 7.45, whereas Dublin does not generally begin its main programme till 8 o'clock. The way out of this difficulty seems fairly obvious.

○○○○

On New Year's Eve.

Nothing revolutionary has yet been decided upon for ushering in 1929. According to present arrangements, an item entitled "1928-1929" will occur in the programme at 11.50 p.m. on December 31st, but at the time of writing the precise nature of the item is a mystery.

○○○○

A Coincidence.

In view of B.B.C.'s forthcoming move from Savoy Hill, 5GB's Christmas pantomime, which is to be broadcast on December 29th, provides a singular coincidence. The titling was arranged some weeks ago, and entirely without knowledge of the statement about the move. It is "The House the B.B.C. Built."

○○○○

More Trouble for 5XX.

As if Kalundborg and Lahti were not enough, poor old Daventry (5XX) is threatened with another noisy neighbour—no less a personage than Eiffel Tower himself. On January 1st Eiffel Tower is to abandon the present 2,650-metre

FUTURE FEATURES.

London and Daventry.

DECEMBER 18TH.—Nativity Play, relayed from St. Hilary's Church, Marazion, Cornwall, S.B. from Plymouth.
DECEMBER 19TH.—"The Blue Forest" (Aubert), a fairy opera.
DECEMBER 21ST.—"Alice," a play by C. A. Lewis.
DECEMBER 22ND.—Carols by the Civil Service Choir.

Daventry Exp. (5GB).

DECEMBER 18TH.—Further Fireside Singing.
DECEMBER 21ST.—Excerpts from Gounod's "Faust."
DECEMBER 22ND.—"Moonshine," a radio show written and arranged by Charles Brewer. Sketches by Edwin Lewis.

Cardiff.

DECEMBER 18TH.—Roads Through Songland, and Songs Heard by the Way.
DECEMBER 20TH.—"The Lord's Poor Brother," a play by W. Riley.
DECEMBER 22ND.—A Christmas Carol Concert.

Manchester.

DECEMBER 16TH.—Bells and Service from Chester Cathedral, with an address by the Rt. Rev. Henry Luke Paget (Lord Bishop of Chester).
DECEMBER 18TH.—"Can You Guess These Tunes?"
DECEMBER 22ND.—An Irish Programme.

Newcastle.

DECEMBER 17TH.—"Fair Game," a topical revue by E. A. Bryan.

Glasgow.

DECEMBER 21ST.—Scottish Community Singing Concert.

Aberdeen.

DECEMBER 17TH.—"Impertinent Waves," presented by the Radio Concert Party.

Belfast.

DECEMBER 17TH.—An Ulster Ceilidh.
DECEMBER 21ST.—Christmas Concert of the Belfast Philharmonic Society.

wavelength and drop down to something in the region of 1,500. If the power were to be normal, Daventry might still hope for immunity from interference (at least on reasonably selective receivers); but the persistent rumours that Eiffel Tower will employ 100 kilowatts puts a different complexion on the matter. Fortunately the power increase is likely to be deferred for a time. 5XX is now working on 1,562.5 metres.

One who has watched Daventry's affairs during the last few months suggests that the station's motto might be: "No one knows the trouble I've seen."

○○○○

614 Boy Singers.

The microphone will be severely tested on Sunday next, December 16th, when the 614 boys of Oundle School, Northamptonshire, will sing the chorus parts of Bach's "Christmas Oratorio," to be broadcast from 5GB. The soloists will be Carrie Tubb, Margaret Balfour, John Adams and Topliss Green.

○○○○

Personalia.

Mr. D. Cleghorn Thomson, the Regional Director for Scottish broadcasting, whose engagement was announced a few days ago, is still on the glorious side of thirty, while his fiancée, Miss Virginia Fain, is still at college at Brinmawr. Mr. Cleghorn Thomson's association with broadcasting dates from 1925, when he came to Savoy Hill after being defeated at South Edinburgh in the General Election of 1924, in which he was the youngest Liberal candidate.

○○○○

Broadcasting and the Theatres.

Contrary to the opinions expressed by many of the Grand Moguls in the theatrical business, the broadcasts from the Palladium have had no harmful effects on the box-office receipts; indeed, there is a suspicion that a slight upward fillip has been due solely to the microphone. Whether or not this is so, the General Theatres Corporation are continuing to grant broadcasting facilities, and there are grounds for the belief that other theatrical organisations are showing interest in the experiment.

○○○○

What the Theatres Gain.

The programmes of the variety theatres are peculiarly suitable for broadcasting. Out of a total of fifteen or sixteen items constituting one entertainment it is nearly always possible to select one turn, usually vocal or instrumental, which the broadcast listener can enjoy without being tantalised by his lack of sight. At the same time one turn forms such a small proportion of the entire bill that the theatres sacrifice nothing in view of the publicity gained and the sum paid by the B.B.C.

○○○○

Long Contracts.

There is now under consideration a scheme which may possibly overcome one of the biggest obstacles to a *rapprochement* between the B.B.C. and the theatres. The idea is for the B.B.C. to engage variety artistes on long contracts to prepare and perform original material exclusively for the microphone. Too often in the past a variety artiste has been tempted to dip into his stage repertoire for broadcasting purposes, to find later, to his dismay, that the same jokes fell flat when re-hatched in the theatre.

A happy ending may still be in sight if theatrical managers can be persuaded that broadcasting is not another name for poaching.

○○○○

Wireless Services in Church.

The congregation of at least one church, having heard Archbishop Davidson's farewell sermon from loud speakers in their own place of worship, have decided that wireless services are good for the soul and that the loud speakers must be retained. This is at St. Peter's Church, Middlesbrough, where the wireless receiver is used regularly on Thursday afternoons to pick up evensong from Westminster Abbey. The congregation participates in the service, kneeling during prayers, following the lessons in the Bibles and singing the hymns.

The vicar, the Rev. L. H. B. Stavely, a wireless enthusiast of twenty years' standing, has a radio workshop that strikes awe into the most hardened parishioner.

○○○○

A Versatile Playwright.

When Mr. John Drinkwater, the author of "Abraham Lincoln," broadcasts on December 18th from 2LO, he will not deal with any of those subjects which the listener might be inclined to link up with his name, playwriting, for example. He will talk about stamp collecting.

○○○○

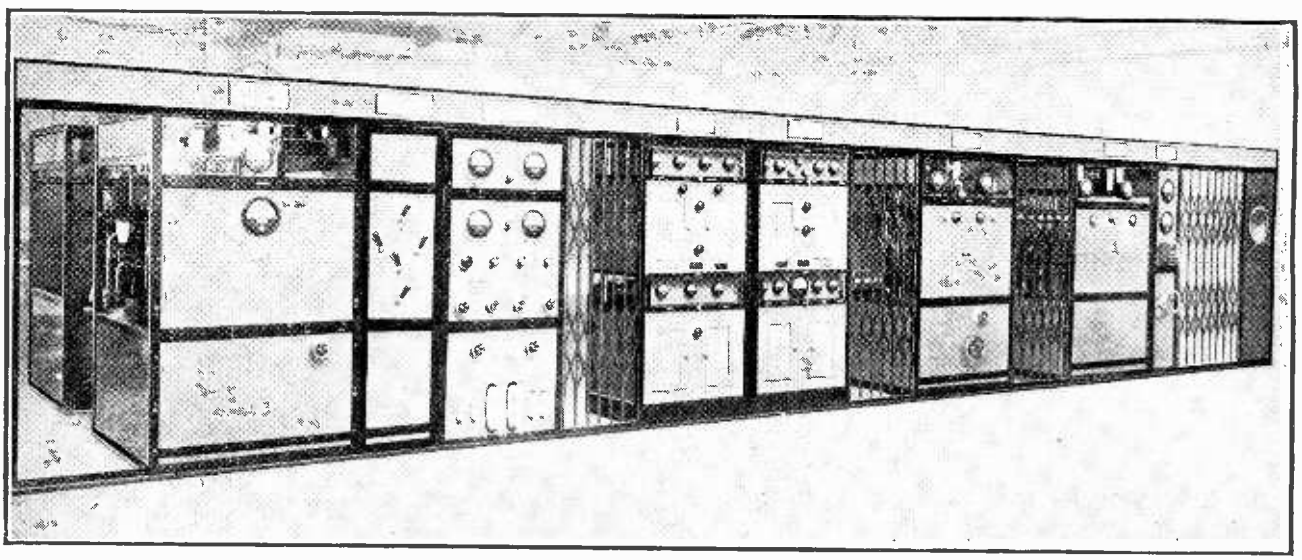
The Music of Finland.

Finland is providing the next of the "National Programmes," on Thursday, December 20th, from 2LO. Although the country is little known to Britons, it has given the world such eminent musicians as Sibelius and Palmgren.

○○○○

Christmas Day at Aberdeen.

The "fireside" aspect of Christmas will be represented in the third part of the very well-balanced Christmas programme which Scottish listeners will hear on Christmas Day. This part of the programme will come from Aberdeen, and will consist of one of those "feature" Scottish programmes in which the Northern station has always been particularly successful. Its title, "Farmer Mowat's Christmas at the Mains o' Drumspeffer," conveys its character.



A MODERN BROADCAST TRANSMITTER. The time has long passed when the mere mention of wireless conjured up visions of wire entanglements and very vulnerable apparatus. The robust nature of modern equipment is well illustrated in this photograph, which shows the new transmitter constructed by the Marconi Company for the broadcasting station at Bratislava, Czecho-Slavakia. It will supply the aerial with 12 kW. A description of the apparatus appears on page 796.

READERS' PROBLEMS ANSWERED

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves.

A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

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

Push-pull or Parallel?

Would you recommend me to use a pair of pentode valves in parallel instead of the single output valve specified in the description of the "Kilo-Mag Four" receiver? My desire is to get a larger output combined with greater L.F. magnification.

R. de G. M.

Pentode valves are not at their best when following an anode bend detector with transformer coupling, and your proposed scheme is not altogether to be recommended. However, there is a way out of the difficulty, and we suggest that you use two pentode valves in a push-pull arrangement. By adopting this plan, the L.F. voltage from the detector will be equally distributed between their two grid circuits.

○○○○

A Tone-raising Device.

The tone of my loud speaker is satisfactory enough, but is rather lacking in brilliance. Is it possible to improve matters in this respect by connecting an L.F. choke in series with it?

J. L.

No; your proposed alteration will have the opposite effect to that which you desire, but it is possible to reduce the response at low frequencies without materially altering the reproduction of higher tones by connecting the choke in parallel with the loud speaker windings. To get well-defined results it is necessary that the D.C. resistance of the choke should be comparatively low. We cannot make helpful suggestions as to the best value for its inductance, as this depends on the impedance of the loud speaker windings, etc., and is best found by trial.

○○○○

A Reaction Failure

Some time ago a statement appeared in "The Wireless World" to the effect that an "aperiodic" aerial winding could be made to serve the dual purpose of a reaction coil. I have tried this arrangement with an "Everyman Four" aerial-grid transformer, connected up in the manner shown in the diagram which I am sending you, but have failed to obtain reaction effects; indeed, the set works better with the reaction condenser disconnected. Is my diagram correct, or does this simple arrangement only apply to some special circuit?

J. S.

Your circuit (reproduced in Fig. 1) is correct: but we think that the trouble is due to the fact that the aerial-reaction winding L is not in the correct sense with respect to the secondary L_1. To use one of these coupling transformers for your special purpose it is necessary that the two windings should be put on in opposite directions.

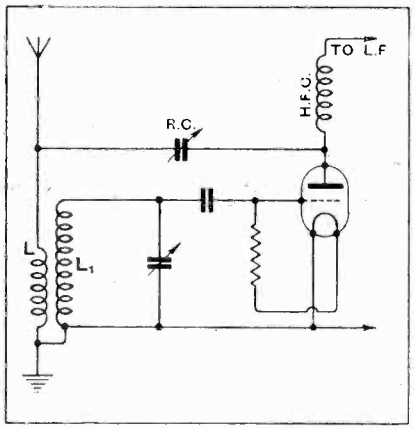


Fig. 1.—Simple reaction circuit with combined aerial and feed-back coil. The two windings must be in opposite directions.

H.F Transformers for A.C. Valves

From statements published in your journal, I gather that it is necessary to remove some two or three turns from the primary and neutralising windings of standard "Everyman Four" transformers when they are used with indirectly heated A.C. valves. From which end of the winding should these turns be taken off?

P. T. C.

Referring to the primary winding, the turns should be taken off from the end which connects to plate of the preceding valve; similarly, the neutralising section should be reduced from the end joined to H.T.+. These are the ends of the parallel superimposed windings which are nearest to the "grid" end of the secondary.

○○○○

The Earth System.

There seems to be some uncertainty as to which type of earth connection is best. Do you prefer a junction to a waterpipe or to a buried plate?

P. C. C.

It is impossible to make a definite statement, as a good deal depends on circumstances. Provided that a reasonably short and direct lead can be taken to a "rising" water main, it is likely to be better than the average buried earth plate, etc., which is seldom of sufficiently large dimensions for maximum effectiveness.

○○○○

Quality Reception.

What modification would you suggest in the L.F. amplifier of the "Europa III" in order to render it specially suitable for operating a moving coil loud speaker?

S. M. D.

Your query is best considered without particular reference to the Europa III, but to circuit systems essentially suited for moving coil loud speaker use in general. Neither leaky grid detection nor reaction should be employed in this instance. For complete details of a suitable circuit system you are referred to the constructional booklet obtainable from the publishers, "The Moving Coil Loud Speaker" (price 1s. 6d., post free 1s. 8d.). It is good advice to use amplifiers of low stage gain and practically restrict your moving coil loud speaker reception to the local station. The Europa III is a good long-range set.

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.

Fitting a Pentode.

Would it be in order to fit a pentode valve to the "Everyman Three" receiver, and, if so, what alteration would be necessary? H. S.

As this receiver has but one transformer-coupled L.F. stage, it would be quite possible to substitute a pentode for the normal output valve. The coupling between H.F. valve and detector is by means of a transformer, so no special modifications would be necessary, beyond adding the usual connections between the pentode screened grid terminal and the H.T. battery.

○○○○

Transformer Coupling with S.G. Valves.

Is it possible to use the type of transformer described for the "Kilo-Mag. Four" receiver in a set with a single stage of H.F., a leaky grid detector, and reaction? If so, will you tell me how a reaction winding may be added? B. R. B.

The transformers in question lend themselves quite well to use in a circuit such as you describe, and a reaction winding

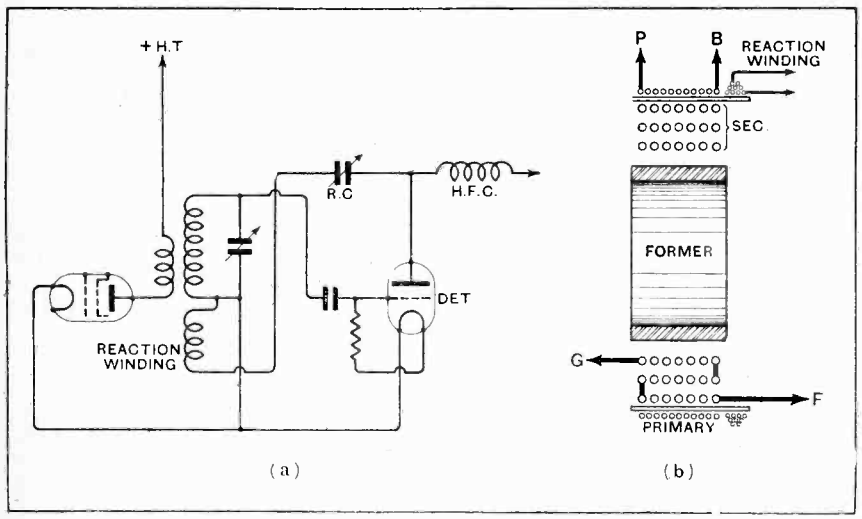


Fig. 2.—Sectional sketch of an H.F. transformer for S.G. valves, with added reaction winding. Its connections are shown in the circuit diagram.

can very conveniently be added in the manner shown in Fig. 2 (b). It should be in the form of a compact "bunched" winding consisting of from 15 to 30 turns (depending on the capacity of the reaction condenser) of No. 40 D.S.C. wire, wound on an extension of the spacing strips which separate primary and secondary, and spaced about $\frac{3}{16}$in. from the other windings. For the long-wave transformer, the reaction winding should be added in a similar manner, but 70 or more turns will be necessary.

The connections may be as in Fig. 2 (a); by adopting this arrangement the number of external leads to the transformer is kept down to five, but if you wish to keep one side of the reaction control condenser at low potential it is, of course, necessary to bring out a second connection from the reaction coil.

Referring again to diagram (b), external connections are indicated by the conventional lettering: P, plate; B, H.T. positive; G, grid; F, filament.

○○○○

Sets for Abroad.

Will you make a suggestion as to the most suitable type of circuit for a receiver which I propose to take out to the Soudan? I should like to be able to receive both the broadcast wavebands, and imagine that three valves would be sufficient, as loud speaker reproduction would not be required. I suppose that two H.F. stages would be essential for such long-distance reception? C. M. T.

We hardly agree that two H.F. valves would be necessary or desirable. At very great distances, where one depends entirely on "freak" reception on the normal wavebands, ease of operation and facilities for rapid "searching" are more important than the utmost possible degree of magnification. A good H.F.-det.-L.F. combination with an S.G. H.F. valve and reaction should meet your needs as well as anything else. May we suggest, however, that you would probably be well advised to concentrate entirely on the ultra-short wavelengths, to the exclusion of the normal broadcast bands?

○○○○

A Low-magnification Stage.

I have read that in cases where an anode bend detector is followed by two L.F. stages, it may sometimes be desirable to sacrifice amplification in the first stage by using a low value of anode resistance. Why is this? Surely it would be possible to reduce the input to the detector to a suitable value, and to avoid any sacrifice of L.F. magnification? T. L. W.

The important point here is that an anode bend detector gives more perfect rectification from the point of view of quality when the H.F. voltage applied to its grid circuit is large; this is apart from the fact that it is also more sensitive to considerable inputs. If a detector of this kind is followed by two high-magnification L.F. stages, it is now widely appreciated that any H.F. input sufficiently great to give good detection will badly overload a normal output valve, even if the H.T. voltage applied to its anode is somewhat above the average. It will therefore be obvious that for good quality reproduction it will often be necessary to reduce L.F. amplification; it is not a bad plan to have this amplification under control so that the user can take advantage of maximum sensitivity for long-distance reception when it is desired.

○○○○

Low-loss Superfluous.

My Det.-L.F. receiver, of which I am sending you a circuit diagram, is fitted with commercial plug-in coils; would it be worth while replacing them with single-layer Litz windings, and would this substitution give more signal strength and selectivity? F. A.

The commercial coils you are using are quite good, particularly when their extreme compactness is taken into consideration. In any case, in a circuit such as you show, where the grid coil is damped by connection to the aerial and also by leaky grid condenser detection, it is quite useless to reduce coil resistance beyond a certain point, and we hardly recommend you to make a change.

○○○○

Points of Criticism.

Will you please criticise the diagram of my proposed receiver, bearing in mind the fact that I am hoping for good-quality reproduction combined with the maximum possible range-getting properties, and a high degree of selectivity. T. P. A.

Your circuit diagram shows a screened grid H.F. amplifier with tuned H.F. transformer and a loosely coupled and separately tuned aerial circuit, followed by an anode bend detector. Up to this point we have nothing but favourable criticism to offer, but with regard to the L.F. amplifier, which consists of two transformer-coupled stages of high magnification, we think that some alteration will be desirable. You show no form of volume control other than that afforded by the H.F. valve rheostat, and it will be found that any signal voltage sufficiently great to give good rectification with your anode bend detector will undoubtedly overload the output valve with an applied H.T. voltage as indicated in your diagram.

The remedy would be to fit a control of the signal voltages delivered to the first L.F. grid. This might take the form of a variable resistance across the first transformer primary. Alternatively, you could use grid rectification, but this would imply the addition of reaction, which would tend to complicate matters. Again, it would be possible to substitute a resistance coupling of low—or, at any rate, controllable—magnification in the first stage.

The Wireless World AND RADIO REVIEW

(16th Year of Publication)

No. 486. WEDNESDAY, DECEMBER 19TH, 1928. VOL. XXIII. No. 25.

Editor: HUGH S. POCOCK.

Assistant Editor: F. H. HAYNES.

Editorial Offices: 116-117, FLEET STREET, LONDON, E.C.4

Editorial Telephone: City 9472 (5 lines).

Advertising and Publishing Offices:

DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street.

Telegrams: "Cyclist, Coventry." *Telephone:* 6210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street.

Telegrams: "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 260, Deansgate.

Telegrams: "Iliffe, Manchester." *Telephone:* 8970 City (4 lines).

PUBLISHED WEEKLY.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

Entered as Second Class Matter at New York, N.Y.

CONTENTS OF THIS ISSUE.

SHOULD THE B.B.C. ADVERTISE THE PROGRAMMES?

IT is interesting to contemplate what proportion of the owners of broadcast receivers listen to the programmes regularly. It has become the fashion to own a wireless set, and the home is scarcely regarded as complete without one, but how often is it used? There are, of course, some devotees of listening-in who probably never lose an opportunity of switching on the set if they can possibly avoid it, but there must be thousands of others who only listen occasionally and who do so less and less for the reason that the bulk of the programme matter has little or no appeal to them.

A B.B.C. Obligation.

It is the business of the B.B.C. to popularise broadcasting and to induce the public to form the habit of constant listening, but in these days of continual activity few of us can be systematic about our hours of leisure and consequently do not search through the programmes from day to day to ascertain what items are likely to be of special interest to us. There is also, perhaps, the feeling that since in the published programmes all items are given equal prominence and the programmes day after day are treated in the same way, that they are of necessity all of equal merit. If the B.B.C. took steps to advertise extensively a forthcoming programme of particular character is it not likely that this would result in a great extension of the listening audience on that particular night, and would, in many instances, serve to revive interest in broadcasting amongst those on whom it may be beginning to lose its hold?

The Effect of Advertising.

The public more and more requires to be reminded of forthcoming events through the medium of bold advertising, and whilst it might be argued that the immediate effect to the B.B.C. and to broadcasting generally of increasing the number of listeners on any particular night by, say, 50 per cent. would be imperceptible, yet we cannot believe that the achievement of such a result, which could certainly be done through the medium of advertising, would be devoid of beneficial consequences to the cause of broadcasting generally, provided the programmes so advertised were of a high standard—a condition which is, of course, obviously necessary whatever may be the subject of advertisement.

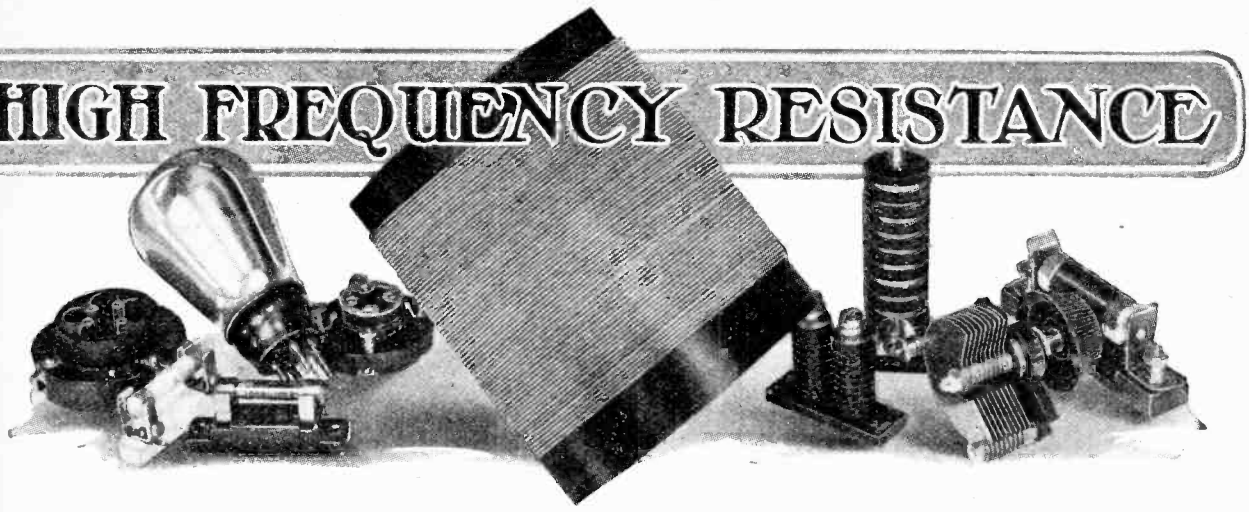
oooo

HOLLAND'S NEW EXAMPLE.

JUST as Holland was the first European country to establish a short-wave broadcasting station with a world-wide range which enabled her to communicate direct with her colonies, so again Holland has taken the lead by arranging that the famous station PCJJ, now at Hilversum, shall transmit on a weekly schedule with times and languages so arranged that far-distant countries will be able to listen to transmissions by the station in their own tongue at times most favourable for reception.

We have previously urged that the time has come when our short-wave transmitter, 5SW, should cease to be regarded as an initial experiment only, and should be established on a permanent basis and conduct transmissions at intervals throughout the twenty-four hours so that reception in various parts of the British Empire may be made possible at suitable times for reception. If there is no intention of establishing 5SW on a permanent basis, then it would seem to us that what time and money has already been spent on the station has been wasted effort; if, on the other hand, it has been intended since the start that eventually 5SW should become a permanent service station, then surely the time is long overdue when this change of status should come about.

HIGH FREQUENCY RESISTANCE



What It Is and Whence It Comes.

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

THERE has been in the past much argument and discussion on the subject of high-frequency resistance, especially in connection with the tuning coils used in wireless reception, and a vast amount of energy and enthusiasm has been expended in winding coils of all types, shapes, and sizes in the endeavour to find a means of keeping the resistance down to a minimum.

Interest in the subject was kept fully alive till about two years ago, because up to that time no one, whether radio engineer, pure scientist, or set constructor, could formulate any rules that would enable him to decide definitely how to wind a coil giving the lowest attainable high-frequency resistance. The only known way of finding how best to wind a coil was to adopt the "hit or miss" method of making up a number of coils, measuring their high-frequency resistance, and choosing for incorporation in the receiver that coil for which the lowest value had been found experimentally. Such a process is intolerably tedious, calls for laboratory apparatus, and is intellectually unsatisfying.

The Wireless World Coil Tests.

By the middle of 1925 a physicist, S. Butterworth, had worked out in detail a means of calculating the high-frequency resistance due to the wire of which a coil was wound, and in July of that year he published an article (*Experimental Wireless*, July, 1925, p. 613) in which the formula for calculation was given, though without the tables of constants that are necessary for the full application of the formula. In the article he applied his formula to a coil of which experimental measurements had been made by another writer, and showed that the agreement between experimental and calculated results was very close.

In November of that year *The Wireless World* inaugurated a competition in which readers were invited to submit for measurement the best coil that they could make, and a prize was offered for that with the lowest high-frequency resistance. The results of the tests were published in *The Wireless World*, and a large amount of practical information on the subject of coil design was in this way made public for the first time, but the information was difficult to apply owing to the fact that the basic principles underlying the whole matter had not then been made public.

A month or two later there began in *Experimental Wireless* a series of articles by S. Butterworth, in which the result of his mathematical researches was fully presented (*Experimental Wireless*, April, May, July, and August, 1926) for the first time; the publication of these articles was possibly hastened by the competition, as it provided a wealth of experimental data to confirm the purely mathematical deductions. This series was finally summarised in a couple of articles of practical type which appeared in these pages (*The Wireless World*, December 8th and 15th, 1926) giving the fullest instructions, with curves and tables, for calculating the best dimensions, the best gauge of wire, and the best spacing to give the lowest possible high-frequency resistance for coils of any given bulk. Alternatively, the high-frequency resistance of any coil of which the dimensions were known could be calculated.

The Advent of the Screened Grid Valve.

The publication of these articles promptly put a stop to all controversy on the subject of the high-frequency resistance of tuning coils, for here was the information necessary to calculate the answer to practically any problem that might arise, the sole mathematical equipment necessary for the user of the formula being a slide-rule or a table of logarithms in order to shorten an otherwise tedious series of arithmetical operations.

The cessation of interest in high-frequency resistance that was brought about in this way has resulted in the almost complete neglect of this topic by writers on wireless subjects, so that it is not improbable that some who have only lately become addicted to

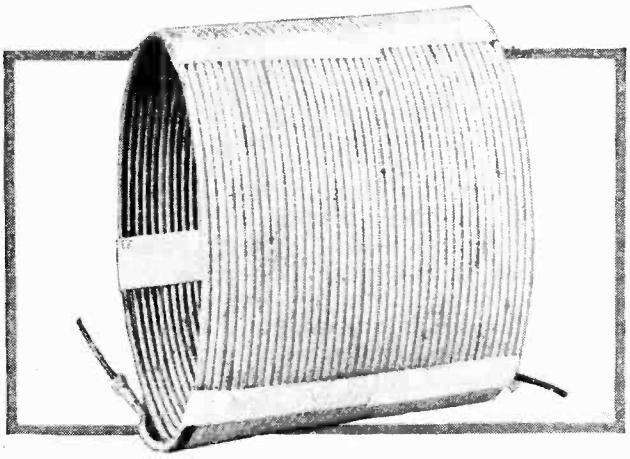
High Frequency Resistance —

wireless are not quite clear as to what this high-frequency resistance may be, and why there has been so much fuss about it in the past. A short discussion of it may, therefore, not be out of place at the present time, especially as the advent of the, as yet, imperfect screened valve must inevitably arouse fresh interest in the subject, though from a different angle.

As applied to tuning coils, the semi-slang term "low-loss," which will be familiar to all through its wide use by advertisers of components, is practically synonymous with "having a low high-frequency resistance." The only difference between the two ways of expressing the same idea is that in using the term "low-loss" it is generally implied that all possible sources of loss have been kept down to a minimum, especially losses due to the former upon which the coil is wound, and to the plug or method of connection employed. The statement that a coil has a low high-frequency resistance is usually taken, perhaps owing to the influence of the articles mentioned above, to refer more specifically to the losses due to the wire itself and to the method of winding, the influence of extraneous factors such as the former and the connections being ignored.

The Origin of High-frequency resistance.

In the copper wire of which the coil is wound there are several distinct sources of high-frequency resistance. In the first place, there is the ordinary direct-current resistance of the wire; that is to say, the absorption of power that occurs when a direct current, as from an accumulator, for example, is sent through the coil. The power so absorbed is converted into heat and so dissipated, just as the power drawn from an accumulator by the filament of a valve serves to heat up that filament. This loss does not depend upon the frequency of the



A typical coil submitted for "The Wireless World" low-loss coil tests. The inductance was 102 microhenrys, and the coil was wound with 42 turns of No. 16 D.C.C. The high-frequency resistance was 1.5 ohms.

current flowing, and is therefore the same whether the current is direct or alternating, and may be looked upon as a kind of frictional resistance that the current meets in forcing its way through the wire. An analogy may be found, though it is not a complete one, in the friction encountered by water in flowing through a pipe.

It is very well known, however, that this is not the only kind of obstruction offered by a coil of wire to the passage of an alternating or high-frequency current. For example, that familiar component, the high-frequency choke, permits the steady plate current to pass with but little hindrance, while it is a very serious barrier indeed to the passage of high-frequency currents. In such a case as that of Fig. 1, where the alternative path offered to them is a comparatively easy one, practically the whole of the high-frequency currents will pass

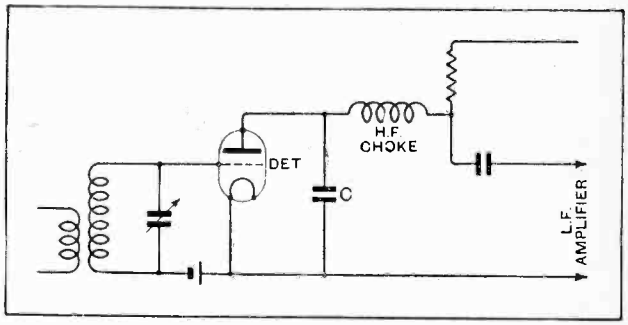


Fig. 1.—The high-frequency choke in the above detector valve anode circuit does not absorb high-frequency energy but deflects it to earth through a comparatively low-resistance path C.

through the condenser C and so be deflected from the L.F. amplifier.

The reluctance of a choke to pass high-frequency currents must not be looked upon, however, as being due to the absorption of these currents, and their conversion into heat by that component; we have just restated the well-known fact that, on the other hand, they are deflected through the condenser. *Why does the choke do this?* The question seems far enough from our subject, but when it is answered we shall have arrived at a very clear conception of the origin of high-frequency resistance.

In passing through a coil of wire an electric current sets up a magnetic field—or, in other words, converts the coil into a magnet. Familiar examples of this are found in the electric bell, the "pot" of a moving-coil speaker, or the ordinary telephones. Now, a magnetic field, since it will cause pieces of iron (the armature of the bell, or the diaphragm of the telephones just mentioned) to move about, must quite evidently possess a very appreciable amount of energy, and this energy it must derive from the current that brought it into existence. That is one of the two fundamental properties of the magnetic field.

The Function of a High-frequency Choke.

The other is that this energy can be reconverted into an electric current, thus reversing the process already mentioned. It is of this fact that advantage is taken in the transformer, where the energy of the varying magnetic field set up by the alternating current in the primary is used to produce currents in the secondary. A more homely, and perhaps more convincing, demonstration of the storing of energy in a magnetic field is found in the fact that when the field current of a moving-coil speaker is suddenly interrupted, and the magnetism of the pot is no longer maintained by the current, a very

High Frequency Resistance.—

vicious spark ensues. The very considerable energy of this spark is drawn from the powerful magnetic field of the pot-magnet.

Applying these principles to our high-frequency choke (and ignoring the steady plate current flowing through it) we have only to remember that the chief feature of an alternating or high-frequency current is that it is perpetually reversing its direction. As it begins to flow in one direction through the choke it sets up the inevitable magnetic field, and as the energy of this has to come from the current the latter is considerably impeded in its progress. By the time the current has reached its maximum value in one direction the magnetic field has, of course, reached its maximum intensity. As the current tries to die away again in preparation for starting to flow in the other direction it is again thwarted by the magnetic field, which, in collapsing again, tends to keep the current flowing in its original direction. By the time the current has been permitted to die away again completely the magnetic field has also gone.

Exactly the same routine is gone through again as the current flows in the other direction, the sole difference being that the reversal of the current implies also the reversal of the direction of the magnetic field. This whole double process is gone through, if the set of Fig. 1 is tuned to 300 metres (1,000 kilocycles), a million times every second.

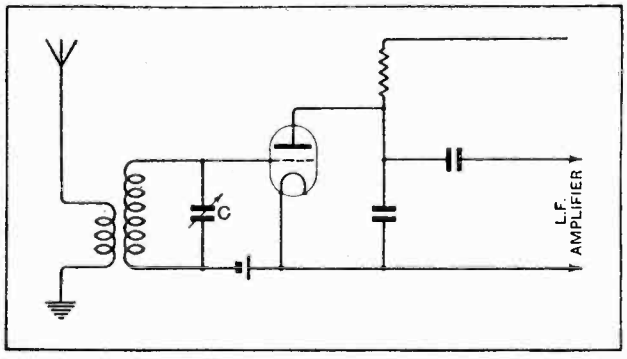


Fig. 2.—A simple circuit in which the secondary of an aerial transformer is connected to an anode bend detector valve. The rectified output to the low-frequency amplifier depends to a large extent on the high-frequency resistance of the tuned circuit.

The point to which it is desired to draw attention is that the high-frequency current has been checked in its passage through the choke by its interaction with the magnetic field, and that at the end of the process, since all the field built up at one instant has vanished again—*has been converted back again into current*—everything is as it was before the process began, and *no energy has been absorbed by the choke.*

The Tuning Coil.

It will no doubt be clear that the effects we have described are in no way dependent for their existence, but only for their magnitude, upon the number of turns in the choke. If the number of turns of the choke were to be reduced from the 2,000 or so to perhaps 60 only, the production and disappearance of the magnetic field would naturally still go on. But 60 turns, on a rather larger former, makes not a choke (except for the ultra-short waves) but our familiar friend the tuning coil, so that we see that the passage of a high-frequency current through a tuning coil is attended with precisely the same magnetic phenomena that we have been discussing.

We have said that no energy is absorbed by the choke—or, as we will now noncommittally call it, the coil—owing to the production and disappearance of the magnetic field. This is true in the ideal case only; in practice, some energy is always lost by secondary effects that we have still to take into account. It is these secondary effects that provide the high-frequency resistance, which is the title given to the sources of energy loss in the coil.

As already mentioned, we have first the direct-current resistance of the coil, which absorbs a certain small amount of energy. This is the only loss caused *directly* by the passage of the current itself.

Losses Due to Eddy Currents.

Other losses, and these peculiar to alternating or high-frequency currents, can be caused by the fact that the magnetic field is continually building up and then collapsing again. We have assumed that the whole of the energy of this field is returned to the coil when it collapses, but it is evident that if any energy is abstracted from it in any other way, this complete refund of energy cannot occur. The only source of such abstraction of energy is to be expected in the setting up of currents other than that which we have already considered. This can take place if there is any piece of metal or other conducting material within the range of the magnetic field; in this case "eddy currents" (which may be looked upon as aimless currents that go nowhere in particular and are no use to anybody) are set up or "induced" in the metal. Since the material in which they are set up has a direct-current resistance, these currents give rise to heat, and in this way some of the energy of the magnetic field is abstracted from it, dissipated, and lost. This is, in fact, the source of the component of the total losses that is peculiar to alternating or high-frequency currents.

At first sight, this source of loss seems easy enough to eliminate, by simply ensuring that there is no metal within the magnetic field of the coil. This is an excellent idea, as far as it goes, and supplies the reason for keeping metal screens in high-frequency amplifiers as far from the coils as possible, but it is quite impossible to carry out this removal of metal entirely. *There must always remain the wire of which the coil itself is wound.* Thus, in addition to providing the "legitimate" current that we have already, the magnetic field sets up in the wires of the coil eddy currents that circulate aimlessly in small closed paths, and, encountering the resistance of the material of which the wire is composed, give rise to heat-losses over and above those that would be caused by the passage of an ordinary direct current.

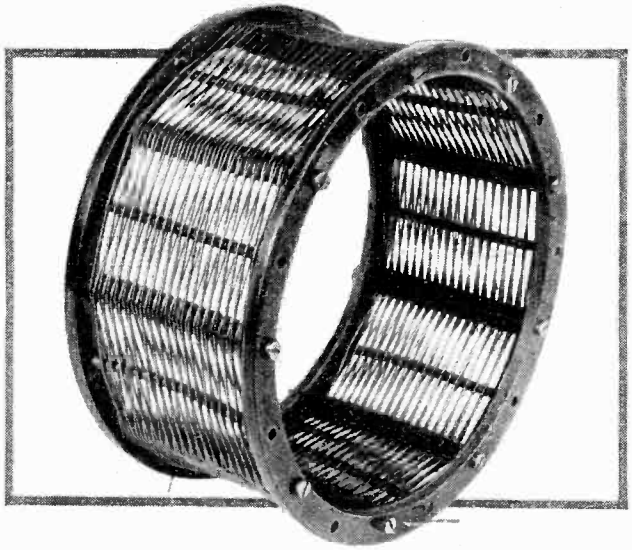
For convenience of calculation, those engaged in the study of this source of loss have divided these eddy currents into two classes, by taking each turn of the coil, instead of the coil as a whole, as the unit. On this basis, we think of the magnetic field as the sum

High Frequency Resistance.—

of all the fields set up by the separate turns, and then, regarding the field of a single turn, we observe that the eddy currents to which it gives rise are partly in itself and partly in neighbouring turns.

The Skin Effect.

The eddy currents which each turn induces in itself, since they are perfectly independent of neighbouring turns, will remain the same whether the turn that we choose to consider is in the middle of the coil, with other turns on both sides of it, or at one end, when it will have other turns only on one side; they will even remain almost unchanged if we undo the turn in question and stretch the wire out straight. The direction of flow of these eddy currents is such as to neutralise some of the original current at the centre of the wire, and to augment it at the surface, so that the net result is as though the original current had been forced to flow mainly on the surface of the wire instead of being, as one would find if this effect were non-existent, equally distributed throughout the whole wire. In consequence of this, the phenomenon we are discussing is generally called the "skin effect," under which title it will be known, at least by name, to most readers. The numerical value of the extra resistance introduced by thus forcing the current to utilise a portion only of the wire has long been calculable with exactness.



This coil won second place in "The Wireless World" low-loss coil tests in February, 1926. Although wound with 38 turns of bare No. 19 gauge wire, the high-frequency resistance at 400 metres was 3.0 ohms.

The other part of the eddy current losses, due to the currents induced by the turn we are considering in those near it, must clearly depend on the distance between turns, the total number of turns, the shape of the coil, and the position of our turn relative to the others; in other words, upon the exact manner in which the wire is coiled up. It is this portion of the total losses, which is a very high one, that made it impossible until recently to calculate the high-frequency resistance of a coiled wire, and drove coil-users to the "hit or miss" methods of coil-design to which reference has already been made. If reference is made to the articles mentioned, dealing with the calculation of the high-frequency resistance of a coil, it will be found that all three losses are included in the calculation, and that, although they are all dealt with in the same formula, this contains two terms to deal with the "skin effect" and the losses due to coiling the wire respectively, while the fact that all three losses represent, in the end, dissipation of heat through the direct current resistance of the wire is expressed by the fact that this occurs as a multiplier to the whole expression.

This very brief analysis of the constituent parts of the losses in a coil has so far only taken account of those losses due to the wire of which the coil is wound, and has omitted altogether to consider the possibility of absorption of energy by the former, or by other parts of the tuned circuit. These losses are by no means negligible, as will be shown, though in the coil itself they result in augmenting its resistance by only some 15 per cent. They are, unfortunately, not calculable, and introduce into receiver design a source of uncertainty which is too large to be neglected.

Before attempting to consider these other sources of loss, let us turn our attention, now that high-frequency resistance has become a fairly familiar conception, to its effects in a tuned circuit. We shall then see why the desire for low resistance has arisen, and the need for it in a practical receiver.

The simplest form of receiver, so far at least as the high-frequency side of it is concerned, is shown in Fig. 2. It consists of a single tuned circuit, fed from an aerial with the high-frequency voltage derived from, let us say, the local station at fairly close range. Across the circuit is connected an anode rectifier, this type being chosen because we can assume, to a first approximation, that adding it to the tuned circuit makes no difference to it in any way, for it requires no power to operate it.

Disregarding entirely the mathematics of the circuit, which is outside our present scope, we can nevertheless arrive quite easily at the exact effects of high-frequency resistance. A glance at the circuit shows that the detecting valve is connected across the tuning condenser C, so that the voltage we have to operate the detector is simply the voltage developed across this condenser. It is clear enough that the greater this voltage can be made the louder will be the signals that we shall get, for they depend upon no other factor than the high-frequency voltage applied to the detector.

Signal Strength and H.F. Losses.

Just as in the case of an ordinary direct current circuit, where the magnitude of the voltage-drop across a resistance depends entirely upon the current flowing through it (see Fig. 3), the voltage-drop that works our detector depends directly upon the high-frequency current that is flowing through the condenser C. If this is large, the voltage will also be large; if the current is small, so will be the voltage. Since, in a practical case, the size of the condenser is fixed by the necessities of tuning, we have no option but to make the current

High Frequency Resistance.—

flowing in the circuit as large as possible if we want to get the loudest signals. The voltage supplied by the aerial is more or less fixed, so that the only control we have over the current in the tuned circuit is obtained by alterations of its high-frequency resistance, and, to get a large current, it is evident that this must be made as small as possible.

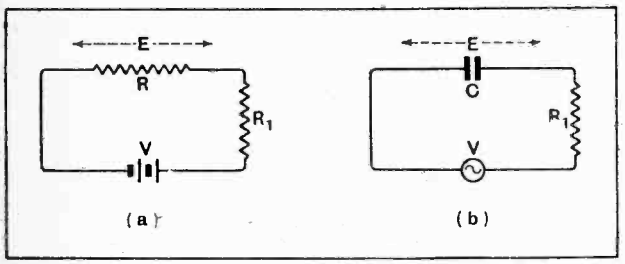


Fig. 3.—(a) An ordinary direct current circuit where the magnitude of the voltage drop across a resistance depends entirely upon the current flowing through it. Voltage drop equals resistance multiplied by current, or E=IR. (b) current through C at any frequency equals voltage drop across C divided by Z, the impedance of C: $\left(I=\frac{E}{Z}\right)$. Hence voltage drop equals impedance multiplied by current, or E=IZ.

We can safely carry the analogy with the direct current circuit a stage farther; in both cases halving the resistance will result in doubling the current, and, therefore, in our receiver, in doubling the voltage applied to the detector. The fact that we are using an anode detector is an additional inducement to do all we can in this direction, for this type of detector responds to a doubling of input voltage with a fourfold increase in signal strength.

This, then, is the reason why the subject of high-frequency resistance has received so much attention in the past, for every lowering of resistance results in an increase of signal strength. Where there are several tuned circuits in the receiver, as, for instance, in sets employing high-frequency amplifiers, the benefits obtained by attention to this point are even greater, for the effect is cumulative from stage to stage.

We have so far discussed the sources of energy loss in a coil alone, considered as an isolated component, and we have seen both that it is desirable to keep these losses down to a low figure for the sake of efficiency, and that they can be calculated with reasonable accuracy for the purposes of receiver design. It must not be forgotten, however, that the coil is only part of the tuned circuit, and that set design is based on the characteristics of the tuned circuit as a whole, and not on those of the coil alone. The various components—tuning condenser, valve-holder, grid leak, and so forth—that are connected to the coil in a completed amplifier give rise to further losses, of a type quite different in their origin to the losses we have been considering. These other sources of loss are equivalent in their effects to an increase of the high-frequency resistance of the coil, and must therefore be taken into account when designing an amplifier.

Although these incidental losses cannot, so far as the writer knows, be calculated with an exactitude, they can at least be measured, and some measurements of them, together with an account of the way in which they arise, will be given in the second part of this article.

(To be concluded.)

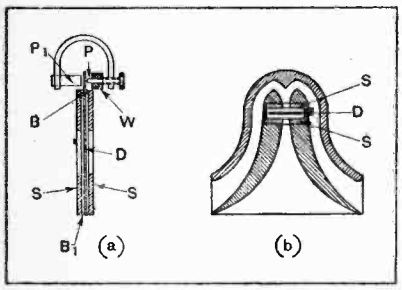
INVENTIONS OF WIRELESS INTEREST.

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.

Loud Speakers.
(No. 288,386.)

Application date: January 19th, 1927.

The diaphragm D, Fig. (a), consists of a band-shaped member which is housed inside an elongated sound-box S and supported at two points, B and B_1. The upper support B is a point bearing, whilst the lower B_1 is designed to allow of a slight longitudinal movement. A part of the diaphragm extending outside the sound-box projects into the magnetic field between two pole pieces, P_1, P. One pole piece P is thinner than the other and carries the actuating winding or speech coil W.



A double-horn loud speaker with centrally slotted sound-box. (No. 288,386.)

The sound-box S is slotted centrally, and is preferably mounted inside a double horn of the shape shown in Fig. (b), so that sound waves emitted from the upper opening of the slot are deflected by a central rib on the outer horn, whilst waves coming from the lower opening are fed directly into the inner horn.

Patent issued to H. Sachs.

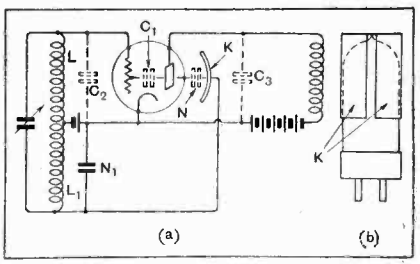
o o o o

Stabilised H.F. Amplification.
(No. 283,497.)

Convention date (U.S.A.): January 11th, 1927.

Relates to an improved method of stabilising a H.F. amplifier so as to secure accurate symmetry. The dotted-line condensers C1, C2, C3 in Fig. (a) indicate the several inter-electrode valve capacities in operation. The ordinary neutralising condenser, inserted in series with the plate electrode and a split input L_1, L1, is shown at N. In practice, however, the capacity C2 between the grid and filament tends to upset the balance at high frequencies.

Accordingly, an extra condenser N1 is inserted in parallel with the coil L1 in order to balance the effect of the grid-filament capacity C2, which shunts the coil L. Actually the capacitance N takes the form of an external cylinder K (Fig. b) closely surrounding the glass bulb of the valve. The cylinder makes a sliding fit on the bulb, so that its effective capacity, represented by the condenser N in Fig. (a) can be readily adjusted as to the required value. In these circumstances the plate of the valve forms a common capacity surface between the condensers C and N.



Neutralising the grid filament capacity of a valve. (No. 283,497)

Patent issued to The Marconi Co., Ltd.

DRY CELL H.T. BATTERIES

How to Secure the Maximum Output under Receiving Conditions.

By R. W. W. SANDERSON, M.Sc.

THE development of the modern valve has resulted in a very greatly increased emission with a diminished filament current. Practically every wireless set has its "power valve," this generally taking about 80 per cent. of the total anode current of the set, where sets of the simpler type are being considered. The result is that there is often very little difference between the total anode currents of, say, 2, 3, and 4-valve sets where only one power valve is used.

It is also true that practically all modern sets consume more watts in their H.T. than in their L.T. circuits. As the price of batteries in pence per watt hour is very much greater in the former case, the importance of a knowledge of the best way in which to use them is obvious.

Measurement of Anode Currents.

Only a very small proportion of wireless set owners have any accurate idea of their anode currents. Some, indeed, make an effort to measure it, but it must be emphasised that any measurements either of current or voltage that can be relied upon must be made with a moving-coil instrument of good quality. Cheap voltmeters have their use provided that they are regarded as nothing more than a rough indication. They serve well for detecting completely "dud" sections of a battery.

In the absence of an instrument a fairly accurate estimate of the anode current can generally be made by calculation from the published characteristic curve supplied by the valve manufacturers. A knowledge of the anode current is essential when the H.T. battery is being chosen.

The different sources of high-tension supply are well known, they are the "eliminator" and batteries. Whether an eliminator is suitable in any particular case depends upon the type of electric power available, the anode current required, and the type of set. Some sets require considerable modification before they will work satisfactorily with an eliminator.

Accumulators, satisfactory in many cases where care is exercised and where charging facilities are available, have troubles peculiar to themselves. At their best they are bulky, heavy for the same capacity as a dry cell, and are capable of doing much more damage to the surrounding furniture. They must be carefully looked after or they deteriorate. They have the merit of giving a more constant voltage in comparison with a dry cell, the fall during effective life being about 15 per cent., in comparison with 30 per cent. for a dry cell. Where exceptionally high anode currents are required they are, however, almost essential.

IN view of the fact that there must be many millions of people dependent for their entertainment upon the use of dry cell H.T. batteries it is of interest to review the position of that much-maligned but almost indispensable component.

It is not the purpose of this article to defend the dry cell high-tension battery for it needs no defence, but to discuss the intelligent use of it in those circumstances where it is the most convenient source of supply.

The great majority of wireless listeners still use dry cells and will probably continue to do so. It is for the information of this large group of people that this article is written.

Characteristics of the Leclanché Dry Cell.

A battery of dry cells gives its rated voltage, that is, the voltage on the label, only for the first few hours of its life. As circumstances vary, it is impossible to give a general figure, but considering the normal standard small unit at, say, five milliamperes, the voltage of a single cell falls from the 1.50 volts, upon which the total battery voltage is calculated, to 1.40 volts in the course of six periods of discharge of four hours each. Frequently batteries of reputable make are found on the market with individual cell readings below 1.50 volts, although no current has been taken out of the cell. This initial figure is dependent, to a great extent, upon the type of material used in the manufacture of the cell, and it does not necessarily follow that the cell with the low reading will give a short life, though admittedly if the discrepancy is very pronounced the tendency would be in that direction. For this reason it has been the custom of most manufacturers, among them the best known in the country, to "give away" an extra cell or cells in their batteries; that is, they calculate the voltage at 1.50 volts on a number of cells less than that actually present, the additional cells giving them a safe margin. At one time it was quite usual to find batteries labelled "15 volts" giving well over 16.5 volts. It is an obvious psychological fact that a buyer who gets a battery reading more than the rated voltage is very satisfied, even if individual cells are below the proper readings, as they

Dry Cell H.T. Batteries.—

easily may be, when certain types of material are used. The initial drop in voltage from 1.5 to 1.4 volts is fortunately not continued. Batteries made by the best methods when tested intermittently at a rate of five milliamperes will have an average voltage throughout their life of 1.3 volts or over. (This refers to the standard small unit.)

A feature of the advertisements made by certain battery

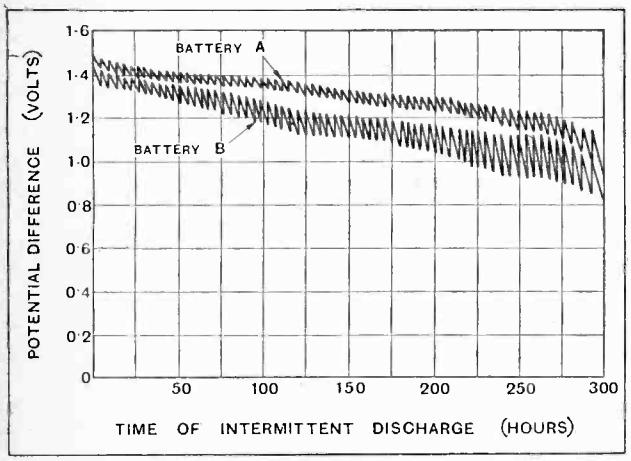


Fig. 1.—Intermittent discharge curves of two typical small-size cells delivering a constant current of 5 mA. for 30 hours per week. Both batteries have the same ampere-hour capacity but the watt-hour capacity of battery A is greater than battery B.

manufacturers is the "recovery" of the battery between discharge periods. Actually all batteries recover, the degree of recovery depending largely upon the extent to which the battery fell during the previous day's run. This recovery may be looked upon in a light which does not make it so favourable for the battery maker who makes this claim. It obviously implies that the battery falls considerably during the course of the day's run, for the degree of recovery must be measured by the difference between the final reading of one period, and the initial reading of the next. It is actually found that the recovery of the very worst battery is very much higher than that of the best, owing to its fall during the working period (See Fig. 1). As in any normal set it is of the greatest importance that the voltage should remain constant during the course of the working period, the ideal battery would fall very little, if at all, in which case its recovery would be negligible.

Intermittent Discharge.

In practice, of course, all cells used for wireless work are discharged intermittently. Two curves showing the results of intermittent discharge at constant current are shown in Fig. 1. They are results selected from many which have been obtained, and they are typical of the discharge curves of two very well-known makes.

As will be seen, both batteries fail at about the same point, and therefore they have given the same number of ampere hours. In spite of this there is no doubt about which is the better battery. The one with the higher voltage, and therefore with the higher watt hours, is obviously the better. The "recovery" of the poorer cell is shown to be greater than that of the better one.

It is customary for some makers to carry out tests on a constant resistance rather than a constant current. This means that at the end of the life of the cell the load is very much reduced, the current often falling to half its original value. In effect this permits the cell to give a very long "tail" in the discharge curve, which is never found when the cell is tested on an intermittent constant current test.

H.T. Battery with Replaceable Sections.

The most satisfactory way to use a high-tension battery, both from the point of view of economy and good results, is to find that voltage of high-tension supply which will give most satisfactory results either in quality or ability to pick up distant stations, and maintain the voltage at that point by the provision of new batteries. For this purpose, small units (such as 15-volt strips) are ideal, as they can be discarded separately as they become useless, not before all available power has been used. If a user does this, he will obviously get better service from the type of battery where the volts are well maintained.

It has often been stated that it is unwise to put old batteries in series with new ones. Provided that the old ones are not practically useless, that the user has a method (such as a voltmeter test) for detecting "dead" sections, and that his set is provided with means of preventing back coupling through the battery resistance, this statement need not be taken seriously.

If the voltage on the set be maintained constant it is clear that the anode current will also remain constant,

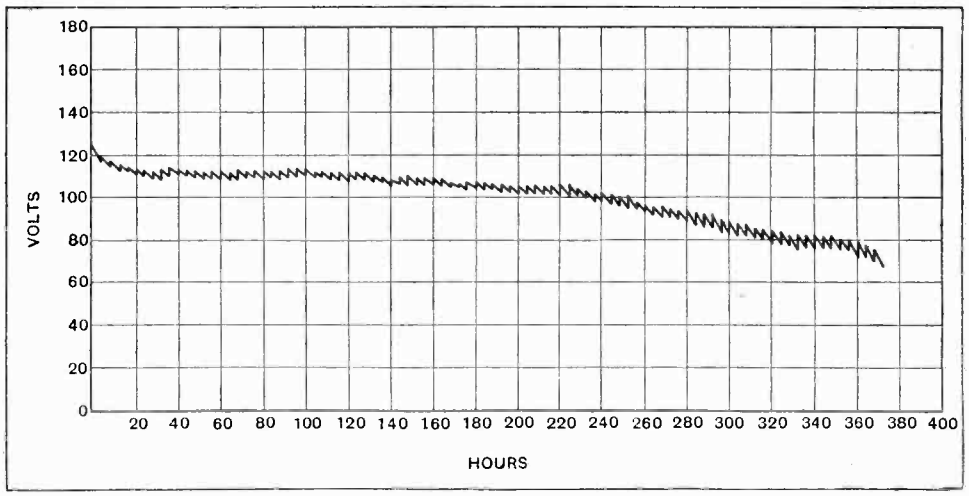
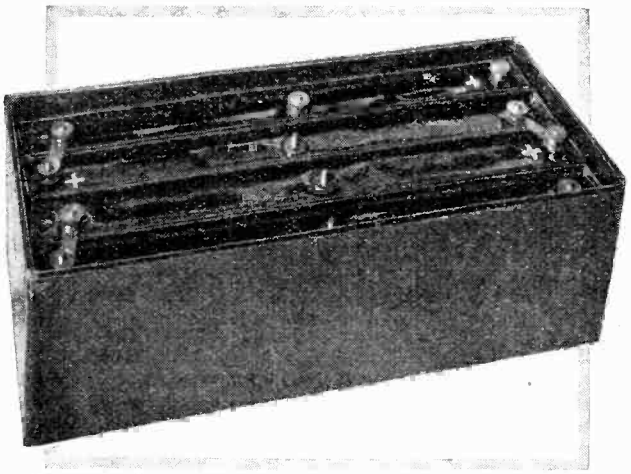


Fig. 2.—Voltage discharge curve of a triple-capacity battery on a three-valve set comprising two D.E.L. 210 valves and a D.E.P. 215.

Dry Cell H.T. Batteries.—and for the purpose of determining the behaviour of batteries, the tests of the type given in the figures will be immediately applicable.

On the other hand, if, as is more usual, the grid bias is kept constant, and no effort is made to maintain the anode voltage, it is still important to choose a battery in which the volts are well maintained. The more rapid diminution of anode voltage of the battery B (Fig. 1) as compared with A will cause the volume to fall off, while distortion or inability to pick up weak signals will become apparent at an early stage. The point at which the battery will fail to work cannot be the same for each set as the needs of listeners vary, the quality often remaining passably good when the set can no longer pick up distant stations. In the writer's experience, wireless sets normally will fail to work satisfactorily at about three-fifths of the voltage recommended for use either by the set makers or the valve manufacturers concerned. As a rule, particularly with the better type of battery, there is fortunately very little life left in the cell by the time it has reached this point, corresponding to about 0.9 volts per cell.



A H.T. dry cell manufactured by the General Electric Company. Each section of 15 volts is replaceable and can be discarded separately as it becomes useless.

A discharge curve of a complete battery under working conditions is shown in Fig. 2. This is selected from a series and is typical. The set in question was a simple set with a detector and two L.F. stages, comprising two D.E.L.210 valves and a D.E.P.215. In the concluding instalment of this article the anode requirements of typical sets will be given, together with suggestions for H.T. batteries of suitable capacity.

(To be concluded.)

NEWS FROM THE CLUBS.

Secretaries of Local Clubs are invited to send in for publication club news of general interest.

Loud Speakers on Trial.

Comparative tests with loud speakers concealed behind a screen always provide a considerable measure of excitement owing to the startling results often disclosed when the identity of the instrument is revealed. The Swindon and District Radio Society carried out an event of this kind at its last meeting, and the voting on an ear test of music reception gave the honours to a home-made roll-type instrument employing wallpaper. On speech a home-made diaphragm loud speaker was given the best vote. Later in the evening Mr. Tarrant gave a display of moving coil loud speakers.

Mr. A. Wainwright has been elected Chairman.

Hon. Secretary, Mr. M. Hill, Windyridge, Okus, Swindon.

o o o o

An A.C. Mains Set.

A set drawing all current from A.C. mains was demonstrated by Mr. Remington, ex-vice-chairman of the South Croydon and District Radio Society at the last meeting. Using a simple bell transformer, pure A.C. was obtained at the required voltage. Owing to the presence of "hum" the detector filament was not run off the mains, an indirectly heated cathode valve being used in this stage. The set included one H.F. valve, followed by a detector and two stages of L.F. amplification. Among other interesting features was an arrangement whereby an exceptional amount of play could be obtained with the diaphragm of the moving coil.

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

o o o o

Manchester and Club Research Scheme.

As a step in their vigorous research campaign, the Radio Experimental Society of Manchester have obtained premises at 8, Water Street, which will shortly be opened as club room and laboratory. The whole of the work is done by members, and for the time being all meetings, lecturers, etc., are cancelled, as it is a case of "all hands to the pump" to get the new headquarters ready for 1929. When completed, it is hoped that the new laboratory will be among the best equipped in the north. The technical research will be under the leadership of Mr. A. K. Bentley (a vice-President of the Manchester College of Technology). A new short-wave transmitter will also be installed. All woodwork, including benches, will be constructed by members under the supervision of Mr. J. Meadowcroft, while all electrical and power equipment will be in the charge of Messrs. Colbert and Levy.

The Society still has vacancies for a few technically minded members. All interested are invited to apply for further particulars to the Hon. Secretary, Mr. J. Levy, 19, Lansdowne Road, West Didsbury, Manchester.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 19th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Demonstration of Fault Finding, by Mr. C. L. Thompson.

North Middlesex Radio Society.—At 8 p.m. At St. Paul's Institute, Winchmore Hill. Questions and Answers.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Lecture by Mr. W. Anderson, M.A., F.R.S.E.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.19. Cinema and Lantern Lecture.

THURSDAY, DECEMBER 20th.

Ilford and District Radio Society.—At the Wesleyan Institute, Cleveland Road, High Road, Ilford. Discussion: "The Pros and Cons of the New Valves."

Stretford and District Radio Society.—Annual Dinner.

Slade Radio (Birmingham).—At 8 p.m. At the Parochial Hall, Broomfield Road, Erdington. Sale and Exchange of Apparatus.

Hints on Working a Pentode.

At the meeting of the Wigan and District Technical College Radio Society on November 28th, Mr. J. Clarke, of Messrs. Edison Swan Electrical Co., gave an account of the processes involved in the manufacture of valves and subsequently demonstrated an Ediswan Threesome set. His practical tips on the manipulation of screened grid and pentode valves were much appreciated. The Society held its first Christmas Social on December 12th.

Hon. Secretary, Mr. M. M. Das, B.Sc., Library Street, Wigan.

o o o o

The Screened Grid Valve.

The screened grid valve was the subject of an interesting talk given by a representative of the Marconi Co. at a recent meeting of the Wembley Wireless Society. The talk, which was illustrated by lantern slides, provoked an interesting discussion, revealing the keen interest which is being taken in the subject.

The feature of the evening was the demonstration of one of the latest Marconi sets operating a moving coil loud speaker.

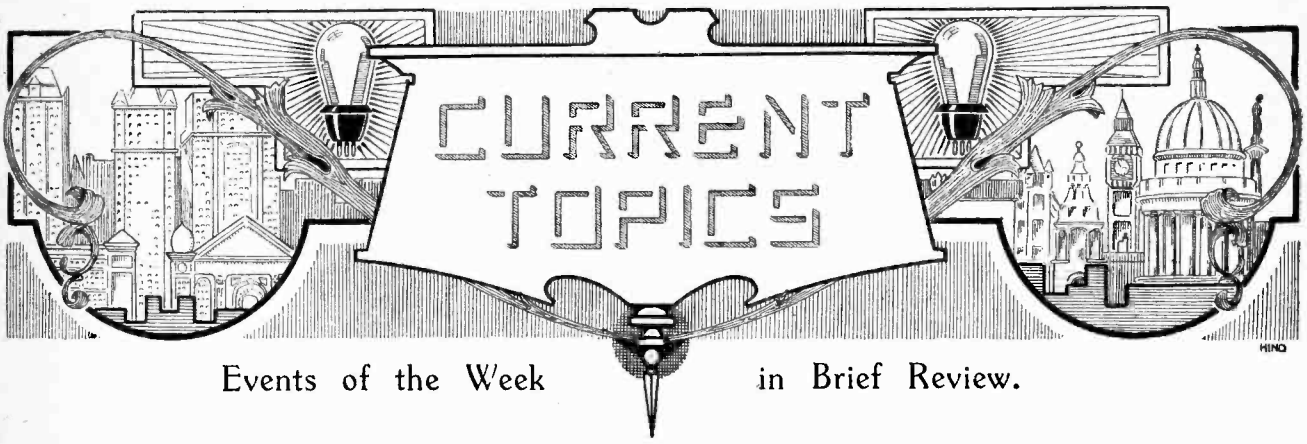
On December 7th the evening was devoted to a comparative test of loud speakers, members bringing their own instruments along. Particulars regarding the forthcoming session will be gladly forwarded by the Hon. Secretary, Mr. H. Comben, 24, Park Lane, Wembley.

o o o o

Moving Coil v. Exponential Horn.

A comparison of the moving coil and exponential horn loud speakers was the feature of the Bec Radio Society's meetings on November 13th. The moving coil demonstrated by Mr. Ecford gave excellent reproduction, while the demonstration of the horn instrument by Mr. Clarke revealed the excellent results obtainable from this class of loud speaker as compared with the ordinary horn type. Opinion was divided on the respective merits of the moving coil and the logarithmic horn.

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



Events of the Week in Brief Review.

ATLANTIC WIRELESS OUTPOST.

A wireless station is to be established at Horta, in the Azores, to supply meteorological information to ships.

o o o o

NEW SWEDISH BROADCASTER.

In a few days' time the Swedish Broadcasting station at Malmö is to be replaced by a new station at Hörhy, in Skane, with a power of 20 kilowatts.

o o o o

BROADCASTING OIL ON TROUBLED WATERS.

King Amanullah is reported to be using broadcasting to influence public opinion during the present revolt of the Afghan tribesmen. Pacificatory speeches have been broadcast from Kabul and also reproduced on loud speakers erected in the main square of the capital.

o o o o

MEDICAL AID BY WIRELESS.

In starting an aerial medical service for pioneers in the Western backwoods, the Australian Inland Mission is making experiments with portable wireless transmitters and receivers of a type suitable for summoning assistance from the nearest medical settlements.

o o o o

SUNDAY CONCERTS FROM HOLLAND.

The Hilversum broadcasting station is continuing its fortnightly concerts for British listeners on Sunday evenings by arrangements with Messrs. Brandes, Limited. The next transmission will be on December 30th on the usual wavelength of 1,071 metres.

o o o o

THE "RADIOVISOR."

A public company known as Radiovisor Foreign and Colonial, Ltd., was registered on December 5th with a nominal capital of £450,000. Among the objects of the company are the manufacture and sale of selenium and other light-sensitive cells, microphone fire alarms, moving-coil apparatus, wireless and television apparatus and loud speakers.

It is understood that the company will also produce the "Radiovisor," a light-sensitive device to work alarm bells, control trains and carry out other operations which can be effected by the action of a light-sensitive cell.

ESPERANTO BROADCASTING.

At the British Esperanto Association's annual dinner on December 8th it was announced that regular transmissions are now made in Esperanto from 56 broadcasting stations.

o o o o

GERMANY 'PHONES THE ARGENTINE.

The wireless telephone service between Berlin and Buenos Ayres opened on December 10th, the cost for a three-minutes conversation being £9. The system employs the Transatlantic telephony services from Rugby.

o o o o

A "B.B.C." FOR CANADA?

Members of a Royal Commission appointed in Ottawa are to tour Britain, France, and the United States to gather data concerning the respective merits of State and privately owned broadcasting. It is believed that Canadian authorities favour a broadcasting system designed on B.B.C. lines.

The members of the Commission are Sir John Aird, President of the Canadian Bank of Commerce, Mr. C. A. Bowman, editor of the *Ottawa Citizen*, and M. Augustin Frigon, director of the Montreal Polytechnic School.

o o o o

WIRELESS-CONTROLLED WATCHES?

The Soviet Inventions Bureau, says the *Daily Telegraph*, has granted patent rights to a Roslave wireless engineer named Zlotnikov in respect of his invention of a so-called "master wireless clock" which, it is claimed, will keep any number of specially adapted clocks, and even watches, synchronised.

o o o o

NEW WIRELESS CENTRE.

The Aldwych and Kingsway district of London, which is rapidly becoming the hub of the British engineering world, has made an important acquisition in the shape of the new wireless and electrical showrooms opened by the B.T.-H. Company at Crown House, Aldwych, on December 6th. A section of the showroom is devoted to a fine display of B.T.-H. radio apparatus, including Mazda valves and the latest gramophone-radio sets. A photograph of the showroom appears on p. 833 of this issue.

WIRELESS SOCIETY OF IRELAND.

Professor F. E. Hackett, Ph.D., M.A., has been elected President of the Wireless Society of Ireland.

o o o o

R.C.A. CONCENTRATES ON BROADCASTING.

The Radio Corporation of America has authorised the formation of a subsidiary company to take over its communications business. It is believed that the new organisation will control both the Western Union and the Communications Department of Radio.

o o o o

A NOTABLE JUBILEE.

The Jubilee of the incandescent electric lamp, which was first shown in public by the late Sir Joseph Swan at Newcastle-on-Tyne on December 18th, 1878, will be commemorated by the Institution of Electrical Engineers at the ordinary meeting to be held on Thursday, December 20th, 1928, when a short lecture on Swan's work will be delivered by Mr. J. Swinburne, F.R.S. Samples of early lamps will be on exhibition.

o o o o

DE-NATIONALISATION?

The Belgian Government is reported to be considering a new project for reorganising the post and telegraph services which control broadcasting. In view of the financial advantages gained from the exploiting of the hitherto nationalised railways by a private company, it is proposed to deal in the same way with other State services.

Should the scheme materialise, the Government would grant to the new P.T.T. concessionaires an annual subsidy of some one hundred and fifty million francs for a period of five years, at the expiry of which the company would be expected to carry on without further assistance. From that period the concessionaires would be called upon to give a reliable postal, telegraphic, and telephonic service to Belgium and to return to the State an annual sum equivalent to 5 per cent. interest on the subsidies advanced. The scheme provides for a sinking fund as well as a necessary reserve capital limited to fifty million francs. All excess profits would be repayable to the Belgian Exchequer.

LONELY WIRELESS JOB.

Bouvet Island, a barren rock in the South Atlantic, the ownership of which has been the subject of contention between Britain and Norway for many years, has now been unconditionally recognised as Norwegian property. A meteorological wireless station is to be erected at once, and already two wireless operators have left Oslo to begin their lonely task of installing and operating the new plant.

oooo

ANOTHER WIRELESS "LIGHTHOUSE."

The wireless beacon installation at Start Point, just completed by the Marconi Company, is the seventh of its kind round the British coasts. The others are at Round Island, Skerries, Spurn Lightship, the Casquets (Channel Islands), Bar Lightship, and Albatross (Coningbeg, Ireland).

This type of station transmits an intermittent signal on an exclusive wavelength of 1,000 metres for the benefit of ships carrying direction-finders. The completion of the Start Point transmitter means that ships can now obtain effective bearings from the three Channel stations and can be assured of their position right up the Channel.

oooo

EMERGENCY WIRELESS FOR ULSTER.

Northern Ireland is asking for an emergency wireless service for use on occasions when telephone and telegraphic communication is cut off during storms. Major J. T. Duffin, president of the Belfast Chamber of Trade, recently stated that it seemed "rather outrageous that in 1928, on account of storms, Ulster should be cut off from the outside world."

oooo

CANADIAN GOVERNMENT ASSISTS WIRELESS AMATEURS.

Canada, in its endeavour to give the amateur transmitter every opportunity to experiment, has already done extensive work to enable him to carry on without interruption when the Washington Radio Convention comes into force on January 1st. According to the convention it is necessary to have the consent of other nations before Canadian amateurs can work with foreign enthusiasts with the freedom they have enjoyed in the past.

The first step, says a *Monitor* correspondent, was taken in August by Commander C. P. Edwards, who wrote to the two telegraph companies in the Dominion, the Canadian National Telegraph and the Canadian Pacific Railway's Telegraphs, and obtained their consent to allow amateurs the freedom of sending experimental and personal messages as would not otherwise find their way over the wires. The same indefatigable official then sent letters to all British Dominions, the United Kingdom, the United States, Portugal, the Philippines, and a number of other South American and European countries.

"We are the first country to have done this for the amateur," said Commander Edwards in an interview. "We want the amateur to go right ahead with his work when the new convention comes into force."

OWING to the Christmas Holidays "The Wireless World" dated December 26th will be on sale on Monday, December 24th.

MERCANTILE MARINE WAR MEMORIAL.

In connection with the unveiling of the Mercantile Marine War Memorial on December 12th, the wireless operators who served during the War, numbering some 6,000, were represented by twenty operators from the Marconi International Marine Communication Co., Ltd. One of these, Mr. Robert Leith, who was senior operator on the *Lusitania* when she was sunk on May 17th, 1915, was presented to Her Majesty the Queen.

On the fateful day of the sinking of the vessel, Mr. Leith at the time of the impact of the torpedo was lunching in the saloon, the junior operator being on watch. Mr. Leith tells us that when he came down a lady on his left remarked that he was late and would not get any lunch. These words of jest came strangely true, for they had hardly been spoken when a dull crashing thud was heard, and it became evident that something serious had happened. The S O S call was sent out continually, until it was evident that nothing further could be done; then and then only the wireless operators gave a thought to their own safety. Mr. Leith was able to jump some distance into a partially submerged lifeboat which had been launched, and later transferred to another.

An amateur transmitter's Christmas card.

THE AC3 RECEIVER.

The Ferranti milliammeter used in the "A.C.3" receiver dealt with in our issue of September 5th was erroneously described as having a scale reading of 0.15 milliamperes. The figure should have been 0.50 milliamperes, type 3F.

oooo

WIRELESS AT WESTMINSTER.

From Our Parliamentary Correspondent.

P.M.G. and Television.

In reply to questions in the House of Commons recently by Lieut.-Commander Kenworthy on the subject of television, Sir William Mitchell-Thomson, Postmaster-General, said: "I know of no system which is at present capable of transmitting moving pictures of actual events for satisfactory reception by wireless listeners. I have not refused permission for the use of the British Broadcasting Corporation's stations for television tests. The Governors of the Corporation decided, in the exercise of the discretion vested in them, after a demonstration by the Baird Company, who hold an experimental licence, that the system did not at present fulfil the conditions which would justify a public trial through one of their stations. I have recently received an application from the Baird Company for further facilities. This application is at present under consideration, and I am not yet in a position to say anything further.

oooo

Licences for Portable Sets.

Replying to Sir Frank Nelson, Lord Wolmer, Asst. Postmaster-General, said that he did not think there was any reason to suppose that the owners of portable sets were more prone to evade their legal obligations than other members of the community. The number of licences now in force was over 2,500,000.

oooo

Daily Profit on Rugby Station.

Sir Nicholas Grattan-Doyle enquired what had been the average daily all-in cost of the Rugby station from May 1st to date, and what had been the average daily revenue during the same period.

Lord Wolmer said that from May 1st to September 30th last (which was the latest period for which complete statistics were available), the average daily all-in cost of the station, including the receiving stations worked in conjunction with it, was £383, and the average daily revenue was £397.

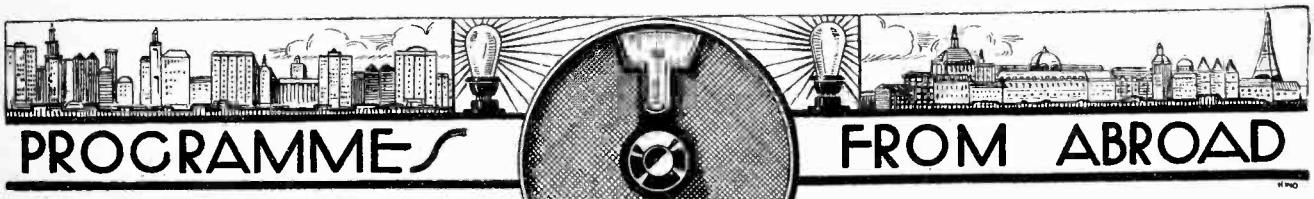
oooo

BOOK REVIEW.

Wireless Trader Year Book and Diary, 1929.

Manufacturers and users of all kinds of wireless sets and components will welcome the fifth issue of the "Trader Year Book," which fully maintains the reputation established by its predecessors of being the most complete list of wireless manufacturers, and one arranged in a convenient form for quick reference. The wireless and gramophone trades are now so closely allied that the directory has been extended to include gramophone manufacturers, and an entirely new section has been added after the technical data giving much useful information and practical points for gramophone traders. The general features of this useful and technical data have been retained and brought up to date. Those interested in the question of royalties on patents will find a useful summary of the various patents owned by the Standard Telephones and Cables, Ltd., and a brief statement of the position regarding the Marconi royalties at the time of going to press.

The book contains 388 pages of useful information and includes a convenient diary for 1929. Published by the Trader Publishing Co., Ltd., Salisbury Square, London, E.C.4. Price 5s. 6d. post free for Great Britain, or 7s. 6d. overseas.



SATURDAY, DECEMBER 22nd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**6.10,** Sextet Selection, The Crown of the Indies (Elgar-Winter). **6.15,** Service from La Basilica de la Merced. **6.25,** Sextet Selections. **8.30,** French Lesson by Prof. Martin. **9.0,** Chimes, Weather Report, Exchange Quotations and News. **9.10,** Orchestral Selections of Dance Music. **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**5.30,** Talk for Girls. **6.0,** Programme for Children. **7.0,** Orchestral Concert. **7.20,** Recitations by Sverre Erichsen. **7.50,** Topical Talk. **8.0,** Entertainment by Victor Ivarson. **9.0,** Weather News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**); 40 kW.—**3.30,** Programme relayed from **Hamburg. 4.30,** Else Kolshorn, Talk: The Employment of Women in the National Post Office. **5.0,** Prof. Woldt, Talk: Discussion between Industrial Workers. **5.30,** Elementary Spanish Lesson. **5.55,** Prof. Werner Jäger, Talk: Ulrichs von Wilamowitz, on the Occasion of his 80th Birthday. **6.20,** Prof. Ehrenbaum, Talk: The Herring Industry. **7.0,** Concert: Bandonion Solos, (a) March, Under the Hamburg Flag (Pörschmann), (b) Schiffsjungentanz (Zogbaum); Tenor Solos, (a) Air from Les Cloches de Corneville (Planquette), (b) Wer Hamburg nicht kennt (Raymond), (c) Deutschland, ade (Raymond); Readings by Dr. Gustav Manz; Tenor Solos, (a) Folk Song, Old Love (Kistenmacher), (b) The Sailor's Destiny (Petrie), (c) Sailor's Chorus (Engel-Berger); Valse brillante in E Major (Pörschmann). **8.0,** Programme from **Voxhaus. 8.30,** Dr. Werner Mahrholz, Talk: German Literature, followed by Programme from **Voxhaus.**

BERLIN (Voxhaus) (**484 metres**): 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Programme of Gramophone Records. **10.30 a.m.,** Exchange Quotations. **11.55 a.m.,** Time Signal. **12.30,** Weather Report and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations, Agricultural Report and Time Signal. **2.30,** Dr. Paul Frank, Talk: Medical Hygiene. **3.0,** Prof. Eduard Norden, Talk: Ulrich von Wilamowitz-Moellendorff, on the occasion of his 80th Birthday. **3.30,** Talk and Reading. **4.0,** Concert: Selections of Opera Music from the Works of Puccini, (a) Manon Lescaut, (b) La Bohème, (c) La Tosca, (d) Madame Butterfly, (e) Gianni Schicchi, (f) Turandot; Moresca (Silesu); Berg Musik (Borch); Suite (Fauchey); Intermezzo appassionato (Becce); Nocturne (Becce); Allegro giocoso (Fresco); Fox-Trot, Angela mia (Rapée); Ballet Suite, The Spring (Delibes); Jubel Serenade (Murzilli); La bella valenciana (Kaempfert); Selection from The Snow Man (Korngold); Wiegenlied (Reger); Siciliano und Rigaudon (Francœur-Kreisler); Tango, Süss singt die Geige, gut' Nacht (Rollins); Jubel Overture (Weber). Followed by Advertising Notes. **6.0,** Georg Hausdorf, Talk: Modern Advertising and its practical application. **6.25,** Psychology Talk by Dr. Max Dessoir. **7.0,** Evening Entertainment. **8.0,** Programme of Christmas Carols by Cornelis Bronssgeest (Baritone) and Bruno Seidler-Winkler (Pianist). **8.30,** Readings for Children by Fred Hildenbrandt, followed by Weather Report, News, Time Signal and Sports Notes. **9.30,** Lesson in Dancing by Reinhold Sömmer, followed by Dance Music. **11.30** (approx.), Close Down.

BERN (**411 metres**): 1.5 kW.—**4.0,** Concert by the Kursaal Orchestra. **6.20,** Time Signal and Weather Report. **6.30,** Hans Burren, Talk: Advent and Christmas Customs. **7.0,** The Christmas Oratorio (Bach), relayed from Basle (1,010 metres). **8.50,** News and Announcements. **8.55,** Weather Report. **9.5,** Concert by the Kursaal Orchestra. **9.35,** Dance Music.

BRESLAU (**322.6 metres**); 4 kW.—**3.30,** Orchestral Concert from the Goldene Krone Café. **5.0,** Film Review. **5.25,** Talk in Esperanto by Alfred Hanuschke. **5.35,** Landrat Neumann, Talk: The Silesian Border Town—Guhrau. **6.10,** Shorthand Lesson. **6.40,** Discussion on Art between Curpart Popl and F. W. Bischoff. **7.15,** Evening Entertainment: A Christmas Number. **9.0,** News. **9.30,** Dance Music by the Station Dance Orchestra. **11.0** (approx.), Close Down.

BRÜNN (**441.2 metres**); 2.5 kW.—**5.15,** Weekly Report for Journalists by Prof. Casmir Jerabek. **6.0,** Programme relayed from **Prague,** followed by News. **9.25,** Concert by a Gipsy Band, relayed from **Bratislava** (300 metres).

BRUSSELS (**508.5 metres**); 1.5 kW.—**7.30,** "Radio-Chronique." **8.15,** Concert from the Salle du Conservatoire, followed by Esperanto Talk and News. **10.30,** Orchestral Concert from the Palace Hotel Tea Room. **11.15** (approx.), Close Down.

BUDAPEST (**556.6 metres**); 20 kW.—**4.10,** Literary Programme. **5.0,** Gramophone Selections. **6.0,** German Transmission. **6.35,** Reading. **7.0,** Selection from Eltörött a hegedüm, Operetta (Zerkovitz-Szilágyi. **8.50,** Concert by the Zigeuner Orchestra from the Hotel Hungaria.

CRACOW (**566 metres**); 1.5 kW.—**4.10,** Talk by Jotor on Flemish, French and Italian Tales. **4.35,** Programme from **Warsaw. 5.0,** Programme from **Warsaw. 6.0,** Miscellaneous Items and News. **6.25,** English Reading by Mr. J. Stanislavsky. **6.55,** Time Signal from the Astronomical Observatory. **7.0,** Agricultural Report. **7.5,** Dr. J. Regula, Talk: Last Week's Foreign Policy. **7.30,** Programme from **Warsaw. 9.0,** Programme from **Warsaw. 9.30,** Concert from a Restaurant.

DUBLIN, Call 2RN (**319.1 metres**): 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News, Announcements and Miscellaneous Items. **7.30,** Talk by Dorothy Day. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Pib Uleann, by Seamus MacAonghusa. **8.15,** Lecture Recital by Seamus MacCall on Spanish Popular Songs, with Vocal Illustrations by Eily Murnaghan (Soprano). **8.45,** Variety Programme by Lettice Newman and Eric Richmond. **9.5,** Selection by the Station Orchestra. **9.20,** Variety by Lettice Newman and Eric Richmond. **9.45,** Selection from Katja the Dancer, Light Opera (Gilbert) with Gertrude Mortimer, Joseph O'Neill and the Station Orchestra. **10.30,** News, Announcements and Miscellaneous Items. **10.40** (approx.), Meteorological Report. **10.45** (approx.), Close Down.

FRANKFURT (**428.6 metres**): 4 kW.—**2.5,** Programme for Children. **3.35,** Orchestral Concert of New Dance Music. **5.10,** Reading by O. W. Studtmann. **5.30,** The Letter Box. **5.45,** Esperanto Lesson by W. Wischhoff. **6.15,** Talk by Walter Ulrich. **6.45,** Lili v. Baumgarten, Talk: The 75th Birthday of Isolde Kurz. **7.15,** Programme relayed from **Stuttgart,** followed by Dance Music from the Café Sacher.

HAMBURG, Call HA (in Morse) (**394.7 metres**): 4 kW.—**9.15 a.m.,** News. **10.0 a.m.,** Programme of Gramophone Records. **11.10 a.m.,** Weather Report. **11.15 a.m.,** Exchange Quotations. **11.30 a.m.,** Concert relayed from **Hanover** (297 metres). In the Interval at **11.55 a.m.,** Time Signal. **12.10,** News. **1.40,** Exchange Quotations. **2.30,** Review of Books. **3.0,** Illustrated Music Talk by Dr. Wilh. Heinitz. **3.30,** Concert of Musical Fairy Tales, from the Works of Wilh. and Jak. Grimms: Reading from Little Red Riding Hood; Orchestral Selection from Little Red Riding Hood (Beudel); Reading from The Fisherman and his Wife; Orchestral Selection from The Fisherman and his Wife (Tscherepnin); Reading from The Brave Little Tailor; Orchestral Selection from The Brave Little Tailor (Zimmer). **4.30,** Request Programme. **5.30,** Legal Talk by Dr. Fischer. **6.0,** "The Golden Saturday": (a) A Stroll through the Town, (b) What is the Weather going to be? (c) An Hour in the Café. **8.0,** Variety Programme. **9.45.** Weather Report, News, Sports Notes and Dance Music. **10.50,** North Sea and Baltic Weather Report.

HILVERSUM (**1,071 metres**); 5 kW.—**9.40 a.m.,** Time Signal and Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Concert of Trio Music. **1.40,** Orchestral Concert from the Tuschinski Picture House, **Amsterdam. 3.40,** Italian Lesson. **4.40,** French Lesson. **5.40,** Time Signal and Concert: Ojos negros (Camponi); Selection (Alongi); En sourdine (Tellam); Roses of the South (Johann Strauss); Pitchounette (Massenet); The Angel (Rubenstein); Spanish Serenade (Boris Lensky); Night in June (Friend). **6.25,** German Lesson. **7.25,** Police Announcements. **7.45,** Concert and Talk arranged by the Workers' Radio Society. **11.15** (approx.), Close Down.

HUIZEN (**340.9 metres**): 4 kW.—Transmits on 1,852 metres from 5.40 p.m. **12.10,** Concert of Trio Music. **2.40,** Programme for Children. **5.10,** Gramophone Selections. **6.10,** Talk by M. v. Schyndel. **6.30,** Catholic Bulletin. **6.40,** English Lesson. **7.10,** Lesson in Dressmaking. **7.40,** Talk by M. L. J. N. Feber. **8.0,** Concert of Orchestral Selections and Baritone Solos by M. W. Herckenrath.

JUAN-LES-PINS (Radio LL) (**244 metres**): 1.5 kW.—**1.0,** Orchestral Concert. **8.30,** News, Talk for Women by Mme. la Comtesse de Tremeuge, and Concert. **9.30,** Dance Music. **10.0,** Close Down.

KALUNDBORG (**1.153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**6.30 a.m.,** Morning Gymnastics. **11.0 a.m.,** Chimes from the Town Hall. **11.2 a.m.,** Orchestral Concert from Wivel's Restaurant. **2.0,** Programme for Children: "What Ole Lukøje showed Else and Jörgen"—Christmas Play with Songs (Johanne v. Kohl). **2.30,** Vocal and Instrumental Concert. **5.20,** Peter Christiansen, Talk: Modern Foreign Authors—Gustav Hellström. **5.50,** Weather Report. **6.0,** News and Announcements. **6.5,** (approx.), Exchange Quotations. **6.15,** Time Signal. **6.30,** Director V. E. Gamborg, Talk: The Enemies and Friends of Mankind. **7.0,** Chimes from the Town Hall. **7.2** (approx.), Concert of Strauss Dance Music: Selections (Johann Strauss), (a) Radetzky March, (b) Annen Polka, (c) Waltz, Wo die Citronen blüh'n, (d) Mazurka, Die Wahrsagerin, (e) Quadrille on Melodies from The Gipsy Baron; Selections (Joseph Strauss), (a) Dorfschwalben aus Osterreich, (b) Mazurka, Frauenherz; Diplomat Polka (Johann Strauss); Selections (Eduard Strauss), (a) Waltz, The Doctrine, (b) Gallop, Mit Dampf, followed by News and Announcements. **8.15,** "Hans Peter's Letter"—a Yule-tide Comedy in One Act by Otto Conradsen. **8.45,** Concert of Light Music. **9.45,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.02** (approx.), Close Down.

KATTOWITZ (**422 metres**); 10 kW.—**3.0,** Gramophone Selections. **4.10,** Music Lesson by Prof. F. Sachse. **4.35,** Children's Letter Box. **5.0,** Programme for Children. **6.0,** Announcements. **6.30,** Talk by Prof. J. Dabrowski. **6.56,** Time Signal and Agricultural Report. **7.5,** Talk by Mr. K. Zienkiewicz. **7.30,** Programme from **Warsaw. 9.0,** Weather Report and News. **9.30,** Dance Music.

KAUNAS (**2,000 metres**); 7 kW.—**4.30,** Announcements. **5.0,** Weather Report and News. **5.15,** Agricultural Report. **5.45,** Popular Concert. **6.15,** Health Talk. **6.30,** News.

LAHTI (**1,522.8 metres**); 35 kW.—**4.0,** Orchestral Selections: March (Metallo); Russian Scenes (Bantock); Waltz (Bucceri). **4.35,** Talk. **4.57,** Time Signal, Weather Report and News. **5.15** Orchestral Selections: Slavonic Dance No. 16 (Dvórak); American Wood Idylls (MacDowell). **7.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (**468.8 metres**); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres), and **Münster** (250 metres).—**12.5,** Orchestral Concert. **1.30,** Hints for the Housewife. **2.30,** Finance Report. **2.40,** Arthur Wurbs, Talk: The Basis of Wireless Technology—The Electrical Oscilla-

Programmes from Abroad.—

tion Circuit. **3.0,** Talk for Women by Marie Theres van den Wyenbergh. **3.25,** Talk. **3.45,** "On a Sleigh through the Fairy Woods"—A Christmas Play with Light Music and Songs for Young and Old. **4.45,** Concert by the Langenberg Station Choir and Orchestra: Introductory Talk by Friedrich Wilhelm Herzog; Variations and Theme, Hans im Glück (Philipp); Marienlieder (Hans Philipp); Geschichte vom Franz Xaver Dampfkessel und der Dame Musica (Weismann). **5.30,** Prof. Dr. Boerschmann, Talk: The Chinese Landscape in Culture and Art. **5.50,** Finance Report, Weather Report and Sports Notes. **6.15,** Schriftführer Carl Worner, Talk for Workers—The Insurance of Office Workers. **6.40,** Dr. von der Leyen, Talk: Fairy Tales in the Literature of the World. **7.0,** Variety Programme. **9.30** (approx.), News, Sports Notes, and Commercial Announcements, followed by Concert of Orchestral Music and Programme of Dance Music, under the direction of Herr Eysoldt. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (365.8 metres); 4 kW.—**3.30,** Orchestral Concert. **4.45,** Wireless News and Talk. **5.20,** Weather Forecast, Time Signal and Labour Market Report. **5.30,** Programme from **Königswusterhausen. 6.0,** Josef Greff, Talk: Psycho-Analysis. **6.30,** Dr. Fritz Reuter, Talk: A Musical Career. **7.0,** "A Winter Idyll": Orchestral Selection, The Greenland Suite (Frederiksen); Recitation, Winter (Prevert); Recitations from The Seasons (Haydn); Songs, (a) Winter Evening (Schubert), (b) Christmas Snow (Grieg); Orchestral Selections from Der Rodelzigeuner (Snaga); Recitation from A Winter Idyll (Stieler); Songs, (a) Greisengesang (Schubert), (b) Zum Punsch (Schubert), (c) Geborgensein (von Stein); Songs (Wolf); Recitation from A Winter Idyll (Stieler); Song from Die Königskinder (Humperdinck); Songs, (a) Winteranfang (Stöhr), (b) Winterlandschaft (Stöhr), (c) Winterweihe (R. Strauss), (d) Winterliebe (R. Strauss). **9.0,** News, Sports Notes and Announcements. **9.30,** Dance Music from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 **(434.8 metres);** 3 kW.—**7.0,** Chimes and Sextet Concert: Agua azucarillos y aguardiente (Chueca); Fantasia on Cavalleria Rusticana (Mascagni); Fantasia on La granjera de Arlés (Rosillo); Interlude by Luis Medina. **8.0,** Dance Music by the Palermo Orchestra, relayed from the Alkázar. **8.25,** News. **9.45,** Market Prices. **10.0,** Chimes, followed by Two Musical Plays, (a) "Los Descamisados" (Cueca), (b) "Los Cadetes de la Reina" (Luna), followed by News. **12.30 a.m.** (approx.), (Sunday), Close Down.

MILAN, Call 1MI **(549 metres);** 7 kW.—**7.15,** Talk by M. G. Ardau. **7.25,** News. **7.30,** Time Signal. **7.32,** Variety Concert: Quintet Selection, Serenade (Mozart); Mezzo-Soprano Solos, (a) Abschied (Schubert), (b) Du bist die Ruh' (Schubert), (c) Noël ancien (Respighi); Programme from the Works of Guglielmi. **9.55,** News and Economic Report. **10.0,** Relay of Tzigane Orchestra from the Fiaschetteria Toscana. **10.45** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Böden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**4.0,** Light Music by Braeckman's Orchestra, relayed from **Falun** (357 metres). **5.0,** Programme for Children. **5.30,** Old-Time Dance Music by the "Spelmanspojkarna," relayed from **Göteborg. 6.15,** Burgomaster Marten Sjökvist of Grönköping, Talk: Christmas and Yuletide Customs, relayed from **Göteborg. 6.30,** Talk: The Porkbutcher's Trade. **6.45,** Pianoforte Recital by Algot Haquinius: Scherzo in F Sharp Major (Mendelssohn); Etude in B Flat Minor (Mendelssohn); Spring Song (Mendelssohn); Novelette in E Major (Schumann). **7.0,** Cabaret Programme relayed from **Malmö. 8.0,** Current Events. **8.45,** Dance Music by the Egerstam Orchestra, relayed from the Restaurant Riche. **11.0** (approx.), Close Down.

NAPLES, Call 1NA **(333.3 metres);** 1.5 kW.—**7.50,** News and Harbour Notes. **8.0,** Time Signal. **8.2,** Variety Programme: Orchestral Selection, Overture to Light Cavalry (Suppé); "The Thief," Comedy (Bernstein); in the First Interval: Orchestral Selections (Centola), (a) Minuet, (b) Canzonetta; in the Second Interval: Musical Selections (Blon), (a) Minuetto della bambola, (b) Serenata d'amore. **9.0,** Talk. **9.50,** News. **9.55,** Calendar and Programme Announcements. **10.0** Dance Music from the Trocadero. **10.30** (approx.), Close Down.

OSLO (461.5 metres); 1.5 kW.—Programme relayed, by **Fredrikstad** (434.8 metres), **Hamar** (555.6 metres) **Notodden** (411 metres), **Porsgrund** (500 metres) and **Rjukan** (448 metres).—**5.0,** Programme for Children. **6.15,** Weather Report and News. **6.30,** Talk by Helge Fossum. **7.0,** Time Signal. **7.2,** Concert of Orchestral Selections and Songs by Miss Greta Syrdahl. **8.0,** Recitations by Mr. Fridtjof Krohn. **8.30,** Weather Report, News and Topical Talk. **9.0,** National Melodies played on the Hardanger Fiddle by M. Eyvind Groven. **9.30,** Dance Music from the Hotel Bristol. **11.0** (approx.), Close Down.

Saturday, December 22nd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

PARIS (Eiffel Tower), Call FL **(2 650 metres);** 5 kW.—**5.0,** Pasdeloup Concert. **7.10,** Weather Report. **7.30,** "Le Journal Parlé."

PARIS (Petit Parisien) **(340.9 metres);** 0.5 kW.—**8.45,** Gramophone Selections. **8.50** (approx.), Talk. **8.55** (approx.), News and Announcements. **9.0,** Selections by Artistes from the Opera and Opéra-Comique: Overture to La Fille de Figaro (Leroux); Fantasia on Miss Decima (Audran). **9.25,** News and Announcements. **9.30,** Symphony Programme, under the Direction of M. Estyle of the Conservatoire: Suite funambulesque (Büsser); Bourrée fantasque (Chabrier). **10.0,** News and Miscellaneous Items. **10.2,** Orchestral Concert: Selection from The Fair Maid of Perth (Bizet); Song of the Mill (Sylvio Lazzari); Gaiety (Florent Schmitt). **11.0** (approx.), Close Down.

PARIS (Radio Paris), Call CFR **(1,750 metres);** 6 kW.—**12.30,** Programme of Columbia Gramophone Records: La Péri (Dukas); Meditation from Thaïs (Massenet) by Albert Sammons (Violin); Organ Solo, Pastorale (Franck), by M. E. Collette; Recitation, Le Colibri (Chausson), by Mme. Jeanne Montjovet; Russian Song, Kolj Slaveni (Bortnjansky), by the Don Cossack Chorus; Duet, Get Out and Get Under the Moon (Shay, Tobias and Jerome), by Van and Schenck; Song, I Know That My Baby is Cheatin' On Me (Endor, Steinberger and Lambert), by Sophie Tucker, accompanied by Ted Shapiro and his Orchestra; Fox-Trot, Felix the Cat, by Paul Whiteman and his Orchestra; Fox-Trot, Kiss and Make Up (Bogate and Hoelle) by the Piccadilly Players; Quasimodo (Sentis), by Lucchesi's South American Orchestra; in the Interval, News. **2.0,** Market Prices and Religious Information. **3.45,** Rosati Concert, dedicated to Arras and Artois; in the Intervals, News. **6.30,** Agricultural Report. **6.45,** Musical Selections. **7.30,** Pianoforte Lesson by M. Pierre Lucas. **8.0,** Dr. Roubinovitch, Talk: The Mentality of Naughty Children; followed by Market Prices and News. **8.15,** Concert: "L'Après-Midi de Jocelyn"; Chamber Music; Dance Music by the Joss Ghislery Symphonians; in the Intervals, News.

PITTSBURGH, Call KDKA **(63 and 27 metres);** 25 kW.—**11.0,** News. **11.10,** Studio Programme. **11.30,** Concert from the William Penn Hotel, **Pittsburgh. 12.0 Midnight,** Session Clock Chimes, followed by University of Pittsburgh Address and Reading from Charles Dickens' "A Christmas Carol." **12.15 a.m.** (Sunday), Home Radio Club, by James W. H. Weir. **12.30 a.m.,** Gems of American Literature, by Elbert R. Moses. **12.45 a.m.,** A Week of the World's Business, by Dr. Julius Klein. **1.0 a.m.,** Violin Solos by Godfrey Ludlow. **1.30 a.m.,** Vocal Selections. **1.45 a.m.,** Instrumental Selections. **2.0 a.m.,** The Philco Hour. **3.0 a.m.,** Longines Time. **3.30 a.m.,** Weather Report. **3.35 a.m.,** Selections by Tracy Brown's Orchestra from the William Penn Hotel Pittsburgh.

POSEN (344.8 metres); 1.5 kW.—**6.50,** Talk for Women. **7.10,** Miscellaneous Items. **7.30,** Programme from **Warsaw. 9.0,** Time Signal and News. **9.30,** Radio Cabaret. **11.0,** Concert, arranged by the Maison Philips. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (348.9 metres); 5 kW.—**5.0** German Transmission. **6.0,** "Halka" (Moniuszko), from the National Theatre, **Prague. 9.0,** Time Signal, News and Theatre Review. **9.25,** Concert by a Gipsy Band, relayed from **Bratislava** (300 metres).

RIGA (526.3 metres); 4 kW.—**4.0,** Programme of Talks. **5.30,** French Lesson. **6.0,** Concert: Orchestral Selections, (a) Overture to Im Reiche des Indra (Lincke), (b) Ballet from Giroflé-Girofla (Lecocq), (c) Latvian National Waltz; Comedy; Orchestral Selection, American Potpourri, Hallo! (Lubbe); Comedy; Orchestral Selections, (a) Serenade (Mendelssohn), (b) Au vent frais qui murmure (Pesse), (c) National March; followed by News. **8.0,** Weather Report. **8.30,** Concert, relayed from the Café de l'Opera. **10.0** (approx.), Close Down.

ROME, Call 1RO **(447.8 metres);** 3 kW.—**7.10,** Time Signal and Announcements. **7.45,** "Cinderella," Opera (Massenet); in the Intervals: Review of Art and Literature and Talk for Women, by Mme. Pompadour. **9.50,** News. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres);** 30 kW.—**11.58,** Weather Report. **12.0 Midnight,** Phil Spitalny's Musical Programme, relayed from **New York. 12.30 a.m.** (Sunday) Orchestral Concert from the Hotel Onondaga, **Syracuse. 1.30 a.m.,** Musical Programme, relayed from **New York. 2.0 a.m.,** Selections by the Male Octet, relayed from **New York. 2.30 a.m.,** Selections by Mildred Hunt and the Marimba Orchestra. **3.0 a.m.,** "Lucky Strike," Programme relayed from **New York. 4.0, a.m.,** Time Signal. **4.2 a.m.,** Dance Music by the Orchestra of the Hotel De Witt Clinton, **Albany.**

STAMBOUL (1,200 metres); 5 kW.—**3.30,** Concert. **4.30,** Market Report. **5.15,** Concert of Turkish Music. **7.30,** Weather Report and Time Signal. **7.40,** Vocal and Orchestral Concert: Symphony No. 5 (Beethoven); Songs; Wedding March from Lohengrin (Wagner). **9.0,** News and Close Down.

STUTTGART (379.7 metres); 4 kW.—**2.0,** Vocal and Orchestral Concert. **3.35,** Programme relayed from **Frankfurt. 5.0,** Time Signal and Weather Report. **5.15,** Talk by Dr. Rappenecker, relayed from **Freiburg** (577 metres). **5.45,** Legal Talk by Dr. Kallee. **6.15,** Willi Marcard, Talk: With Skis across the snow fields of the Black Forest, relayed from **Freiburg. 6.45,** Time Signal and Sports Notes. **7.0,** Programme of Recitations with Musical Interludes: Pianoforte Solo from Turandot (Busoni); Recitations, (a) Der Spiegel (Arthur Silbergleit), (b) Blick in den Spiegel in drei Jahrhunderten (Senta Neckel); Blues for Violin and Pianoforte (Ravel); Recitations (Polly Tiek), (a) (Modeschau), (b) Neue Kollektion, **(c)** Mollig; Colombine for Violin and Pianoforte (Drdla); Recitations, from (a) Geheimnis der Frauen (Eulenberg), (b) Ein Opfergang (Binding); Pianoforte Solo from La fille aux cheveux de lin (Debussy). **8.0,** "Die Insel Tulipatan"—Opéra-comique, in One Act (Offenbach). **8.45,** Wireless Cabaret: Orchestral Selection, Susanne (Raymond); Das alte Lied (Löwe); Kennst du das kleine Haus am Michigansee (Heymann); Come (Dazar); Wenn zwei Blondinen (Raymond); Orchestral Selection, March of the Gladiators (Sousa); "The Champion Boxer"—Farce in One Act (P. Ollop); Es kam ein Bursch (Raymond); Spiel' my Jazzband, Spiel' (Granichstädten); Was der Onkel Dokter sagt (Herzog); Light Poetry and Prose by Ferry Dittrich; Träume, Liebling; (Hirsch); Wenn schöne Frauen nicht lieben (Sobotka); Wenn in Werder (May), followed by News. **11.30** (approx.), Concert of Gramophone Selections, relayed from **Freiburg. 12.30 a.m.** (Sunday), Close Down.

TOULOUSE (Radiophonie du Midi) **(389.6 metres);** 8 kW.—**12.45,** Concert. **8.0,** Market Prices, Exchange Quotations and News. **8.30,** Orchestral Selections of Marches. **9.0,** Time Signal. **9.5,** Concert from the Works of Ganne and Leoncavallo: Orchestral Selections, (a) Extase (Ganne), (b) Selection from I Pagliacci (Leoncavallo), (c) Selection from Hans the Flute Player (Ganne), (d) Marche arabe (Ganne), (e) Overture to Les Saltimbanques (Ganne); Seven Selections from I Pagliacci (Leoncavallo); Two Marches with vocal accompaniment (Ganne), (a) La Marche Lorraine, (b) Le père La Victoire. **9.50,** Programme of Tangos: Marion (Holländer); Moments équivoques (Holländer); Al quines Noies (Pujol); Tendre colloque (Vinale); Plégaria (Bianco); Cancionero (Buzon). **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (517.2 metres); 15 kW.—**3.0,** Orchestral Concert. **4.10,** Reading by Alfred Neugebauer from the Works of Herder. **4.55,** Siegfried Loewy, Talk: Mathilde Wildauer. **5.25,** Readings from the Works of Isolde Kurz and Erwin Kolbenheyer. **6.20,** Concert by the Auber Trio. **7.10,** Time Signal, Weather Report and News. **7.15,** "Doktor Klaus"—Comedy in Five Acts (L'Arronge), followed by Dance Music, from the Grill Room of the Hotel Bristol, and Photo-telegraphy Transmission.

VILNA (435 metres); 1.5 kW.—**6.5,** Poem Recitations. **6.15,** Soprano Songs by Mme. Sophie Wylezynska. **6.30,** Programme relayed from **Warsaw. 7.0,** Talk. **7.30,** Programme relayed from **Warsaw. 10.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**5.0,** Programme for Children. **6.0,** Miscellaneous Items. **6.30** "Radio-Chronique," by Dr. M. Stepovsky. **6.56,** Time Signal. **7.0,** Agricultural Report. **7.5,** News and Announcements. **7.30,** "Gipsy Love"—Operetta in Three Acts (Lehár). In the Interval, Theatre Review. **9.0,** Aviation Notes and Weather Report. **9.5,** News and Announcements. **9.20,** Police Report and Sports Notes. **9.30,** Dance Music from the Oaza Restaurant. **10.30** (approx.), Close Down.

ZÜRICH (588 metres); 1 kW.—**6.17,** Concert of Orchestral Music and Humorous Selections. **7.15,** Request Programme. **9.0,** Weather Report and News. **9.10,** Gramophone Selections of Dance Music.

Programmes from Abroad.—

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**11.0 a.m.**, Relay of Cathedral Chimes. **11.5 a.m.**, Weather Report and Forecast and Aviation Route Report. **1.30**, Concert by the Iberia Trio, with Gramophone Records at Intervals. **2.45 to 5.30** (approx.), No Transmission. **5.30**, Opening Signal, followed by Relay of an Opera from the Gran Teatro del Liceo, Market Prices and Exchange Quotations in the Intervals. **8.0 to 8.20**, Talk under the auspices of the Catalonian Institute of Agriculture at San Isidro. **8.20**, Concert by the Wireless Orchestra: Suite (G. Chevignard), (a) Prelude, (b) Minuet (c) Sarabande, (d) Air de danse, (e) Tambourin. **8.40**, Sports News. **9.0** (approx.), Close Down.

BERGEN (**370.4 metres**); 1.5 kW.—**9.30 a.m.**, Relay of Sacred Service. **11.30 a.m.**, Weather Report and Forecast and General News Bulletin. **4.0**, Church Service. **7.0**, Concert by the Wireless Orchestra. **7.50**, Current Events. **8.0**, Talk. **8.30**, Song Recital by Mrs. Ragnhild Halvorsen (Soprano); Kristenfolkets julehelg (Solheim). **9.0**, Weather Report and Forecast, Late News Bulletin and Time Signal. **9.15**, Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,250 metres**); 40 kW. —**7.55 a.m.**, Relay of Chimes from the Garrison Church at Potsdam. **8.0 a.m.**, Morning Recital and Address, relayed from **Voxhaus**, followed by Chimes from Berlin Cathedral. **10.30 a.m.**, Concert, relayed from **Voxhaus**. **12.45**, Experimental Phototelegraphy Transmission. **1.30 to 2.25**, Agricultural Talks from **Voxhaus**. **3.0**, Talk. **3.30**, Musical Selections. **5.0**, Series of Talks, arranged by the "Deutsche Welle," followed by Relay of Concert or Opera. **9.15**, Press News. **9.30**, Dance Music. **11.30** (approx.), Close Down.

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**7.55 a.m.**, Chimes, relayed from the Potsdam Garrison Church. **8.0 a.m.**, Recital of Vocal and Instrumental Music, followed by Chimes from Berlin Cathedral; Address in the Interval. **10.30** (approx.), Concert. **1.0**, Elementary Lesson in Morse by Hans W. Priwin. **1.30 to 2.25**, Programme of Talks on Agricultural Subjects. **2.30**, Reading of Stories. **3.0**, Talk. **3.30**, Musical Programme. **5.40**, Talk. **6.0**, Talk. **7.15** (approx.), Concert, followed by Weather Report, Late News Bulletin and Sports Notes. **9.30**, Dance Music by the Dajos Bela Orchestra. **11.30** (approx.), Close Down.

BEZIERS (**158 metres**); 0.6 kW.—**8.30**, General News Bulletin. **8.45**, Concert, arranged by the Maison Cabannel, followed by Market Prices. **10.30** (approx.), Close Down.

BRATISLAVA (**300 metres**); 1 kW.—**8.0 a.m.**, Relay of Sacred Recital of Music from **Brünn**. **9.30 a.m.**, Agricultural Report, relayed from **Prague**. **2.0**, Puppet Play. **3.30**, Orchestral Concert. **4.30**, Transmission for Workers. **5.0**, Talk. **5.30**, Sports Talk, relayed from **Prague**. **6.0**, Concert, relayed from **Prague**: Selections of Music for Wind Instruments. **6.45**, Talk, relayed from **Prague**. **7.0**, Concert from **Prague**, followed by General News Bulletin. **9.20**, Relay of Dance Music. **10.30** (approx.), Close Down.

BRESLAU (**322.6 metres**); 4 kW.—Programme relayed by **Gleiwitz** (329.7 metres). **8.15 a.m.**, Chimes relayed from Christ Church. **10.0 a.m.**, Evangelical Recital of Sacred Music with Address. **11.0 a.m.**, Concert. **1.0**, Talk on Horticulture. **1.10**, Talk or Literary Programme. **1.35**, Chess Talk. **2.0**, Stories for Children. **2.30**, Agricultural Talk. **4.15**, Concert. **7.15**, Concert: "Silesian Christmas" (Hans Kaergel). **9.0**, Late News and Announcements. **9.30**, Dance Music. **11.15** (approx.), Close Down.

BRÜNN (**441.2 metres**); 3 kW.—**8.0 a.m.**, Recital of Sacred Music. **9.0 a.m.**, Agricultural Talk. **9.30 a.m.**, Notes on Agriculture relayed from **Prague**. **10.0 a.m.**, Morning Concert. **3.30**, Orchestral Concert **4.30**, Programme relayed from **Prague**. Transmission for Workers. **5.0**, Programme of News and Music for German Listeners. **5.30**, Talk on Sport by Mr. Laufer relayed from **Prague**. **6.0**, Concert of Orchestral Music. Slavonic Rhapsody in G Minor Op. 45 (Dvorák). **7.0**, Concert relayed from **Prague**. **9.20**, Relay of Dance Music. **10.30** (approx.), Close Down.

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0**, Selections of Light Music. **6.0**, Children's Corner. **6.30** (approx.) Concert. **7.30**, La Radio Chronique. **8.15**, Orchestral Concert. **10.15**, Late News Bulletin and Press Notes. **11.0** (approx.) Close Down.

COLOGNE (**283 metres**); 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (**468.8 metres**) and **Münster** (250 metres).—**6.45 a.m.**, Lesson in Boxing by Dr. Ludwig Bach. **7.5 a.m.**, Review in Esperanto of the Week's Programmes. **7.15 a.m.**, Lesson on the Lute and Guitar by Olly Wirtz Koort. **7.35 a.m.**, Lesson in Esperanto. **8.0 a.m.**, Church

SUNDAY, DECEMBER 23rd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Chimes. **8.5 a.m.**, Evangelical Festival with Address in the interval. **10.0 a.m.**, Fritz Worm: The Honour of the German Language. **12.0 Noon**, Concert of Orchestral Music. **1.30**, Talk. **3.30**, Popular Concert. **7.0**, "Der Gläserne Berg," German Fairy Tale by Josefa Elstner-Oertel. Music by Walter Braunfels, followed by Late News Bulletin, Sports Notes and Light Musical Selections. **11.0** (approx.), Close Down.

CORK, Call 6CK (**400 metres**); 1.5 kW.—**8.0**, Programme relayed from **Dublin**. **11.0**, National Anthem and Weather Report and Forecast. **11.15** (approx.), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Cathedral Service. **10.56 a.m.**, Relay of Fanfare from the Church of Notre Dame, followed by Time Signal and Weather Report and Forecast. **11.10 a.m.**, Relay of Programme from **Warsaw**. **1.0 and 1.20**, Talk on Farming. **1.40**, La Chronique Agricole. **2.0**, Weather Report. **2.15**, Concert relayed from **Warsaw**. **4.20**, Talk. **5.0**, Programme from **Warsaw**. **6.55**, Time Signal from the Observatory. **7.0**, Relay of Fanfare from the Church of Notre Dame. **7.30**, Concert of Chamber Music devoted to the works of Polish Composers; Violin and Pianoforte Sonata by François Brezezinski. **9.0**, General News Bulletin relayed from **Warsaw**. **9.30**, Concert relayed from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**8.0**, Handel's "Messiah," by the Dublin Philharmonic Society, conducted by Mr. Turner Huggard; Soloists: Joan Elwes, Joseph Farrington, Elsie Black and W. F. Watt. **10.30**, National Anthem and Weather Report. **11.15** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW. —Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres) and **Kiel** (254.2 metres).—**7.25 a.m.**, Time Signal. **7.30 a.m.**, Weather Report and Forecast, followed by General News Bulletin. **7.50 a.m.**, Talk. **8.0 a.m.**, Legal Talk. **10.0 a.m.**, Talk. **11.55 a.m.**, Time Signal, relayed from **Nauen**. **12.5** (for **Hamburg** and **Kiel**), Concert. **12.5** (for **Bremen**), Programme of Music. **12.5** (for **Hanover**), Light Music. **1.0**, Children's Corner. **6.30**, Talk, arranged by the Hamburg School of Physical Training. **6.40**, Sports News. **6.55**, Weather Report and Forecast. **7.0**, Concert or Play. **9.30**, Weather Report and Late News Bulletin, followed by Programme of Light Music. **10.50** (for **Hamburg**, **Bremen** and **Kiel**), Weather Report for the North Sea and Baltic. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**); 5 kW.—**12.10**, Concert by the Wireless Trio. **1.40**, Talk. **2.10**, Concert of Orchestral Music. **7.40**, Time Signal. **7.42**, News Bulletin, Weather Report and Sports News. **7.55**, Concert by the Augmented Wireless Orchestra, conducted by Nico Treep; 'Cello Solos by Michael Busch. **10.40** (approx.), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits from 5.40 on 1,852 metres.—**8.5 a.m.**, Relay of Morning Service. **9.30 a.m.**, Sacred Service. **12.10**, Concert by the K.R.O. Trio. **1.10**, Talk. **1.40**, Talk. **2.10**, Orchestral Concert. **5.30**, Relay of Evening Service (on 1,852 metres) from **Amsterdam**; Sermon by the Minister, the Rev. J. L. Schouten. **7.10**, Talk. **7.50** (approx.), Orchestral Concert. **10.25**, Epilogue by "Le Petit Chœur," conducted by Mr. Jos. H. Pickkers. **10.40** (approx.), Close Down.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**9.0 a.m.**, Church Service, relayed from **Copenhagen**. **10.30 a.m. to 10.40 a.m.** (**Kalundborg** only), Weather Report and Forecast from the Copenhagen Meteorological Institute. **12.0 Noon to 12.25**, German Lesson, arranged by "Radiolytteren." **12.30**, French Lesson, arranged by "Radiolytteren." **2.0**, Orchestral Concert. **5.50** (**Kalundborg** only), Weather Report and Forecast from the Meteorological Institute. **6.0**, News from the Press. **6.15**, Time Signal, followed by Talk. **7.15**, Vocal and Instrumental Concert; Christmas in Music and Poetry; Concerto grosso, No. 8 in G Minor for Two Violins, 'Cello, Strings and Cembalo, (a) Vivace, Grave, Allegro, (b) Adagio, Allegro, Adagio, (c) Vivace, (d) Allegro, Pastorale, Largo. **10.0**, Dance Music, relayed from the Palace Hotel, under the direction of Teddy Petersen; in the Interval, at **11.0**, Town Hall Chimes, relayed from **Copenhagen**. **11.30** (approx.), Close Down.

KATTOWITZ (**422 metres**); 10 kW.—**9.15 a.m.**, Relay of Church Service. **10.56 a.m.**, Time Signal. **11.0 a.m.**, Weather Report and Forecast. **11.15 a.m.**, Popular Concert by the Wireless Quartet. **1.0**, Talk. **1.20 and 1.40**, Two Talks on Agriculture. **2.0**, Weather Report. **2.15** Relay of Symphony Concert, from the Philharmonic Hall, **Warsaw**: B. Policjant, Concerto for Violin (Tchaikowsky). **5.0**, Concert. **6.0**, Announcements. **6.25**, Humorous Programme by Prof. St. Ligon. **6.56**, Time Signal. **7.0**, Talk, arranged by the Institute of Pedagogy. **7.30**, Concert. **9.0**, Weather Report and Forecast, News from the Press and Sports Notes. **9.30**, Dance Music. **10.30** (approx.), Close Down.

KAUNAS (**2,000 metres**); 7 kW.—**2.30**, Children's Corner. **3.0**, Programme for Young People. **3.30**, Health Talk by Dr. Jurgelionis. **4.0**, Talk by J. Ardickas. **4.50**, Weather Report and Press News. **4.55**, Talk. **6.5**, "Woman and the Home," by O. Masiotiene. **6.30**, Sacred Recital: Die Ehr Gottes in die Natur (Beethoven). **9.30** (approx.), Close Down.

KÖNIGSBERG (**303 metres**); 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**8.0 a.m.**, Morning Festival, with Choral Renderings and Address in the Interval. **10.5 a.m.**, Musical Programme. **3.0**, Orchestral Concert. **7.5**, Christmas Oratorio (Johann Sebastian Bach), conducted by Hermann Scherchen; Tenor Solos by Josef Poerner. **9.15**, Late News Bulletin and Sports Results. **9.30**, Dance Music. **11.30** (approx.), Close Down.

KOSICE (**1,140 metres**); 5 kW.—**8.0 a.m.**, Recital of Sacred Music. **11.0 a.m.**, Time Signal followed by Chimes from the Cathedral and Orchestral Concert: Rhapsody in A Flat Major, Op. 45, No. 3. **5.30**, Talk. **6.0**, Time Signal and General News Bulletin, followed by Chimes. **7.30**, Announcements and Concert. **10.0** (approx.), Close Down.

LAHTI (**1,522.8 metres**); 35 kW.—Programme also for **Helsingfors** (375 metres). **7.0 a.m.**, Relay of Church Service. **9.50 a.m.**, Press News. **10.5 a.m.**, Concert. **10.50 a.m.**, Weather Report and Time Signal. **11.0 a.m.**, Relay of Sacred Service in Swedish. **3.0**, Concert by the Wireless Orchestra. **3.50**, Talk. **4.10**, Selections by the Station Orchestra: Hungarian Dance (Brahms). **4.30**, Talk. **4.57**, Time Signal and Weather Report and Forecast. **5.10**, Concert by the Station Orchestra. **5.30**, History Talk. **6.0**, Recital of Music. **7.45**, General News Bulletin given in Finnish followed by News in Swedish. **8.30** (approx.), Close Down.

LANGENBERG (**468.8 metres**); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**6.45 a.m.**, Boxing Instruction by Dr. Ludwig Bach. **7.5 a.m.**, Summary of the Week's Programmes given in Esperanto by Alfred Dormanns. **7.15 a.m.**, Olly Wirtz Koort's Lesson on the Lute and Guitar. **7.35 a.m. to 7.55 a.m.** Esperanto Lesson by Alfred Dormanns. **8.0 a.m.**, Church Chimes. **8.5 a.m.**, Evangelical Morning Recital and Address. **10.0 a.m.**, Talk by Fritz Worm. **11.0 a.m.**, Organ Recital by Professor Haus Bachem. **12.0 Noon**, Orchestral Concert. **1.30**, Talk. **3.30**, Orchestral Selections. **7.0**, Concert or Play followed by Late News Bulletin, Sports News and Dance Music conducted by Herr Eysoldt. **11.0** (approx.), Close Down.

LEIPZIG (**365.8 metres**); 4 kW.—Programme relayed by **Dresden** (275.2 metres).—**7.30 a.m.**, Organ Recital. **8.0, a.m.**, Concert with Vocal and Instrumental Solos. **10.0 a.m.**, Talk. **10.30 a.m.**, Talk. **11.0 a.m.**, Instrumental Music. **12.0 Noon**, Agricultural Talk. **12.30**, Horticultural Talk. **1.0**, Gleanings from the Foreign Press. **1.45**, Wireless Talk. **3.0**, Musical Programme. **5.30**, Talk. **6.0**, Talk. **6.30**, Concert. **7.30**, Concert of Chamber Music by the Dresden String Quartet and Soloists: Schubert's Quintet in G Major Op. 163 for Two Violins, Viola and Two Cellos, (a) Allegro ma non troppo, (b) Adagio, (c) Scherzo Andante Sostenuto Presto, (d) Allegretto. **9.0**, Sports News. **9.30**, Dance Music relayed from **Berlin**. **11.30** (approx.), Close Down.

LYONS (Radio Lyon) (**291 metres**); 1.5 kW.—**7.30**, Le Journal Parlé with General News Bulletin and News from the Press. **8.0**, Concert with Solos by Madame Ducharne of the Lyons Conservatoire (piano); M. Camand (violin) and M. Testanière (cello); Selection from The Barber of Seville (Rossini). **9.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**434.8 metres**); 1.5 kW.—Programme relayed by **Salamanca** (EAJ22) (405 metres).—**11.30 a.m.**, Concert by the Municipal Band relayed from El Retiro (Weather permitting); Conductor, Maestro Villa. **1.0 to 2.0**, No Transmission. **2.0**, Chimes and Time Signal. **2.5**, Concert by the

Programmes from Abroad.—

Station Orchestra with Soloists; Interlude by Luis Medina. **3.30 to 7.0,** No Transmission. **7.0,** Chimes. **7.5,** Selections by the Wireless Sextet and Item by Luis Medina. **8.0,** Dance Music by the Palermo Orchestra relayed from the Alkazar. **8.30 to 10.0,** No Transmission. **10.0,** Chimes and Time Signal. **10.5,** Concert by the Band of the Wad-Ras Regiment, conducted by Don Pablo Cambronero. **12.0 Midnight,** Chimes followed by Dance Music by the Palermo Orchestra relayed from the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, IMI **(549 metres)**; 7 kW.—**9.0 a.m.,** Opening Signal and English Lesson. **9.30 a.m. to 10.15 a.m.,** Sacred Recital with Soloits. **11.30 a.m.,** Time Signal **11.35 a.m.,** Concert by the Radio Quartet. **12.30 to 3.0,** No Transmission. **3.0,** Opening Signal. **3.5,** Concert. **4.30,** Light Music relayed from the Fiaschetteria Toscana. **5.0 to 6.55,** No Transmission. **6.55,** Opening Signal. **7.0,** Current Topics. **7.15,** History Talk by C. A. Blanche. **7.25,** Sports Results. **7.30,** Time Signal. **7.35,** "The Daughter of the Regiment," Opera by Donizetti. At the end of Act Two: Sports Notes and News from the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (545.6 metres).—**10.0 a.m.,** Relay of Morning Service. **2.30,** Literary Programme. **3.0,** Concert. **4.55,** Relay of Carillon from the Town Hall at **Stockholm. 5.0,** Relay of Evening Service. **6.15,** Pelléas et Mélisande, Play by Maeterlinck, with incidental music by Jean Sibelius. **8.15,** Late News Bulletin and Weather Report and Forecast. **10.0** (approx.), Close Down.

MÜNICH (535.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (277.8 metres) and **Nuremburg** (241.9 metres).—**10.0 a.m.,** Chimes from the Münich Town Hall. **10.10 a.m.,** Wireless Weather Chart for Bavaria. **11.05 a.m.,** Time Signal, Weather Report and Forecast and Programme Announcements. **2.0,** Programme of Music. **3.0,** Concert. **5.30,** Concert. **7.0,** "Educated People," Popular Comedy in Three Acts by Victor Léon, Adapted for Wireless Transmission and Produced by Rolf Pinegger, followed by late News Bulletin and Music. **11.0** (approx.), Close Down.

NAPLES, Call 1NA **(333.3 metres)**; 1.5 kW.—**8.30 a.m.,** French Lesson by Professor Etienne Verdier. **9.0 a.m.,** Sacred Recital. **3.45,** Children's Programme. **4.0,** Concert with Soloists **4.30,** Time Signal. **7.30,** Current Topics. **7.50,** Naples Harbour Report. **8.0,** Time Signal. **8.2,** Concert by the Station Orchestra and Soloists: "Ah per sempre o mio bell' angiolo," from La Forza del destino (Verdi), duet for Soprano and Tenor, by E. Blandi and G. Ferrero, with Pianoforte accompaniment. **9.0,** Sports Results. **9.55,** Calendar and Notes on the next day's programmes. **10.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(2,650 metres)**; 5 kW.—**7.56 a.m.,** Time Signal on 32.5 metres. **9.26 a.m.,** Time Signal on 2,650 metres. **5.0,** Relay of Pasdeloup Concert. **7.10 to 7.20,** Weather Report and Forecast. **7.30,** "Le Journal Parlé par T.S.F." Police Memoirs by Detective Ashelbé. **7.56,** Time Signal on 32.5 metres. **8.0 to 9.0,** Vocal and Instrumental Concert, "Music and Moonlight," The Orchestra, "Invocation à la Nuit" (Charpentier). **10.26,** Time Signal on 2,650 metres. **11.15** (approx.), Close Down.

PARIS (Radio LL) **(370 and 60 metres)**; 1 kW.—**12.30,** Programme arranged by Radio Liberté, General News Bulletin, followed by Instrumental and Vocal Concert. Artistes: Charles Seringes (Violin); Robert Bergmann ('Cello); and Edouard Flament (Pianist). **1.0,** Carillon de Fontenay. **3.0,** Programme of Dance Music. **9.0,** Concert. **10.0,** Carillon de Fontenay. **10.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR **(1,750 metres)**; 6 kW.—**8.0 a.m.,** General News Bulletin and Press Notes. **8.30 a.m.,** Physical Training by Dr. Diffre. **12.0 Noon,** Religious Address. **12.30,** News from the Press. **12.45,** Concert by the Albert Locatelli Orchestra including Selection by Bilboquet. **4.30,** Popular Gramophone Records by "L'Industrie Musicale." In the Interval: Press News. **6.30,** Agricultural Notes. **6.45,** Gramophone Records. **7.30,** Press News. **7.45,** The Radio Paris Guignol. **8.30,** Concert of the Radio Paris Music Hall. Artistes: Madame Fernande Izard and Madame Reine Chanteix; The Orchestra conducted by M. Maurice André. In the Intervals: News from the Evening Papers and Late News Bulletin. **10.30** (approx.), Close Down.

PARIS (Petit Parisien) **(340.9 metres)**; 0.5 kW.—**8.45,** Gramophone Records. **8.50,** Talk. **8.55,** News from the Press. **9.0,** Vocal and Instrumental Concert.

Sunday, December 23rd.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

9.25, General News Bulletin. **9.30,** Symphony Concert. **10.0,** Late News Bulletin. **10.15,** Concert of Orchestral Music. **11.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT **(458 metres)**; 0.5 kW.—Programme relayed at intervals by the following stations: **Bordeaux PTT** (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres), **Lille** (264 metres), **Limoges** (285 metres), **Lyons PTT** (480 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse PTT** (260 metres).—**8.0 a.m.,** General News Bulletin and Time Signal. **9.25 a.m.,** International Time Signal and Weather Report. **12.0 Noon,** Concert. **1.0,** Le Journal de France Economique. **1.30,** Concert organised by the General Association of French Wireless Listeners: Selection from "The Magic Flute" by Mozart. **2.30,** Relay of Symphony Concert organised by the Paris paper "Le Journal." **4.0,** Pasdeloup Symphony Concert, relayed from the Champs Elysées. Conductor: M. Rhené Bâton. **6.30,** Le Radio Journal de France. **8.15,** Sports Talk and Results. **8.30,** Orchestral Concert. **10.30** (approx.) Relay of Dance Music from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PITTSBURGH, Call KDKA **(63 and 27 metres)**; 25 kW.—**4.0,** Sessions Clock Chimes and Church Service. **6.30,** Programme of the Whitehouse Coffee Company, relayed from **New York. 7.0,** "Roxy's Stroll" from WJZ, **New York. 9.0,** Organ Recital by Dr. Charles Heinroth, Director of Music at the Carnegie Institute. **9.45,** Service relayed from the Shadyside Presbyterian Church with Sermon by the Minister, the Rev. Hugh Thomson Kerr. **11.0,** Relay of Concert from the William Penn Hotel, Pittsburgh. **11.30,** Concert by the Whittall Anglo-Persians from **New York. 12.0 Midnight,** Sessions Clock Chimes, followed by Service at the Cavalry Episcopal Church at **Pittsburgh.** Sermon by the Minister, the Rev. E. J. Van Etten. **1.0 a.m.** (Monday), Musical Selections relayed from **New York. 1.15 a.m.,** Collier's Radio Hour from **New York. 2.15 a.m.,** Programme by the Utica Jubilee Singers relayed from WJZ, **New York. 2.45 a.m.,** El Tango Romantico relayed from **New York. 3.15 a.m.,** Longine Time. **3.30 a.m.,** (approx.), Close Down.

POSEN (344.8 metres); 1.5 kW.—**9.15 a.m. to 10.45 a.m.,** Relay of Sacred Service. **11.0 a.m.,** Time Signal. **11.5 a.m. and 11.30 a.m.,** Two Agricultural Talks. **2.15,** Relay of Symphony Concert from **Warsaw. 4.20,** Talk. **4.45,** Talk. **7.0,** Talk. **7.30,** Vocal and Instrumental Concert: Soprano and Tenor Duet from Rigoletto (Verdi); sung by Maria Gasiorowska and Ladislas Sowinski. **8.30,** Recital of Music. **9.0,** Time Signal. **9.5,** General News Bulletin. **9.20,** Dancing Lesson by Mr. Starski. **9.40,** Dance Music relayed from the Carlton Restaurant. **11.0** (approx.), Close Down.

PRAGUE (348.9 metres); 5 kW.—**8.0 a.m.,** Recital of Sacred Music relayed from **Brünn. 9.0 a.m.,** Agricultural Talk. **9.30 a.m.,** Agricultural Report. **10.0 a.m.,** Concert. **12.5,** Industrial Talk. **12.30,** Talk on a Social Topic. **3.30,** Concert of Orchestral Music. **4.30,** Transmission for Workers. **5.0,** Programme for German Listeners, News Notes and Concert. **5.30,** Sports Talk by Mr. Laufer. **6.0,** Orchestral Concert of Popular Selections. **6.45,** Talk. **7.0,** Concert. **8.0** Concert. **9.0,** Time Signal and Late News Bulletin. **9.15,** Theatre News. **9.20,** Dance Music by the Orchestra at the Hotel Sramota. **10.30** (approx.), Close Down.

RIGA (526.3 metres); 4 kW.—**8.0 a.m.,** Relay of Sacred Service in German. **9.15 a.m.,** Sacred Service (in Latvian), relayed from the Mara Church. **12.0 Noon** Stories and Musical Items for Children. **3.0,** Concert by the Station Orchestra, conducted by Arved Parups. **4.0 to 5.30,** Four Talks. **6.0** Popular Concert. **8.0,** Weather Report. **8.30,** Concert relayed from the Café de l'Opera. **10.0** (approx.), Close Down.

ROME, Call 1RO **(447.8 metres)**; 3 kW.—**8.30 a.m.,** Opening Signal, followed by German Lesson. **9.0 a.m.,** Recital of Vocal and Instrumental Music. **9.45 a.m., to 12.0 Noon.** No Transmission. **12.0 Noon,** Opening Signal. **12.5 to 1.0,** Concert by the Wireless Trio. **1.0 to 4.0,** No Transmission. **4.0,** Opening Signal. **4.5 to 5.30,** Popular Concert. **7.10,** Talk on Agriculture. **7.15,** Sports Notes and News from the Stefani Agency. **7.29,** Time Signal. **7.31,** Talk. **7.45,** Concert by the Grand Symphony Orchestra: The Orchestra, March from "The Damnation of Faust" (Berlioz). Talk in the interval. **9.50,** Late News Bulletin. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres)**; 30 kW.—**4.0,** Relay of Church Service. **8.30,** Organ Recital by Elmer A. Tidmarsh, relayed from the Union College Memorial Chapel at **Schenectady,** N.Y. **9.0,** Talk for Men by Dr. S. Parkes Cadman, relayed from **New York. 10.30,** Arcadie Birkenholz in Violin Selections, relayed from **New York. 11.0,** Programme by the Stetson Parade, relayed from **Boston, Mass. 11.30,** The Acousticon Programme from **New York. 12.0 Midnight,** The Old Company's Programme with Songs by Reinald Werrenrath (Baritone), relayed from **New York. 12.30 a.m.** (Monday), Relay from the Capitol Theatre, **New York. 2.0 a.m.,** David Lawrence: Talk on "Our Government," relayed from **Washington, D.C. 2.15 a.m.,** Atwater Kent Hour, relayed from **New York. 3.15 a.m.,** Correct Time. **3.17 a.m.,** Performance of the National Light Opera Company from **New York. 4.15 a.m.,** Experimental Transmission of Television Signals. **4.30 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**3.30,** Concert. **4.30,** Market Prices. **5.15,** Selections of Turkish Music. **7.30,** Weather Report and Forecast, followed by Time Signal. **7.40,** Talk on the History of Music. **8.0,** Concert by the Stamboul Wireless Orchestra. **9.0,** Late News Bulletin. **9.30** (approx.), Close Down.

TALLINN (408 metres); 2.2 kW.—**7.30 a.m.,** Relay of Church Service. **12.30,** Instrumental Concert. **4.45,** Press News. **5.0,** Concert: Selection from Cavalleria Rusticana (Mascagni). **5.30,** Talk. **6.0,** Concert with Soloists. **9.0** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) **(389.6 metres)**; 8 kW.—**12.30,** Weather Report and Forecast and Market Prices for Toulouse. **12.45,** Vocal and Instrumental Concert. **1.0,** Carillon. **1.5,** Concert (continued). **1.45,** News from "Le Télégramme," "L'Express" and "Le Midi Socialiste." **8.0,** Prices of Cereals and Exchange Quotations from Paris and News from the Fournier Agency. **8.15,** News from the Press. **8.30,** Concert. **9.0,** Carillon. **9.10,** Concert arranged by "L'Association des Commerçants Radio-électriciens du Midi": Selections from Manon by Massenet, (a) Je suis encore toute etourdie, (b) Allons, Manon, plus de chimère. **10.15,** The North African "Journal sans papier" and Late News Bulletin. **10.30** (approx.), Close Down.

VIENNA (517.2 metres); 15 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres).—**9.20 a.m.,** Morning Recital of Music. **10.0 a.m.,** Concert by the Vienna Symphony Orchestra and Soloists. **3.0,** Orchestral Concert. **7.5,** "Brüderlein Fein," Old Viennese Musical Play in One Act by Julius Wilhelm. Music by Leo Fall. Musical Director: Josef Holzer. **8.30,** Concert. **10.15** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**9.15 a.m. to 10.45 a.m.,** Cathedral Morning Service. **10.56 a.m.,** Time Signal. **11.0 a.m.,** Relay of Fanfare from Notre Dame at **Cracow. 11.5 a.m.,** Aviation Route Report and Weather Forecast. **11.10 a.m.,** Warsaw Philharmonic Symphony Concert. **1.0 to 2.0,** Three Talks for Farmers. **2.0,** Weather Report and Forecast. **2.15,** Concert of Symphony Music by the Philharmonic Orchestra. **4.20,** Talk. **4.45,** Talk on Aviation. **5.0,** Orchestral Concert. **6.0,** Twenty Minutes' Variety. **6.20,** Talk. **6.45,** General News Bulletin. **6.56,** Time Signal. **7.0,** C. Jablonowski, Talk: Divertissements intellectuels. **7.30,** Popular Concert by the Polskie Radio Orchestra under the direction of J. Oziminski: "L'Arlésienne" Suite No. 1, by Bizet, (a) Prelude, (b) Menuet, (c) Adagietto, (d) Carillon. **9.0,** Aviation Report and Weather Report and forecast. **9.5,** News from the Polish Telegraph Agency. **9.20,** Police and Sports News. **9.30,** Relay of Dance Music from the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (309.2 metres); 0.7 kW.—**10.0 a.m.,** Concert of Instrumental Music. **4.0,** Popular Dance Music relayed from the Club-Cabaret. **6.45,** Radio Talk. **7.0,** Programme relayed from the National Theatre, Zagreb: "Die Königin von der Barenburg," Opera in Five Acts. Music by Lujo Safranek-Kavic. In the Intervals: News and Announcements and Weather Forecast. **10.0** (approx.), Close Down.

ZÜRICH (588 metres); 1 kW.—**10.0 a.m.,** Relay of Programme from the Capitol Theatre. **11.0 a.m.,** Weather Report and Forecast. **11.30 a.m.,** Selections by the Station Orchestra. **3.0,** Relay of Concert by the Castellano Orchestra at the Carlton Elite Hotel **6.30,** Time Signal and Weather Report. **6.33,** Concert of Chamber Music, Violin Solos by Erwin Gilbert and Cello Solos by Julius Bächi. **7.0,** Programme of Music. **9.0,** Weather Report, Late News Bulletin and News from the Neue Züricher Zeitung. **9.30** (approx.) Close Down.

The Theory of the Metal Rectifier

Some Notes on the Properties and Method of Using the Dry Metal Rectifiers.

This article has been contributed by the Engineering Department of the Westinghouse Brake and Saxby Signal Co., who are the originators of dry-metal type of rectifier in this country

MANY references to metal rectifiers have appeared in the technical Press during the past few years, but it is thought that there is still room for some further notes on the subject, accompanied by definite measurements to indicate the performance which may be expected under given conditions.

Dealing firstly with the theories recently advanced as covering the operation of the metal rectifier, we find that a thermoelectric effect is often put forward as offering a solution. That the rectification is not due to such an effect is proved by the fact that heating the rectifying junction produces an E.M.F. in the wrong direction to account for the rectification that actually takes place. Another theory advanced is that of the well-known electrolytic rectifier, but this theory is untenable in the light of the instantaneous response without lag and lack of chemical change which are two of the outstanding characteristics of the metal rectifier.

It has been suggested that the operation of the metal rectifier is similar to that of a large number of crystal or like detectors in parallel. Those who have investigated the properties of crystal or contact detectors, consisting of minute contact areas between dissimilar materials, have found that the detection is variable both in direction and magnitude, and research work has shown that in such cases the effect is obtainable at the point of contact of many indifferent contact specimens. In the metal rectifier the rectification takes place at the surface of the metal on which the oxide has been formed, not at a surface to which external connection is made.

Probable Electronic Action.

This great distinction between the contact detectors, so widely used in the early days of the wireless industry, and the true power rectifier cannot be too clearly understood. None of the explanations so far advanced for contact detectors accounts for the performance of the metal rectifier, and this fact led Dr. Grondahl to publish the outlines[1] of an electron theory which agrees in practice with the measured characteristics of the rectifier. For the present it is easiest to think of the metal rectifier as a diode, the cathode of which requires a minute E.M.F. but no heating to cause electron emission, the anode being formed by a layer of material formed on the surface of the cathode.

All rectifiers are analogous to non-return valves, and the fact that they provide a uni-directional current from an alternating source is due entirely to this fact. By suitably arranging two or more of these non-return valves both of the directional impulses of an alternating current cycle can be passed in the same direction to a uni-directional circuit. The bridge connection preferred by the manufacturers of the metal rectifier has the advantage that the voltage applied to the rectifier need be little more than the output voltage required, whereas with the centre-tap connection a secondary of double this voltage is required, only one half of the winding being used for each half-cycle, an inefficient use of the transformer copper.

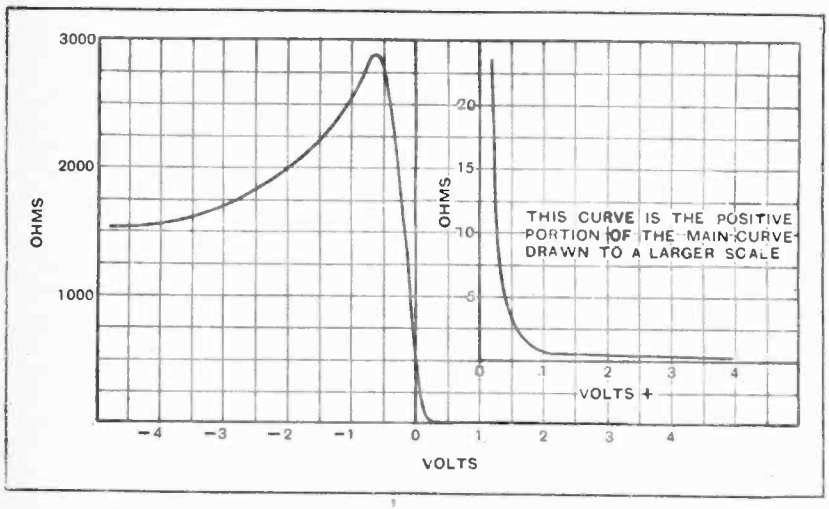


Fig. 1 —Typical characteristic curves of the Westinghouse meta' rectifier showing the relation between resistance and voltage.

[1] *Science*. September 24th, 1926.

The Theory of the Metal Rectifier.—

The fact that full-wave bridge-connected metal rectifiers are the commonest in radio work does not mean that the rectifier is not used in the half-wave variety—frequent applications of the "non-return valve" principle to spark arresters, telephony, and telegraphy circuits are made with half-wave units.

It has sometimes been stated that the small reverse current shown in the characteristic curves of single rectifying discs would militate against the use of the rectifier for battery charging, but a little consideration will show that with a bridge-connected rectifier any reverse current can only result in an increase in A.C. input for a given D.C. output, but, assuming that the supply has failed, the battery E.M.F. would be applied in the reverse direction to two arms of the bridge in series and two such paths in parallel. In practice the rectifier is so proportioned that even under such conditions the discharge that can occur is negligible.

The characteristic curves of a typical rectifier are shown in Figs. 1 and 2. The characteristic curve is not a rigid one; it has been found that certain treatments

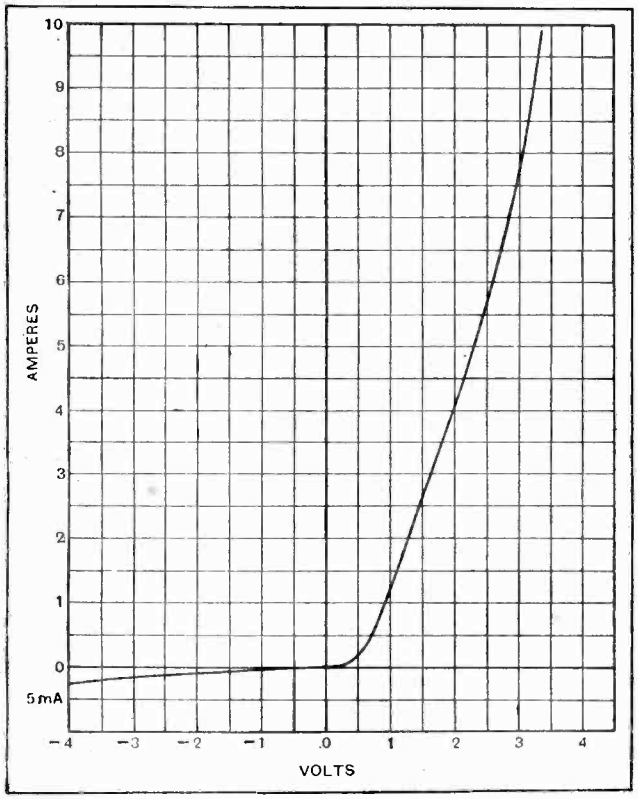


Fig. 2.—Current-voltage characteristics of the metal rectifier.

can be applied which will vary the characteristic widely. This feature enables special rectifiers for instrument work and similar application requiring special performance to be constructed. It will be appreciated that a rectifier required to transpose an appreciable A.C. wattage to the equivalent D.C. wattage should primarily have a negligible internal resistance so that the losses of transposition may not be appreciable. In instrument work the power to be handled is negligible, and internal resistance is secondary to rectifying ratio; for this reason specially made rectifiers, having a high ratio even with appreciable internal resistance, are preferable for this purpose.

The typical characteristic curves in Figs. 1 and 2 show that there are decided optimum points in both the reverse voltage-resistance and consequently in the volt-

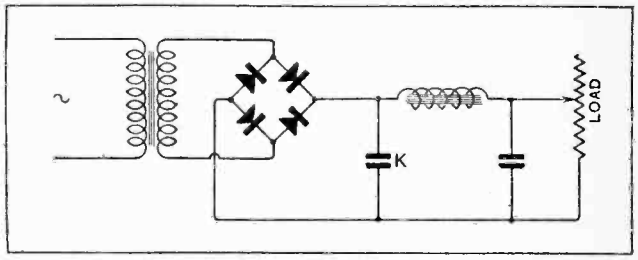


Fig. 3.—A metal rectifier feeding a capacity-inductance filter. The condenser K is charged to the peak value during each half-cycle.

age-rectifying ratio curves, and these optimum points are used in designing rectifiers for special purposes.

In operation the rectifiers are only subjected to a low forward voltage, this voltage being of the value necessary to drive the load current through the units in the low-resistance direction, whereas the voltage at which each unit works and must withstand in the reverse direction is much higher. For this reason static ratio curves are not published here, since they would be misleading.

Effective Cooling Necessary.

Where the optimum point in the reverse voltage-resistance characteristic is not adopted as the design basis, the limitation on reverse voltage becomes the reverse breakdown voltage. This reverse breakdown voltage is itself a variable depending partially on temperatures and mechanical pressures at the rectifying junction. The temperature limit is controlled by the use of cooling fins, oil immersion, or other well-known methods of forced cooling, and the pressure feature by building the rectifier units with spring washers, giving a certain predetermined pressure which is maintained over the whole of the working temperature range. The latter feature accounts for one of the manufacturer's instructions that assembled rectifier units must not have the clamping nuts altered from the factory setting.

In considering the maximum voltage to which rectifiers may be subjected, the circuit being supplied is frequently the governing feature. In Fig. 3 a rectifier is shown feeding a capacity-inductance filter. In such a circuit the condenser K is charged to peak value during each half-cycle; this peak voltage has to be withstood by one arm of the bridge network of the rectifier. As each unit in the rectifier has a limitation on the reverse voltage which it can safely withstand at the maximum working temperature, it follows that this peak voltage will largely govern the number of rectifying units to be used in each arm of the bridge.

The forward resistance-voltage characteristic is largely a matter of area of the unit under consideration, and the question of large area and natural cooling or small area with assisted cooling is largely one for the manufacturer.

The Theory of the Metal Rectifier.—

By paralleling a number of units in each arm of the bridge, the current-carrying capacity of the whole network can be increased to any desired figure. It may be of interest to mention the recent construction of series-parallel units running up to over 1,000 amperes at 12 volts for plating purposes, and of series units up to 80,000 volts for potential purposes.

Enough has been said above on the temperature limitation to indicate that ventilation of housings for metal rectifiers is important. The fact that the larger units have in themselves a considerable mass enables these units to take extraordinary high overloads for short periods of time, these overloads being insufficient to heat the mass of the unit to any serious degree. It is on record that one of the commonest units—that used in many well-known 0.5 amp. 6-volt trickle chargers—has repeatedly rectified 10 amperes for periods of 20 seconds without damage, a performance that few valves could emulate! Such overloads, or, in fact, any load above the manufacturer's rated value, may not cause immediate damage, but will if sustained cause an increase in the forward resistance.

One of the problems in determining what rectifier to use to obtain a certain mean direct current from a filter lies in determining what additional current will be taken from the rectifier and dealt with as ripple current by the condenser immediately following the rectifier. To avoid increasing the load on the rectifier unduly, it is the manufacturer's practice to recommend 2 or 4 mfd. condensers only across the output of the rectifier, these values being sufficient for the "H.T.1" type of unit.

As the measured performance of a rectifier will differ with the nature of the load, the curves in Fig. 4 have been prepared to show these differences when operating on resistance and filter circuits.

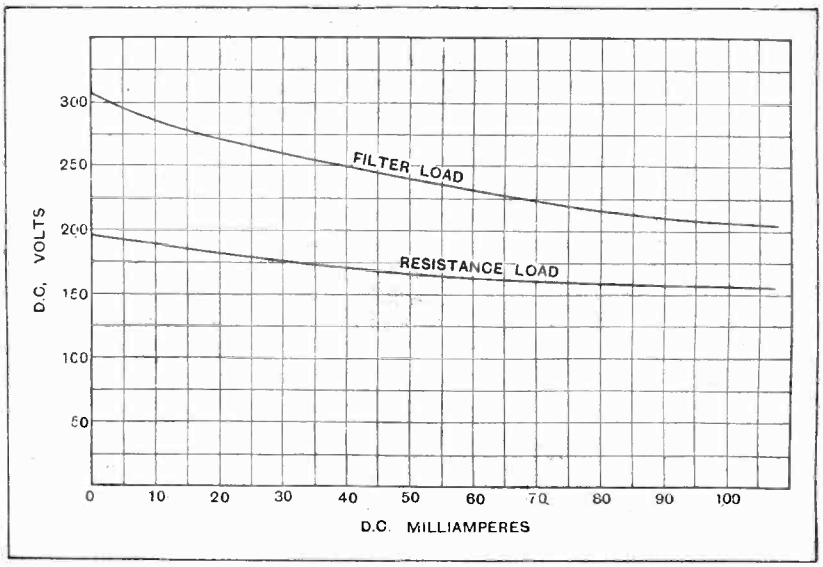
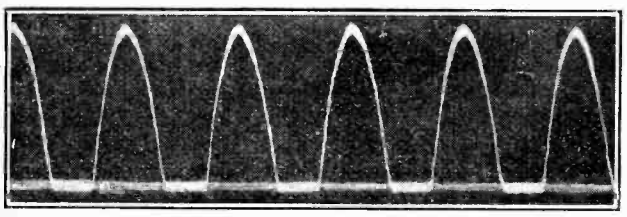
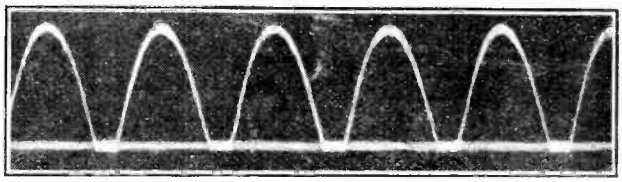


Fig. 4.—Voltage regulation curves for the H.T.1 type of metal rectifier with 250 volts A.C. input. Both filter and resistance loads are shown.

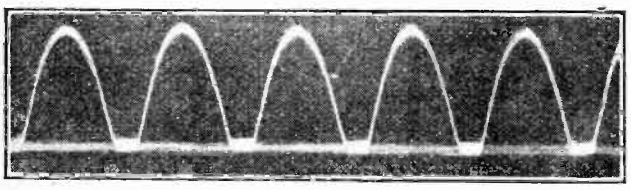
It will be noted from Fig. 4 that when operating on a filter circuit the output voltage is very high at low loads; it is obvious from this that transformers having high open-circuit voltages are undesirable.



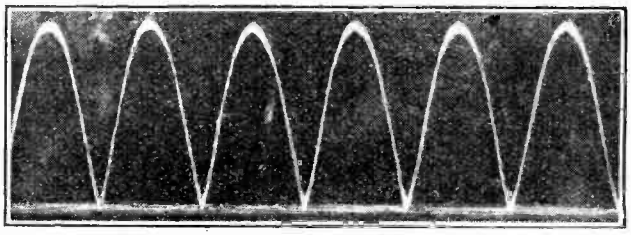
Charging a battery at 0.1 amp.



Rectifier on a charging load of 3.0 amps.



Rectifier charging at 1.0 amp.



Rectifier with a non-inductive load.

Fig. 5.—Oscillograms of output current.

A flash lamp bulb rated at 6 volts 100 mA. placed in the A.C. input leads of H.T. units is desirable.

The output wave-form of the rectifier has been carefully studied, and the oscillograms reproduced in Fig. 5 show the wave-form of a typical unit operating on open circuit, and when charging a battery at several loads. The wave-form is singularly free of any indication of lag in action or other complication, facts which are of advantage in applying the rectifier to many uses.

MEGAVOX ELIMINATOR

Full Constructional Details.

Data for the Design of a Universal H.T. Eliminator.

By W. I. G. PAGE, B.Sc.

(*Concluded from page 791 of last week's issue.*)

IN the first instalment of this article in last week's issue it was shown to be almost impossible to design an H.T. eliminator for A.C. mains capable of fulfilling the needs of various types of multi-valve receiver without a fairly heavy financial expenditure. To conform to regulations and to assure absence of hum, motor boating, and distortion demand a multiplicity of chokes, resistances and condensers which have been tested at high voltages. The theory concerning the isolation of each anode circuit, together with the necessity of series feeds to all but those valves which have exceedingly small currents, has been dealt with at some length, and it is now necessary to give constructional details of the eliminator as specifically designed for the *Megavox-Three*.

In calculating the values of the various resistances which perform the dual function of dropping volts and smoothing out ripple, it should be pointed out that the D.C. resistance of the chokes, amounting to a few hundreds of ohms, need not be taken into account. Examining Fig. 6, and taking first the pentode (H.T. + 4) feed at 150 volts H.T. and 7.5 volts bias, the current is 21 mA. (see Fig. 2). The drop from 265 volts (as shown in the regulation curve, Fig. 4) to 150 is 115, which, when divided by 0.021 amperes (21 mA. expressed as amperes), gives the value of R_1 as 5,500 ohms approximately. The nearest commercial size is 5,000 ohms, and this value is used. The condenser C_1 may have to withstand nearly the full surge voltage, and should be of the type tested at 1,000 volts.

Working Out Resistance Values.

As regards the *Megavox* detector feed (HT + 3), reference must be made to p. 725 of November 28th issue, where the equivalent circuit is shown in Fig. 2 (*b*) and the method of calculating the resistance values is given in the text. The potentiometer shunted across 265 volts should pass considerably more current than that taken by the valve when working under leaky grid conditions; a total value of 50,000 ohms has been considered satisfactory (passing between 5 and 6 mA.). The

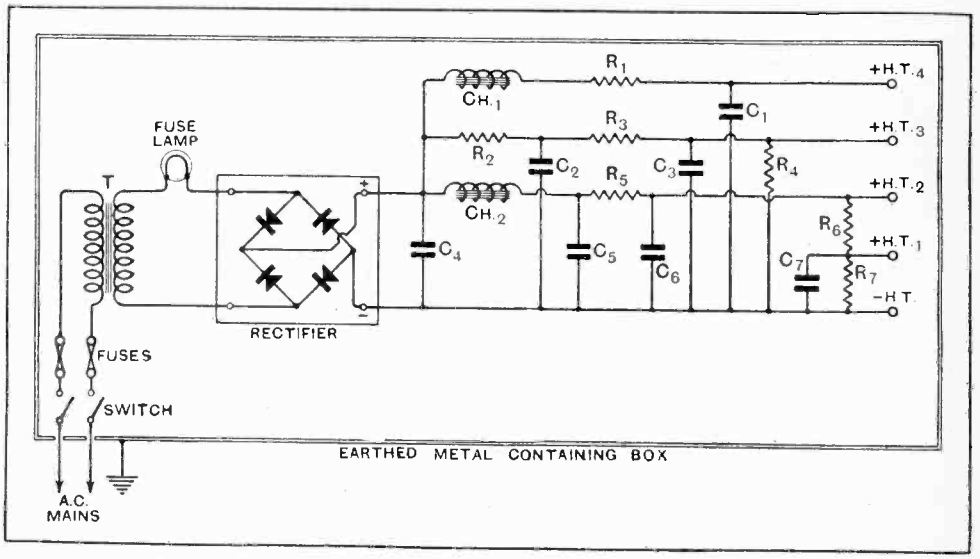


Fig. 6. — The *Megavox-Three* eliminator circuit. CH_1, 20 henrys; CH, 32 henrys; R_1, 5,000 ohms; R_2, R_3, 10,000 ohms; R_4, 30,000 ohms; R_5, R_6, 20,000 ohms; R_7, 30,000 ohms; C_1, C_5, 2 mfd. condensers, 1,000-volt test; C_4, two 2 mfd. condensers in parallel, 1,000-volt test; C_2, C_3, C_6, C_7, 2 mfd. condensers, 500-volt test.

Megavox Eliminator.—

series limb of 20,000 ohms has been divided into two resistances of 10,000 ohms each to assist in smoothing, whilst the second limb, R_4, has a value of 30,000 ohms. Examining Fig. 2 (*b*) in the article already referred to, and substituting the present values, it will be seen that when the switch in the receiver is thrown over to leaky grid the applied voltage is 65, and under anode-bend conditions the voltage is about 140, which, although a little high, is not excessive. The triple potentiometer R_5, R_6, R_7, feeding the plate and the screen of the screened grid valve has now to be considered.

Assuming that R_5 will have to be of such a value that the voltage at H.T.+2 is 150, it is evident that R_6, R_7, is shunted across 150 volts. A convenient total current is 3 mA., which will pass with 50,000 ohms; if the limbs are made 20,000 and 30,000 ohms respectively and the voltage at H.T.+1 is worked out in accordance with Fig. 2 (a) in the article entitled "Dropping Volts" it will be found to be 83, which is a satisfactory screen potential.

Knowing the screen current to be about 0.5 mA., the H.F. anode current 1.9 mA., and the R_6, R_7 potentiometer current 3 mA., giving a total of 5.4 mA., the value of R_5 is obtained by dividing the difference between 265 and 150=115 by 0.0054, which comes to about 20,000 ohms. The condenser C_5 has to withstand the full surge voltage, and should be of the 1,000-volt test variety; C_4 must also be of this type, and consists of two 2-mfd. condensers in parallel. The condensers C_2, C_3, C_6, and C_7, being connected on the receiver side of resistances of 10,000 ohms and over, can safely be of the type tested at 500 volts.

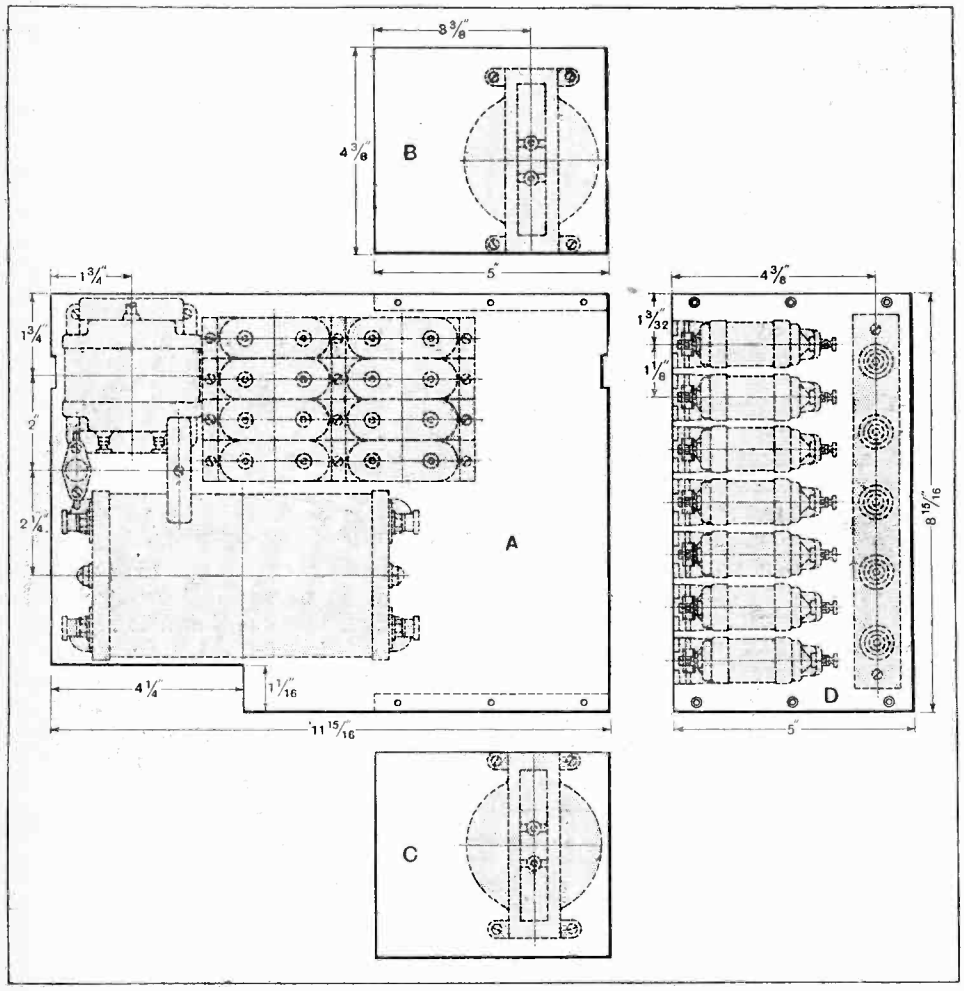


Fig. 7.—The baseboard layout A. The superstructure D is held up by the two vertical boards B and C, to which the chokes are attached.

Gramophone Pick-up.

If the *Megavox-Three* receiver has been modified for use with a gramophone pick-up, as described on page 622 of October 31st, 1928, issue, the resistances R_1, R_6, and R_7 can be removed from their clips, and R_2 and R_3 replaced by resistances of 5,000 ohms each; if these, however, do not provide sufficient smoothing a choke of 32 henrys could be interposed between the common positive lead of the rectifier and R_2. The general layout of the components can easily be seen from the photographs and from Figs. 7 and 8. The fuse lamp in the Burndept resistor holder is mounted on the top of a piece of half-inch wooden dowelling $3\frac{3}{4}$in. long, so as to be visible through one of the ventilation holes in the side of the safety box. The lamp will glow while the receiver is being operated, and will carry the momentary surge voltage without detriment.

To facilitate lifting the chassis clear of the safety box an ebonite rod $4\frac{1}{2}$in. long terminating with a cross piece is attached to the baseboard. The ebonite terminal strip with shrouded, labelled terminals is raised from the top wooden platform by two pieces of ebonite tube. For rapid change of resistances to suit new conditions, the resistance holders have been labelled with numbers which correspond to those in Fig. 6. These numbers can be cut out of an old calendar and attached by means of Chatterton's compound. Readers are not advised to depart substantially from the general layout, for there is a reason for the position of every component; the transformer and rectifier, for example, must be close together and as far away from the output end as pos-

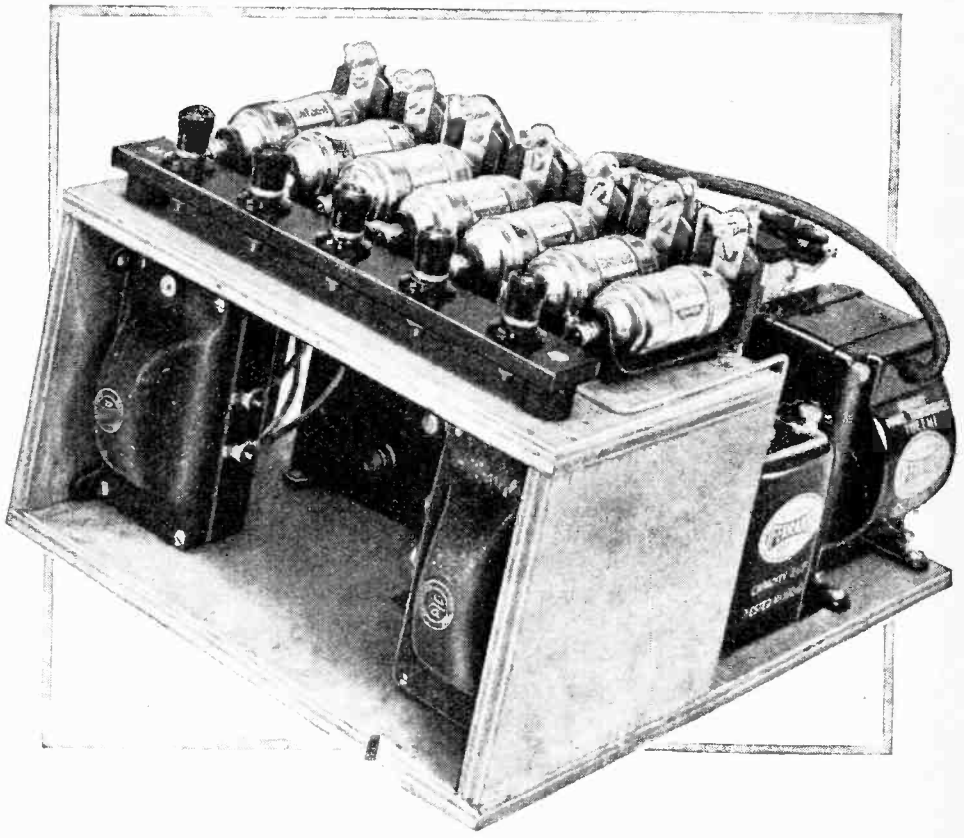
Megavox Eliminator.—

sible. There should be no superstructure above the rectifier which might prevent efficient ventilation. It is advantageous to mount the metal-cased condensers touching each other in two banks of four, whilst the chokes should be as far apart as possible from one another and away from the input end. It is possible for a choke, in spite of metal-shrouding, to have an external field. The logical place for the interchangeable resistances is on a platform near the lid of the box, so that access to them is easy.

The A.C. input through the 3-member flexible cable to the switch in the safety box is best derived from a wall plug, as it is generally easier to arrange an earth point at this position than at a lamp-holder. The five output leads from the eliminator are brought through two holes in the side of the box, and are terminated with insulated spade ends and ivorine tags labelled to correspond with the terminals on the *Megavox* receiver as modified in Fig. 2. The eliminator should be operated about 18in. away from the receiver, for, although the former has an earthed metal case, there may be a small stray field.

As this article will conclude with a *résumé* of the considerations necessary when designing an H.T. eliminator with metal rectifier for almost any multi-valve set, it is important to examine the question of the arrangement of H.T. terminals on receivers in general, for where the anodes of a number of valves have a common feed (without the use of decoupling resistances) it may be found extremely difficult to avoid back-coupling and hum when an eliminator is used. It would seem desirable when designing a set which is destined to be used with either H.T. batteries or mains equipment to provide some of the resistances and by-pass condensers in the receiver, as by this means, on the one hand, there would only be one positive connection to the H.T. battery, and distortion due to its internal resistance would be prevented; while, on the other hand, the eliminator would need to have much less elaborate smoothing equipment, and could be connected to the receiver, which would not have to be modified in layout or wiring. Fig. 9 exemplifies such a suggestion, and, while its advantages will be appreciated, it must be admitted that it incurs an additional expenditure when the receiver is being built. The four H.T. terminals would be short-circuited for battery supply, and the lead XYZ removed for mains operation. The skeleton set shown is a popular combination of screened-grid valve transformer-coupled to an anode-bend detector directly coupled to an L.F. transformer, which, in turn, is connected to a single L.F. power valve. If with H.T. batteries R_{15} and R_{12} are not required, dummy short-circuiting bars obtainable commercially can be inserted in the holders.

A D.C. eliminator for the *Megavox-Three* will be described shortly, having a filter circuit similar to that in the A.C. unit. The receiver will require slight modification for the case where the mains have a positive earth.



View of the chassis showing the disposition of the chokes and the interchangeable resistances.

To return to the A.C. eliminator, the following summary may be found useful when designing such a unit for any three- or four-valve set, the requirements of which are not more than 100 mA. at 200 volts. It is assumed that the present layout will be followed in detail as regards the relative position of chokes, resistances, condensers, fuse lamp, etc., and that the same transformer-rectifier combination will be used. It should be pointed out here that the regulation curve for the transformer alone shows a drop of only eight volts R.M.S. between no load and a load of 100 mA. R.M.S.,

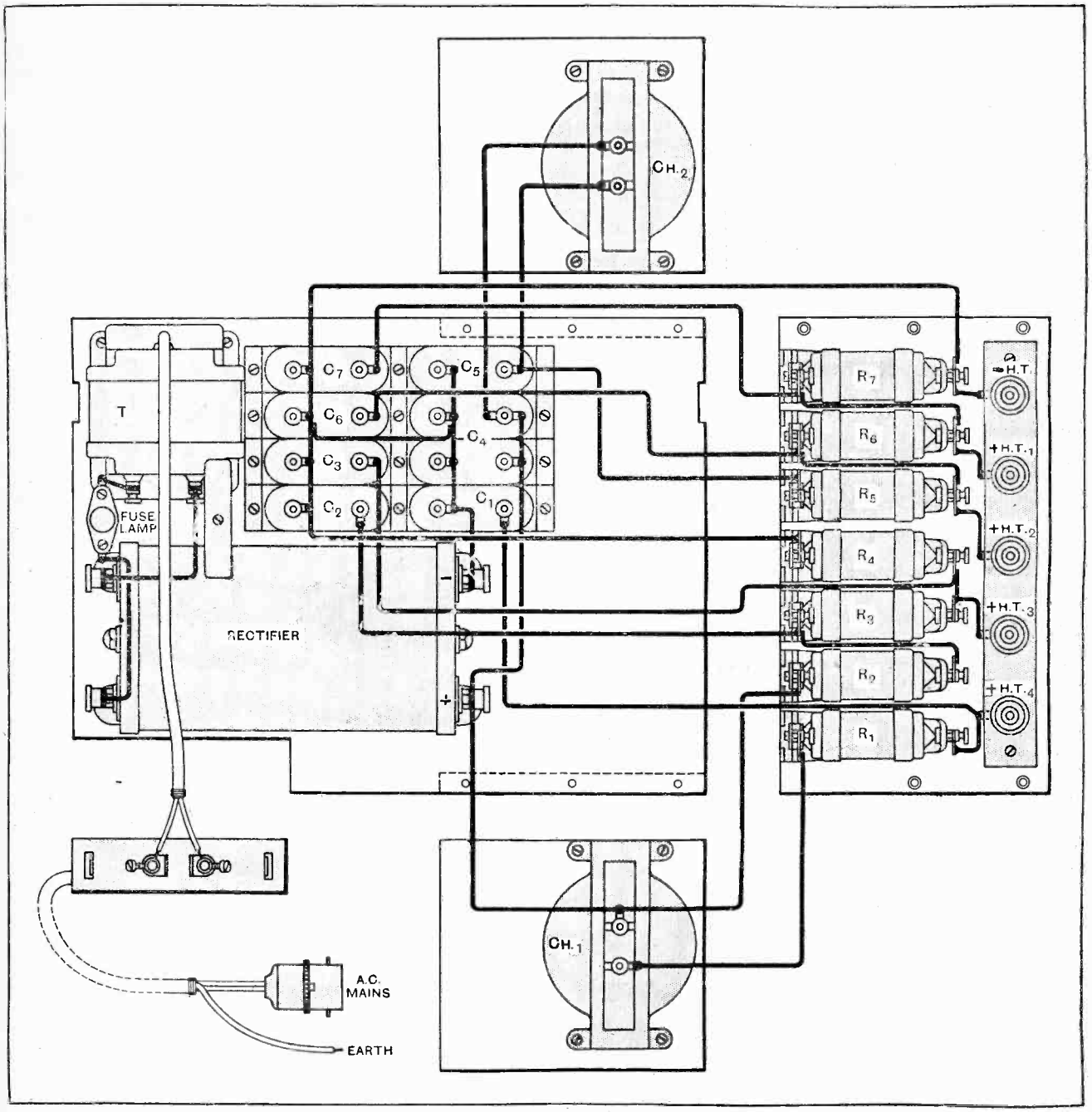


Fig. 8.—The general wiring diagram. It may be more convenient to derive the A.C. input from a wall plug as explained in the text.

which is a very creditable performance. That the regulation curve given in Fig. 4 for the smoothed D.C. output of the rectifier has a greater percentage drop than this is due to the inevitable effective resistance of the rectifier, which, however, is small when compared with other rectifiers. The transformer cannot be supplied for mains with a frequency of 25 cycles.

Summary.

CHOKES should be chosen with a specified inductance which is effective under the D.C. load conditions. Even with metal shrouding there may be a small external field necessitating the mounting of two chokes at a short distance from one another and, if possible, with their axes at right angles. The D.C. resistance of a choke need not be taken into account if it is low compared with that of the voltage-dropping resistances used in the same lead.

CONDENSERS to be used in an eliminator should have low internal resistance, otherwise a potential difference may be set up, resulting in back-coupling. To withstand surge voltages all condensers connected

Megavox Eliminator.—

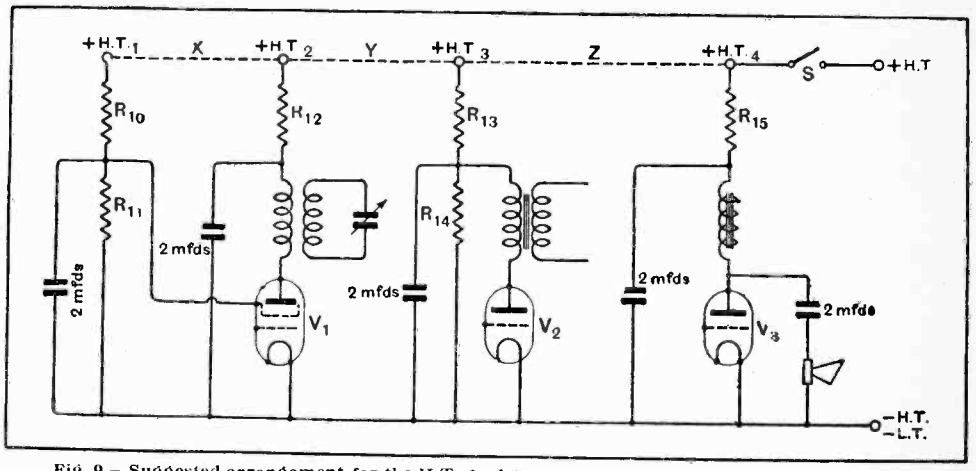


Fig. 9.—Suggested arrangement for the H.T. feed to a multi-valve receiver. The H.T. terminals are short-circuited for battery supply and the lead XYZ is removed for mains operation. A receiver so designed gives a better performance with H.T. batteries and when used with an eliminator the latter would require very simple smoothing equipment.

directly across the output of the rectifier, or only separated from it by a choke, should have been tested at 1,000 volts. If a condenser is connected to the rectifier by 10,000 ohms or over, a voltage test of about 500 is adequate.

RESISTANCES, while having the required current-carrying capacity, must also be capable of dissipating the *watts* without heating up. Resistances are used in an eliminator, not only to drop volts but also to assist in smoothing out ripple, so that where, for instance, a resistance of 40,000 ohms is required to break down a certain voltage it may be advantageous to use two 20,000-ohm resistances in series and connect a by-pass condenser to the junction point (*e.g.*, R_2 and R_3).

SINGLE SERIES RESISTANCES are used where the current is comparatively large, and where there is no change in the steady D.C. current when signal amplitude is altered. Triode H.F. valves, leaky grid detectors, and all L.F. valves would be fed in this way. In Fig. 10 the lead AB represents the usual feed to an output valve where a choke of low D.C. resistance is necessary. A very suitable output valve when using this eliminator is the PX650, which at 200 volts H.T. will handle 80 volts grid swing. If another L.F. stage were used prior to the output valve two resistances in series would be needed, but no choke. With leaky grid detection the feed CD without R_4 would be satisfactory, and for a neutralised H.F. stage the lead EF without R_6, R_7, and C_7 would be used.

POTENTIAL DIVIDERS are necessary for screen current and for the H.T. supply to an anode-bend detector. It is also convenient for the sake of economy to feed the plate of a screened-grid valve from a potential divider which is common to the screen. It must be remembered that the greater the current passing through a potentiometer the less the change in voltage on the valve when the current alters, but the less the smoothing by reason of the small values of resistances used; a compromise must thus be struck. In Fig. 10 EF represents a typical feed to the plate and screen of a screened-grid valve, provided that H.F. transformer coupling is used. If tuned anode is employed, a choke would have to be embodied in the lead EF, as in the eliminator for the *Megavox*. CD together with R_4 give adequate smoothing and a steady supply when signals of varying amplitude are applied to an anode-bend detector.

TWO SCREENED-GRID VALVES coupled by H.F. transformers can be fed from one tapping, such as EF, provided that the extra current taken is considered when fixing the values of R_5, R_6, and R_7.

TWO VALVES IN PUSH-PULL can be operated from the lead AB.

THE GENERAL PROCEDURE is to decide on the smoothing arrangement demanded by the receiver circuit, and to work out the H.T. current taken by the set plus the potentiometers (if any). The voltage regulation curve (Fig. 4) will give the input voltage to the filter for the total load, and the resistances which are required to drop the necessary volts can be calculated.

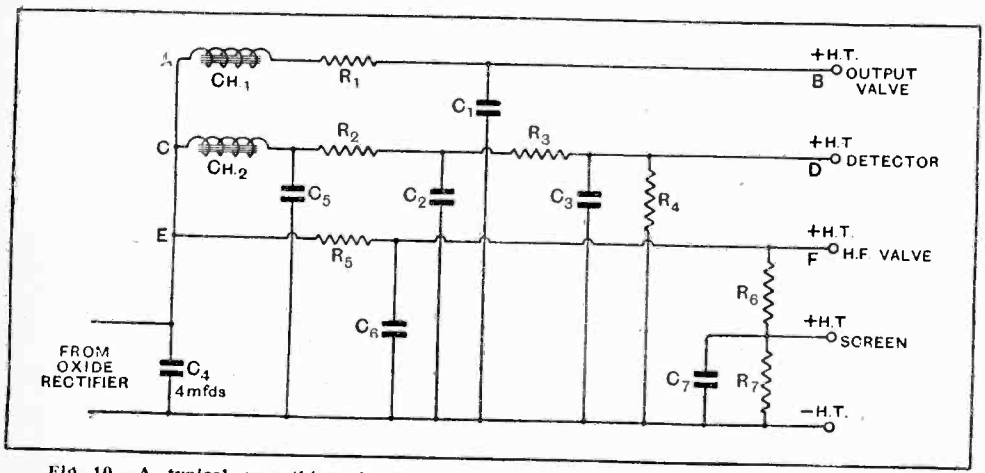
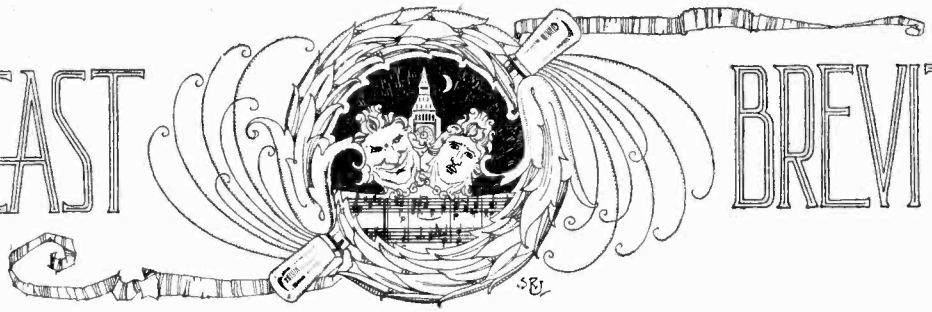


Fig. 10.—A typical smoothing circuit which can be adapted for use with almost any three- or four-valve set not employing tuned anode coupling.

This eliminator is available for inspection by readers at the Editorial Offices of this journal: 116-117, Fleet Street, London, E.C.4.

BROADCAST BREVITIES



By Our Special Correspondent.

Broadcast Drama Developments.—"Research Programmes."—The Case of the Relays.—On New Year's Eve.—"24-Hour Time."—The Savoy Hill Site.—Interrupted Speeches.

Dramatic Changes.

Various important changes are under contemplation at Savoy Hill in connection with the Dramatic Department. For instance, I hear that Val Gielgud, who assists Eric Maschwitz in the production of the B.B.C.'s official organ, is to take over R. E. Jeffrey's duties, while "R.E." himself will devote himself to "Research Programmes."

o o o o

No Connection with Clapham.

These "Research Programmes" have nothing in common with activities of Captain West, who is busy in research programmes of his own. The "Research Programmes" have earned their name, I gather, from the amount of research which goes to their compilation.

Among recent examples of this form of entertainment have been "Love" and "Kaleidoscope," both by L. de G. Sieveking, produced since he left the Talks Department.

o o o o

Musical "Scenery."

There is a growing tendency towards this drama-*cum*-music-*cum*-literature form of broadcast in the B.B.C. programmes, and one assumes that here the Corporation is following the demands of listeners. The idea is, partly, to give musical "scenery" to atone for the lack of legitimate stage furniture.

The results are often successful, but several listeners of my acquaintance confess that music, of whatever kind, is always too obtrusive to form a mere background; they cannot give complete attention to the spoken word so long as there is a fragment of a tune in the offing.

o o o o

A Busy Task.

As dramatic producer for several years, R. E. Jeffrey has prepared more than fifty plays for broadcasting and has himself written six, the most noteworthy of which was "Speed," produced about six months ago.

In view of forthcoming developments in "Research Programmes," "R.E.," as he is familiarly known, is likely to be very busy indeed.

o o o o

A Deputation from Sheffield.

If the importance of broadcasting in the modern scheme of things required further emphasis it was surely furnished by the deputation which waited upon Sir John Reith at Savoy Hill a few days ago.

The deputation, which spoke for the citizens of Leeds, consisted of Sir William Hart (Town Clerk), the Deputy Lord Mayor, the Pro-Chancellor of Sheffield University, the Director of Education, and representatives of the Chamber of Commerce.

FUTURE FEATURES.

London and Daventry.

DECEMBER 23RD.—"The Messiah," relayed from York Minster, S.B from Leeds.
DECEMBER 25TH.—Service relayed from St. George's Chapel, Windsor.
DECEMBER 27TH.—Programme composed by A. J. Alan.
DECEMBER 28TH.—"Montezuma," a play by C. A. Lewis.

Daventry Exp. (5GB).

DECEMBER 23RD.—Excerpts from Bach's "Christmas Oratorio."
DECEMBER 24TH.—"The Do-Drop Inn," a comedy by Gladys Joiner.
DECEMBER 25TH.—"Dick Whittington."
DECEMBER 27TH.—"Montezuma."
DECEMBER 28TH.—"Out of the Hat," a Christmas Vaudeville Draw.

Cardiff.

DECEMBER 25TH.—"Upon the Midnight Clear," a Christmas Evening in a Welsh Village, by Vaughan Thomas.
DECEMBER 26TH.—"Hänsel and Gretel," a fairy opera by Adelheid Wette.

Manchester.

DECEMBER 24TH.—"Scrooge," adapted from "A Christmas Carol" (Charles Dickens), by J. C Buckstone.

Newcastle.

DECEMBER 27TH.—"King Midas," an operetta.

Glasgow.

DECEMBER 25TH.—"No Room at the Inn," a Christmas Morality Play by David Cleghorn Thomson.
DECEMBER 28TH.—"Oor Ain Fireside," a Scots Christening.

Aberdeen.

DECEMBER 25TH.—A Scottish Feature Programme.

Belfast.

DECEMBER 24TH.—"Christmas Eve in Ballymulcaghey."

Drawbacks to Group Programme System.

All these gentlemen protested against the new dispensation which would turn 6FL into a mere mouthpiece for the Manchester station. Sheffield, like Liverpool and Hull, is suffering from the group programme system, which centralises all northern broadcasting at Manchester, to the detriment of local talent.

The B.B.C. expresses entire sympathy with local aspirations, but contends that the grouping system is essential in preparation for the Regional Scheme which will, it is hoped, provide a satisfactory alternative service to every listener in the country.

o o o o

Pertinacity Required.

It looks as if Sheffield and the other affected towns will have to accept the present situation with as good a grace as possible, but all fair-minded listeners will heartily second their efforts to obtain reasonable representation at the microphone. Their best course will be to continue the fusilade at frequent intervals; only their own sturdy efforts will prevent the main station from gradually assuming entire control of the programme material.

o o o o

Seeing the New Year In.

On New Year's Eve listeners will hear a star vaudeville programme from 2LO, 5XX, and other stations.

The artists are expected to be the Trix Sisters, Neil Kenyon, Jack Strachey, Madge Kennedy, and Violet Essex. The programme will wind up with reminiscences entitled "Songs we used to sing." Finally we shall hear Mr. J. C. Stobart's "Grand Good Night," which is now a regular event in the annual calendar.

o o o o

"24-Hour Time."

If the plea of the Astronomer Royal for the general adoption of "24-hour time" meets with success, one of the first evidences of the new order of things will appear in the broadcast programmes.

Already many of the Continental stations use the 24-hour clock, so long-distance listeners will have no difficulty in accommodating themselves to the new conditions. As for DX enthusiasts, "ack emma" and "pip emma" have long vanished from their vocabulary.

o o o o

Heartache.

I hear that there is already a certain amount of heartache over the prospect of leaving "the precincts of the Savoy." In many respects the place is ideal for

broadcasting headquarters. The heavy traffic of the Strand is well out of earshot, and even the Embankment, with its trams and other heavy vehicles, is separated from Savoy Hill by the pleasant Embankment Gardens.

If a portion of the present building were not in the honourable occupation of the Institution of Electrical Engineers the new Broadcasting House would undoubtedly have been built on the Savoy site.

o o o o

A Misconception.

In occupying "Broadcasting House" as ordinary rent-paying tenants, the B.B.C. will be creating no precedent. The present building at Savoy Hill is Crown property, coming under the estate of the Duchy of Lancaster, and the rent paid by the B.B.C. is, it will be noticed, in the annual revenue account.

During recent constructional alterations at Savoy Hill the sudden appearance of the Royal Arms over the main entrance suggested to many people that a final touch was being given to the "official" nature of the B.B.C. As a matter of fact, the Royal Arms merely indicated the ownership of the building and bore no relation to the activities of the tenants!

o o o o

A Prince as Soloist.

At the National Sunday League concert to be broadcast from the Palladium on January 6th, Grieg's Piano Concerto will be played by Prince George Chevchevadzi. The new Symphony Orchestra is to be conducted by Dr. Malcolm Sargent.

o o o o

Mr and Mrs. O. Listener.

On New Year's Eve, Belfast is to broadcast some "Reminiscences of 1928," in which Mr. and Mrs. Ordinary Listener will spend an hour reviving memories of those programmes which have given them the most enjoyment during the past year. Symphony concerts, variety, opera, plays, and running commentaries will pass in ghostly procession as the magic of the microphone evokes their shades.

o o o o

For Older Children.

L. du Garde Peach's fantasy, "The Charcoal Burner's Son," was one of the most successful Children's Hour features of 1928. There have been many demands for a repeat performance, and the B.B.C. proposes to meet them by including the fantasy in the evening programme on January 4th, so that the elder, as well as the younger, children may hear it. The cast will include members of the B.B.C. staff.

o o o o

A Shavian Joke.

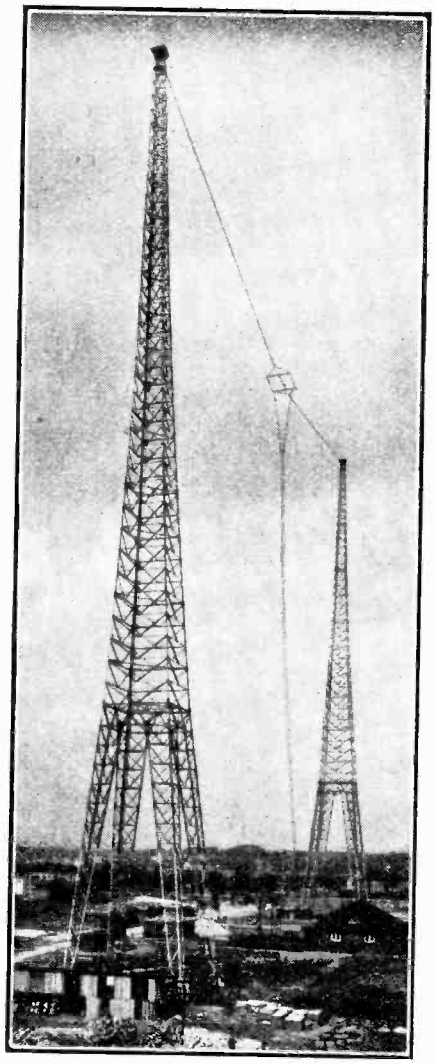
I wonder how many talkers other than George Bernard Shaw would have been allowed to tantalise listeners as he did on December 7th? He spoke at the Royal Academy of Dramatic Art for more than an hour, though we may assume that he was aware that the allotted period for broadcasting was three-quarters of an hour. What happened was that listeners were cut off in the midst of his sins.

o o o o

Interrupted Speeches.

It is surely a debatable point whether the B.B.C. should undertake the broadcasting of speeches which are likely to be interrupted before their conclusion. To listen to a speech without hearing the conclusion is often a pure waste of time.

Not always, of course.



A POPULAR STATION. A striking view of the masts at Hamburg. The station can be heard nightly on 394.7 metres.

The Swing of the Pendulum.

In the days of the old carbon microphone there was no need for Sir Harry Lauder's wet towel device to damp out the accompaniment. The soloist had the field to himself, and if the accompaniment leaked through with any precision it was a sure sign that the singer was (*a*) prolonging the pauses, (*b*) getting tired, or (*c*) suffering from laryngitis.

Pianoforte Accompaniment.

Whereas, in the old days, pianoforte accompaniments in the studio were too soft, they are now too loud, and the result is unpleasant flatness except when the singer is "swamped," as often happens. The result is as unfair to the accompanist as to the singer.

In most outside halls, however, the "stereoscopic" effect is at once evident. The piano is heard as a member of the audience hears it—assertive enough at the right moment, but always subservient to the singer.

o o o o

Sanctity of the Studio

If the B.B.C. wish us to retain a proper respect for the sanctity of the studio they must really give up outside broadcasting, or do something to spoil it. Recent "O.B.s" have been so good as to put many of the studio performances into the shade.

o o o o

A Maeterlinck Play.

On January 3rd Maeterlinck's symbolic play, "The Sightless," will be broadcast from 2LO and 5XX. It will be preceded by explanatory notes.

o o o o

Scottish Group Programmes.

Aberdeen is providing a programme for all Scotland on January 2nd. This is one of the first Scottish "group" programmes which 2BD has put on under the new scheme. The programme includes songs by Lawrence A. Morgan, a Glasgow tenor, violin solos by Alec Nicol, reels and strathspeys played on the mouth organ by Donald Davidson, and selections by the Station Octet. A feature will be the duet arrangements of Scottish songs sung by two well-known Edinburgh singers, Marion Richardson and Dorothy King. There will also be a short Scots comedy sketch by Rae Elrick called "The Finishing Touch."

o o o o

A Distinguished Listener.

The Talks Department are confident that their listeners are growing in numbers and that many eminent people are included among the supporters of the present talks policy.

Sir Maurice Amos, who recently gave a talk on Egypt, was heard by Sir Austen Chamberlain, and on the following day received a telephone message asking if he would call and discuss the subject with the Foreign Secretary.

o o o o

Letters to Talkers.

Many broadcast speakers receive dozens of letters from listeners, and it is only by chance that news of these percolate through to Savoy Hill. Sometimes the B.B.C. only learns of the fact when a speaker, in a subsequent talk, mentions how many letters he had received in regard to his previous effort.

Few letters are forwarded to speakers c/o B.B.C. In most cases, listeners are enthusiastic enough to hunt up the addresses of the talkers and send their letters direct.

USEFUL DATA CHARTS. (No. 19. STAGE I.)

Diameter of Wire or Strand to give Coil of Minimum H.F. Resistance.

THE theory involved in designing coils of minimum H.F. resistance, whether single or multi-layer, has been given by Butterworth:[1] his results may be expressed as follows:—

Let L = self-inductance of coil in microhenrys.
S = a shape factor.[2]
D = diameter of coil.
f = frequency in cycles/sec.
d = diameter of wire or strand required.
n = number of strands.
σ = a number depending on n.

Then for solid wire coils a quantity P^2 can be calculated such that $P^2 = LS^2/D^3$.

A curve is then given connecting f/P^2 and Pd so that Pd can be read off and d revealed.

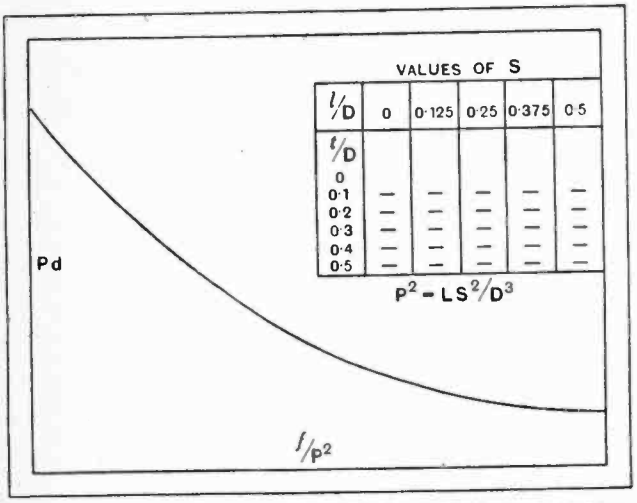


Fig. 1.—Chart by Butterworth giving the best diameter of wire or strand.

When stranded wire is used, P^2 must be replaced by $\sigma + n^2P^2$, and the curve used as before to find Pd and d. d now means the diameter of a single strand.

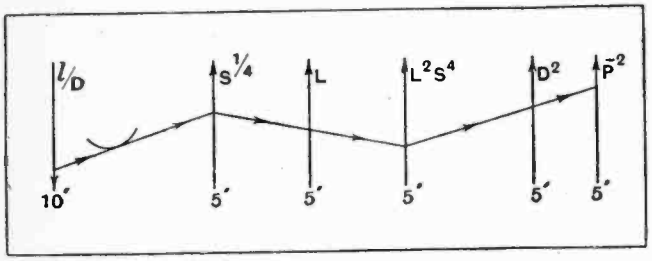


Fig. 2.—The extended abac is here shown; equal scales are used except for l/D, whose scale is immaterial

Butterworth puts D = *outside* diameter of coil, but for graphical computation it is better to use the *mean* diameter: the values of S have been re-calculated on this basis and have been extended over a greater range.

[1] *The Wireless World*, Dec. 8th, 15th, 1926, pp. 754, 811.
[2] Depending on two quantities: (*a*) ratio of axial length to diameter of coil; (*b*) ratio of radial thickness to diameter of coil.

The operations summarised above are carried out in three stages. Stage 1, which accompanies this article, gives P^2 for solid wire coils. Stage 2, which will appear as the next useful data chart, will give $\sigma + n^2P^2$ for stranded wire. Stage 3 will finally give d.

Fig. 2 shows the extended abac using equal scales (except for l/D, whose scale is immaterial): it is easy

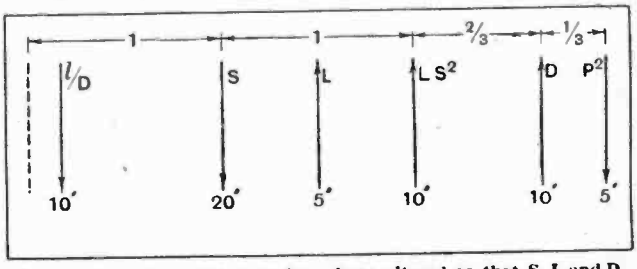


Fig. 3.—Here the scale units have been altered so that S, L and D can be read off directly.

to verify that $P^2 = LS^2/D^3$. Note that D^2 is not midway between L^2S^4 and $1/P^2$, which position would require a special scale for D^2. In Fig. 3 the scale units have been altered so that S, L, and D can be read off directly, and Fig. 4 is obtained by folding Fig. 3 in three, using S and LS^2 as hinges. S and LS^2 are no longer required, and disappear into reference lines.

The Shape Factor Curves.

These have been plotted for a single-layer solenoid and for multi-layer coils whose ratio of thickness to mean diameter ranges from zero to unity. In the case of $t/D = 0.05$, $t/D = 0.1$, each curve shows a kink, and the short arm of the curve merges into the curve for $t/D = 0$, and coincides with it for the rest of its course.

A single-layer coil of 200 microhenrys is wound to a length of 2in., and its diameter is 4in. We start at the point $l/D = 0.5$, draw a tangent to the curve

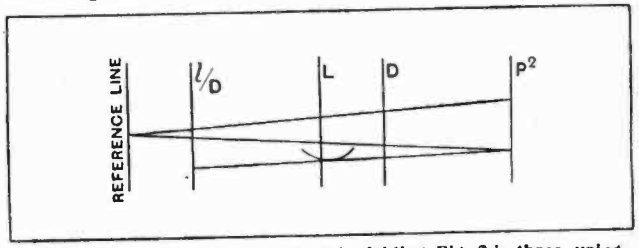


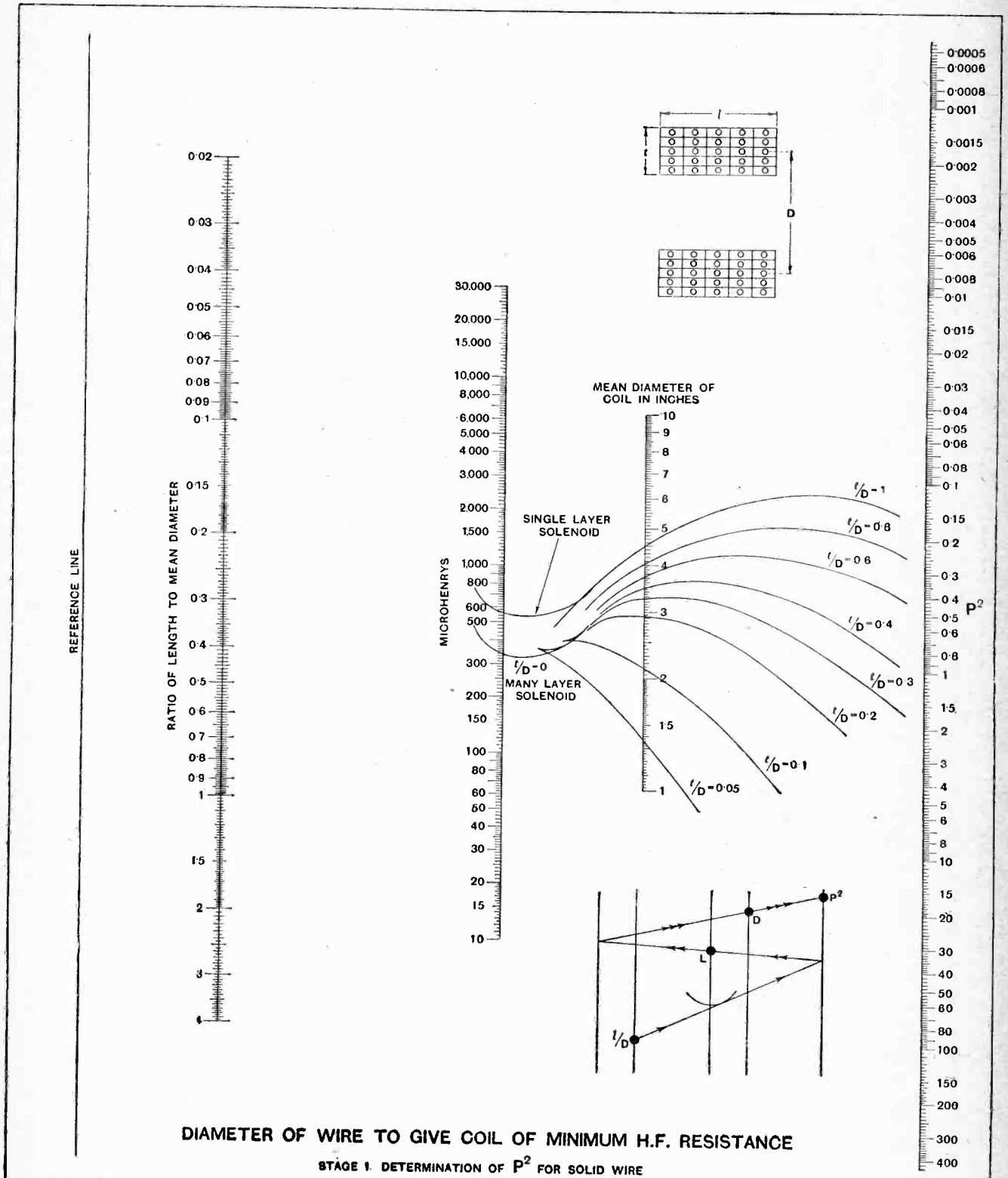
Fig. 4.—This diagram is obtained by folding Fig. 3 in three, using S and LS^2 as hinges.

marked "single layer solenoid," and after passing through L and D we obtain $P^2 = 0.044$.

A multi-layer coil has L = 20,000 microhenrys, mean diameter = 10in., length = 10in., thickness = 10in. Hence $l/D = t/D = 1.0$. We obtain finally $P^2 = 0.105$.

Stage 2, which will be the next published abac, is only necessary when stranded wire is used. When P^2 has been found by Stage 1 for a solid wire coil, Stage 2 enables us to find the value of $\sigma + n^2P^2$, which replaces P^2.

R. T. B.



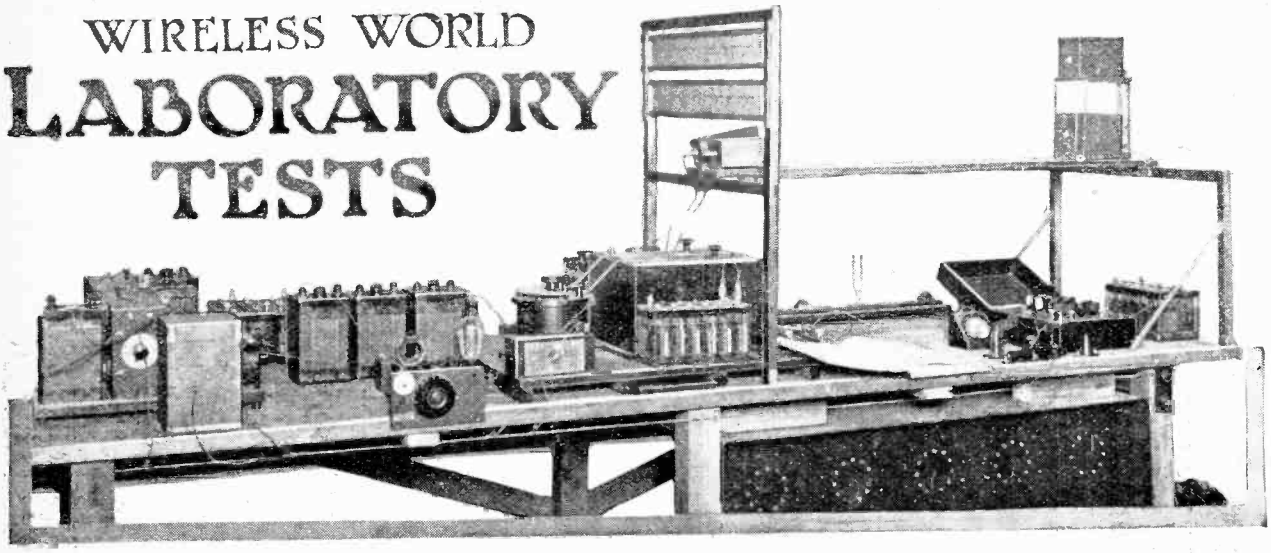
DIAMETER OF WIRE TO GIVE COIL OF MINIMUM H.F. RESISTANCE

STAGE 1. DETERMINATION OF P^2 FOR SOLID WIRE

W.W. ABAO

Nº 19
STAGE 1.

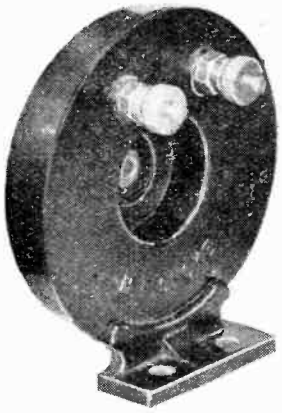
WIRELESS WORLD LABORATORY TESTS



A Review of Manufacturers' Recent Products.

IGRANIC H.F. CHOKE.

The wire in this choke is wave-wound and the finished coil looks like a miniature edition of a honeycomb plug-in tuning coil. The D.C. resistance is low and the impedance curve indicates that the H.F. resistance is also lower than the



Igranic H.F. choke; D.C. resistance, 239 ohms.

average. The curve approximates more closely to the form of tuning curve to which we are accustomed, more particularly at the base, which is flatter than usual. This means that the choking effect is more evenly distributed over the 200-500 metre band—a property which should tend to give equal reaction over this band if the reaction coil and feed condenser are suitably chosen.

The impedance values at various typical wavelengths are as follow :—

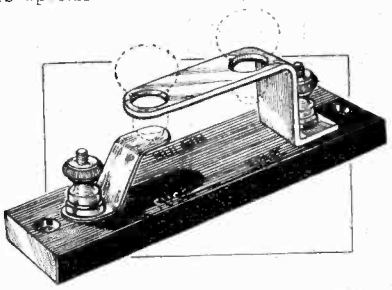
Wavelength (metres).	Impedance (ohms).
200	8,500
500	12,000
1,600	136,000

With 8 micro-mfd. external capacity across the choke the resonant wavelength is 2,650; in the average receiving circuit the resonance would be higher and it would be safe to assume that self-oscillation due to the choke would not occur below 3,000 metres.

The winding is completely enclosed in a moulded bakelite case provided with terminals and a moulded foot for baseboard mounting.

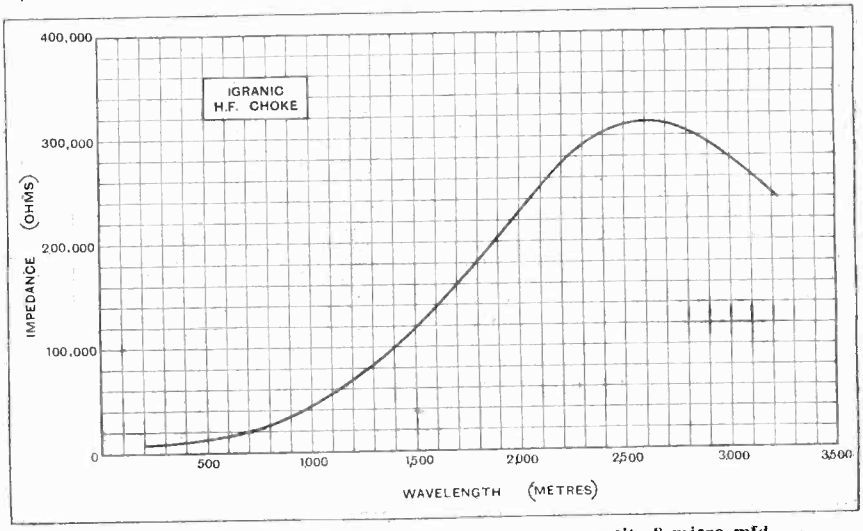
"BULGIN" SAFETY FUSE HOLDER.

As it is now possible to obtain small bulbs of the "flash lamp" pattern which "blow" at a very low current, the employment of these as safety fuses in H.T. circuits is becoming more general. Hitherto the advantages conferred by fuses of this type were more imaginary than real, unless, of course, the receiver was fitted with a sufficient number of valves. Those who follow the safety-first policy and fit fuses must, at some time or other, have experienced the annoyance of not being able to lay their hands on a spare lamp when a fuse has satisfactorily performed its special function. Messrs. H. F. Bul-



The Bulgin safety fuse holder. Provision is made for a spare fuse lamp.

gin and Co., foreseeing this difficulty, have produced a fuse lamp carrier, with accommodation for a spare lamp, and if these are always kept loaded it will never



Impedance curve of Igranic H.F. choke; external capacity 8 micro-mfd.

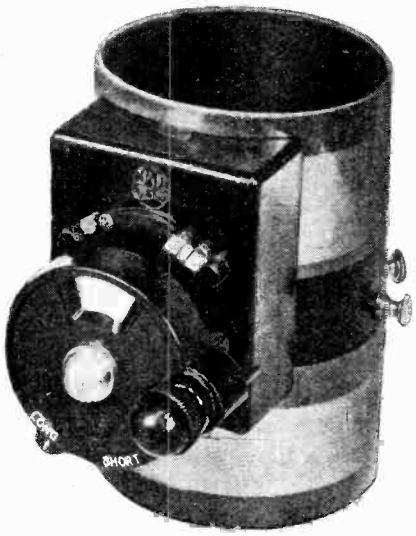
be necessary to endanger the valves by operating the set without adequate safeguards.

The price of this useful component is 1s. 3d., without fuses, and the maker's address is 9-11, Cursitor Street, Chancery Lane, London, E.C.4.

o o o o

A NEW TWO-RANGE AERIAL TUNER.

Messrs. R.I. and Varley, Ltd., have long specialised in all-wave tuning devices, and the latest addition to their wide range of components is an aperiodic



A two-range tuner, an R.I. and Varley product.

aerial tuner. This consists of a paxolin tube 3½in. in diameter and 5in. long, carrying two coils spaced about 1¾in. apart and protected by celluloid strips. Normally the two coils are in series, but a switch is fitted to short-circuit one coil for reception on the medium broadcast wave-band. This is mounted on a moulded bakelite box cover, which protects also the various wires connected to the switch.

The reaction coil is wound on a former of smaller diameter than the outer tube, and can be rotated through 180°. This former is carried on a spindle passing through the centre of the switch arm and terminating in a small, slow-motion dial. The driving knob is fitted on the right-hand side of the dial, and not below as is usual in reduction drives. The object of this is to leave the lower portion free from obstruction to accommodate the arm actuating the wave change switch. The upper portion of the dial cover is cut away, forming a window through which can be seen the graduation on the ivorine scale, and to facilitate accurate adjustment a fine hair line has been fitted on the celluloid inset covering the window.

Six terminals are fitted on the large former, two being connected by flexible leads to the reaction winding, one to each outside end of the tuning coils marked "G" and "E" respectively, and the remaining pair go to tappings on the medium-wave coil. These are marked A1 and A2, and are intended as alternative aerial connections. Used in conjunction with a standard P.M.G. aerial (about 100 ft. of wire) and connected in shunt with a 0.0005 mfd. variable condenser, the medium-wave coil tunes from about 265 metres to 600 metres, and with the loading coil in circuit from 1,200 to 2,000 metres. Although the two ranges do not overlap, the blank portion should not be noticed, as there are so few broadcast stations working between 600 and 1,200 metres.

The tuner is designed for single hole fixing, but a small hole should be drilled in the panel to take the positioning pin protruding to the rear of the dial. The function of this is to hold the dial cover rigid and prevent this rotating when adjusting the reaction coupling. Each carton contains a book of instructions which explains fully the method of mounting the turns and the connections to the various terminals. In addition, some very useful circuit diagrams have been included showing the many uses to which the device can be put. The tuner is a product of Messrs. R.I. and Varley, Ltd., Kingsway House, 103, Kingsway, London, W.C.2, and the price complete is 25s.

o o o o

A NEW PYE TRANSFORMER.

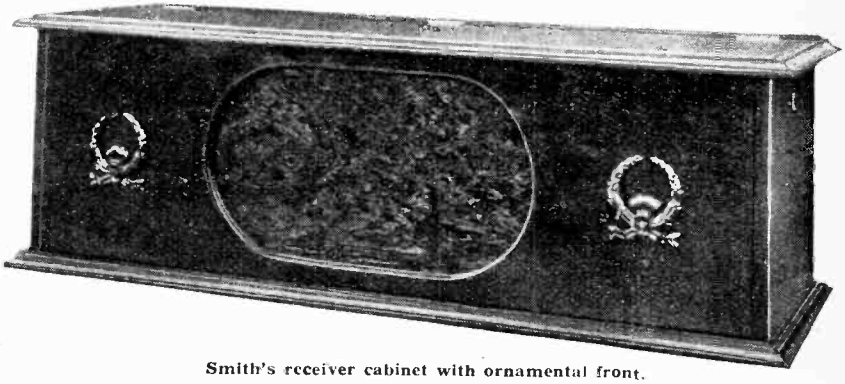
An output transformer designed specially for use in sets fitted with a pentode output valve has been put into production by Messrs. W. G. Pye and Co. The secondary winding has been arranged to suit the average medium impedance loud speakers, and best results will be obtained under these conditions.

The price of this new component is 20s., and the maker's address is "Granta" Works, Montague Road, Cambridge.

o o o o

SMITH'S CABINETS.

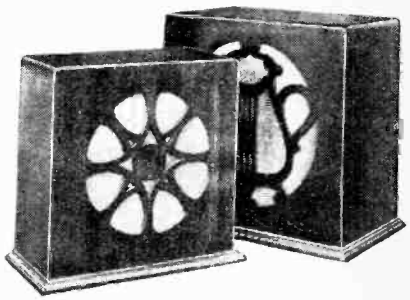
The three cabinets reviewed all exhibit very fine workmanship and finish. The receiver cabinet accommodates a panel 26in. × 8in., a baseboard 8in. in depth, and has an ornamental front with an oval shaped opening measuring approximately 12in. × 6½in. across the major and minor



Smith's receiver cabinet with ornamental front.

axes. It is fitted with a hinged lid and a removable back. This slides upwards in grooves cut in the sides. Two rectangular-shaped openings have been left in the back to accommodate terminal strips for aerial, earth and battery leads. The price of the cabinet as illustrated is 32s. 6d.

The two loud speaker cabinets measure 12 × 12 × 8in. and 10 × 10 × 6in. respectively, the former having a circular ornamental grille 10in. in diameter and the smaller 7½in. In both cabinets the apertures are covered with tinsel attached to the inside. These are ideal for the home constructors' use; the larger size, which costs 15s., is suitable for mounting moving-coil type of loud speakers, and the smaller is



Two loud speaker cabinets by S. A. Smith. The larger of the two is suitable for housing a moving coil loud speaker.

perhaps more suitable for the reed-driven cone type. The price of this in mahogany, oak or teak is 10s. 6d, and the makers are Messrs. S. A. Smith, 159, New Kent Road, London, S.E.1.

o o o o

HAY'S RADIO WAX.

This is a compound specially prepared for wireless purposes and is ideally suited for sealing fixed condensers after repair, or to protect exposed metal parts of accumulators or wet batteries against corrosion, due to creeping of the electrolyte. Its melting point is between 125° and 130° F., so that it will not melt or become soft at normal atmospheric temperatures. As it is an excellent substitute for paraffin wax, and, moreover, being black imparts a more workmanlike appearance, the experimenter will find this a very useful addition to the workshop equipment.

The makers are Hay's Marine Waterproof Glue Co., Ltd., 6, Surrey Street, Portsmouth, and the price is—small size tin 6d., 1lb. size 2s, and 7lb. tins 7s. 6d.

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

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

TELEVISION.

Sir,—I overlooked the letter from Mr. E. J. Crampton, which appears to have inspired replies by two correspondents.

I am compelled, however, to reply to "D.A.T." and Mr. McDowell in your issue of November 28th. The former says: "The B.B.C. have no axe to grind by their recent ban on television, and are merely acting in the interests of the listener"; the latter almost offers the same argument.

But how do they know that? The B.B.C. have not said *why* they rejected television, and, in view of the methods employed in the turning down of this twentieth-century wonder I take leave to doubt that all the representatives who visited the Baird laboratories were unprejudiced.

After all, what it comes to is this. For reasons best known to themselves, and certainly not to me or the multitude of amateurs who read *The Wireless World*, the B.B.C. granted facilities to wireless pictures which they withheld from television. If the same chances are afforded television as were afforded wireless pictures, and if the same results accrue, then we who support Mr. Baird will have nothing to grumble at. As it is, we certainly feel a definite grievance, and do not propose to accept the B.B.C. decision, with the rather strange air of mystery and suggestion of intrigue which is behind it.

It will be for the world of amateurs, and not the B.B.C., to decide what there is in television. The attitude of *The Wireless World* in the matter is reasonable enough.

S. A. MOSELEY,
Television Press, Ltd.

26, Charing Cross Road, W.C.2.

CARDIFF HETERODYNED.

Sir,—Can you use the undoubted influence of your valuable paper to expedite the removal of the awful heterodyning of the Cardiff Station? Every evening from 6 o'clock some station interferes and provides a continual background to Cardiff reception. Then at 8.30 starts such a howling and whistling that it is hardly worth listening to the local broadcast. This latter station is, I believe, Algiers.

The Brussels laboratory published a chart for August showing how the Algiers wavelength has dropped to that of Cardiff.

Letters to the B.B.C. elicit an expression of regret and an assurance that "Everything possible is being done." Surely some remedy could have been found since August?

Your help will be greatly appreciated, and if this letter will only tempt you to use your good offices I shall be very pleased.

CYMRO.

Cardiff,
December 5, 1928.

TRANSMISSION QUALITY.

Sir,—Different letters under the above heading appearing in your highly esteemed paper remind me very much of correspondence appearing some years ago in an American magazine under the heading of "Brickbats and bouquets"—with bouquets for the B.B.C. far and few between.

At a distance of nearly 1,000 miles from the Daventry stations I am fully aware of being unable to judge the justness of some of the criticism levelled at the transmission quality of these stations. It is fact, however, that at times 5GB comes through here so well that I doubt whether it could be better received even in the more distant points in England. At such times the quality is so noticeably better than most of the stuff "put on the air" by the rest of the European inferno that I cannot understand anyone suggesting that the B.B.C. could learn anything from its foreign rivals (from the technical side, anyway!).

Furthermore, I firmly believe that some of the ardent advocates of the elimination of "control" are going to get a bit of a shock when they are actually confronted with the problem of trying to receive in their living rooms a non-controlled piece of orchestral rendition. I got an actual taste of such a transmission not so very long ago from a German station, or, at least assume that it was practically "non-controlled," as the same question is agitating part of the listening public here. The result was that to bring "*pp*" passages up to audibility the whole volume level had to be brought up to a point where it was simply impossible to stay in the room with the "*ff*" passages, to say nothing of the fact that a valve of the transmitter class with about 400 v. on the anode had not a chance of handling the input. So the only result of that little experiment, so far as I was concerned, was that I had to do the "controlling" at my end instead of someone else doing it for me at the transmitting end.

With the notable exception of the Kallundborg transmitter and perhaps Warsaw, Vienna and Budapest, I know of no station in my reach that can compare with the British Broadcasting stations in the quality of the transmitted music. If any readers want to hear some real land line distortion I can only suggest to them to tune in on a transmitter such as Königswusterhausen on a broadcast from some distant city, such as Leipzig, when they will hear more humming, buzz and telephone cross-talk in five minutes than the B.B.C. would let loose on its public in a year.

Hence I, for one, am willing to hand the B.B.C. a bouquet in lieu of heaving a brick.

F. L. B.

Danzig,
December 3rd, 1928.

PICTURE BROADCASTING.

Sir,—I am sure that the majority of listeners will agree with Mr. E. J. Crampton's remarks in your issue of November 14th regarding picture broadcasting.

At the moment there is a certain amount of novelty in this new venture, but the B.B.C. will find that it is only of passing interest and that, barring adolescent enthusiasts who only play at science, many people will not consider the advantages, such as they are, worth the extra expense and trouble. And how meagre these advantages are! Who wants pictures that can be obtained, as Mr. Crampton says, for a penny a dozen in the evening papers? There are very few outlying districts with the means for installing and operating a picture-receiving apparatus that are not served by a newspaper service. In addition to this, I believe I am right in saying that, under the process used, the pictures received are by no means permanent.

The receiving of pictures by wireless is comparable to receiving the ordinary programmes on gramophone records when, as is often the case, the matter transmitted is purely of an ethereal nature without any secondary interests attached to it. Admitted that permanent pictures would not be required in the circumstances, but why go to the expense of recording a semi-permanent picture by means of expensive apparatus when television is bound to come and will not be available to listeners who only have the existing picture-receiving apparatus.

Therefore I consider that when the B.B.C. came to the parting of the ways they took the wrong turning. Television

may be a rough and practically untrodden path, but it is the right way for the march of progress; picture broadcasting is a cul-de-sac. Radio developed wonderfully when broadcasting began, so will television. Pictures of news events, crossword puzzles, and the latest fashions are nothing by comparison with the wide field this would open up.

Though I do not for a moment think that television will reach perfection in any of its present forms, I regard the action of the broadcasting authorities in choosing stationary pictures in preference to moving ones as a waste of their time and our money. Whatever system they choose they will have to make radical alterations from time to time, so that, it being just as easy to change over to a different scheme, there are no grounds for hesitation on the score of economy. Let them start at once and consign picture transmissions to the Press, the War Office, and such others as have need of them.

Shortlands, Kent. H. A. RAMPTON.

Sir,—With reference to Mr. E. J. Crampton's letter of the 14th October, in connection with the broadcasting of still pictures, which, to use his own words, is wasting the money of the B.B.C. subscribers, may I venture to suggest that this is anything but the case.

If Mr. Crampton will allow his mind to return to the early days of broadcasting he will find that a lot of very useful work was done by amateurs towards the betterment of radio receivers and reception, until to-day our receiving sets leave little to be desired.

Now I presume that all those people using still picture receivers are potential experimenters with television and who hope at some future date to reproduce on their screen "the real thing," and I am sure Mr. Crampton will grant me that real, sound experimental work may be, and is, based upon these transmissions. Considering that it is only twenty-five minutes a day, and the only time the amateur may test his ideas in a practical manner, I fail to see any cause for complaint. In conclusion, I am certain that the ordinary "listener in" is not given an inferior programme so that these transmissions may be financed. So why worry?

Rhyl, North Wales. TREVOR R. LITTLE.

A GRIEVANCE FROM THE NORTH.

Sir,—May I be permitted space in your columns to air the grievances of listeners in the North with regard to the B.B.C.'s services?

In Orkney no British station can be received free from interference. On the 200-600-metre waveband reception is rendered impossible owing to a spark transmitter station at Wick and also ship stations. No consideration seems to be given by these to the power required to communicate with ship and shore stations as per the P.M.G.'s regulations—they simply blaze away full force on all occasions.

Apart from morse interference, however, 5GB is subject to frequent fading, although stations around it remain quite steady; Aberdeen is hopelessly heterodyned by foreign stations; in fact, at times it cannot be distinguished at all in the din.

I have been in communication with the B.B.C. regarding this matter, but they reply that they cannot guarantee a service from any of their main stations beyond thirty miles (5GB 100), with the exception of 5XX. This latter is now at times also hopeless, owing to interference from Lahti, which causes distortion and a loud heterodyne whistle. The German station, Zeesen, also seems prone to wander off its wavelength, as even now, when Daventry's wavelength has been altered, it breaks in at intervals, coming right on top of Daventry and wiping it out. There is also a C.W. morse station which interferes badly at times.

The result is that we have no broadcast service here at all which can be relied on.

Could not some remedy be found? We pay a licence fee of 10s. per annum, and for this we receive chiefly morse and the clamour of Babel.

The B.B.C. promised to alter Aberdeen's wavelength before this winter season set in, but so far nothing has been done except to talk of a new wavelength of 326.1 metres—20 Kcs. nearer the morse waveband than before and also lying between two fairly powerful German stations.

Meantime they are spending their energy and resources on altering and rearranging stations in England where a fairly satisfactory service is at present in existence.

Why should they not take Aberdeen in hand at once and increase its power to, say, 30 kW, and enable it to hold its own amongst the foreigners?

Even if 5XX were free from interference, we should like to have a Scottish programme as an alternative at times, particularly from 8 to 8.30 p.m. on Tuesday evenings.

I think the B.B.C. would be better employed if they would concentrate on ensuring a satisfactory service to the outlying districts instead of entering on the new service of "picture transmission." By the way, who provides the necessary funds for these transmissions?

I have heard the opinion expressed more than once that, until the B.B.C. can give a satisfactory service in the outlying districts, the licence fee for these should be reduced.

St. Margaret's Hope, Orkney. IAN I. BARCLAY.

CONTROL.

Sir,—With reference to your notes "A Chat with Control," *vide* page 481, *The Wireless World* of October 3rd, 1928, I was surprised to know that the B.B.C. has not yet endeavoured to remedy the inefficiency arising from "the difficulty that the man at the control can never be sure whether the speaker will be two, three or four feet away from the 'mike,' and matters can only be adjusted when speech begins."

Prior to the formation of the Indian Broadcasting Co. I did a little transmitting for the Bombay Radio Club, when mostly gramophone records were transmitted. I used to classify the records prior to transmission in three groups, the low, medium and high, and during the transmission place them at three specified distances from the "mike" so as to ensure even volume with the lot. I used to shift the "mike" to adjust the required distance from the gramophone. The microphone used was an ordinary Ericsson telephone microphone. If the B.B.C. also resorted to the same strategy in classifying their lecturers previous to the lecture, and allotted them their "respectful" distance from the "mike," the B.B.C. would help their "blind" control half-way. JOSEPH ALAMS.

Bombay.

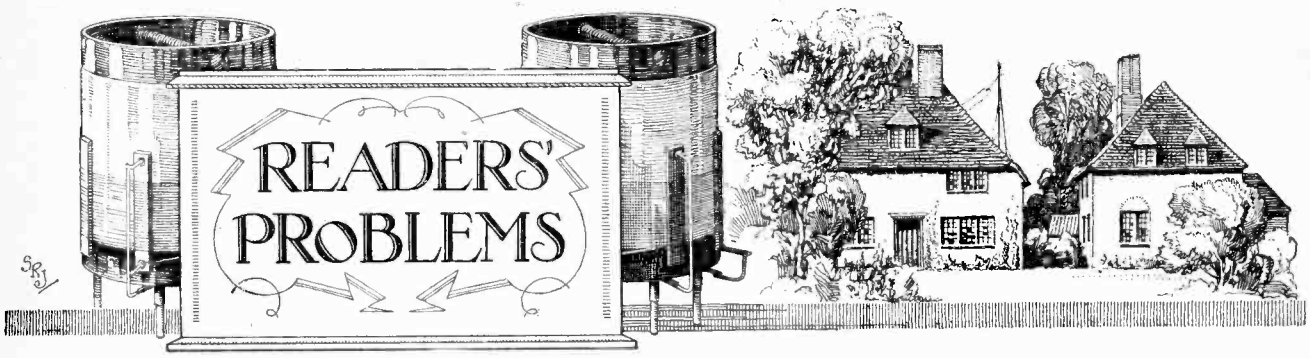
IS 5GB STILL EXPERIMENTAL?

Sir,—Surely it is ridiculous for the B.B.C. to insist still that 5GB is only an experimental station, seeing that they have now definitely transferred Nottingham listeners over to Daventry Junior for their regular programmes.

Bristol. BM/GEL.

A NEW LONDON SHOWROOM.

A PERMANENT WIRELESS SHOW. A corner of the new wireless and electrical showroom of the B.T.H. Company at Crown House Aldwych, London, W.C.



"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.

Reducing H F. Amplification.

Will you tell me if there is any simple way of cutting out one of the H.F. stages of the "Kilo-Mag. Four" receiver, the idea being to reduce the sensitivity of the receiver for reception of the less distant stations.
N. H R.

The first H.F. amplifying valve may be cut out of circuit in a very simple way by joining the aerial through a condenser of about 0.0001 mfd. to the socket which connects to its anode. Of course, provision must be made for breaking its filament circuit when receiving in this way, and precautions must be taken against a short-circuit of the H.T. battery, which would be introduced were the socket allowed to touch the screening case.

○○○○

An Ambitious Project

Will you please let me have a circuit diagram of a "high-power" three-stage amplifier for radio and gramophone amplification? E. F. J.

The construction of an amplifier of this kind is hardly to be undertaken lightly, and the subject is rather too involved for adequate treatment in a letter; a bare circuit diagram, without information as to valves, components, voltages, etc, is hardly likely to be of much use to you. If you will let us have some indication of your requirements as to output and the H.T. voltage available we can probably help you by giving a reference to a back number.

○○○○

Rebuilding Variable Condensers.

If I remove half the total number of moving plates in my 0.0005 mfd. variable condenser, will its maximum capacity be reduced by this alteration, and will it be less efficient than before? D. R. P.

A condenser altered in this way will have approximately half its original maximum capacity, and its efficiency should not be impaired. The modification must be carefully executed, however, as the reassembly of a bank of vanes is often rather more difficult than would appear at first sight.

An Impossibility.

For some tone-control experiments which I am carrying out I wish to connect a single-pole stud switch so that any number (up to a total of five) of fixed condensers may be placed in circuit. Will you give me a diagram showing how this may be done?
M. M.

It is not possible to connect an ordinary switch in the manner you desire, although

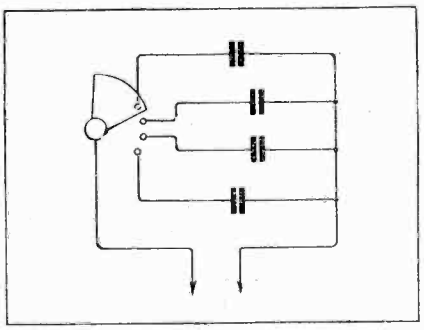


Fig. 1.—A special selector switch for a bank of condensers.

it is, of course, easy to arrange it so that any *one* of a bank of condensers may be joined in circuit. For your purpose you will require a special switch with a wide blade of springy metal, shaped and mounted in such a way that it will make contact with any desired number of studs. This will be connected in the manner shown in Fig. 1.

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.

○○○○

Momentary Oscillation.

My H.F.-Det.-L.F. set works satisfactorily, but I notice a curious effect on first switching-on; the H.F. valve seems to oscillate for about a second, but this oscillation quickly dies out. The circuit is conventional, and H.T. is obtained from the D.C. mains through an eliminator, a common voltage of about 120 being applied to the three valves. Can you explain this effect? P. L. F.

It seems likely that on switching on the set the H.T. voltage applied to your valve is considerably in excess of normal value. This may be due to the fact that the smoothing condensers in the eliminator are charged up to the full voltage of the mains, and are not immediately discharged, as very possibly the filament of the output valve does not give its full emission as quickly after switching on as does that of the H.F. valve. Moreover, apart from the question of a condenser charge, there is likely to be a considerable rise in eliminator voltage when the full output is not being taken, as will be the case if the H.F. filament heats more quickly than the others.

Assuming this explanation to be so far correct, it is quite conceivable that the H.F. valve will oscillate with an excess H.T. voltage, particularly if you adopt the very usual expedient of operating it in a slightly deneutralised condition, in order to obtain maximum sensitivity.

○○○○

The Megavox.

Will it be in order to use a suitably designed output transformer in the "Megavox Three" instead of the choke filter output arrangement which was included in the original design?
J. C. S.

Yes, this modification is quite permissible; you must choose a transformer specially designed for a pentode, and having a secondary approximately matched to your loud speaker windings.

The Wireless World AND RADIO REVIEW

(16th Year of Publication)

No. 487. WEDNESDAY, DECEMBER 26TH, 1928. VOL. XXIII. No. 26.

Editor: HUGH S. POCOCK.

Assistant Editor: F. H. HAYNES.

Editorial Offices: 116-117, FLEET STREET, LONDON, E.C.4

Editorial Telephone: City 9472 (5 lines).

Advertising and Publishing Offices:

DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: Ethaworld, Fleet, London."

COVENTRY: Hertford Street.

Telegrams: "Cyclist, Coventry." *Telephone:* 5210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street.

Telegrams: "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 260, Deansgate.

Telegrams: "Iliffe, Manchester." *Telephone:* 8970 City (4 lines).

PUBLISHED WEEKLY.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

Entered as Second Class Matter at New York, N.Y.

CONTENTS OF THIS ISSUE.

BROADCASTING IN 1928.

THE close of the year is a fitting time to look back upon the progress which has been made in the development of broadcasting in all its aspects over the past twelve months, and whilst congratulating ourselves on what has been achieved in this country, we should at the same time look forward to that which remains to be done in the New Year, in order not only to make good any shortcomings of the past, but also that we may welcome 1929 with the determination to make it an outstanding year in the record of broadcasting progress.

It has been suggested that in wireless generally the present year has been one of consolidation rather than initial achievement of outstanding character, and probably this is an accurate general summing-up, although certain events of outstanding importance must not be overlooked.

Much has been done to consolidate the position of broadcasting generally, and it has come to be recognised more and more as a factor in our daily life. Old prejudices are giving place to a recognition of the value of this new means of simultaneous communication with all parts of the country. In this connection we can cite the instance of the broadcasting of the Service of Remembrance at the Cenotaph on November 11th as of outstanding importance. Until this year permission to broadcast this service had been consistently refused by the authorities, probably for the reason that it was feared that such a step would detract from the solemnity of the occasion. But experience has surely proved that, far from this having been the case, the effect of broadcasting was to make the Remembrance Service a more important event in the life of the nation than had been possible in previous years.

Opposition to broadcasting has been overcome in a number of other directions, and it is particularly exemplified in the improved relations between the broadcasting authorities and those who cater for general public entertainment through the medium of the stage or the concert hall. Permission for the broadcasting of controversial matter, at the discretion of the B.B.C., has also taken practical form during the current year. Whether or not the decision, and the way in which the permission has been interpreted, has proved a success is probably even more a subject of controversy than anything which has been broadcast up to date, but nevertheless the experiment has been tried, and that in itself is a new achievement.

Technical Progress.

On the technical side, in addition to a general improvement in the quality of transmission of some of the stations, we have experienced several ambitious experiments in the direction of re-broadcasting distant transmissions and linking up our own transmitters by land-line to the Continent. These attempts have, in general, been an improvement on former trials, and we may look forward to this aspect of broadcasting becoming of greater importance as time goes on. The regional scheme and alternative programmes have made progress during the past year. With the stations at present available the principle of regional programmes has been in operation for some time past, but will not, of course, take effect in complete form until the proposed new regional stations are ready. Substantial progress has been made towards the construction of the regional station intended to supply London with its alternative programme under the scheme, but we must wait until 1929 before this station can be in operation.

In the direction of short-wave broadcasting by our own station we are afraid that little progress has been made, but we hope that the development of this service and many other important new activities await us in 1929.

TALKING FILMS

No. 2.—

The British Acoustic Film System.

IN the method used by the British Acoustic Films, two films are employed, one for the ordinary pictures and one for the sound record, and both in recording and reproducing these films are run in synchronism. The process of recording involves the conversion of sound variations into electrical current variations with the aid of a microphone. These electrical variations are amplified in the recording amplifier and the resulting currents passed through the element of a special oscillograph which carries a tiny mirror that is turned about a vertical axis, the movement being proportional to the current flowing through the element. A source of light

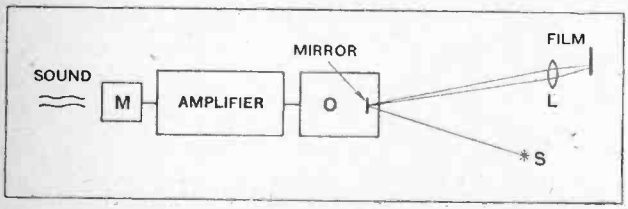


Fig. 1.—Schematic diagram of the recording system. Sound is converted to electric vibrations by a microphone M and amplifier, and a separate film records the light fluctuations which are produced by means of the oscilliograph O.

in the form of a thin straight filament is used and the light reflected by the oscillograph mirror after passing through suitable optical condensing arrangements falls on to the surface of a moving sensitised film as shown in Fig. 1.

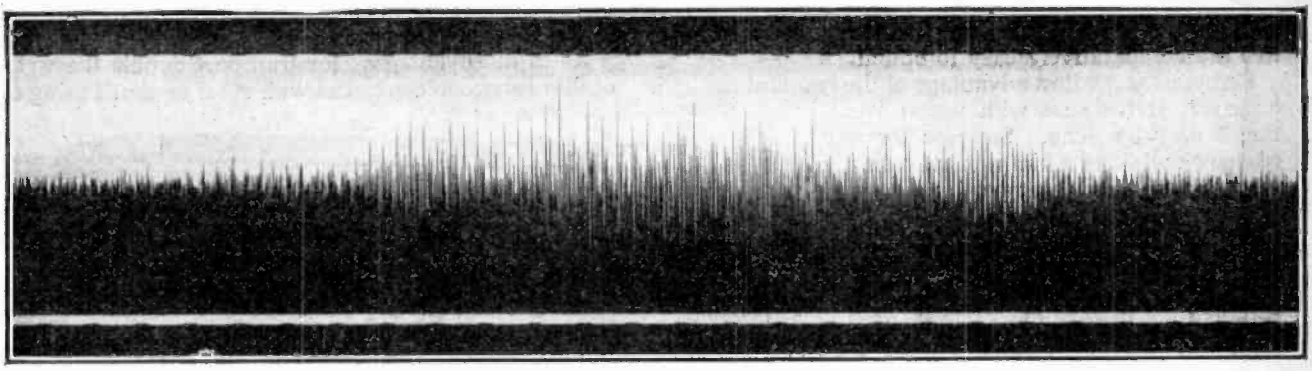
The reflected light from the oscillograph mirror is so arranged that when no current is flowing (i.e., no sound) just one half of the film is exposed and one half unexposed. When the mirror moves, the line of light which is doing the exposing moves more or less over the surface of the film, giving a record as shown in the photograph. The "sight" or "mute" film is run synchronously with the second film, either by direct drive or by synchronous motors.

The Reproducing Process.

Starting with the sound film containing oscillographic record of the sound, the reproducing gear consists of four main parts, (1) a projector for running the film, together with the illuminating lamp and optical focusing arrangements; (2) a light-sensitive cell of special construction; (3) an amplifier, and (4) the loud speakers.

The sound film is run steadily and not in jerks like the mute film, involving a special constant-speed device for the projector. The drive may be direct from the ordinary projector or both projectors may be driven by synchronous motors. The light, after passing through the sound film, is focused on to a selenium cell.

This cell is of very special construction, being in the form of a slit whose width is slightly greater than the



The separate sound film.

width of the film. A current is passed through the cell by means of a local battery, and the resulting fluctuations of current through the cell, as the illumination is varied by the sound film, are passed through a special filter circuit which effectively counteracts the lag of the selenium cell by attenuating the lower frequencies in correct proportion.

The voltage developed across part of the filter circuit is applied to the input of the amplifier, which, in the case of the smaller type, is of straightforward design capable of giving 30 watts of undistorted A.C. output to the loud speakers. The H.T. voltage for this amplifier is 400.

Photographs of the projector and cell show the actual arrangement used, while the illustration of the amplifier shows the general appearance. The filter circuit is incorporated in the amplifier and the only controls on the latter are the loud speaker switch, input change-over switch (for two sound projectors) and the volume control, which is the absolute minimum number of controls that could be used and shows the extreme simplicity of the apparatus.

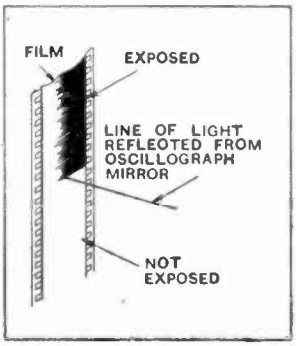
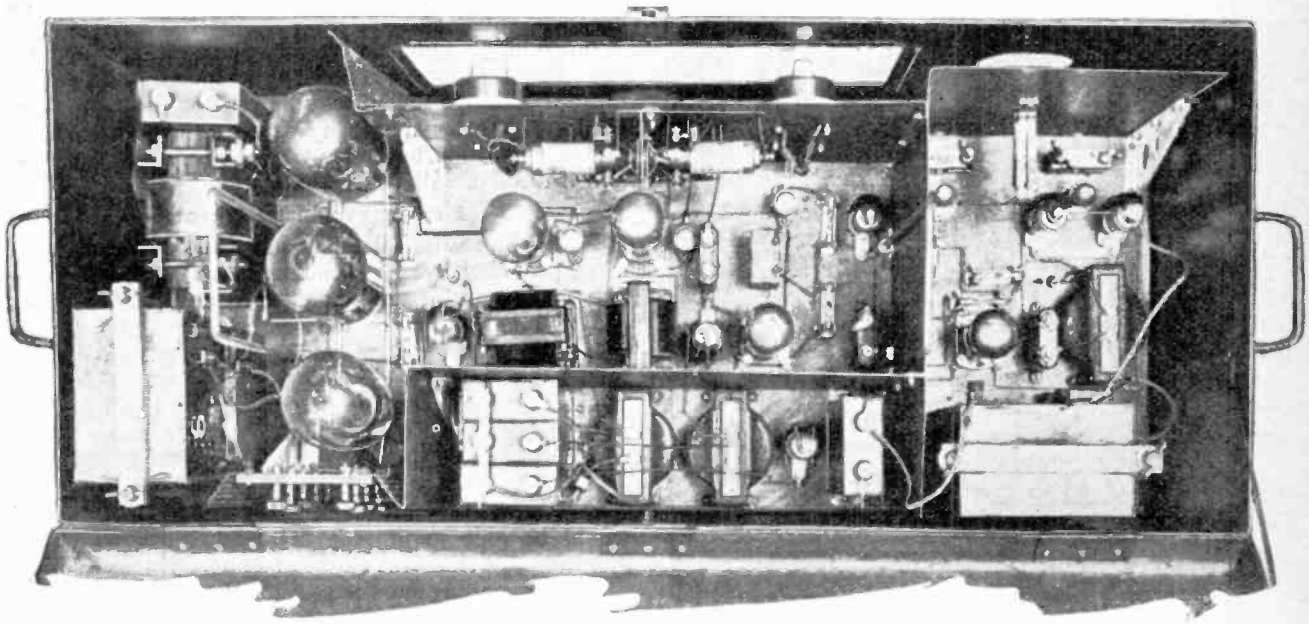


Fig. 2.—A film on which the light fluctuations corresponding to the electric vibrations have been recorded.

To turn now to the relative merits of the one- and two-film methods, it must be stated that, firstly, in the two-film method a much larger area of film is available for the sound record than in any other single film method now in use, which enables more "detail" (i.e., higher frequencies) to be obtainable in the sound record, so that the quality of the resulting sound should be better than with the single film methods. Secondly, the type of film and developing technique which has been evolved after much research for taking ordinary cinematograph pictures is intended to give a comparatively "soft" negative—that is, a non-contrasty negative—whereas for the sound record a very highly contrasty negative is required so as to obviate blurred tones and general lack of the higher audio fre-



The general layout of the amplifier. A filter circuit is incorporated which effectively counteracts the lag of the selenium cell.

Talking Films.—

quencies. With two separate films the two types of negative are comparatively easy to obtain.

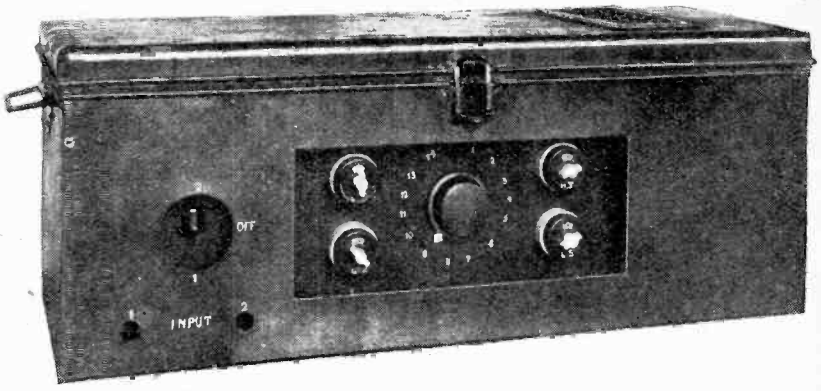
Perhaps the greatest advantage of the two-film method, however, is the ease with which "cutting" may be done. Suppose for any reason a section of a film was not required to be shown—for instance, if the censor objected to it—it is extremely easy to remove the unwanted section by running the sound and sight films together on a double re-winder, cutting out equal lengths from the two films and then joining up the ends again—all of which can be done in a few minutes.

With single film methods cutting of a section is by no means easy—where the sound record is on the edge of the film. The portion which synchronises with a given picture is displaced by some inches, so that the film must not be cut straight across if synchronism is to be preserved. In the case of a single film with the sound record on gramophone discs, the cutting of a section is even more difficult.

Musical Accompaniment with any Film.

It should be remembered that a certain amount of cutting—although it is a small amount—is involved whenever a film breaks, and also that the synchronism must be almost exact or the sight and sound will be noticeable "not together."

As to disadvantages; for transport double the weight of film is needed compared with other methods using one film—however one of these methods utilises gramophone discs which are equally heavy and liable to be broken if not carefully handled.



The amplifier panel. Note the simplicity of control.

There is also the need of synchronising the two films, which is a difficulty more apparent than real except when one of the films—usually the "mute," as it is under more mechanical strain—happens to break, when the two films must be re-synchronised. This latter difficulty, however, can be got over quite simply in practice by having a continuous record of the length of each film that has passed through the apparatus.

When the Film Breaks.

When one film breaks and a piece is cut out in mending, the corresponding piece on the other film can very easily be found and removed. The breaking of a film, luckily, is not a very common occurrence, and the breakage difficulty involves at least as much trouble with any single film system.

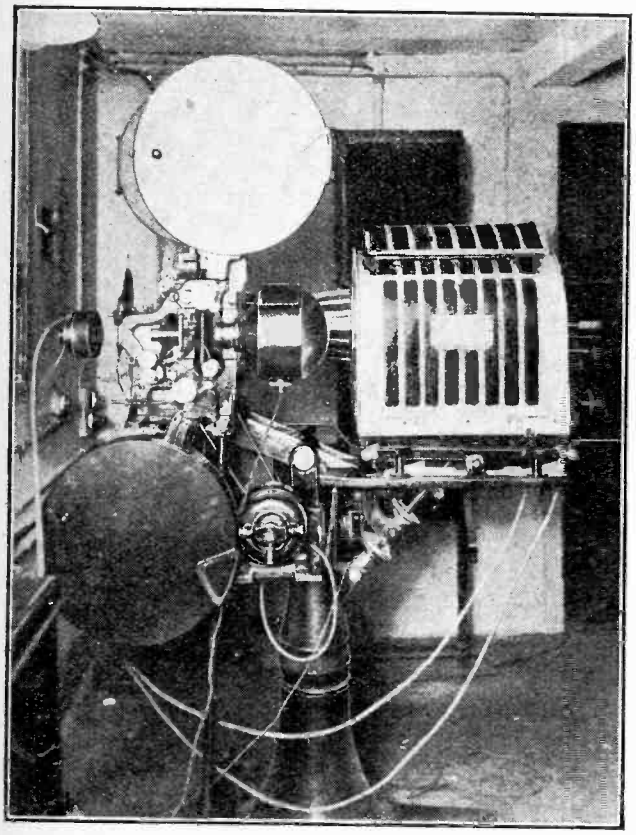
A further advantage of the two-film method is that with any given sight or mute film, either speech or an entirely musical accompaniment may be used on the same reproducing apparatus simply by changing the sound film—also a musical programme may be supplied with *any* film if desired.

For the Provincial Cinema.

It will be realised that the usual musical accompaniment provided by the orchestra actually at the cinema may in this way be supplemented by any desired musical programme supplied by the separate film—and, further, that the music recorded on the film may be produced in the first case by a really first-class orchestra. The musical programme of the small cinema is often a butt for the humorist; there should be little scope for his wit when synchronous reproduction becomes widely used.

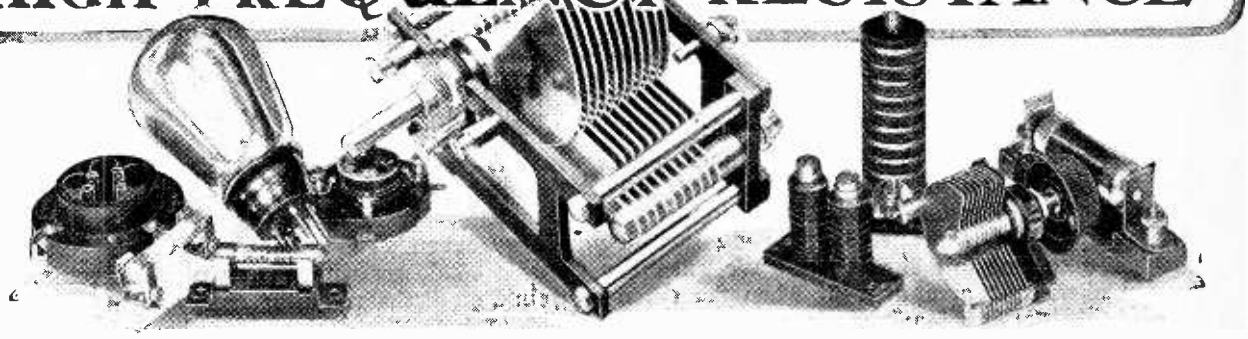
In this way the small suburban and provincial cinemas would be able to provide first-class music as well as synchronised talking pictures at quite a reasonable cost.

Beyong putting on the second film and switching on the amplifier, the operator has no more to do than he has in showing any ordinary "silent" cinema picture.



The projector with light-sensitive cell and equipment to handle the sound film

HIGH FREQUENCY RESISTANCE



Loss of Energy Due to Dielectric.

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

(*Concluded from page 814 of last week's issue.*)

WHEN discussing, in the first part of this article, the high-frequency resistance of a coil, the remark was made that the calculated losses, all of which can ultimately be traced to the copper wire with which the coil is wound, make up together some 85 per cent. of the total measured high-frequency resistance of that component. The source of the remaining 15 per cent., and of the losses due to the other parts of the tuned circuits, have yet to be considered.

Turning our attention to the simplest possible form of tuned circuit, we find that it consists of a coil, with its high-frequency resistance, in parallel with a condenser, as indicated in Fig. 4. If we imagine that a high-frequency voltage is induced into the coil, by coupling it, for example, to a second coil connected to an aerial, a high-frequency current flows round the tuned circuit, developing a voltage in its passage through the coil L. Since the condenser is connected in parallel with the coil, this high-frequency voltage is applied to the condenser, and we have to see in what way the condenser responds to this voltage. In case any reader is vague as to the action of a condenser, we will digress for a moment to see the effect of a simple direct voltage.

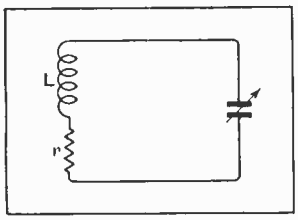


Fig. 4.—A simple tuned circuit. The resistance r is shown external to the coil; in actual fact r is the high-frequency resistance of the coil itself and the two are not separable.

If, as in Fig. 5, a steady potential difference is applied to a condenser, at the instant of completing the circuit we have the two plates of the condenser, which are at the same potential, connected to the two terminals of the battery, whose potential must necessarily differ by the voltage of the battery. This is clearly an unstable state of affairs, so that a current will flow round the circuit until each plate of the condenser attains the potential of the battery terminal to which it is connected. The flow of current will then stop, because the plates of the condenser are insulated from one another, while the amount of electricity that flows into the condenser before equilibrium with the battery is reached will depend on the capacity of the condenser, being greater if this is larger.

The Conversion of Energy.

Suppose now the battery is disconnected; in that a current has been taken from it, it has lost energy, and this energy has been transferred to the condenser, which retains it in the form of an electric charge. But the energy is not lost; on the contrary, it is easily recoverable. If, as in Fig. 6, the terminals of the charged condenser are joined by a resistance R, the potential difference between the two will drive a current through R, and this current will last just long enough to enable the two plates of the condenser to arrive once more at the same potential. The condenser is then said to be discharged again.

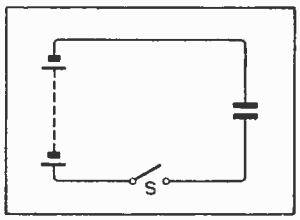


Fig. 5.—Illustrating the application of a steady potential from a battery to a condenser.

Thus the energy taken from the battery during the process of charging the condenser is given up again in the form of an electric current when the condenser is permitted to discharge, and thus no energy is lost. Perhaps a more familiar example of the energy stored in a charged condenser and released again by discharge may be found in the spark that may be drawn from a reservoir condenser of high capacity after charging it from the H.T. battery; a similar manifestation is found when unexpected shocks are mysteriously received from the interior of a set after disconnecting the source of anode

High Frequency Resistance.—

voltage. All this may be summed up by saying that just as the magnetic field set up in the neighbourhood of a coil by the passage of a current stores energy in a form readily reconvertible into an electric current, so the electric field set up within a condenser by the application of a potential difference stores energy in another, but equally reconvertible, form.

A Mechanical Analogy.

Now let us apply this to the simple tuned circuit already mentioned, and shown in Fig. 4, remembering that a high-frequency voltage or current is nothing more than its simple D.C. equivalent continually reversing in direction according to a simple law. We will arrest this rapid alternation at a moment when the current round the circuit is at a maximum, with the condenser uncharged, and will trace at our leisure the succeeding stages, which may occupy an extremely short space of time such as a millionth part of a second or less.

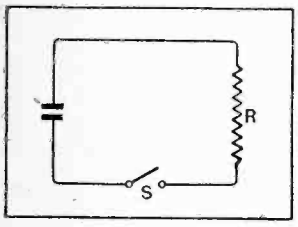


Fig. 6.—If a resistance is connected across a charged condenser the current through *R* will continue until the plates of the condenser are at the same potential.

The current, then, is flowing into the condenser and charging it up; as the charge accumulates, the counter-voltage from the condenser slows down the current until finally it ceases, leaving the condenser fully charged—that is, with an electric field surrounding its plates. The current now begins to flow in the opposite direction, and while it is increasing it is helped by the voltage in the condenser, which discharges itself through the coil just as, in our previous example, it discharged through the resistance. By the time the current has reached its maximum value again, the charge on the condenser has all been used up, and the energy stored in its electric field during the first part of the process has been returned to the circuit as current. The same series of operations is then gone through again, with the sole difference that the current and the voltage are both reversed in direction; we are then back at the beginning of the cycle, at the point where we started, and the millionth of a second is over.

In the case of the magnetic field of the coil we saw that in the ideal case there were no energy losses, but that all the energy withdrawn from the circuit in building up the field was returned to it again as the field collapsed. We also saw that the ideal case could not be realised in practice, but that there were always some sources of energy loss due to the production of unwanted currents in any conductors, including its own wire, that might be within range of the coil. In the case of the electric field set up in a condenser the possibility of losses does not arise through the presence of conductors in the field, but through that of insulators.

So long as there is nothing but air between the plates of the condenser practically all the energy absorbed on charging is returned when the condenser discharges, but if the air is replaced by an insulator less energy is given out on discharge than was absorbed during charge. If we compare the charging of a condenser to the compressing of a spring we shall have a remarkably close mechanical analogy, the insulator or dielectric situated between the plates, and in which the energy is stored, representing the material from which the spring is made. If the spring is of finely-tempered steel it corresponds to the perfect dielectric, returning on release (discharge) all the energy absorbed during the compression (charge). But if the spring is made of softer material it will take a permanent "set" when compressed, and though it will return towards its original form it will not completely regain it, so failing to return some of the energy expended in compressing it. In just the same way a condenser with an imperfect dielectric does not refund on discharge all the energy spent in charging it, and in both electrical and mechanical cases the lost energy appears as heat.

Losses in Coil Plugs and Formers.

It will be realised that the loss of energy caused by imperfections of dielectric will not be limited in its appearance to components to which the name condenser is applied, but will make its appearance whenever we have an arrangement which in actual fact *is* a condenser, whatever may be the name under which it chooses to masquerade. Thus whenever there arises a potential difference between two conductors separated by an insulator, there we have the essentials of a faulty condenser. In the tuning coil, for example, there are a number of turns, separated by the insulation of the wire and by that of the former on which the coil is wound; as the high-frequency current flows through the coil there will be a potential difference between different turns, and this will be larger the further apart the turns are in order of winding. If, for example, the first and last turns are brought to sockets in a plug made of an insulator which has poor dielectric properties, the losses introduced will be very appreciable indeed, and will form quite a big proportion of the total high-frequency resistance of the coil. It is clear from this that it is essential to choose for the plug of a plug-in coil, and for the holder that is to receive it, a material in which the dielectric losses are small, and that if the highest efficiency is sought no material other than air, which is a dielectric introducing practically no losses whatever.

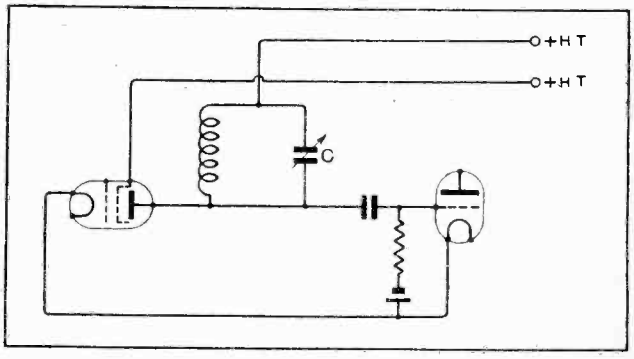


Fig. 7.—A popular coupling used to connect a screened grid valve to the succeeding valve.

High Frequency Resistance.—

must be allowed to intervene between these two points of connection.

The odd 15 per cent. of the high-frequency resistance of a coil, which cannot be accounted for by the calculated losses in the wire itself, are due to the dielectric losses in the former of the coil and in the insulation between turns; in this estimate no allowance is made for plugs or holders for making connection to the ends.

In the tuning condenser itself, where the dielectric between the plates is almost entirely air, the absorption

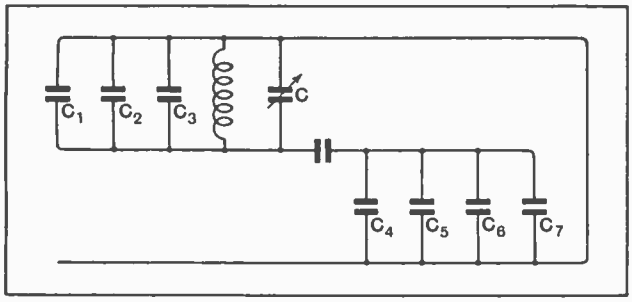


Fig. 8.—The equivalent circuit of Fig. 7, where each component that is likely to increase the high-frequency resistance is represented as a condenser.

of energy due to imperfections of dielectric are truly negligible; this component contributes but an inconsiderable trifle to the high-frequency resistance of the tuned circuit as a whole.

But, as already hinted, there are other condensers in the circuit in parallel with that used for tuning, and in these the dielectric is seldom above reproach. In Fig. 7 there is given a circuit in common use to-day; it represents the intervalve coupling between a screened-grid valve and the valve, whether H.F. amplifier or detector, that follows it. In Fig. 8 the same circuit is repeated, with each component that is likely to increase the high-frequency resistance of the tuned circuit through dielectric losses represented as a condenser, and with the high-tension battery omitted to simplify the diagram.

Actual Measurements of H.F. Resistance.

It will be seen that across the tuned circuit, in addition to the legitimate tuning condenser C, there are no fewer than seven other sources of capacity, and each of them, owing to the presence of solid insulating material of some kind or another, is a possible cause of serious loss. C_1 and C_2 stand for the glass pinch and insulating base respectively of V_1, while C_3 is its holder. C_4 is the grid-leak holder, C_5 the holder for V_2, and C_6 and C_7 the base and pinch of this valve. The capacity of each of these components is connected across the tuned circuit, each contains solid dielectric, and each is therefore a potential source of high-frequency losses.

The writer has estimated the resistance thrown into the tuned circuit by some of these incidental capacities; that is to say, has found the value of the high-frequency resistance that needs to be added to that of the coil in order to produce the same effect as connecting these components across the tuned circuit. The apparatus used for the purpose is shown in Fig. 9, where the valve is an anode detector with a meter in its plate circuit; this meter indicates by its deflections the high-frequency voltage induced into the tuned circuit by the oscillator (not shown). R stands for a number of inter-changeable resistances of fine wire, the values of these resistances being known, and being the same, within narrow limits, for high-frequencies as for direct current, on which they were measured. The measurements consist in reading the deflections of the meter, for a fixed position of the oscillator, with each of the resistances R connected in turn in the tuned circuit, and plotting a curve connecting the deflections obtained with the values of the resistances. Keeping the oscillator coupling unchanged, the various components to be tested are then connected in turn across the tuned circuit, and the deflections of the meter are noted. Reference to the curve at once gives the effective resistance introduced by the component in question.

Measurements were carried out in this way with a number of components of different types and different makes, and on a number of different wavelengths, varying from 200 to 550 metres. In all cases the coil was a standard *Wireless World* Litzendraht coil on a 3in. paxolin former; it had an inductance of 259 microhenrys. The tuning condenser was an ordinary "low-loss" instrument of well-known make.

Valve-holders.

Two valve-holders of different types have been selected as examples; for obvious reasons the names of the makers are not given. Holder A consisted of a solid block of (apparently) bakelite containing the four sockets; this was suspended by springs in a larger bakelite block carrying the terminals. It is a thoroughly well-made and very popular holder. Holder B had no

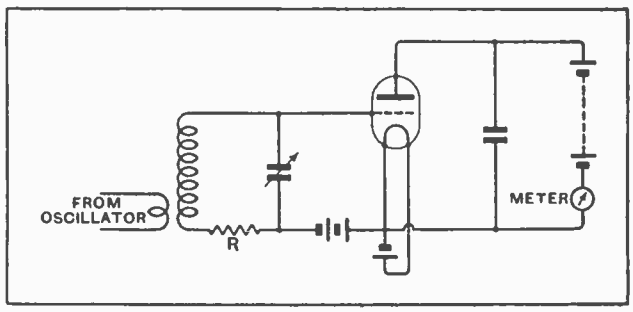


Fig. 9.—Circuit diagram of valve voltmeter for measuring relative values of high-frequency voltage induced in the tuned circuit by the oscillator. *R* represents interchangeable resistances of fine wire.

insulating material at all between the valve-legs, except for a thin shell through which the legs passed to the four sockets below; these were supported by the sides of the shell. This holder is a cheap one, not very prepossessing in appearance. The results obtained were as follows:—

	Wavelength of Test. (Metres.)					
	200	225	250	300	400	550
Holder A ..	8.3	5.7	4.2	2.7	1.1	0.5 ohms
Holder B ..	1.6	1.1	0.8	0.5	0.4	0.2 ohms

High Frequency Resistance.—

In making the measurements, the plate terminal of the holder was joined to the two filament terminals, these three being connected to one side of the tuned circuit and the grid terminal to the other. This arrangement represents the state of affairs in a Moulin voltmeter, in connection with which the measurements were primarily made.

Valve-base Dielectric Losses.

Two things will at once be noticed from the table above; first, that the "better" valve-holder turns out to be by far the worse from our present point of view, and, second, that the effective resistance in both cases increases rapidly towards the bottom end of the wavelength range covered by the coil used. This latter effect is common to all such measurements as these, and is due to the fact that as the capacity of the tuning condenser is decreased a greater and greater proportion of the total high-frequency current flowing has to pass through the capacity of the component being examined.

Now the calculated resistance of the tuning coil with which these valve-holders were in parallel varies with wavelength, too; the values of the high-frequency resistance due to the copper of the coil, ignoring any dielectric losses, are as follows:—

Wavelength.					
200	225	250	300	400	550 metres
H.F.R. of coil.					
5.9	5.0	4.3	3.5	2.5	2.0 ohms

The very considerable effect that Holder A will exert on the characteristics of the tuned circuit across which it is connected will at once be seen, for at all wavelengths up to 250 metres it *more than doubles* the effective high-frequency resistance of the circuit as a whole, and even at 550 metres, where it has least effect, it adds 25 per cent. to the resistance. And this valve-holder is unfortunately only one of seven sources of enhanced high-frequency resistance.

These figures throw into strong relief the necessity for choosing valve-holders in which there is the minimum of insulating material between the sockets, at least when efforts are being made to keep the high-frequency resistance of the circuits down to as low a value as possible. Even when extremely low resistance is not required, the use of such holders renders the design of a receiver very difficult, for the tuned circuits, when in the completed receiver, will have a resistance widely different from that anticipated by calculation during the working out of the design.

It was suspected that, from the point of view of high-frequency losses, bakelite might be a less desirable material than ebonite, and tests were made on this point.

The writer had no ebonite valve-holders available, and so turned his attention to grid-leak holders. Holder A was of bakelite, being the beautifully finished product of a first-class firm. Holder B was a shoddy thing, made of very doubtful-looking ebonite, but being to hand was put through its paces. The results were these:—

	Wavelength of Test. (Metres.)					
	200	225	250	300	400	550
Holder A	1.35	0.85	0.7	0.5	0.2	—
Holder B	0.15	0.1	0.1	—	—	—

The fact that the equivalent resistances introduced by these components was small made the taking of accurate measurements difficult; there is no doubt, however, which is the better material.

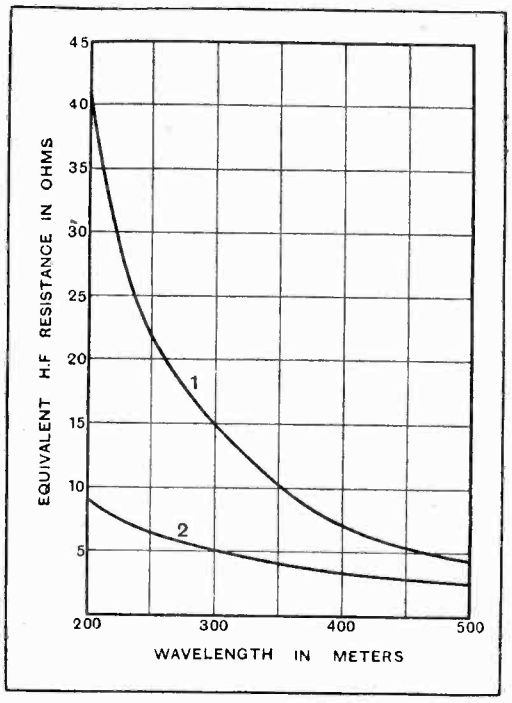


Fig. 10.—Curves showing variation of high-frequency resistance of complete tuned circuit with wavelength. Curve 1 gives the result of employing normal components with high dielectric losses, while in curve 2 all precautions to eliminate dielectric losses have been taken. In both cases the coil is a standard Litz coil of 68 turns on a 3in. former.

It occurred to the writer that there would be but little point in choosing valve-holders and other components with care if the insulating bases of the valves themselves were likely to introduce a large equivalent resistance; the stock of valves was therefore investigated, and it was found that one of a pair of identical valves had a loose base. This was therefore removed, and comparison measurements were made with the two valves, filament and plate being in both cases connected to one side of the tuned circuit, while the grid was connected to the other, just as in the case of the valve-holders already mentioned. The following were the results:—

	Wavelength of Test. (Metres.)					
200	225	250	300	400	550	
		Valve with base.				
7.8	5.3	3.8	2.5	1.0	0.5	ohms
		Without base.				
1.05	0.8	0.6	0.5	0.25	0.1	ohms
		Difference.				
6.75	4.8	3.6	2.0	0.75	0.4	ohms

The last line represents the losses in the valve-base itself, while the second represents the losses caused by the glass pinch of the valve. Other valves were also examined, and gave results similar to those in the first line of the table. It is therefore clear that considerable high-frequency resistance is introduced into any tuned circuit across which a valve is connected by the dielectric imperfections of the insulating compound in which the legs are embedded.

Total Losses.

If we revert to the circuit of Fig. 7, and consider the total high-frequency resistance that may be introduced into the tuned circuit by an incautious selection of com-

High Frequency Resistance.—

ponents, we arrive at a rather alarming result. Two "A" valve-holders, two valves, and an "A" grid-leak holder provide the following:—

	Wavelength of Test. (Metres.)					
	200	225	250	300	400	550
Total added resistance	33.5	22.8	16.7	10.9	4.4	2.0 ohms

If these figures are compared with those calculated for the coil alone, it will be seen that at the highest wavelength the resistance is doubled, while at the lowest it is increased to nearly seven times the expected value. Such variations as these, unless allowed for, make receiver design a matter of pure guesswork; it need hardly be pointed out that it is better to avoid these losses as far as practicable. As a comparison, the following table gives the minimum additional resistance that can be obtained, on the basis of these measurements, by using "decapped" valves (two), no valve-holders, and the "B" grid-leak holder.

Wavelength.. ..	200	225	250	300	400	550 metres
Added resistance..	2.25	1.7	1.3	1.0	0.5	0.2 ohms

The difference between this table and the last is so overwhelmingly great that it needs no stressing, but as pictures speak more clearly than figures, curves of H.F. resistance of coil *plus* components, on the basis of these last two tables, are appended to show the result of a whole-hearted effort to remove these sources of dielectric loss.

SWITCHING OUT AN L.F. STAGE.

A Simplified System which Requires no Change of Grid Bias.

ALTHOUGH there are so many objections to the use of switching in wireless receivers that it is, on the whole, a practice to be avoided, yet there are many who prefer, from motives of economy, to switch out one valve at least from their receiver when listening to the local station. With certain receivers there is an additional advantage in so doing, in that the quality of reception is often better when fewer stages of amplification are in use. This is more particularly true when an anode rectifier, which is not easily overloaded, is in use, and in this case especially it pays, from the point of view of quality, to give the detector a generous input, and amplify but little afterwards, rather than to cut down the input to the detector and to follow it by a considerable degree of low-frequency amplification.

Fig. 1 shows an anode rectifier coupled by a resistance to the low-frequency amplifier, which is in turn coupled by a transformer to the output valve. This circuit has very wide appeal, and is employed in a large number of receivers now on the market, for it gives the highest amplification attainable with two valves following an anode rectifier, while the quality may be made, by suitable choice of components and valves, as good as any transformer-coupled amplifier can give.

The simple switching arrangement shown in Fig. 1 enables the low-frequency amplifying valve V_2, together with its transformer, to be cut out, by connecting the grid of the output valve V_3 to the grid of V_2, so that V_3 receives directly the output of the detector. The filament of V_2 may be switched off by means of another pair of contacts on the switch, or by its individual rheostat, if one is fitted.

It will be noticed that the secondary of the transformer is still left in circuit, taking the place of the usual grid-leak. By this means grid bias connections need no alteration when the intermediate valve is cut out, while the last valve may still be overloaded, by those who are in the habit of so doing, without fear of the choking that overloading brings in its train when a grid condenser and leak are used.

There is a complete circuit, when the switch is closed, through the transformer secondary, the grid leak, and a portion of the grid-bias battery, through which a small current, drawn from that battery, must flow. This current is so small, being only that which ten or fifteen volts can drive through the leak, that its effect in diminishing the life of the battery need not be taken into account. If a five-megohm leak is used—and there is no necessity to employ a lower resistance than this—the current will only be about three microamperes.

The circuit shown has the additional advantage that in listening to the local station, when the value of a distortionless amplifier is most clearly felt, the transformer primary is eliminated, so improving the quality. For distant reception, where high amplification is very helpful and small differences in quality are not noticeable against the noisier background, the transformer is replaced.

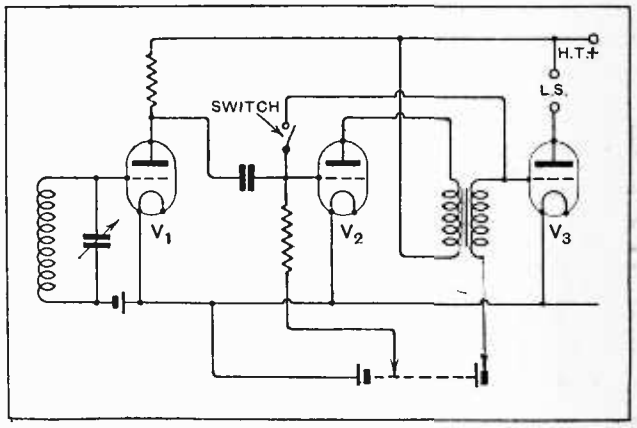
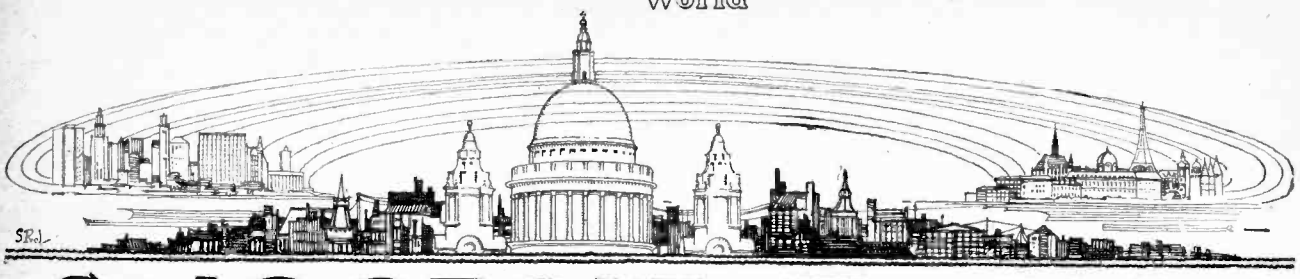


Fig. 1.—Switching out the first L.F. valve in an amplifier of the type used in many popular receivers.

In arranging this circuit in practical form, the switch should be placed as close as convenient to the grid of V_2, so that the connecting wire may be short, even at the expense of lengthening the wire connected to the grid of V_3. By so doing any ill-effects of the switch will be kept to a minimum.



CURRENT TOPICS

Events of the Week in Brief Review.

PROS AND CONS.

Controversial topics are to be included in German broadcasting, beginning in January.

o o o o

BRITISH LICENCE JUMP.

An increase of 34,706 receiving licences was registered in November, the total being 2,564,516. The increase noted in November, 1927, was 18,000.

o o o o

AUSTRALIAN WIRELESS SHOW.

The Melbourne Exhibition Building is to be the venue of a Radio Show, organised by the Victoria Wholesale Radio Association, from April 13th to 20th next.

o o o o

BOXING DAY VENTURE.

The Calcutta broadcasting station will make a special effort to receive and relay the 32-metre transmission from WGY, Schenectady, in the early hours of December 26th.

o o o o

SOUTHEND RADIO SHOW.

The Southend and District Radio Society will hold its 5th Annual Radio Exhibition and Demonstration at the Boys' High School, Victoria Circus, on January 5th.

o o o o

MARCONI HOUSE ON THE MARKET.

Marconi House is now in the lists of the estate agents preparatory to its sale when the wireless-cable merger company enters into occupation of new premises on the Embankment.

o o o o

WHERE THE "SPARKS" GO.

At the recent annual dinner at Portsmouth of past and present members of the Royal Naval Wireless Society it was stated that many "ex-sparks" were now engineers of the B.B.C.

o o o o

BERLIN RELAYS JAVA.

On December 14th the Berlin broadcasting stations successfully relayed a Wagner concert from Java, in the Dutch East Indies. The transmitter was Bandoeng, on 31.93 metres.

o o o o

MAN-MADE STATIC.

The Austrian Parliament is shortly to consider a Bill making it a punishable offence to operate high-frequency apparatus for massage or other purposes to the detriment of broadcast reception.

AERIAL TOWN.

The little town of Colyton, in Devon, is becoming entangled in its own wireless aerials. At a recent Council meeting it was decided to ask residents to try to install their aerials at the backs of the houses instead of across the street.

o o o o

VISITORS TO OLYMPIA.

During the seven days of the Olympia Radio Show in September, 123,531 visitors paid for admission. The corresponding number for 1927 was 99,135, and for 1926 116,570. The 1926 exhibition was open for thirteen days.

THE TELEVISION SOCIETY.

Mr. J. Cameron Rennie, B.Sc., M.I.E.E., will lecture on "Scanning Methods Used in Television" at a meeting of the Television Society on January 1st, at 8 p.m., at the Engineers' Club, Coventry Street, London, W.1.

o o o o

A SEDUCTIVE OFFER.

A Southport firm of building contractors announces that all purchasers of a house or bungalow to the price of £495 will be given a wireless receiver, complete with loud speaker and all accessories, installed free of charge.

o o o o

BEAM BRINGS PROSPERITY TO AUSTRALIAN WIRELESS.

The Amalgamated Wireless Company of Australia has just paid its first dividend since 1922. The new dividend is 6 per cent. for the year ended June 30th last. It is understood that the increased profits are due to the company's beam system.

ALL ABOUT TRANSMITTING AERIALS.

Messrs. P. P. Eckersley, T. L. Eckersley, and H. L. Kirke will give a joint paper at the meeting of the Wireless Section of the Institution of Electrical Engineers on Wednesday, January 2nd. Their subject will be "The Design of Transmitting Aerials for Broadcasting Stations."

o o o o

OLD SETS PLAY QUEER TRICKS.

"There are too many American homes with receiving sets bought in 1924 and 1925," declared Mr. O. H. Caldwell, a Federal Radio Commissioner, in a recent speech. Such homes, he said, were not listening to 1928 radio. What they were hearing, without knowing any better, was 1924 or 1925 radio.

o o o o

MARCONI'S AND FOREIGN SHAREHOLDERS.

At an extraordinary general meeting of the Marconi International Marine Communication Company, Ltd., held on December 14th, it was unanimously resolved that alterations be made in the articles of association providing that at no time should more than 25 per cent. of the company's issued shares be in the hands of foreigners.

o o o o

WIRELESS PICTURES AS SOUVENIRS.

A sum of £1 10s. 6d. was realised by the sale of wireless pictures at a recent luncheon of the Glasgow Business Club, the money being handed over to a fund for disabled ex-Service men. Three of the pictures were received from Daventry on a "Fultograph" during the luncheon; the others had been received on different occasions from Berlin and Vienna.

o o o o

NEWS PICTURES AT SEA.

Following the recent production of the first picture paper ever printed and published at sea, the *Daily Telegraph* picture broadsheet was a daily feature on board the *Olympic* on her voyage to New York last week.

The pictures, transmitted from Rugby, and received on an ordinary "Fultograph" instrument, consisted of typical news photographs. Although the *Olympic* encountered heavy weather, this in no way affected reception, though it caused some difficulty in the making of process blocks.

TELEPHONING TO TRAWLERS

A wireless telephone operator has been specially detailed at Humber Radio to facilitate communication between trawlers on the Dogger Bank and the owners and relatives on shore. Many of the trawlers are now fitted with telephony sets, though not equipped with ordinary ships' wireless installations.

oooo

THE PHANTOM ORCHESTRA.

The latest combined gramophone and wireless reproducer is known as the "Phantestra." A company of that name has been formed with a capital of £250,000. It is stated that the "Phantestra" will be supplied either in the form of a super model for cinemas, theatres, etc., or as a cabinet model for home use.

oooo

LUXURY OR NECESSITY?

A Peckham resident, summoned for working a wireless set without a licence, pleaded that he was on short-time work, but had intended to take out a licence when his work was full time.

The Magistrate: Wireless is a luxury. If you can't afford, you should not install it.

The defendant was fined half-a-crown and 10s. 6d. costs.

oooo

TRANSATLANTIC GREETINGS BY 'PHONE.

The Postmaster-General announces that for members of the public who wish to exchange greetings with friends in Canada, the United States, Cuba, or Mexico arrangements have been made to open the Transatlantic telephone service at 8 a.m. (British time) on Christmas Day instead of at the normal hour of 11.30 a.m. The service will remain open all day and up to 3 a.m. on December 26th.

oooo

EMPIRADIO AT CHRISTMAS.

Special arrangements have been made by the Post Office to enable the public to make the utmost use of the Imperial wireless and cable services for the dispatch of Christmas and New Year greetings. A similar service will be introduced for the first time to most European countries.

Messages for India, Burma and Ceylon *via* Empiradio are accepted at 2s. 6d. for ten words and 3d. per word thereafter. The same rate holds good for messages to Canada *via* Imperial or Empiradio. Reduced rates are also in force for greetings to South Africa, Australia and Kenya.

All greetings telegrams by these services should bear the indication "XLT," which is charged as one word. The reduced rates remain in force until January 2nd.

oooo

A ROVING MESSAGE.

Probably the most roundabout method of sending a wireless message was that adopted recently by the radio operator in the *New York Times* office who wished to communicate with a friend in a New York suburb. Unable to reach him on the telephone and knowing that his friend was listening to a message from the Byrd Antarctic Expedition 10,000 miles away, he got in touch with the operator in the expedition ship, *Eleanor Bolling*, who in turn relayed the message to the sealing vessel *City of New York*. The operator on this boat included the message in a Press dispatch to New York, and it reached its destination only a few miles from its starting point.

oooo

INTERNATIONAL WIRELESS OPERATORS' MEMORIAL.

The parents of Michael Joseph O'Loughlin, the wireless operator who lost his life in the *Vestris* disaster, have been informed by the Veteran Wireless Operators' Association that their son's name is to be inscribed in granite on the wireless operators' monument in Battery Park, New York. The monument was erected in 1915 and is international. It carries the names of operators of all countries who have died in the course of duty.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 26th.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Lecture by Mr. M. Scroggie, B.Sc.

THURSDAY, DECEMBER 27th.

Slade Radio (Birmingham).—At 8 p.m. At the Parochial Hall. Members' Night. Talk on Electricity.

Golders Green and Hendon Radio Society. —Third dance. At 7.30 p.m. At the Club House, Willifield Way. Fancy dress optional. (Tickets 3s. 6d., inclusive of refreshments.)

MONDAY, DECEMBER 31st.

Hackney Radio and Physical Society.—At 8 p.m. At the Electricity Showrooms, Lower Clapton Road, E.5. Informal meeting: Discussion of Future Programme.

ILLICIT TRANSMISSIONS IN SOUTH LANCASHIRE.

A year's search by Post Office engineers culminated in the appearance at the Bolton Police Court last week of Cecil Grundy, of Rishton Lane, Bolton, who was found guilty of operating a wireless transmitter without a licence. He was fined £5 and ordered to pay £5 5s. costs.

Mr. Frank Elliott, prosecuting for the Post Office, said that Grundy's call sign ORS had been heard in Manchester for two years, usually on Sundays and at midnight, after ordinary broadcasting had ceased. Engineers had made about twenty visits to the town before narrowing down the search sufficiently to detect the defendant's set. He added that there were more unauthorised transmitting stations in South Lancashire than in all the rest of England put together.

oooo

SCREENED-GRID VALVES IN D.F.

Messrs. Elder Dempster & Co., Ltd., have given orders for their ships *Adda*, *Accra*, *Apapa*, *Appam* and *Abinsi* to be fitted with Marconi direction-finding apparatus, and the work of installation will proceed as the ships become available.

The Marconi International Marine Communication Company's Direction Finder Type 11G is the latest design of marine direction finder, and uses high-frequency amplifying valves of the screened-grid type.

Another feature of this instrument is the introduction of two calibrated dials in the direction finder unit. One is fixed, and the bearings indicated thereon are relative to the ship's head. The second dial is rotatable, and on being set to the ship's true course will indicate true bearings that need no correction, providing the ship is on her course when the bearing is taken.

oooo

PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION.

The Nineteenth Annual Exhibition of the Physical and Optical Societies is to be held on Tuesday, Wednesday and Thursday, January 8th, 9th and 10th, 1929, at the Imperial College of Science, Imperial Institute Road, South Kensington, and will be open in the afternoon from 3 p.m. to 6 p.m., and in the evening from 7 p.m. to 10 p.m.

Over eighty firms have accepted the invitation to exhibit in the Trade Section at this exhibition, and in addition a group of research and experimental exhibits is being arranged, which will be shown by Fellows of the Societies and others, and a number of research laboratories and other institutions. Some interesting historical exhibits will also be included.

On January 8th Professor F. Lloyd Hopwood, M.A., F.Inst.P., will deliver a lecture on "Experiments with High-frequeucy Sound Waves."

Invitations to the exhibition have been sent to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Royal Aeronautical Society, the Royal Meteorological Society, the Faraday Society, and a number of other societies and bodies. As in previous years, members of these socicties should apply for tickets to their secretaries. Others may obtain tickets on application to the Secretary, the Physical and Optical Societies, 1, Lowther Gardens, Exhibition Road, London, S.W.7. Tickets are required only on January 8th and 9th. Admission on the third day, January 10th, will be without ticket.

oooo

WIRELESS AT WESTMINSTER.

(From Our Parliamentary Correspondent.)

The New Broadcasting Premises.

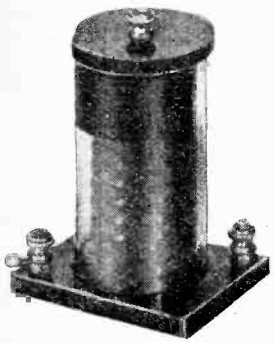
Mr. Malone asked the Postmaster-General last week whether the British Broadcasting Corporation obtained his approval before deciding on the purchase of new premises; and, if so, whether the question of a national opera house was considered.

Sir W. Mitchell-Thomson said that this matter was dealt with by the British Broadcasting Corporation under the general powers which had been conferred upon them, and it was not necessary for them to obtain his approval. The second part of the question did not therefore arise.

A Review of Manufacturers' Recent Products.

"TAYLORADIO" H.F. CHOKE.

The winding of this choke is air spaced, and is wound in seven sections supported on slotted vertical ebonite rods. The



"Tayloradio" H.F. choke; D.C. resistance, 770 ohms.

windings are set up in a cylindrical glass tube mounted on an ebonite base provided with terminals.

The choke has an excellent impedance curve which is not too peaked, and gives the following values :—

Wavelength (metres).	Impedance (ohms).
200	12,800
500 ... —	47,700
1,600	263,000

Resonance occurs at about 2,200 metres, up to which wavelength the choke can be used without fear of self oscillation.

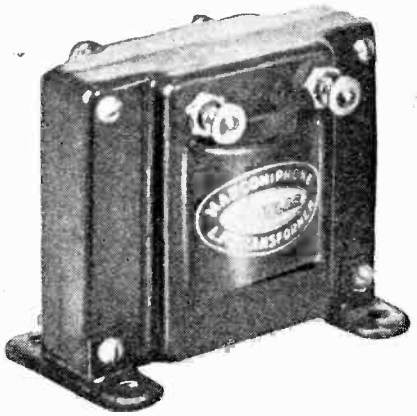
The "Tayloradio" choke is make by Messrs. W. W. Taylor, 33, Furnival Street, London, E.C.4, and the price is 4s. 6d.

o o o o

MARCONIPHONE "POPULAR" TRANSFORMER.

The small dimensions of this transformer—2½in. × 2¼in. × 1¾in.—make it eminently suitable for use in portable sets or where space is limited. In spite of its small dimensions, it has a remarkably good performance when preceded by a valve of medium impedance, e.g., 10,000 ohms. A practical test proved the reproduction to be clean and crisp; the amplification of extremely high frequencies was good, and it is only when the very lowest frequencies of the order of 30 or 50 cycles are reached that any inferiority to more expensive transformers is noticed, and then only to a small degree.

The transformer has a ratio of 4 : 1, and the inductance of the primary was shown by measurement to be 12.2 henrys without D.C. flowing through the windings.



Marconiphone "Popular" L.F. transformer for use in portable sets.

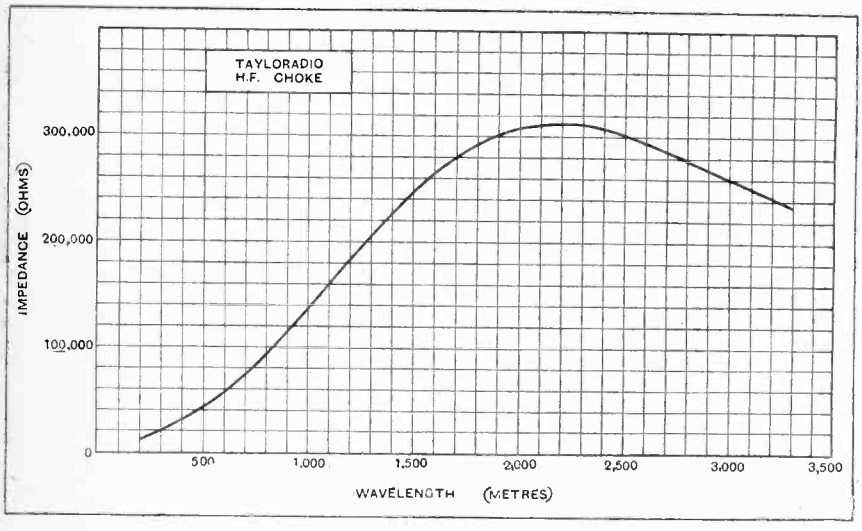
The screening case is fitted with reversible feet and the transformer can be mounted with the terminals in the best position for wiring

A twelve months' guarantee is given and the price is 12s. 6d.

o o o o

GAMBRELL VOLUVERNIA.

This is a high resistance potentiometer designed primarily for use as a volume control. The maximum resistance of the particular specimen tested was within 2 per cent. of its stated value and the minimum resistance, with the moving contact just free from the end stops, approximately 300 ohms. Between these two limits the value change is practically proportional to the angular displacement of the control knob. Only at one part of the track was there any appreciable deviation from the straight line, and this was in the order of 8 per cent. only at



Impedance curve of the "Tayloradio" H.F. choke; external capacity, 8 micro-mfds.

the maximum. The movement is very smooth, denoting an even pressure at all parts of the track, and this doubtlessly attributes largely to the steady change in resistance over the whole scale. The resistance changes from maximum value to minimum in slightly less than one complete revolution of the knob. The component is intended for panel mounting, and is provided with a single hole fixing attachment. The makers have apparently

Gambrell "Voluvernia," a one-megohm potentiometer primarily intended as a volume control.

given careful thought to the design, and, bearing in mind the extensive use of metal panels, have supplied with each component two ebonite bushes. In these cases a half-inch diameter hole must be drilled in the panel, but for mounting on insulating material the ebonite bushes can be removed and a $\frac{3}{8}$in. hole will suffice to clear the fixing attachment.

The component is particularly suited for use in any position provided it is not required to pass too large a current. For example, it can be connected across the input terminals of a gramophone amplifier and the moving contact taken to the grid of the valve with one end of the resistance element connected to a suitable point on the grid bias battery, or it can be used in place of the grid leak in either a resistance-capacity or choke-coupled amplifier. Many other uses will suggest themselves to the experimenter. The component is very compact, the dimensions being 2in. in diameter over the terminals and 1in. in depth. The makers are the Gambrell Radio, Ltd., Buckingham House, Buckingham Street, London, W.C.2, and the price is 6s. 9d.

o o o o

"STANDARD" LECLANCHÉ L.T. BATTERY.

It is in remote country districts that the benefits of broadcasting are most appreciated, yet it is in these circumstances that there is difficulty in installing a valve set owing to the problem of accumulator charging. Many isolated farmers at present struggling along with a crystal set and a big aerial would willingly purchase a valve set if they could be assured of trouble-free service over a reasonable period.

The old D.E.3 valve used in conjunction with dry batteries of the bell-ringing type, partly solved a problem which now finds its complete solution in the use of large capacity wet Leclanché cells. These cells are well suited for supplying filament current to modern "point one" filament valves and should run a two-valve set for 6 months or more without attention.

The "Standard" sac Leclanché low-tension battery consists of two cells enclosed in a wooden cabinet measuring $12\frac{1}{4}$in. × $6\frac{1}{2}$in. × 10in. The cells are separated by a partition and the glazed earthenware jars are treated at the top with paraffin wax to prevent creeping of the electrolyte. The sacs and zincs are of unusually large dimensions, and completely fill the interior of the jars, the inside dimensions of which are $7\frac{1}{2}$in. × $4\frac{1}{2}$in. diameter. The zinc is separated from the sac by square-section rubber rings.

The maximum economical discharge of the battery is 0.25 amp., which is the current required by the average 2-volt two-valve set employing a 0.1 filament detector and a 0.15 filament output valve. In order to keep the current constant during the life test, a variable resistance was employed in conjunction with a fixed minimum resistance of 8 ohms. The fixed resistance represents the two-valve filaments in parallel, and the variable resistance is necessary in order to keep the voltage across the filaments constant at 2 volts. The initial voltage of the battery is 3.0 volts (1.5 volt per cell), so that a variable filament resistance of not less than 4 ohms is essential in any receiver using these batteries for L.T. supply. If the resistance is not incorporated in the set it must be fitted externally—preferably in the +L.T. lead.

Throughout the test the resistance was adjusted to keep the current constant at 0.25 amp., and this value was maintained for the first 400 hours. By this time the contact arm on the resistance had reached zero, and from 400 hours onwards the only resistance in circuit was the 8 ohms representing the filaments. The receiver would continue to give signals with less than the normal filament current, probably for a further 50 or 100 hours, depending on the type of valves used. The life of the battery can therefore be put at about 450 working hours, which is equivalent to six months' normal use. It is interesting to note that this will also be the average life of the H.T. battery if its capacity is correctly chosen to suit the anode

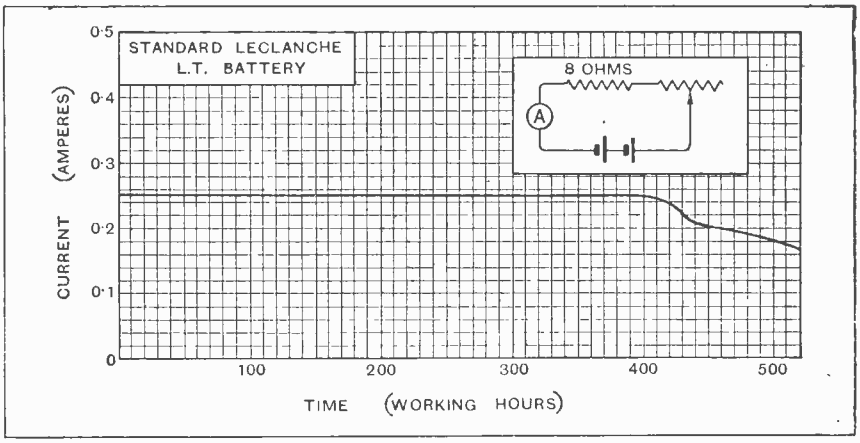
"Standard" sac Leclanché low tension battery.

current taken by the set and the replenishment of both batteries may be undertaken at the same time.

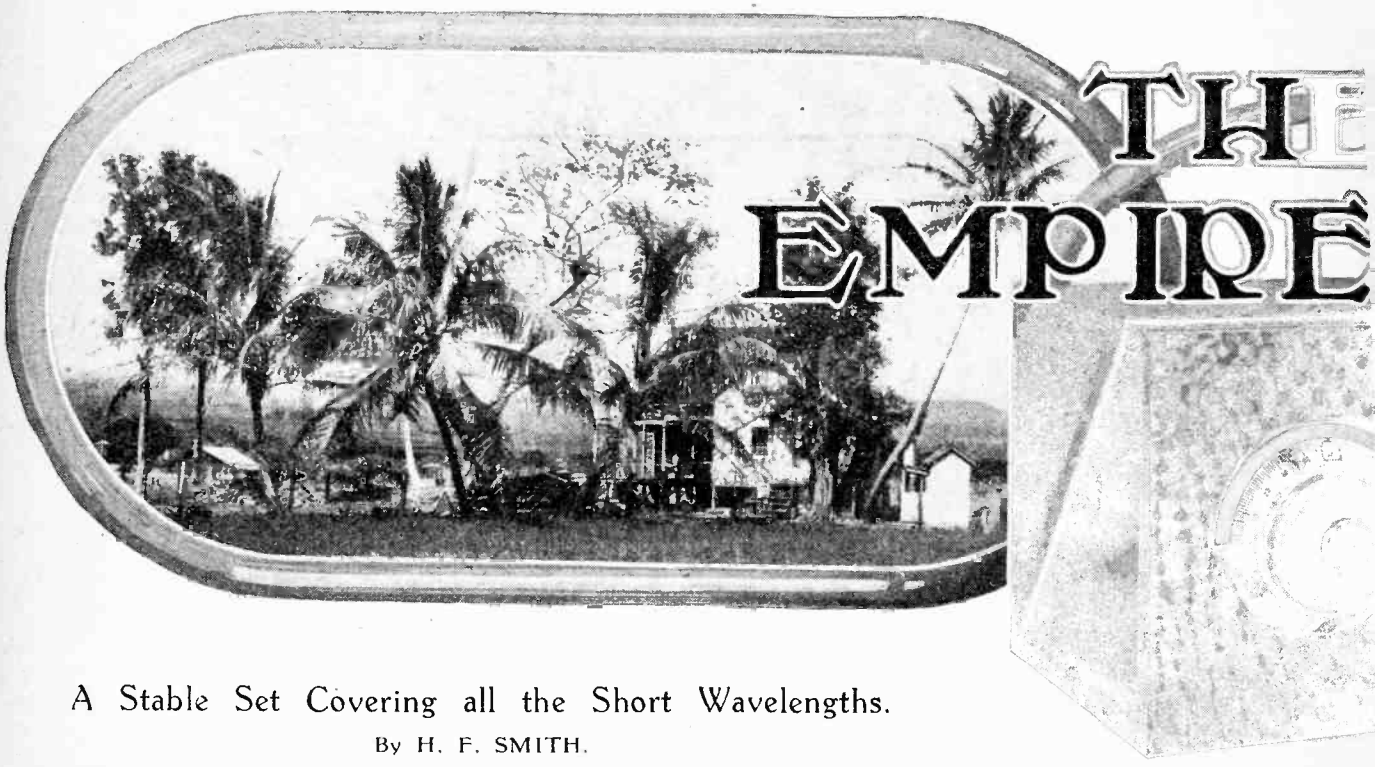
When renewing the L.T. battery, fresh sacs as well as zincs should be used, and the cost of recharging, including electrolyte, will amount to 14s.

A thin layer of oil on the surface of the electrolyte is recommended and will prevent evaporation. Oil was used in the battery under test, and no addition of water was necessary during the time of the test, the liquid maintaining the correct level throughout.

The battery is made by the Standard Wet Battery Co., 184-188, Shaftesbury Avenue, London, W.C.2, and the initial cost complete with electrolyte is 26s. 6d.



Discharge curve of the "Standard" L.T. battery; *current* maintained constant at 0.25 amp. by means of variable resistance until E.M.F. fell below 2.0 volts when the *resistance* in circuit was maintained constant at 8 ohms.



THE EMPIRE

A Stable Set Covering all the Short Wavelengths.

By H. F. SMITH.

SHORT-WAVE broadcasting has come to stay. Unless something amounting almost to a new principle in transmission is evolved, this statement may be made with confidence, in view of the fact that many existing stations are increasing their activities, and new ones—among them the high-power German "World Sender"—are projected or actually in course of construction. A short-wave set is now a useful addition to the equipment of a wireless amateur in this country, as it opens up a new field for his interest and amusement, but to the exile abroad it is a great deal more than this. In many cases short waves afford the only really practicable means of reception, and in others they bring from Home—in spite of our present rather rudimentary service—a much appreciated supplement to local programmes which are often inadequate. The set to be described in this article is intended to meet the needs of users both at home and abroad, but particular attention has been given to the requirements of the latter.

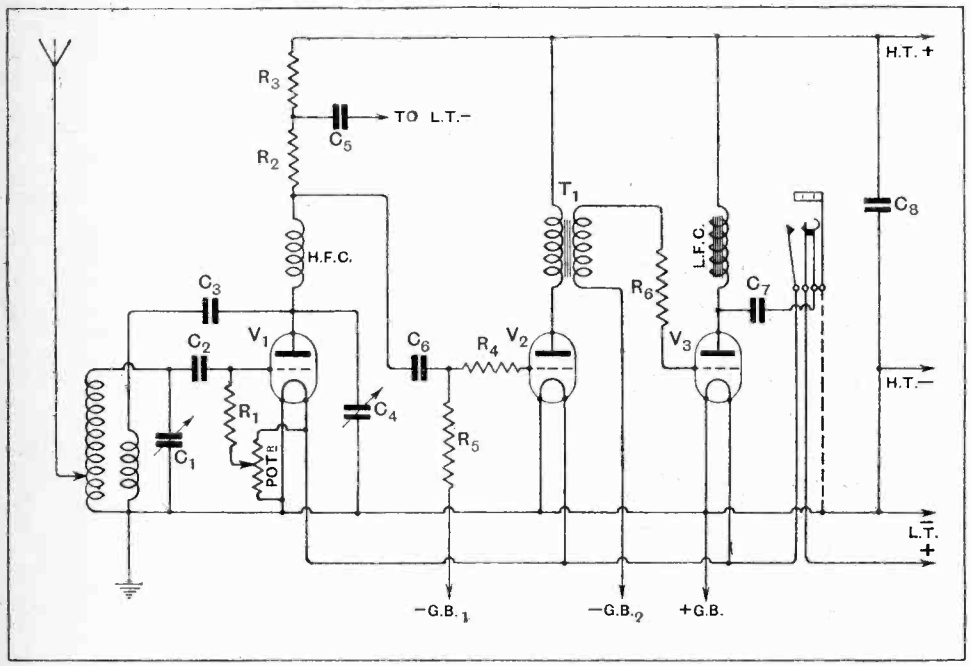


Fig. 1.—The circuit diagram. C_1, 0.00015 mfd.; C_2, C_3, 0.0001 mfd.; C_4, 0.00025 mfd.; C_5, C_7, C_8, 2 mfds.; C_6, 0.01 mfd.; R_1, 5 megohms; R_2, 20,000 ohms; R_3, 20,000 or 50,000 ohms; R_4, 250,000 ohms; R_5, 1 megohm; R_6, 100,000 ohms.

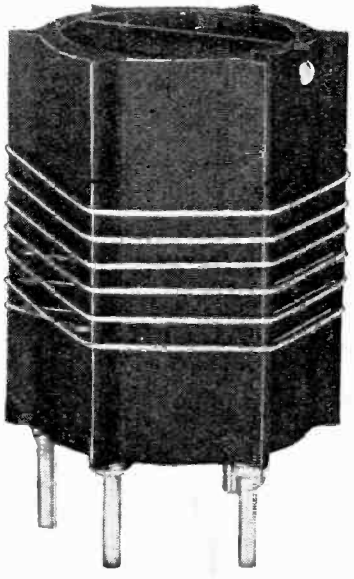
Those without experience of the short waves must not imagine that they afford a royal road to consistent reception of distant stations. They do not; for some reason not yet fully explained, signals which are normally good will at times almost disappear for many days on end. Fortunately, this disability has its compensations; for long periods excellent reception is pos-

NEW RECEIVER

Special Precautions are taken to Counteract Hand-capacity Effects.

sible with the simplest apparatus. It is true to say that when signals are coming in really well, they can be received on almost any skilfully handled set, even if it has serious shortcomings; during the "fading" periods nothing will yield satisfactory results. It is when signals are of medium intensity that one most appreciates a receiver with some reserve of amplification, freedom from hand-capacity effects, and with controls that are not too difficult to operate; there is little pleasure in working with a tricky and unstable set.

In designing the present set, the writer has been helped by correspondence from readers in many parts of the world with regard to the original "Empire" receiver, described in *The Wireless World* of June 29th, 1927; some of the modifications included are the result of these suggestions. An extra L.F. stage has been added to give adequate magnification for loud speaker reproduction when signals are really good enough, but this stage is so arranged that amplification is not excessive for reception with 'phones. Regeneration control has been improved by adopting the "parallel feed" throttle method, with close magnetic coupling between grid and reaction windings. Instead of a single tapped tuning coil, plug-in inductances of simple construction are used; it is thus possible to use the set for reception on the normal broadcast waveband if desired.



Plug-in coil for the 23–45 metre waveband.

The circuit diagram, Fig. 1, shows that the first valve operates as a grid detector, and is coupled to the L.F. amplifier by a resistance of low value, in series with which is a decoupling resistance with its by-pass condenser. The next stage is transformer coupled. A choke output is so arranged that one side of the 'phones or loud speaker is earthed, while a suitable jack affords a convenient method of connecting either of these instruments at will, and also switches on the filament current. The set is completely screened, so hand-capacity effects are negligible provided the earth connection is of reasonably low resistance.

The Metal-sheathed Container.

Screening is effected by enclosing the apparatus in a metal cabinet; in this matter the constructor may follow his own ideas, but will be wise at least to retain the metal front panel if he prefers to use a wooden box. The container illustrated is made of "Plymax," a material consisting of plywood covered each side with thin sheet metal, the total thickness being $\frac{1}{8}$in. It was built by the manufacturers to the writer's specification. The construction is shown in Fig. 2. The front panel is sheathed with copper, which, before assembly of the components, was given an "engine-turned" finish by rotating a piece of fine emery paper at regular intervals over the surface, which was then pro-

The New Empire Receiver.—

tected by a coat of clear cellulose lacquer. The remainder of the box is sheathed in lead-coated steel.

In addition to the holes indicated in Fig. 3, the positions of which are given in relation to the inside dimensions of the container, the front panel must be drilled for the securing screws of the variable condenser and its dial in accordance with the template supplied by the manufacturers. Three $\frac{3}{8}$in. holes are also drilled through the back; two of them immediately opposite the apertures of the terminal block (for aerial and earth leads) and a third to pass the battery leads.

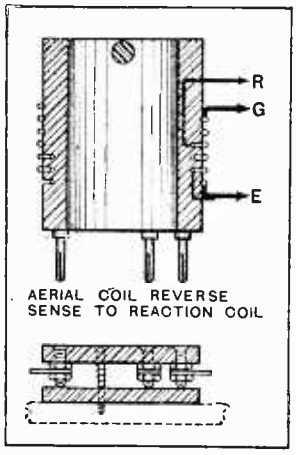


Fig. 2.—Construction of coils and base.

Before discussing construction of the set proper, it will be as well to describe the coils, which are the only "home-made" components used. They are wound on 3in. lengths of "Becol" six-ribbed ebonite former, $2\frac{1}{2}$in. in diameter, fitted with four pins spaced as shown in the practical wiring plan. Actual dimensions are not given, as it is best for the constructor to drill his own formers, using the first as a guide in marking off the others, and also the base; by these means it is easy to ensure that all the coils will fit properly.

The disposition of the windings is shown in Fig. 2, from which it will be seen that the reaction winding is under the low-potential end of the aerial-grid coil, and is parallel to it, being wound at the bottom of slots cut in the ribs with a fine saw. These slots must be sufficiently wide to take the fine wire reaction winding (No. 36 D.S.C.), but the thicker wire (No. 20 tinned copper) of the grid coil rests in shallow V-shaped depressions filed in the lip of the slots, which should be of such a depth that the spacing between the two wires is $\frac{1}{16}$in.

It is essential that these two coils should be wound in opposite directions, and to simplify matters the series of slots are cut so that the windings are not in the form of a regular helix, but advance from turn to turn at a fixed point between two adjacent ribs. Both windings should make their advance at the same point.

Most of the important short-wave broadcasting stations operate between 23 and 45 metres, so one of the coils—the most useful of the series—is arranged to cover this band. Its grid winding has $6\frac{1}{2}$ turns, with a reaction section of 3 turns.

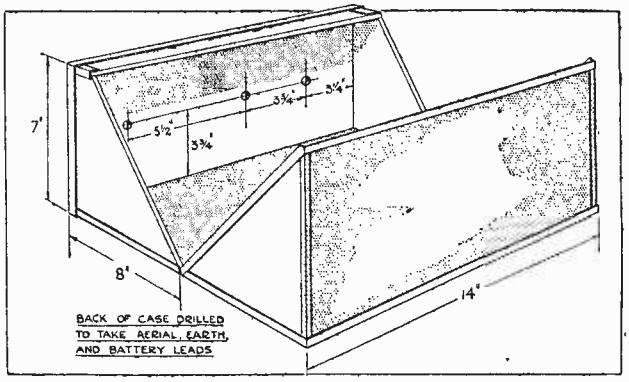


Fig. 3.—Dimensions of the screening box. Inside measurements are given.

For the ultra-short waves, from 16 metres upwards, a coil with a total of three turns in both the grid and reaction sections is suitable. The maximum wavelength attainable with this inductance is 28 metres, so there is ample overlap. In both cases, adjacent turns are spaced $\frac{3}{16}$in. between centres.

Up to 90 Metres.

With the exception of KDKA, there are not many high-power short-wave transmissions above 45 metres, but to complete the series another inductance may be wound with 4 reaction turns and a grid coil of $12\frac{1}{2}$ turns, with a spacing of $\frac{3}{32}$in. This covers a wavelength of from 38 to 90 metres. The ends of the windings are

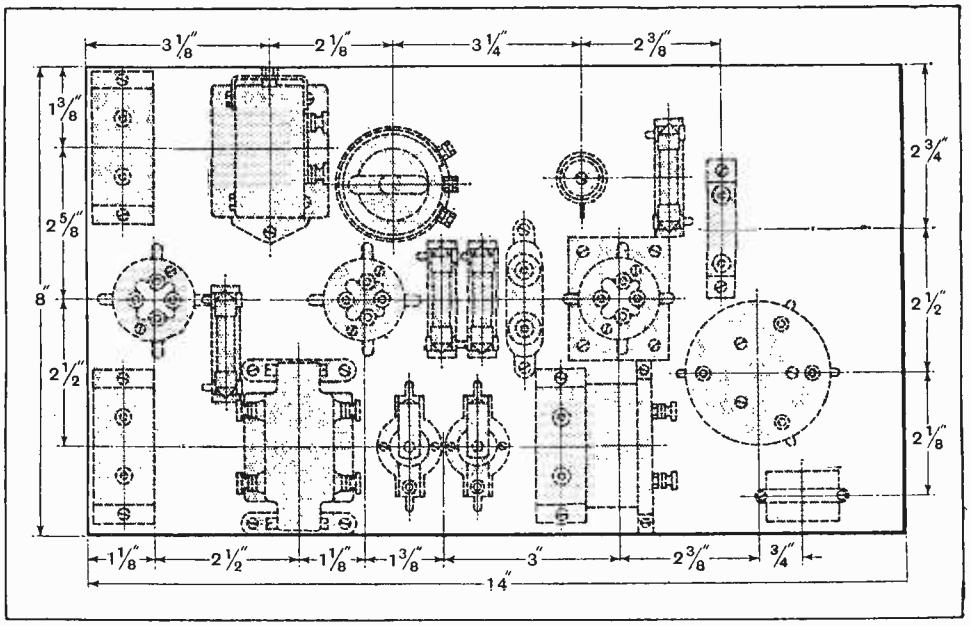


Fig. 4.—Position of components on the baseboard. Note sponge rubber support of detector valve holder.

The New Empire Receiver.—

jointed to their appropriate pins in accordance with Fig. 2, care being taken to make each connection to a pin which will engage with a socket on the base bearing corresponding lettering (Fig. 5). The base itself consists of two 2½in. discs of ¼in. ebonite, the upper of which carries four short sockets, the lower merely serving to insulate their projecting ends. The whole assembly is secured to the baseboard by three screws.

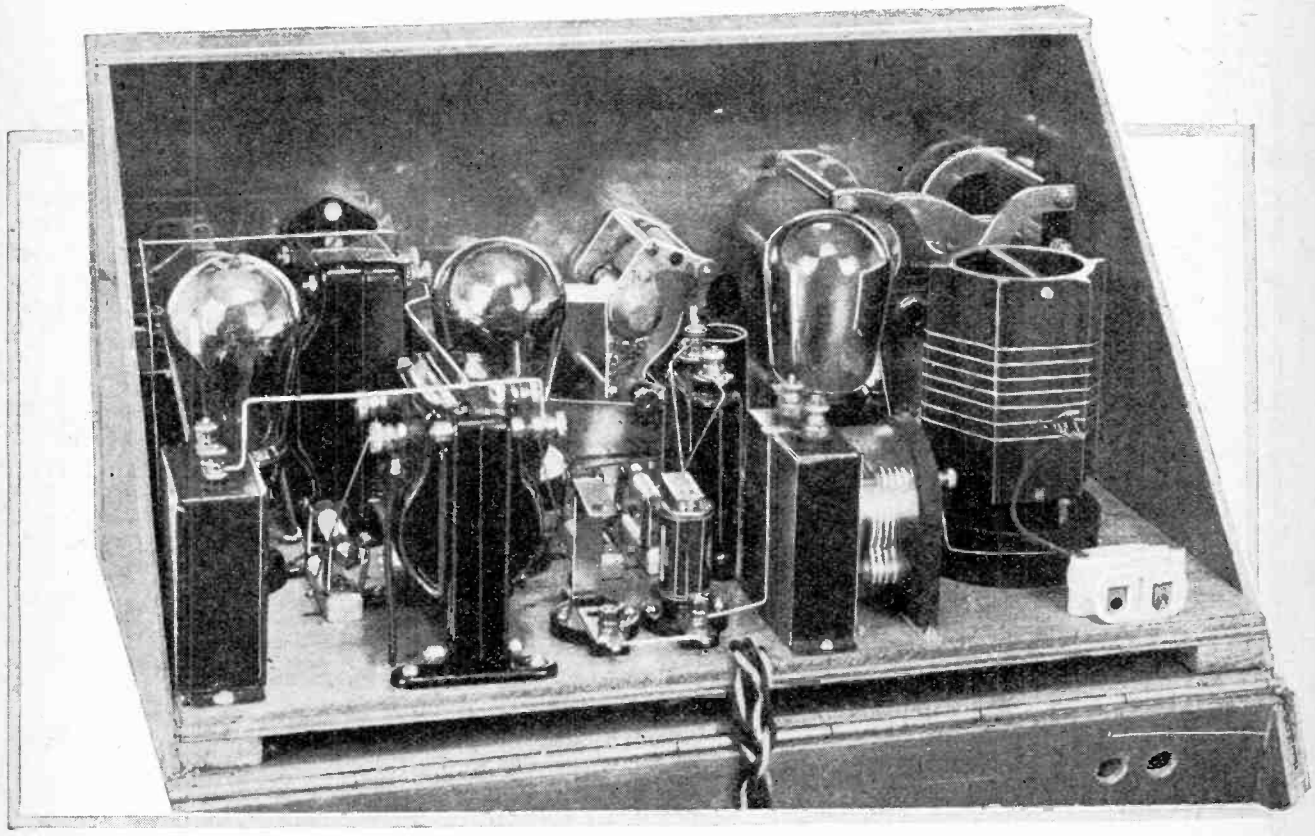
Points in Mounting and Wiring.

Care has been taken to reduce the overall dimensions of the set to a practical minimum, but in the course of assembly and wiring no difficulty will be experienced if the right course of procedure is followed. The first step is to prepare the wooden baseboard, which measures 14in. by 8in. by ⅜in. in thickness, and is fitted with a batten ½in. wide and ⅜in. thick at each end in order to provide space for wiring. Components should now be mounted on it in positions indicated in Fig. 4, after which the majority of connections may be made before fitting it in the cabinet.

Valve filaments are wired with bare leads, passed through the baseboard and insulated only by the wood, which is quite adequate for these low-tension circuits. It will be noticed that the detector valve is mounted on a block of sponge rubber—microphonic noises are particularly objectionable in a short-wave receiver—so the final connections to the terminals of its holder must be made with short lengths of flexible wire; otherwise the advantage of a shock-absorbing mounting will be lost.

Tinned copper wire, No. 20 gauge, was used for wiring up the receiver illustrated. Battery leads of flexible wire are joined to appropriate points; it should be noted that the positive L.T. lead is taken direct to the upper contact of the jack. All these wires are plaited or twisted together and passed up through a hole near the rear edge of the baseboard.

The two variable condensers and jack should now be mounted on the panel, after which the baseboard may be fitted and the few remaining leads joined up. It will be observed that a connection is made to the cabinet metalwork *via* the tuning condenser frame from the common L.T. and H.T. negative lead; it therefore follows that the body of the jack and one set of vanes of reaction control condenser C_4 will be in metallic connection with the same point; if a panel of insulating material is used, extra leads must be added.



Rear view of receiver with lid fully opened. The decoupling resistance is removed from its holder.

Details of Assembly.

The Sterling L.F. choke is fitted with feet, of which the position may be altered so that the component may be mounted in any desired manner: one of these is secured to the baseboard, and the other, by means of a screw, to a 4 B.A. nut soldered to the rear surface of the panel. This is quite a simple operation, but it is

The New Empire Receiver.—

LIST OF PARTS.

1 Variable condenser, 0.00015 mfd. (Cyldon).
1 Reaction condenser, 0.00025 mfd. (Polar).
3 Condensers, 2 mfds. (Sterling).
1 Condenser, 0.0001 mfd. (Dubilier, Type 620).
1 Condenser, 0.01 mfd. mica (Dubilier, Type B. 775).
1 Condenser, fixed, air dielectric, 0.0001 (Ormond).
1 Slow-motion dial (Bowyer-Lowe).
1 H.F. Choke (Igranic, short-wave type).
1 Resistance, 250,000 ohms (Ediswan).
1 Resistance, 100,000 ohms (Ediswan).
1 Grid leak, 5 megohms (Ediswan).
1 Grid leak, 1 megohm (Ediswan).
4 Grid leak holders, porcelain (Bulgin).
1 L.F. transformer (Ferranti, A.F.4).
1 L.F. choke, 30 henrys (Sterling).
1 Anode resistance, 20,000 ohms, with base (Igranic).
1 Anode resistance, 50,000 ohms, with base (Igranic).
1 Terminal block (Athol Electrical Co., Tyson Street, Cheetham Hill, Manchester).
3 Valve holders, skeleton type (Pye).
1 Potentiometer, porcelain (Igranic).
1 Jack, single circuit open, filament control (Edison Bell, Type R/166).
1 Plug (Edison Bell, Type R/168).
3 Ribbed formers, 2½in. dia., 3in. long (Becol).
1 Cabinet, metal-sheathed plywood (Venesta, Ltd., Vintry House, Queen Street Place, London, E.C.4).
Wire, screws, ebonite, etc.

Approximate cost, including cabinet, but without valves and accessories, £7 2s. 6d.

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.

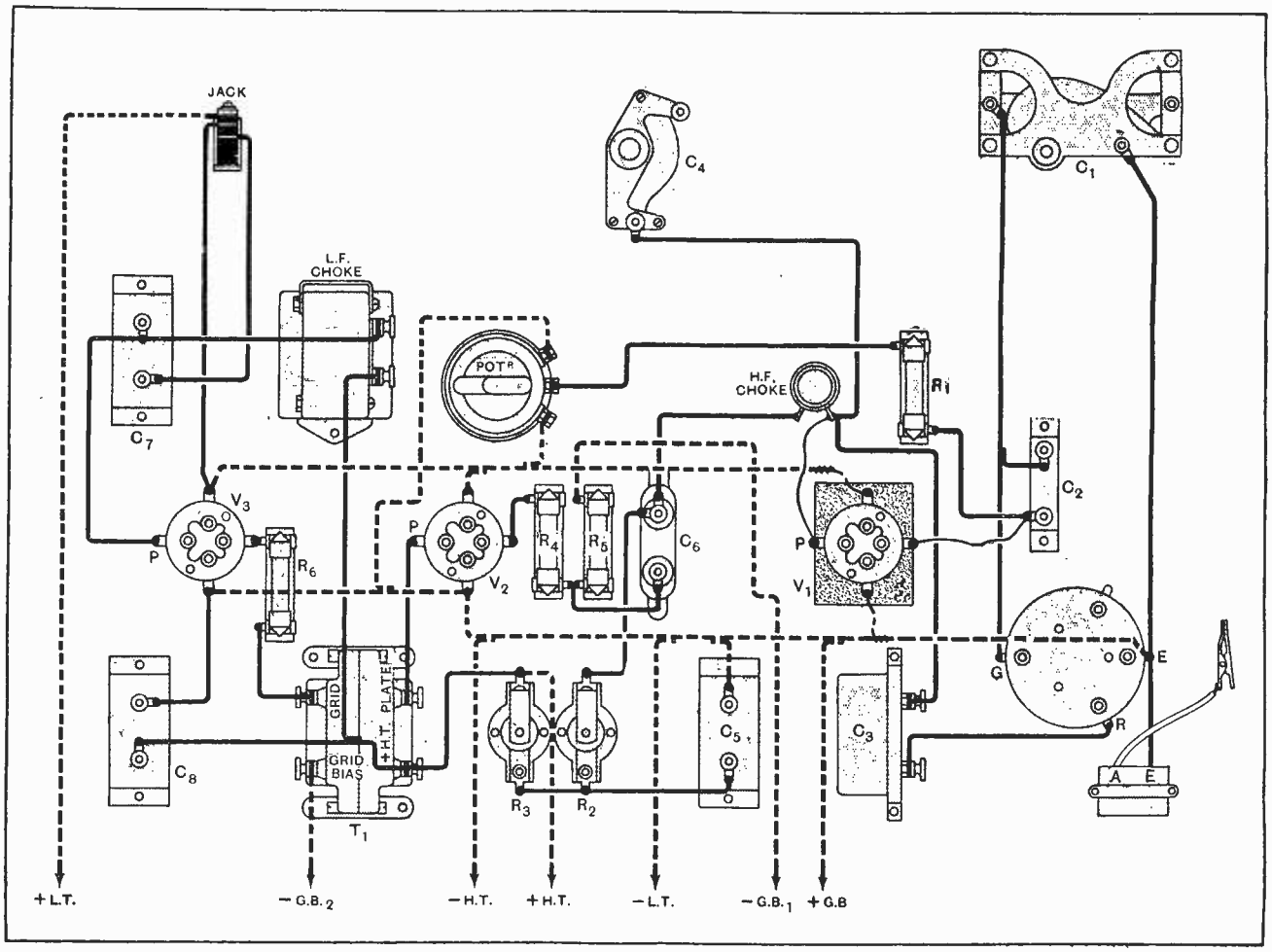


Fig. 5.—Practical wiring plan. The frames of both variable condensers and of the jack are in metallic connection with the screen and the common negative lead. Leads which pass through the baseboard are shown in dotted lines. The single connection to C_4 must be made to the insulated set of vanes.

necessary to mark the exact position of the nut before the baseboard assembly is finally placed in position. It may be added that this method of fitting is adopted only to avoid defacing the front surface of the panel by a screw head, and that a second support is unnecessary unless the set is likely to receive rough treatment.

For the detector position, a good "general purpose" valve, with amplification factor in the order of 20, is a safe choice. As a first-stage L.F. amplifier, a similar type will do excellently, but where headphone reception only is required, an "L.F." pattern giving a smaller overall magnification is perhaps more pleasant to work

The New Empire Receiver.—

with. Choice of an output valve is, as usual, governed entirely by requirements as to volume, and need not be discussed here.

Aerial Coupling Adjustments.

It will have been noticed that one of the coil base sockets is "idle," and (from the practical wiring plan) that the aerial lead-in terminates in a short wander lead carrying a spring clip. This is for the reason that it is often necessary to vary the position of the aerial tapping on the grid coil, and it is convenient to have a ready means of making connection at the point found to be best by trial Generally speaking, this tapping will vary from a point half a turn to three turns above the lower (earthed) end of the coil, the first-mentioned position being suitable for the shorter wavelengths. The fourth pin is retained, however, both to give rigidity to the mounting and to serve as an aerial connection for the broadcast coil, which is to be described later.

In the inscription under Fig. 1, the value of the decoupling resistance R_3 is given as 20,000 or 50,000 ohms. This point requires a word of explanation: it will be realised that the resistor, apart from its function of deflecting signal currents from the common battery circuit, also reduces the voltage applied to the detector anode. The first-mentioned value is suitable for applied voltages of less than 100, and the second for pressures above this and up to some 140 volts, which is the maximum likely to be used.

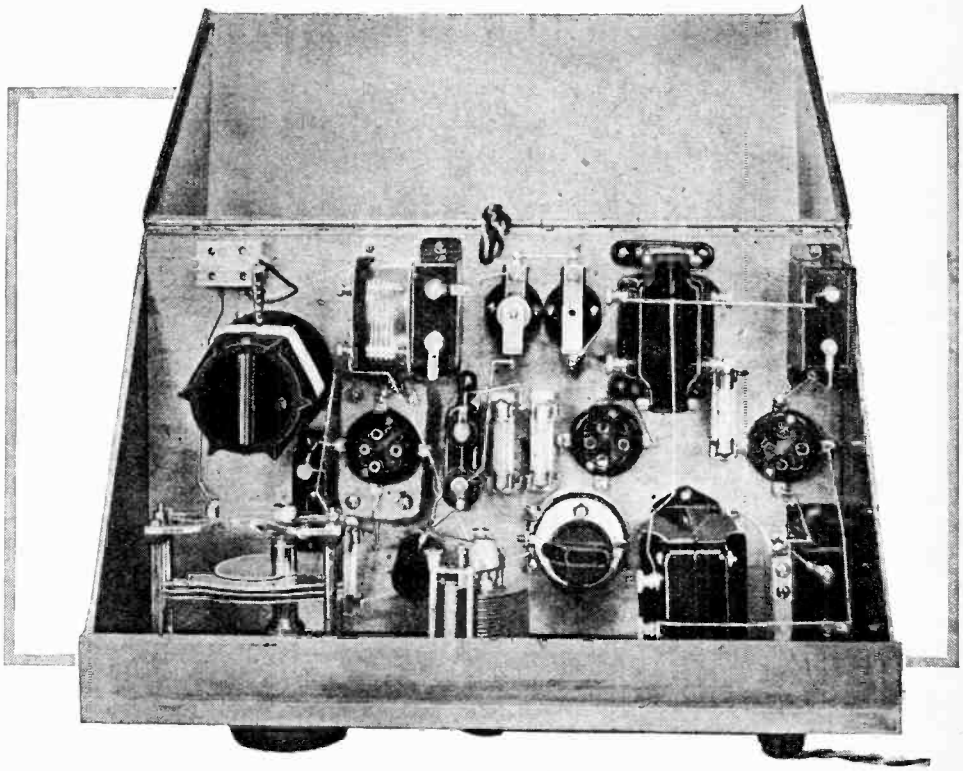
Throttle reaction of the type included depends for its operation on the relationship between the values of the feed (C_3) and control (C_4) condensers, and it is for the reason that some adjustment may be necessary to the capacity of the first mentioned that a component with an air dielectric is used; this may easily be reduced by removing one or more of the plates.

It is recommended that the 23-45-metre coil should be used for initial tests. Among the transmissions on this band are those of the well-known Schenectady relay station, 2XAF, Pittsburgh on 27 metres (which at the time of writing is "coming over" better than any other American station), Chelmsford, Melbourne, and PCJJ. At the top of the tuning scale will be found the amateur telephony transmitters on about 42 metres.

The jaws of the crocodile clip used for connecting the aerial to the grid coil must be filed away (as shown in Fig. 5) so that contact may be made at any point without introducing a short-circuit between turns. As a start, it should be joined to include a single turn; if oscillation cannot readily be produced with this connection, it should be moved half a turn nearer the earthed end. If, on the other hand, there is a tendency towards too free oscillation, it will be as well to reduce the capacity of the feed condenser as already described.

Smoothness of reaction control is even more important in a short-wave set than the highest possible detection efficiency, so the grid potentiometer should be set at a point which gives the best practical compromise; generally speaking, this condition will be realised if its slider is rather nearer the negative than the positive end of its winding.

Finally, the question of reception of normal broadcasting stations. In view of the necessarily low capacity of the tuning condenser, the band covered is strictly limited, but by winding a coil with a grid section of 95 turns of No. 28 D.S.C., wavelengths from about 300 to 500 metres may be received. The associated reaction coil has 14 turns of No. 36 D.S.C. divided between two narrow slots spaced ½in. apart, under the earthed end of the grid section. An aerial tapping is made at the 20th turn, and is joined to the pin which, in the short-wave inductances, is idle. Its corresponding socket carries a tag projecting beyond the edge of the base, to which the aerial clip may be attached.



Plan view of the receiver.

This set is available for inspection by readers at the offices of "The Wireless World," 116-117, Fleet Street, London, E.C.4.

PROGRAMMES FROM ABROAD

SATURDAY, DECEMBER 29th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

BARCELONA (Radio Barcelona), Call EAJ7 (**344.8 metres**); 1.5 kW.—**6.10,** Sextet Selections: Two-Step, Clásico (Martí); Selection from La casita blanca (Serrano-Pacheco); Intermezzo, Capricho andaluz (Orejón); Waltz, Dolores (Waldteufel); Selection from Manon (Masscnet). **8.30,** Elementary French Lesson. **9.0,** Chimes and Weather Report. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Concert: Two-step, Como los buenos (Jarque); Selection from La Gran Via (Chueca and Valverde-Finck); Waltz, Estudiantina (Waldteufel); Fox-Trot, My inspiration is you (Leslie, Nicholls-Somers); Pizzicato, The Twilight Serenaders (Hoby); Czardas, Ilonka (Michiels). **10.0,** Programme relayed from **Madrid**, EAJ7.

BERGEN (**370.4 metres**); 1.5 kW.—**5.30,** Programme for Girls. **6.0,** Programme for Children. **7.0,** Orchestral Concert. **7.20,** Selections by the Wiener Schrammel Quartet. **7.50,** Topical Talk. **8.0,** Talk by Colonel J. Wahl. **8.30,** Sonata in G Major for Pianoforte and Violin (Grieg). **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,649 metres**); 40 kW.—**3.30,** Programme from **Hamburg**. **4.30,** Dr. Gustav Manz, Talk: Public Speaking. **5.0,** Industrial Talk. **5.30,** Elementary Spanish Lesson. **5.55,** Dr. M. H. Böhm, Talk: The Problem of the Eastern Frontier States. **6.20,** Prof. Ehrenbaum, Talk: The Herring Industry. **7.0,** "Agricultural" Programme: Hunter's Chorus from Der Freischütz (Weber); Abschied vom Walde (Mendelssohn); Selection for Bugle Quartet; Baritone Solos, (a) Selection from Das Nachtlager von Granada (Kreutzer), (b) Jagdlied (Mendelssohn-Bartholdy); Jagdfanfare for Bugle Quartet (Lindner); Humorous Hunting Stories; Selection for Bugle Quartet, Die Instigen Jagabuan (Koschat); Baritone Solos, (a) Willkommen mein Wald (Kranz), (b) Das Jägerhorn (Pohlens); O Wald, wie ewig schön bist du (Reinecke); Bugle Quartet Selection, Jägermarsch (Lorenz). **8.0,** Talk on Books. **8.30,** Programme from **Voxhaus**. **11.30** (approx.), Close Down.

BERLIN (Voxhaus) (**484 metres**): 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Programme of Gramophone Records. **10.30 a.m.,** Exchange Quotations. **11.55 a.m.,** Time Signal. **12.30,** Weather Report and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations, Agricultural Report and Time Signal. **2.30,** Talk, by Herr W. Mehlan. **3.0,** Reinhold Stahl, Talk: Rembrandt. **3.30,** Gertrud Isolani reads from her own Works. **4.0,** Orchestral Concert: Selection from Carmen (Bizet); Waltz from Gipsy Love (Lehár); Sérénade mélancholique (Tchaikovsky); Selection from Madame Butterfly (Puccini); In a Spanish Town, Valse triste (Sibelius); Elegie (Bullerian); Ave Maria (Schubert); Merry Christmas (Rhode); In the Interval, Advertising Notes. **6.0,** Prof. Esau Jena, Talk: Short Waves. **6.30,** Prof. Hans Delbrück, Talk: The Relation of the various forms of Government to War and Peace. **7.0,** "Der Mann in der Operette," by Else Knepel (Soprano), Bernhard Bötel (Tenor), and the Station Orchestra. **8.30,** Talk on Journalism. Followed by News, Time Signal and Sports Notes. **9.30,** Dancing Lesson, followed by Dance Music. **11.30** (approx.), Close Down.

BERN (**411 metres**): 1.5 kW.—**6.29,** Time Signal and Weather Report. **6.30,** Reading by Herr Max v. Kaenel. **7.0,** Popular Concert arranged by the Bern Chüejerjodler. **8.20,** Selections by the Kursaal Orchestra. **8.45,** News, Announcements and Weather Report. **9.0,** Selections by the Kursaal Orchestra. **9.35,** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**322.6 metres**): 4 kW.—**3.0** Review of Books. **3.30,** Concert of Dance Music. **5.0,** Film Review. **5.25,** Alfred Hamuschke, Talk in Esperanto: The Silesian Town of Grünberg. **5.35,** Herr Gerhard Haebler, Talk: The Land and Inhabitants of North China. **6.20,** Shorthand Lesson. **6.50,** Herr E. Buchwald, Talk: Insurance. **7.15,** Concert: Overture to Die Prinzessin von Trapezunt (Offenbach); Waltz, Jonathan (Millöcker); Selection from A Night in Venice (Joh. Strauss); Polka-Mazurka, Der erste Liebestraum (Delli ger); Selection from The Bird Fancier (Zeller); Overture to La Belle Galathée (Suppé); Intermezzo from A Thousand and One Nights (Joh. Strauss); Overture to Fesche Geister (Ziehrer); Schützenliesel-Marsch (Eysler); Waltz from Die geschiedene Frau (Fall); March from The Chocolate Soldier (Oscar Straus); Waltz, Mädi (Stolz); March, Fideler Bauer (Fall); Waltzes from Liebe im Schnee (Benatzky). **9.0,** News. **9.30,** Dance Music.

BRÜNN (**441.2 metres**); 2.5 kW.—**4.45,** German Programme. **5.15,** Wireless Review. **6.0,** Orchestral Selections. **6.45,** Dr. Stanek, Talk: Czech Literature from the National Reformation until To-day. **7.0,** Programme from **Prague**. **8.0,** Concert of Popular Music: Overture, In the Well (Blodek); Czech Suite (Moor); Songs (Steinmann); Czech Dances (Smetana); Songs (Novotny); The Blacksmith of Lesetin (Suda); Slavonic Dances (Dvorák). **9.0,** Programme from **Prague**. **9.25,** Dance Music relayed from **Bratislava** (300 metres).

BRUSSELS (**508.5 metres**): 1.5 kW.—**5.0,** Orchestral Concert from the Armenonville Tea Rooms, **Brussels**. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45** Pianoforte Solos. **7.0** Selection of Columbia Gramophone Records. **7.30,** "Radio-Chronique." **8.15,** Concert arranged by "La Meuse." **9.0,** Topical Talk. **9.5,** Concert (Continued). **10 10,** News and Esperanto Report. **10.15,** Orchestral Concert from the Palace Hotel, **Brussels**. **11.0** (approx.), Close Down.

BUDAPEST (**556.6 metres**): 20 kW.—**4.10,** Programme of Stories. **4.45,** Selection of Tzigane Music. **6.0,** Italian Lesson. **6.40,** Hints for Wireless Amateurs. **7.30,** "I Pagliacci"—Opera in Two Acts (Leoncavallo). **8.45** Gramophone Selections. **10.0,** Selection of Tzigane Music from the Hotel Britannia.

CRACOW (**566 metres**); 1.5 kW.—**5.0,** Programme relayed from **Warsaw**. **6.0,** Miscellaneous Items. **6.25,** English Reading by M. Jean Stanislavsky. **6.56,** Time Signal. **7.0,** Agricultural Report. **7.5,** Mr. J. Regula, Talk: Foreign Politics of the Past Week. **7.30,** Programme relayed from **Warsaw**. **9.30,** Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**1.30,** Weather Report and Gramophone Selections. **7.20,** News. **7.30,** Mr. E. C. FitzHenry, Talk: New Year Customs. **7.45,** Irish Lesson, by Seamus O'Duirinne. **8.0,** Selections from French and German Opera by the Augmented Station Orchestra. **8.30,** Irish, English and Scotch Ballads by May Mortell (Mezzo-Soprano). **8.40,** Tenor Solos by Victor Cole. **8.50,** The Station Orchestra. **9.0,** Scotch Ballads by Annie Broadhurst **9.15,** Instrumental Selections by Edmund Burke. **9.30,** Sketch by Elizabeth Young and Company. **10.0,** Selections by the Station String Orchestra. **10.20,** The Augmented Station Orchestra. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**428.6 metres**); 4 kW.—**2.5,** Concert: Folk-song, Heilige Nacht (Reinhardt); Stille Nacht (Mohr); Alle Jahre wieder (Hey); Süsser die Glocken (Kritzinger); Weihnacht, wie bist so schön; Schlaf wohl, du Himmelsknabe (Schubart); Folk-song, Still, Still; Gloria, Gloria (Enslin); O, Come All Ye Faithful (Reading). **2.55,** Hints for the Housewife, by Fini Pfannes. **3.35,** Orchestral Concert of Operetta Music. **5.10,** Reading from Kurd Lasswitz' Novel, "On Two Planets," by O. W. Studtmann. **5.30,** The Letter Box. **5.45** Esperanto Lesson by W. Wischhoff. **6.15,** Otto Specht, Talk: The National Hunting League. **6.45,** Astronomical Talk by Prof. Edmund Sittig. **7.15,** Programme relayed from **Stuttgart**. **8 30,** Variety Programme in Frankfurt Dialect, followed by Dance Music from **Voxhaus**. **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—**3.0,** Illustrated Music Talk, by Dr. Wilh. Heinitz. **3.30,** Mass in C Major (Schubert) for Four Voices, Orchestra and Organ. **4.30,** Request Programme. **5.30,** Dr. Johs. Prüfer, Talk: School Punishments—a Question of Practical Discipline. **6.0,** Dr. Meusch, Talk: Handicraft, relayed from **Hanover** (297 metres). **6.25,** Herr B. Rössler, Talk: The Building of a Market Hall in Hamburg. **6.55,** Weather Report. **7.0,** Concert of Popular Music: Three Selections from The Barber of Seville (Rossini); Mücke und Frosch (Sommerstorff); Uebertrumpft (Sommerstorff); Air from Der Freischütz (Weber); Overture to The Czar and Carpenter (Lortzing); Duet from Undine (Lortzing); Song from The Czar and Carpenter (Lortzing); Die Fliege im Zirkus (Hochstetter); Overture to The Merry Wives of Windsor (Nicolai); Songs from The Merry Wives of Windsor (Nicolai); Feldpredigers Kriegstaten (Körner); Overture and Air from The Barber of Bagdad (Cornelius); Air and Waltz from Der Rosenkavalier (Strauss). **9.30,** Weather Report, News, Sports Notes and Programme Announcements, followed by Concert from the Café Wallhof. **10.50,** North Sea and Baltic Weather Report.

HILVERSUM (**1,071 metres**); 5 kW.—**9.40 a.m.,** Time Signal and Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Concert of Trio Music. **1.40,** Musical Programme, relayed from the Tuschinksi Picture House, **Amsterdam**. **3.40,** Italian Lesson by Giovanni Rizzini. **4.40,** French Lesson by M. Raymond Lafont. **5.40** Time Signal. **5.41,** Concert of Trio Music. **6.25,** German Lesson by Herr Edgar Grün. **7.25,** Police Announcements. **7.40,** Programme, arranged by the Workers' Radio Society: Talk and Concert. **11.15** (approx.), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits on 1,852 metres from 5.40 p.m.—**12.10,** Concert of Trio Music. **2.40,** Programme for Children. **5.10,** Gramophone Selections. **6.10** Talk. **6.20,** Gramophone Selections. **6.30,** Catholic Bulletin. **6.40,** English Lesson. **7.10,** Lesson in Dressmaking. **7.40,** Talk by M. L. J. N. Feber. **8.0,** Concert of Orchestral Music, Choral Selections and Soprano Solos.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres). **6.30 a.m.,** Morning Gymnastics. **10.0 a.m.,** Weather Report. **2.0,** Programme for Children. **2.30,** Concert of Instrumental and Vocal Selections. **5.20,** Herr Frantzen, Talk: Galileo Galilei. **5.50,** Weather Report. **6.0,** News and Exchange Quotations. **6.15,** Time Signal. **6.30,** Ruth Sieverts, Talk: Women Abroad. **7.0,** Chimes from the Town Hall. **7.5** (approx.), "Hamlet": Drama in Five Acts (Shakespeare) Danish Translation by Edv. Lembcke. Introductory Music by Brass Band. Canzona (Florentio Maschera, 1593). Sonata (Giovanni Gabrieli, 1597). Followed by News. **9.0,** Concert of Light Music by the Station Orchestra: Chinese March, Kwang-Hsu (Lincke); Selection from Rose Marie (Friml-Stothart); Waltz (Kollo); Pizzicato Gavotte (Borregaard); Copenhagen Pictures in Music (Lumbye); Intermezzo, Kadettenstreiche (Jessel); Blues from Jonny spielt auf (Krenek). **10.0,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.5** (approx.), Close Down.

KATTOWITZ (**422 metres**); 10 kW.—**3.0,** Gramophone Selections. **4.10,** Music Lesson by Prof. F. Sachse. **4.35,** Children's Letter Box. **5.0,** Programme for Children. **6.0,** Announcements. **6.30** Talk. **6.56,** Time Signal and Agricultural Report. **7.5,** Talk by Mme. M. Szczepanska. **7.30,** Programme relayed from **Warsaw**. **8.0,** Weather Report and News. **9.30,** Dance Music.

KAUNAS (**2,000 metres**); 7 kW.—**3.30,** Musical Selection. **3.45,** Talk. **4.30,** Announcements. **5.0,** Weather Report and News. **5.15,** Agricultural Report. **5.45,** Musical Interlude. **6.0,** Aviation Report. **6.30,** Concert: Orchestral Selections, (a) Overture to the Vampire (Marschner), (b) Andante from The Jupiter Symphony (Mozart); Selection for Baritone, Bass and Tenor from Faust (Gounod); 'Cello Solos, (a) Chant du menestrel (Glazounoff), (b) Minuet (Glazounoff); Fantasia on Wagner's Tannhäuser (Hamm); Selections (Micheli), (a) Sonnen Untergang, (b) Mondschein Serenade, (c) Des Tages Erwachen, (d) Morgensonne; The Italian in Algiers (Rossini); Selections

Programmes from Abroad.—

(Renée) (a) Romance, (b) Serenade; Hungarian Dances Nos. 1 and 2 (Brahms); Lage di Garda (Morena); International Suite (Tchaikovsky).

LAHTI (1522.8 metres); 35 kW.—**4.0,** Orchestral Selections: The March of the Gnomes (Blon); Concert Overture (Keler Béla); Strandidyllen (Fétras); Selection from Der Orlov (Granichstaedten). **4.35,** Agricultural Talk. **5.15,** Orchestral Selections: Overture to Ilka (Doppler); Acceleration Waltz (Strauss). **5.40,** Talk. **6.0,** Evening Entertainment. **7.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (468.8 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres), and **Münster** (250 metres).—**12.5,** Concert: Overture to The King of Athens (Zeh); Air from A Life for the Czar (Glinka); Waltz, Evening Star (Lanner); 'Cello Solos, (a) Song without words (Berbuto), (b) Minuet (Werkmeister), (c) Largo (Werkmeister); Ballet Music from La Gioconda (Ponchielli); Song, Wenn nicht Frühling wär (Eysoldt); Selection from Donnerwetter, tadellos (Lincke); March, Die Wachtparade (Blankenburg). **1.30,** Household Hints. **2.0,** Programme for Children. **2.40,** Arthur Wurbs, Talk: The Foundations of Wireless Technique. **3.0,** Eva Eichbauer, Talk: The Woman Worker in Poetry. **3.30,** Helmut Jaro Jaretzki, Talk: Heinrich Zille. **4.0,** Talk. **4.20,** English Lesson by Prof. Hase. **4.45,** Gramophone Selections. **5.30,** Prof. Boerschmann, Talk: Chinese Architecture and Landscapes. **6.15,** Talk for Workers: Lay Justice in Penal Law. **6.40,** Prof. Hessen, Talk on Psychology: What do we know of the Soul? **7.0,** Variety Programme. **9.30** (approx.), News, Sports Notes, Commercial Announcements, Orchestral Selections and Dance Music. **12.0 Midnight,** Close Down.

LEIPZIG (365.8 metres); 4 kW.—**3.30,** Concert by the Station Orchestra. **4.45,** Wireless News and Talk. **5.20,** Weather Forecast, Time Signal and Labour Market Report. **5.30,** Programme relayed from **Königswusterhausen. 6.0,** Josef Greif, Talk: Psycho-Analysis. **6.30,** Herr Emil Oschatz, Talk: The Secrecy of the Telegraph and Postal Services. **7.0,** Song Recital by Elena Gerhardt. **8.0,** Orchestral Concert: Overture to A Night in Venice (Strauss-Korngold); Intermezzo and Barcarolle from Tales of Hoffmann (Offenbach); Waltz and Polonaise from Eugen Onegin (Tchaikovsky); Selections from The Barber of Bagdad (Cornelius); Selections from Undine (Lortzing). **9.0,** News, Announcements and Sports Notes. **9.30,** Dance Music relayed from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 (434.8 metres); 3 kW.—**7.0,** Chimes and Exchange Quotations, followed by Sextet Concert: Selections from (a) La chula de Pontevedra (Luna and Bru), (b) Don Juan (Mozart), (c) La Hebrea (Estela); Interlude by Luis Medina. **8.0,** Dance Music from the Alkázar. **8.25,** News and Announcements. **9.45,** Market Report. **10.0,** Chimes, followed by "La del soto del parral": Musical Play (Soutullo and Vert). Followed by News and Announcements. **12.30 a.m.** (approx.) (Sunday), Close Down.

MILAN. Call 1MI (549 metres); 7 kW.—**6.55,** Time Signal and Announcements. **7.15,** Industrial Notes by G. Ardau. **7.25,** News. **7.30,** Time Signal. **7.32,** Symphony Concert: Overture to Manfred (Schumann); Symphony in D Major (Sinding); Literary Talk by Umberto Morucchio; Concerto in D Major for Violin (Beethoven); Andantino all' antica (Marinuzzi); Nocturne (Martucci); Antiche arie e Danze (Respighi). **9.55,** News and Economic Notes. **10.0,** Relay of Tzigane Orchestra from the Fiaschetteria Toscana. **10.45** (approx.), Close Down.

MOTALA (1,380 metres); 30 kW.—Programme also for **Stockholm** (454.5 metres), **Böden** (1,190 metres), **Göteborg** (416.5 metres), **Malmö** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.6 metres).—**4.0,** Concert of Light Music. **5.0,** Programme for Children. **5.45,** Cabaret Programme relayed from **Göteborg. 6.45,** Pianoforte Recital by Algot Haquinius; Intermezzo marziale (Palmgren); Romance (Hinton); Prelude in G Major (Rachmaninoff); Prelude in E Major (Rachmaninoff); In the Autumn (Moszkovsky). **7.0,** Dance Music with Vocal Interludes. **1.0 a.m.** (approx.) (Sunday), Close Down.

NAPLES, Call 1NA (333.3 metres): 1.5 kW.—**7.30,** Wireless Talk. **7.40,** Announcements. **7.50,** News. **7.55,** Harbour Notes. **8.0,** Time Signal. **8.2,** Variety Programme: Orchestral Selection, Overture to La Belle Hélène (Offenbach); "L'Alba, Il Giorno e la notte": Comedy in Three Acts (Dario Niccodemi). In the First Interval: Orchestral Selections (Longo) (a) Tramonto, (b) Le campane di S. Petronio. In the Second Interval: Orchestral Selections (Siede), (a) Ballata primaverile, (b) In Siviglia. **9.0,** Talk and Announcements. **9.50,** News. **9.55,** Calendar and Programme Announcements. **10.0** (approx.), Dance Music from the Trocadero. **10.30** (approx.), Close Down.

Saturday, December 29th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

OSLO (461.5 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), and **Rjukan** (448 metres).—**5.0,** Programme for Children. **6.0,** Birthday Greetings. **6.15,** Weather Report and News. **6.30 to 11.45,** Christmas Programme. **6.30,** Concert by the Station Orchestra. **8.30,** Weather Report and News. **8.45,** Talk by a Journalist. **9.0,** Dance Music from the Hotel Bristol. **11.45** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (458 metres); 0.5 kW.—**5.0,** Relay of the Pasdeloup Symphony Concert from the Champs Elysées Theatre. **6.30,** "Radio-Journal de France." **8.0,** Talk by M. Geville, Sports Notes and Review. **8.15** Talk by M. Cépède. **8.30,** Concert, followed by Time Signal, Weather Report, News, Announcements and Dance Music from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (265.0 metres); 5 kW.—**5.0,** Relay of Debate arranged by the Confederation of Intellectual Workers. **7.10,** Weather Report. **7.30,** "Le Journal Parlé."

PARIS (Petit Parisien) (340.9 metres); 5 kW.—**8.45,** Gramophone Selections, Talk, News and Announcements. **9.0,** Concert: Symphonic Prelude to L'Etranger (d'Indy); Polonaise for 'Cello and Orchestra (Casadesus), conducted by the Composer. **9.25,** News and Announcements. **9.30.** Symphony Concert: Variations symphoniques for Piano and Orchestra (Franck); Molto vivace from the Ninth Symphony (Beethoven). **10.0,** News and Concert: Orchestral Suite (Saint-Saëns); Dansenses des Delphes from the Preludes (Debussy); Fantasia on two Angevin Airs (Lekeu).

PARIS (Radio-Paris), Call CFR (1,750 metres); 6 kW.—**12.30,** Concert of Columbia Gramophone Records: Tango, Nostalgia, Dolores; Fox-Trot, Yum, Yum, Yum; Waltz, Together; Fox-Trot, Boublitshki; Fox-Trot, Rag-Doll; La belle amie est morte (Gounod); Paysage (Hahn); Pastorale (Franck); in the Interval, News and Announcements. **2.0,** Market Prices and Religious Information. **3.45.** Dance Music by the Joss Ghislery Symphonians. In the Intervals, News and Announcements. **6.30,** Agricultural Report. **6.45,** Musical Selections. **7.30,** Pianoforte Lesson by M. Pierre Lucas. **8.0,** Talk arranged by the Union des Grandes Associations Françaises, followed by Market Prices and News. **8.15,** Concert arranged by "Le Matin": Petite Suite (Borodine); Sounnia Pisnia (Akimenko-Chapelier); Promenade Sentimentale (Flament); Melopée dans le soir (Duhamel); Le Barbier de Trouville (Lecocq); In the Intervals, News and Announcements.

POSEN (344.8 metres); 1.5 kW.—**3.45,** Programme of Classical German Music for Piano: Passacaglia (Handel); Sarabande (Handel); Sonata in A Major (Mozart). **4.15,** Talk on Boy Scouts. **4.35,** Programme from **Warsaw. 5.0,** Programme from **Warsaw. 6.0,** Programme for Women. **6.20,** English Lesson. **6.45,** Talk on Cinema Stars. **7.10,** Miscellaneous Items. **7.30,** Programme from **Warsaw. 9.0,** Time Signal and News. **9.30,** Cabaret Programme. **11.0,** Concert arranged by the Maison Philips. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (348.9 metres); 5 kW.—**4.30,** Talk: The Art of Observation in the Legal Profession. **4.40,** Programme for Workers. **4.50,** Agricultural Report. **5.0,** German Programme. **6.0,** Recital by Tambourine Orchestra. **6.45,** Talk: Reminiscences of Old Prague. **7.0,** Christmas Programme. **8.10,** Selection of Popular Music. **9.0,** Time Signal, News and Theatre Report. **9.25,** Dance Music, relayed from **Bratislava** (300 metres).

ROME, Call 1RO (447.8 metres): 3 kW.—**4.30,** Concert of Vocal and Instrumental Selections. **6.50,** Time Signal, Wireless Talk, and Announcements. **7.10,** Sports Notes, News, Exchange Quotations and Weather Report. **7.29,** Time Signal. **7.30,** International Labour Office Report. **7.45,** "Othello," Opera in Four Acts (Verdi). In the Intervals, Review of Art and Literature by Lucio D'Ambra and Talk for Women by Mme. Pompadour. **9.50,** News. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD and 2XAF (31.96 and 31.4 metres); 30 kW.—**11.58,** Weather Report. **12.0 Midnight),** Phil Spitalny's Musical Programme, relayed from **New York. 12.30 a.m.** (Sunday), Musical Programme relayed from **Rochester. 1.30 a.m.,** Musical Selections. **2.0 a.m.,** Selections by the Male Octet, relayed from **New York. 2.30 a.m.,** Selections by Mildred Hunt and the Marimba Orchestra. **3.0 a.m.,** "Lucky Strike" Programme, relayed from **New York. 4.0 a.m.,** Time Signal. **4.2 a.m.,** Dance Music by the Orchestra of the Hotel Ten Eyck, **Albany. 5.0 a.m.** (approx.), Close Down.

SEVILLE, Call EAJ5 (375 metres); 2 kW.—**9.0,** Concert: Paso-doble, Belmontico (Prieto); Largo (Tartini); Overture to L'Oasis (Corrin); followed by Programme relayed from **Madrid,** EAJ7, with Interludes by the Station Orchestra. **12.0 Midnight** (approx.), Close Down.

STAMBOUL (1 200 metres); 5 kW.—**3.30,** Concert. **5.30,** Market Prices Report. **5.15,** Concert of Turkish Music. **7.30,** Weather Report and Time Signal. **7.40,** Vocal and Orchestral Concert: Orchestral Selections, (a) Overture to Don Juan (Mozart), (b) Selections from Néron (Boito); Songs, Orchestral Selections, (a) Le Chant du Berger (Wagner); Walzer aus der Serenade (Tchaikovsky); The Entry of the Gods into Valhalla (Wagner); Marche Militaire No. 1 (Schubert). **9.0,** News.

STUTTGART (379.7 metres); 4 kW.—**5.0** Time Signal and Weather Report. **5.15,** Legal Talk by Herr L. Leibfried. **5.45,** Talk relayed from **Karlsruhe. 6.15,** Herr A. M. Grzywienski, Talk: Oahu, or a day on a Hawaiian Island in the South Seas. **6.45,** Time Signal and Sports Notes. **7.15,** Concert: Seranade for String Instruments (Reger); Serenade in F Major (Glazounoff); Serenade (Novak). **8.30,** Wireless Cabaret: Orchestral Selection, Pierrot March (**Bosc**), Heut ist heut! (Obermeyer); Es braucht ja nicht gerade Frühling zu sein (Blum); Ging da nicht eben das Glück vorbei? (Lehár); Italienisches Ständchen (Capua); Maccaroni (Benes); Musikanten (Salten); Flirtation (Steck); Rothaarig ist mein Schätzelein (Steinbach); Duet, Lache mir zu! (Benatzky); Ich kann dei grünes Seidenkleid nicht leiden (Struve); Veronica (May); Grossmama, lass dir die Haare schneiden (May); "Krause versus Lange"—Play (Senff-Georgi); Orchestral Selection, Schwarz u. Weiss (Rot); followed by News and Dance Music.

TOULOUSE (Radiophonie du Midi), (389.6 metres); 8 kW.—**12.45,** Selections from "Pélleas et Mélisande" (Debussy). **8.0** Exchange Quotations, Market Prices, News and Announcements. **8.30,** "Faust"—Opera (Gounod), relayed from the Capitol Theatre, **Toulouse.** In the Intervals, News and Announcements. **10.15** North African News. **10.30** (approx.), Close Down.

VIENNA (517.2 metres): 15 kW.—**3.15,** Concert: Overture to Phèdre (Massenet); Waltz, Herbststimmen (Lincke); The Nutcracker Suite (Tchaikovsky); Serenade (Grünfeld); Kinematographie in Tönen (Ertl); Musica Proibita (Gastaldon); Selection from The Merry Widow (Lehár); Feststimmungsmarsch (Stix). **5.0,** Dr. Paul Stefan, Talk: Hector Berlioz, on the 125th Anniversar of his Death. **5.30,** Chamber Music: String Quartet No. 1 in A Major (Borodine); Quartet Movement in C Minor (Schubert). **5.45,** Ludwig Bäte reads from his own Works. **7.0,** Time Signal, Weather Report and News. **7.5,** Musical Review of Old Vienna (Skurawy). Followed by Dance Music and Phototelegraphy Transmission.

VILNA (435 metres); 1.5 kW.—**4.10,** Concert by Military Orchestra. **4.35,** Programme relayed from **Warsaw. 5.0,** Concert (continued). **5.25** Poem Recitations by Mme. Halina Zawadzka. **5.40,** Soprano Song Recital by Mme. Swiecicka. **6.10,** News. **6.30,** Programme relayed from **Warsaw. 7.0,** Humorous Selections. **7.30,** Programme relayed from **Warsaw. 10.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**4.10,** Talk, followed by "Christmas Carols"—A Short Historical Review with Musical Illustrations. **4.35,** Talk. **5.0,** Programme for Children. **6.0,** Miscellaneous Items. **6.30,** Wireless Review by M. H. Stepovsky. **6.56,** Time Signal. **7.0** Agricultural Report. **7.30,** "The Castle of Czorszty"—Musical Play in Three Acts (Kurpinski). **9.0,** Aviation Notes and Weather Report. **9.5,** News and Announcements. **9.20,** Police Report and Sports Notes. **9.30,** Dance Music. **10.30** (approx.) Close Down.

ZURICH (588 metres); 1 kW.—**4.15** Concert of Accordian Selections. **4.45,** Weather Report and Exchange Quotations. **5.0,** Selection of New Gramophone Records. **6.0,** Chimes from the Zurich Churches. **6.15,** Time Signal and Weather Report. **6.17,** Popular Concert. **7.30** (approx.), Concert of Humorous Songs to the Lute and Selections by the "Elite" Music Corps. **9.0,** Weather Report and News. **9.10** Gramophone Selections of Dance Music.

SUNDAY, DECEMBER 30th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Programmes from Abroad.—

BARCELONA (Radio Barcelona), Call EAJ1 (**344.8 metres**); 1.5 kW.—**11.0 a.m.**, Relay of Cathedral Chimes. **11.5 a.m.**, Weather Report and Forecast followed by Aviation Route Conditions. **1.30**, Concert by the Iberia Trio with Gramophone Records at Intervals. **2.45 to 5.30**, No Transmission. **5.30**, Opening Signal followed by Relay of an Opera from the Gran Teatro de Liceo. In the Interval: Market Prices and Exchange Quotations. **8.0 to 8.20**, Transmission arranged by the Catalonian Institute of Agriculture at San Isidro. **8.20**, Concert by the Barcelona Station Orchestra. Suite, Les Danses de Chez Nous (Jacquet-Mouton). (a) Berceuse et Carillon Lillois. (b) Volte de Provence. (c) La Dérobée Bretonne. (d) Bourrée d'Auvergne. (e) Danse Alsacienne. **8.40** Sports News. **9.0** (approx.), Close Down.

BERGEN (**370.4 metres**); 1.5 kW.—**9.30 a.m.**, Relay of Church Service. **11.30 a.m.**, Weather Report and Forecast and General News Bulletin. **4.0**, Orchestral Concert. **7.0**, Concert by the Station Orchestra. **7.50**, Talk on the Week's Happenings. **8.0**, Pianoforte Recital by Maja Hjort Wemmestead. Compositions by Glück, Brahms, Chopin and Schumann. **8.30**, Musical Programme. **9.0**, Weather Report and Forecast, Late News Bulletin and Time Signal. **9.15**, Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,649 metres**); 40 kW.—**7.55 a.m.**, Garrison Church Chimes relayed from Potsdam. **8.0 a.m.**, Musical Recital and Address relayed from **Voxhaus**, followed by Chimes from the Berlin Cathedral. **10.30 a.m.**, Programme of Music relayed from **Voxhaus**. **12.45**, Experimental Transmission of Pictures. **1.30 to 2.25**, Three Agricultural Talks from **Voxhaus**. **2.30**, Reading of Stories from **Voxhaus**. **3.0**, Talk. **3.30**, Musical Programme. **5.0**, The "Deutsche Welle" Series of Talks, followed by Relay of Concert or Opera. **9.15**, Press News. **9.30**, Relay of Dance Music. **11.30** (approx.), Close Down.

BERLIN (Voxhaus) (**484 metres**); 4 kW.—**7.55 a.m.**, Chimes relayed from the Garrison Church at Potsdam. **8.0 a.m.**, Morning Concert of Vocal and Instrumental Music and Address, followed by Relay of Chimes from the Berlin Cathedral. **10.30 a.m.** (approx.), Orchestral Concert with Soloists. **1.0**, Lesson in Morse for Beginners by Hans W. Priwin. **1.30 to 2.25**, Programme of Talks on Farming. **1.30**, Practical Hints for the Farmer. **1.45**, The Weekly Markets and Weather Conditions. **1.55**, Chat on an agricultural topic. **2.30**, Reading of Stories. **3.0**, Talk. **3.30**, Recital of Music. **6.0**, Talk. **6.30**, Talk. **7.15** (approx.), Concert of Play followed by Weather Report and Forecast, Late News Bulletin and Sports Results. **9.30**, Dance Music. **11.30** (approx.), Close Down.

BÉZIERS (**158 metres**); 0.6 kW.—**8.30**, General News Bulletin. **8.45**, Concert arranged by the Maison Relin-Minoles at Béziers. Selections of the Pathé Art Records. **10.30** (approx.), Close Down.

BORDEAUX (Radio Sud-Ouest) (**238 metres**); 1 kW.—**12.30**, The Latest Gramophone Records. **1.45**, Close Down.

BRESLAU (**322.6 metres**); 4 kW.—Programme relayed by **Gleiwitz** (329.7 metres).—**8.15 a.m.**, Chimes relayed from Christ Church. **10.0 a.m.**, Catholic Recital of Choral Music, with Address in the interval. **11.0 a.m.**, Concert with Soloists. **1.0**, Guessing Competitions. **1.10**, Talk. **1.35**, Hints for the Chess Player by Adolf Kramer. **2.0**, Programme for Children. **2.30**, Talk for Farmers. **2.55**, Concert. **3.35**, Talk. **4.5**, Concert. **6.50**, Talk. **7.15**, Concert by the Band of the Seventh Infantry Regiment, conducted by Herr Keifer. Overture to Lysistrata, operatta by Lincke. **9.0**, Late News Bulletin. **9.30**, Programme of Light Music. **11.15** (approx.), Close Down.

BRUSSELS (**508.5 metres**); 1.5 kW.—**5.0**, Orchestral Selections relayed from the Armenonville Tea Room, Brussels. **6.0**, Programme for Children arranged by the Théâtre des Enfants, and under the direction of M. Léon Leroy. **6.30**, Musical Programme. **7.30**, Le Journal Parlé de Radio-Belgique. **8.15**, Concert or Play. **10.15**, Late News Bulletin and News from the Evening Press. **11.0** (approx.), Close Down.

COLOGNE (**283 metres**); 4 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Langenberg** (468.8 metres) and **Münster** (250 metres).—**6.45 a.m.**, Boxing Instruction by Dr. Ludwig Bach. **7.20 a.m.**, Weekly Programme Review in Esperanto by Alfred Dormanns. **7.30 a.m.**, Esperanto Lesson by Alfred Dormanns. **8.0 a.m.**, Church Chimes. **8.5 a.m.**, Catholic Festival of Music with Address in the Interval. **10.0 a.m.**, Talk by Fritz Worm on the German Language. **12.0 Noon**, Orchestral Concert. **1.30**, Talk. **3.30**, Concert. **6.35**, Sports News. **7.0**, "The Magic Flute," Musical Play in Two Acts by Mozart. Followed by Late News Bulletin, Sports Notes and Musical Programme. **11.0** (approx.), Close Down.

CORK, Call 6CK (**400 metres**); 1.5 kW.—**8.30** Vocal and Instrumental Concert: Selections by the All Ireland Trio. **11.0**, National Anthem and Weather Report and Forecast. **11.15** (approx.), Close Down.

CRACOW (**566 metres**); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Relay of Cathedral Service. **10.56 a.m.**, Relay of Fanfare from the Church of Notre Dame, followed by Time Signal and Weather Report and Forecast. **11.10 a.m.**, Relay of Philharmonic Concert from **Warsaw**. **1.0 and 1.20.** Agricultural Talks. **1.40**, "La Chronique Agricole," by Dr. St. Wasniewski. **2.0**, Weather Report and Forecast. **2.15**, Concert relayed from the Philharmonic Hall at **Warsaw**. **4.20**, Talk. **5.0**, Concert relayed from **Warsaw**. **6.56**, Time Signal from the Observatory. **7.0**, Relay of Fanfare from the Church of Notre Dame, followed by Sports Notes. **7.30**, Concert of Vocal and Instrumental Music: Duet from "Carmen"—Opera (Bizet) by Mademoiselle Raczynska and M. Demar-Mikuszewski. At the Piano: M. B. Wallek-Walewski. **9.0**, Late News Bulletin from **Warsaw**. **9.30**, Concert relayed from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**319.1 metres**); 1.5 kW.—**8.30**, Programme relayed from **Cork**. Mezzo-Soprano Solos by Miss G. Gallagher. **11.0**, National Anthem and Weather Report. **11.15** (approx.), Close Down.

GENEVA (**760 metres**); 1.5 kW.—**9.0 a.m.**, Relay of Service and Address from the Victoria Hall, Geneva. **7.15**, The Day's Sport by M. Vieux, Sports Editor of the "Geneva Tribune." **7.25**, Service relayed from the Temple de Caronge. **8.0**, Concert in the Studio by the Geneva Wireless Orchestra: Fantasia on Popular Russian Melodies (Léopold).

HAMBURG, Call HA (in Morse) (**394.7 metres**); 4 kW.—Programme relayed by **Bremen** (272.7 metres), **Hanover** (297 metres), and **Kiel** (254.2 metres).—**7.25 a.m.**, Time Signal. **7.30 a.m.**, Weather Report and Forecast, followed by General News Bulletin. **7.50 a.m.**, Talk. **8.0 a.m.**, Weekly Legal Notes. **10.0 a.m.**, Talk. **11.55 a.m.**, Time Signal relayed from **Nauen**. **12.5** (for **Hamburg** and **Kiel**), Concert. **12.5** (for **Bremen**), Musical Selections. **12.5** (for **Hanover**), Gramophone Records. **1.0**, Entertainment for Children. **6.30**, Transmission arranged by the School of Physical Training in Hamburg. **6.40**, Sports Notes. **6.55**, Weather Report and Forecast. **7.0**, Play. **8.30**, Concert of Songs and Dance Tunes of 1928. In the interval at **9.30**, Weather Report and Forecast and Late News Bulletin. **10.50** (for **Hamburg**, **Bremen** and **Kiel**), Weather Report and Forecast for the North Sea and Baltic. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**); 5 kW.—**12.10**, Concert by the Hilversum Station Trio. **1.40**, Concert. **2.55**, Concert by the Wireless Orchestra, conducted by Nico Treep: 'Cello Solos by Thomas Canivez and Pianoforte Solos by Jeannette Walen. **7.40**, Time Signal. **7.42**, General News Bulletin, Weather Report and Forecast and Sports News. **7.55**, Opera. **10.40** (approx.), Close Down.

HUIZEN (**340.9 metres**); 4 kW.—Transmits from 5.40 on 1,852 metres.—**8.5 a.m.**, Sacred Service. **9.30 a.m.**, Relay of Morning Service. **12.10**, Concert of Trio Selections. **1.10**, Talk. **1.40**, Talk. **2.10**, Orchestral Concert. **5.15**, Relay of Evening Service from **Almelo** (on 1,852 metres), Sermon by the Minister, the Rev. W. L. Milo. **7.10**, Talk. **7.50** (approx.), Concert of Orchestral Music. **10.25**, Choral Epilogue under the direction of Mr. Jos. H. Pickkers. **10.40** (approx.), Close Down.

KALUNDBORG (**1,153 metres**); 7 kW.—Programme also for **Copenhagen** (337 metres).—**9.0 a.m.**, Relay of Divine Service from **Copenhagen**. **10.30 a.m. to 10.40 a.m.** (**Kalundborg** only), Weather Report and Forecast of the Meteorological Institute, at Copenhagen. **12.0 Noon to 12.25**, German Lesson for Beginners arranged by "Radiolytteren." **12.30**, Elementary French Lesson, arranged by "Radiolytteren." **2.0**, Concert of Instrumental Music. **4.0**, Relay of Church Service from **Copenhagen**. **5.20**, Programme for Children. **5.50** (**Kalundborg** only) Weather Report and Forecast from the Copenhagen Meteorological Institute. **6.0**, News from the Press. **6.15**, Time Signal. **6.30** Talk. **7.0**, Chimes relayed from the Copenhagen Town Hall. **7.5**, Concert. **9.0** Concert by the Copenhagen Station Orchestra, devoted to National Music by Fröhlich, Gade and Lumbye. **9.45**, Dance Music by the Orchestra at the Palace Hotel, conducted by Teddy Petersen. In the Interval at **11.0**, Chimes relayed from the Copenhagen Town Hall. **11.30** (approx.), Close Down.

KATTOWITZ (**422 metres**); 10 kW.—**9.15 a.m.**, Relay of Morning Service. **10.56 a.m.**, Time Signal. **11.0 a.m.**, Weather Report and Forecast. **11.15 a.m.**, Popular Concert by the Kattowitz Station Quartet. **1.0**, Talk. **1.20 and 1.40**, Two Talks for Farmers. **2.0**, Weather Report and Forecast. **2.15**, Relay of Philharmonic Symphony Concert from **Warsaw**. **5.0**, Concert. **6.0**, Miscellaneous Announcements. **6.20**, Half-hour of Humour by Professor St. Ligon. **6.56** Time Signal. **7.0**, Talk, under the auspices of the Pedagogical Institute. **7.30**, Concert relayed from **Warsaw**: The Polskie Radio Orchestra, Impromptu in B Flat Major, Op. 142, No. 3. (Schubert). **9.0**, Weather Report and Forecast, News from the Press and Sports Notes. **9.30**, Dance Music. **10.30** (approx.), Close Down.

KAUNAS (**2,000 metres**); 7 kW.—**2.30**, Programme for Children. **3.0**, Half-hour for Young People. **3.30**, Talk on a Health Subject by Dr. Jurgelionis. **4.0**, Talk by J. Ardickas on Economics and Daily Life. **4.50**, Weather Report and Forecast and News from the Press. **4.55**, Talk with Lithuania, and Polish News. **5.35**, Concert of Popular Music, followed by Miscellaneous Items. **9.0** (approx.), Close Down.

KÖNIGSBERG (**303 metres**); 4 kW.—Programme relayed by **Danzig** (272.7 metres).—**8.0 a.m.**, Recital of Sacred Music with Soloists and Address in the interval. **10.0 a.m.** (**Königsberg** only). Weather Report and Forecast. **10.5 a.m.**, Morning Concert. **11.0 a.m.**, Concert by the Station Orchestra. **11.55 a.m.**, Time Signal relayed from **Nauen**, followed by Weather Report and Forecast. **3.15**, Orchestral Selections. **7.30**, Concert by the Königsberg Station Orchestra conducted by Dr. Rolf Hänsler: Ballet Music from "La Gioconda" by Ponchielli. **9.15**, Late News Bulletin and Sports Results. **9.30**, Dance Music. **11.30** (approx.), Close Down.

LAHTI (**1,522.8 metres**); 35 kW.—Programme also for **Helsingfors** (375 metres).—**8.0 a.m.**, Relay of Church Service. **9.50 a.m.**, News from the Press. **10.5 a.m.**, Musical Selections. **10.50 a.m.**, Weather Report and Forecast and Time Signal. **11.0 a.m.**, Relay of Church Service (in Swedish). **3.0**, Concert by the Lahti Station Orchestra conducted by Erkki Linko. Selection from the Opera, "Pique Dame" (Tchaikovsky). **3.50**, Talk. **4.10**, Concert by the Station Orchestra. **4.30**, Talk. **4.57**, Time Signal and Weather Report and Forecast. **5.10**, Concert by the Wireless Orchestra. **5.30**, History Talk. **6.0**, Concert of Popular Selections. **7.45**, General News Bulletin given in Finnish. **8.0**, News Bulletin in Swedish. **8.30** (approx.), Close Down.

LANGENBERG (**468.8 metres**); 20 kW.—Programme also for **Aix-la-Chapelle** (400 metres), **Cologne** (283 metres) and **Münster** (250 metres).—**6.45 a.m.**, Lesson in the Art of Self Defence by Dr. Ludwig Bach. **7.20 a.m.**, Summary in Esperanto of the Week's Programmes by Alfred Dormanns. **7.35 a.m. to 7.55 a.m.**, Esperanto Lesson by Alfred Dormanns. **8.0 a.m.**, Relay of Church Chimes. **8.5 a.m.**, Catholic Morning Recital of Choral and Instrumental Music with Address in the Interval. **10.0 a.m.**, Talk by Fritz Worm: The Worth and Honour of the German Language. **12.0 Noon**, Concert of Orchestral Music. **1.30**, Talk. **3.30**, Concert: Stories of Karl Löwe about the Christ-Child. **6.35**, Sports News. **7.0**, Play followed by Late News Bulletin, Sports Notes and Concert. **11.0** (approx.), Close Down.

LEIPZIG (**365.8 metres**); 4 kW.—Programme relayed by **Dresden** (275.2 metres).—**7.30 a.m.**, Organ Recital. **8.0 a.m.**, Vocal and Instrumental Concert. **10.0 a.m.**, Talk. **10.30 a.m.**, Talk. **11.0 a.m.**, Musical Programme. **12.0 Noon**, Agricultural Talk. **12.30**, Talk. **1.0**, Gleanings from the Foreign Press. **1.45**, Wireless Talk. **2.15**, Gramophone Records. **3.0**, Concert. **5.30**, Talk. **6.0**, Talk. **6.30**, Christmas Oratorio (J. S. Bach), conducted by Alfred Szendrei: Soloists—Lotte Mäder-Wohlgemuth (Soprano), Martha Adam (Contralto), Hans Lissmann (Tenor) and Kurt Wichmann (Bass). **9.0**, Sports News and News from the Press. **9.30**, Dance Music relayed from **Berlin**. **11.30** (approx.), Close Down.

LYONS (Radio Lyon) (**291 metres**); 1.5 kW.—**7.30**, The Radio Lyon "Journal Parlé" with General News Bulletin and News from the Press. **8.0**, Instrumental Concert with Pianoforte Solos by Madame Ducharne and Violin Solos by M. Camand of the Lyons Conservatoire: Selection from "L'Arlésienne" Suite by Bizet **9.0** (approx.), Close Down.

Sunday, December 30th.

All Times are reduced to Greenwich Mean Time and are p.m. except where otherwise stated.

Programmes from Abroad.—

MADRID (Union Radio), Call EAJ7 **(434.8 metres)**; 1.5 kW.—Programme relayed by **Salamanca** (EAJ22) (405 metres).—**2.0,** Relay of Chimes and Time Signal. **2.5,** Concert by the Station Orchestra with Violin Solos by Celso Diaz and Selection by Luis Medina in the interval, Romanza Andaluza (Sarasate). **3.30 to 7.0,** No Transmission. **7.0,** Chimes. **7.5,** Concert by the Union Radio Sextet and Selection by Luis Medina. **8.0,** The Palermo Orchestra at the Alkazar in a programme of Dance Music. **8.30 to 10.0,** No Transmission. **10.0,** Chimes and Time Signal. **10.5,** Concert by a Military Band. **12.0 Midnight,** Relay of Chimes followed by Dance Music by the Palermo Orchestra playing at the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN. 1MI **(549 metres)**: 7 kW.—**9.0 a.m.,** Opening Signal and Instruction in English. **9.30 a.m. to 10.15 a.m.,** Vocal and Instrumental Concert of Sacred Music. **11.30 a..m,** Time Signal. **11.35 a.m.,** Concert by the Milan Station Quartet. **12.30 to 3.0,** No Transmission. **3.0,** Opening Signal. **3.5,** Variety Concert. **4.30,** Light Music by the Orchestra at the Fiaschetteria Toscana. **5.0 to 6.55,** No Transmission. **6.55,** Opening Signal. **7.0,** News and Announcements. **7.15,** History Talk by C. A. Blanche. **7.25,** Sports News. **7.30,** Time Signal. **7.35,** Relay of the Opera "La Leggenda delle sette Torri" by Alberto Gasco. At the end of Act Two: Sports Results and News from the Stefani Agency. **10.30** (approx.) Close Down.

MOTALA (1,380 metres): 30 kW.—Programme also for **Stockholm** (454.5 metres), **Boden** (1,190 metres), **Göteborg** (416.5 metres), **Malmo** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.6 metres).—**10.0 a.m.,** Relay of Service from a Church in **Stockholm. 3.0,** Musical Programme. **4.0,** Children's Entertainment. **4.55,** Chimes relayed from the Town Hall at **Stockholm. 5.0,** Relay of Evening Service. **7.0,** "The Merry Widow" (Lehár). **8.15,** General News Bulletin and Weather Report. **9.30** (approx.), Close Down.

MÜNICH (535.7 metres): 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (277.8 metres) and **Nuremburg** (241.9 metres).—**10.0 a.m.,** Chimes relayed from the Münich Town Hall. **10.10 a.m.,** The Wireless Weather Chart for Bavaria. **10.50 a.m.,** Time Signal followed by Weather Report and Forecast. **11.0 a.m.,** Concert. **12.5,** Time Signal and Weather Report and Forecast followed by Announcements of Forthcoming Programmes. **2.0,** Musical or Literary Programme. **4.0,** Concert by the Münich Wireless Trio. **7.5,** "Die Schöne Helena," Operetta by Offenbach. **9.20,** Late News Bulletin followed by Relay of Concert. **11.0** (approx.), Close Down.

NAPLES. Call 1NA **(333.3 metres)**; 1.5 kW.—**8.30 a.m.,** Elementary Lesson in French by Professor Etienne Verdier. **9.0 a.m.,** Sacred Concert. **3.45,** Children's Corner. **4.0,** Variety Concert. **4.30,** Time Signal. **7.30,** News of the Day. **7.50,** Report of the Naples Harbour Authorities. **8.0,** Time Signal. **8.2,** Concert by the Naples Wireless Orchestra and Soloists: "Pietoso al par del nume" from "La Favorita" (Donizetti), Duet for Mezzo-Soprano and Tenor, accompanied by the Orchestra. Sung by Signora Ada Testa and G. Ferrero. **9.0,** Sports Notes. **9.55,** Calendar and Summary of Forthcoming Programmes. **10.0** (approx.), Close Down.

OSLO (461.5 metres): 1.5 kW.—Programme relayed by **Fredriksstad** (434.8 metres), **Hamar** (555.6 metres), **Notodden** (411 metres), **Porsgrund** (500 metres), **Rjukan** (448 metres).—**9.20 a.m.,** Chimes. **9.30 a.m.,** Divine Service relayed from St. Saviour's Church. **4.50,** Chimes. **5.0,** Relay of Service from St. Saviour's Church. **6.15,** Weather Report and Forecast, followed by Press News. **6.30,** Talk. **7.0,** Time Signal. **7.5,** Concert of Christmas Music. The Station Orchestra, conducted by Hugo Kramm; "The Children's Christmas" (Kling). **8.30,** Weather Report and Forcast and News from the Press. **8.45,** Talk by a Journalist on the Day's Topics. **9.0,** Musical or Literary Programme. **9.30,** Relay of Dance Music. **11.30** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT **(458 metres)**; 0.5 kW.— Programme relayed at intervals by the following stations: **Bordeaux PTT** (275 metres), **Eiffel Tower** (2,650 metres), **Grenoble** (416 metres) **Lille** (264 metres), **Limoges** (285 metres), **Lyons PTT** (480 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse PTT** (260 metres).—**8.0 a.m.,** General News Bulletin and Time Signal. **9.25 a.m.,** International Time Signal and Weather Report. **12.0 Noon,** Concert. **1.0,** Le Journal de France Economique. **1.30,** Concert organised by the General Association of French Wireless Listeners. **2.30,** Relay of Symphony Concert from the Concert Hall of the Paris paper "Le Journal." **4.0,** Pasdeloup Symphony Concert relayed from the Théâtre des Champs Elysées, conducted by M. Rhené Bâton. **6.30,** "Le Radio Journal de France." **8.0,** Sports Talk and Results. **8.15,** Talk under the auspices of the Union of French Associations. **8.30,** Orchestral Concert, arranged by the General Association of French Wireless Listeners. **10.30** (approx.), Relay of Dance Music from the Coliseum de Paris. **12.0 (Midnight)** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(2,650 metres)**: 5 kW.—**—7.56 a.m.,** Time Signal on 32.5 metres. **9.26 a.m.,** Time Signal on 2,650 metres. **5.0,** Relay of Pasdeloup Concert. **7.10 to 7.20,** Weather Report and Forecast. **7.30,** "Le Journal Parlé par T.S.F.," with Talks by regular contributors, Dr. Pierre Vachet: Portez-vous bien. **7.56,** Time Signal on 32.5 metres. **8.0 to 9.0,** Orchestral Concert with Vocalists. **10.26** Time Signal on 2,650 metres. **11.15** (approx.), Close Down.

PARIS (Petit Parisien) **(340.9 metres)**: 0.5 kW.—**8.45,** Popular Gramophone Selections. **8.50,** Talk. **8.55,** News from the Press. **9.0,** Instrumental Concert with Soloists. **9.25,** General News Bulletin. **9.30,** The Symphony Half Hour, conducted by Professor Estvle of the Paris Conservatoire. **10.0,** Late News Bulletin. **10.15,** Orchestral Concert. **11.0** (approx.), Close Down.

PARIS (Radio Paris), Call CFR **(1,750 metres)**: 6 kW.—**8.0 a.m.,** General News Bulletin and News from the Press. **8.30 a.m.,** Physical Instruction by Dr. Diffre. **12.0 Noon,** Religious Address, followed by Sacred Recital arranged by "La Vie Catholique." **12.30,** Press News. **12.45,** Concert by the Albert Locatelli Orchestra. **4.30,** Gramophone Selections arranged by "L'Industrie Musicale." In the interval: Press News. **6.30,** Agricultural Talk. **6.45,** Gramophone Records. **7.30,** Press News. **7.45.** The Radio-Paris Circus. **8.15,** Concert of Symphony Music, under the direction of M. Eugène Bigot. In the intervals: News from the Evening Papers and Late News Bulletin. **10.30** (approx.), Close Down.

POSEN (344.8 metres): 1.5 kW.—**9.15 a.m. to 10.45 a.m.,** Relay of Sacred Service. **11.0 a.m.,** Time Signal. **11.5 a.m. and 11.30 a.m.,** Two Talks on Farming Topics. **2.15,** Symphony Concert relayed from **Warsaw. 4.20,** "Silva rerum," by Mr. B. Busiakiewicz. **4.45,** Talk. **5.25,** Programme for Children. **6.0,** Transmission arranged by the League of Polish Youth. **6.20,** Talk, relayed from **Warsaw. 6.45,** Talk. **7.10,** Twenty Minutes of Variety Items. **7.30,** Concert. **9.0,** Time Signal. **9.5,** General News Bulletin. **9.20,** Lesson in Dancing by Mr. Starski. **9.40,** Dance Music relayed from the Carlton Restaurant. **11.0** (approx.), Close Down.

RIGA (526.3 metres): 4 kW.—**9.15 a.m.,** Relay of Morning Service (in Latvian) from the Mara Church. **12.0 Noon,** Songs, Tales and Music for Children. **2.0,** Two Talks. **3.0,** Concert by the Riga Wireless Orchestra, under the direction of Arved Parnps. **4.0 to 5.30,** Four Talks. **6.0,** Concert of Popular Selections conducted by Janis Medin: Selections from The Tales of Hoffmann (Offenbach). **8.0,** Weather Report. **8.30,** Concert relayed from the Café de l'Opera. **10.0** (approx.), Close Down.

ROME, Call 1RO **(447.8 metres)**: 3 kW.—**8.30 a.m.,** Opening Signal, followed by German Lesson for Beginners. **9.0 a.m.,** Vocal and Instrumental Recital. **9.45 a.m. to 12.0 Noon,** No Transmission. **12.0 Noon,** Opening Signal. **12.5 to 1.0,** Concert by the Radio Trio. **1.0 to 4.0,** No Transmission. **4.0,** Opening Signal. **4.5 to 5.30,** Variety Concert. **6.50,** Opening Signal, followed by News and Announcements. **7.10,** Talk for Farmers. **7.15,** Sports Results and News from the Stefani Agency. **7.29,** Time Signal. **7.31,** Talk. **7.45,** "La Chaste Susanne," Operetta in Three Acts. Music by Gilbert, with the Station Orchestra and Choir. Talk in the interval. **9.30,** Late New Bulletin. **10.0** (approx.) Close Down.

SCHENECTADY, Call 2XAD and 2XAF **(21.96 and 31.4 metres)**; 30 kW.—**4.0,** Relay of Sacred Service. **8.30** Relay of Organ Recital by Elmer A. Tidmarch, from the Union College Memorial Cabpel at **Schenectady,** N.Y. **9.0,** Dr. S. Parkes Cadman's Address to Men relayed from **New York. 10.30,** Instrumental Programme relayed from **New York. 11.0,** The American Legion Band in a Concert relayed from **Boston, Mass. 11.30,** The Acousticon Programme from **New York. 12.0 Midnight,** The Old Company's Programme, relayed from **New York. 12.30, a.m.** (Monday) Relay from the Capitol Theatre, **New York. 2.0 a.m.,** Talk on the United States Government by the Editor of "The United States Daily," relayed from **Washingtom, D.C. 2.15 a.m.,** Atwater Kent Programme, relayed from **New York. 3.15 a.m.,** Correct Time. **3.17 a.m.,** Programme of the National Light Opera Company, relayed from **New York. 4.15 a.m.,** Experimental Transmission of Television Signals. **4.30 a.m.** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) **(389.6 metres)**: 8 kW.—**12.30,** Weather Report and Forecast and Local Market Report. **12.45,** Concert of Vocal and Instrumental Music. **1.0,** Time Signal. **1.5,** Concert (continued). **1.45,** News from the Daily Papers. **8.0,** Stock Exchange Quotations from Paris and Local Market News. **8.15,** News from "La Dépêche" and "Le Petit Parisien." **8.30,** Concert arranged by "L'Association des Commerçants Radio-Electriciens du Midi": Selections from Carmen by Bizet. In the interval at **9.0,** Time Signal. **10.15,** News from North Africa and Late News Bulletin. **10.30** (approx.), Close Down.

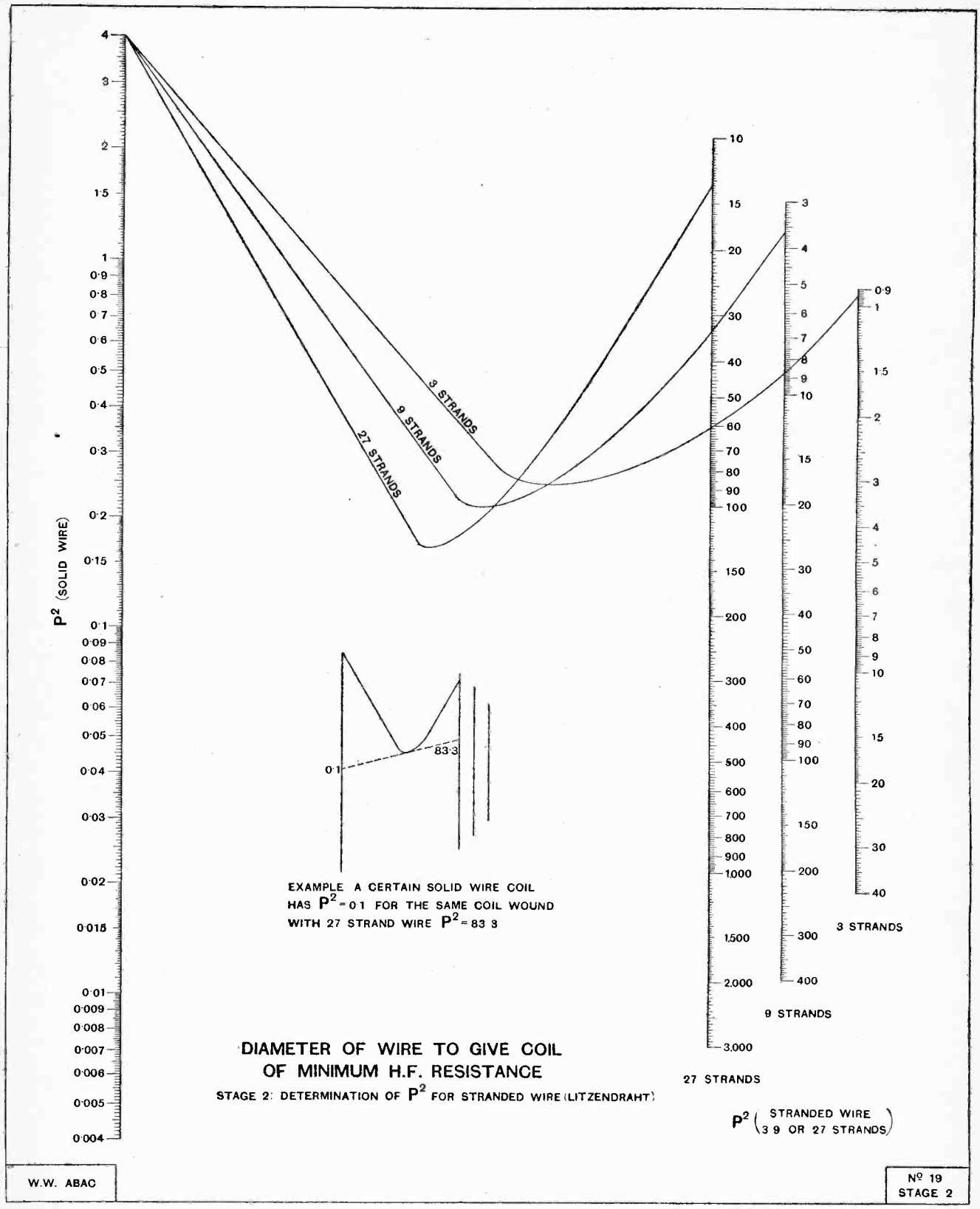
VIENNA (517.2 metres); 15 kW.—Programme relayed by **Graz** (357.1 metres), **Innsbruck** (294.1 metres), **Klagenfurt** (272.7 metres), and **Linz** (254.2 metres).—**9.20 a.m.,** Organ Recital. **10.0 a.m.,** Concert by the Vienna Symphony Orchestra with Soloists. **2.15,** Experimental Transmission of Pictures. **3.0,** Orchestral Concert with Soloists. **7.0,** Time Signal, Weather Report and Forecast and General News Bulletin. **7.5,** "Love's Labour Lost," Comedy in Five Acts by Shakespeare, Translated into German and produced by Stefan Hock. Followed by Relay of Dance Music and Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

VILNA (435 metres): 1.5 kW.—**9.15 a.m. to 10.45 a.m.,** Relay of Morning Service from a Cathedral. **10.56 a.m. to 4.20,** Programme relayed from **Warsaw. 10.56 a.m.,** Time Signal followed by Fanfare from the Church of Notre Dame at Cracow. **11.5 a.m.,** General News Bulletin. **11.10 a.m.,** Symphony Concert of the Warsaw Philharmonic Society. **1.0 to 2.0,** Three Talks on Agricultural Matters. **2.15,** Orchestral Concert. **4.20,** Talk. **5.0,** Gramophone Records. **5.20,** Programme for Children. **6.45,** Selections of Zither Music by Professor Witolo Jodko. **6.56,** Time Signal. **7.0 to 10.30,** Programme relayed from **Warsaw. 7.0,** Talk. **7.30,** Concert of Orchestral Music conducted by J. Dworakowski: Madame Trombini; Kazuro, Pianoforte Solo, Nocturne in E Minor (Chopin). **9.0,** Aviation Route Report and Weather Report and Forecast. **9.5,** News Bulletin from the Polish Telegraph Agency. **9.20,** Sports News and Police Report. **9.30,** Dance Music relayed from the "Oaza" Restaurant, **Warsaw. 10.30** (approx.), Close Down.

WARSAW (1,111 metres); 10 kW.—**9.15 a.m. to 10.45 a.m.,** Morning Service from a Cathedral. **10.56 a.m.,** Time Signal. **11.0 a.m.,** Relay of Fanfare from the Church of Notre Dame at **Cracow. 11.5 a.m.,** Aviation Route Report and Weather Report and Forecast. **11.10 a.m.,** Philharmonic Symphony Concert arranged by the Magistracy of Warsaw. **1.0 to 2.0,** Three Talks on Agriculture. **2.0,** Weather Report and Forecast. **2.15,** Relay of Concert of Symphony Music by the Warsaw Philharmonic Society. **4.20,** Talk. **4.45,** Aviation Talk. **5.0,** Concert by the Polskie Radio Orchestra conducted by J. Oziminski: Overture to Norma, Opera by Bellini. **6.0,** Variety Items. **6.20,** Talk. **6.45,** General News Bulletin. **6.56,** Time Signal. **7.0,** C. Jablonowski, Talk: Divertissements intellectuels. **7.30,** Concert by the Polskie Radio Orchestra. **9.0,** Aviation Report and Weather Report and Forecast. **9.5.** Communications from the Polish Telegraph Agency. **9.20,** Police Report and Sports News. **9.30,** Relay of Dance Music from the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (309.2 metres); 0.7 kW.—**10.0 a.m.,** Concert of Symphony Music by the Croatian Philharmonic Society, under the direction of Oskar Nedbal: Fire Worship and Wotan's Farewell (Wagner). **4.0,** Programme of Dance Music relayed from the Club-Cabaret. **6.45,** Talk on a Wireless Topic. **7.0,** Relay of an Opera from the National Theatre, Zagreb. In the intervals: General News Bulletin and Weather Report and Forecast. **10.0** (approx.), Close Down.

ZÜRICH (588 metres); 1 kW.—**10.0 a.m.,** Programme of Light Music. **11.29 a.m.,** Weather Report and Forecast. **11.30 a.m.,** Concert by the Zürich Wireless Orchestra. **3.0,** Concert by the Castellano Orchestra playing at the Carlton Elite Hotel. **6.30,** Time Signal and Weather Report and Forecast. **6.33,** Religous Address. **7.0,** Violin Recital by Fred Rothpletz, of Cologne. At the Piano: Otto Strauss. **9.0,** Weather Report and Forecast, Late News Bulletin and Communications from the Neue Züricher Zeitung. **9.30** (approx.), Close Down.



USEFUL DATA CHARTS (No. 19, STAGE 2).

An explanation of this abac was given in the text accompanying Useful Data Charts (No. 19, Stage 1).

By Our Special Correspondent.

Royalty at the Microphone.—Fewer Oscillators.—More about "Broadcasting House."—Radio Drama Demonstration.—A Queer Kink.—"Carnival."

The Prince of Wales.

If all goes well, listeners will hear H.R.H. the Prince of Wales broadcasting through all stations, including 5GB, on Christmas Day. His Royal Highness, who will make a personal visit to Savoy Hill, is to speak at 7.25 p.m. for ten minutes on behalf of the Miners' Distress Fund.

o o o o

Royal Broadcasters.

The past year has been notable for the number of broadcasts by Royalty. H.M. the King was heard on July 10th at the opening of new University buildings at Nottingham and again on October 10th, when His Majesty inaugurated the new Tyne Bridge. The Prince of Wales has addressed the microphone on several occasions, while on December 12th Her Majesty the Queen broadcast for the first time, when unveiling the Merchant Seamen's memorial.

o o o o

A New Contact.

There can be no doubt that broadcasting has established a new contact between the Royal Family and the nation—much stronger than in the days when royal personalities were known to the majority of people merely through the medium of "pretty pretty" postcards and blurred pictures in the papers.

o o o o

The Decline in Oscillation.

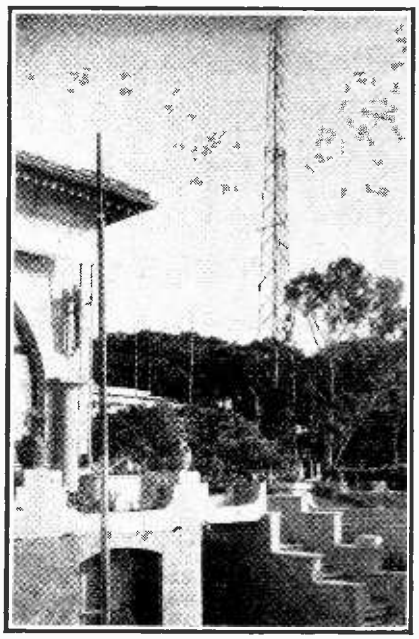
The humble oscillator has been rather forgotten of late, except by those who are not allowed to forget him, but Savoy Hill has been on the watch, and some rather surprising statistics have been prepared showing that the oscillation family has diminished considerably during 1928.

o o o o

When Oscillation is Very Local.

From December 1st, 1927, to November 30th, 1928, 2,037 cases of oscillation were referred by the B.B.C. to the Post Office. Of this number, 1,445 were dealt with by the Post Office engineers, and in nearly 17 per cent. of the cases the fault was found to lie in the complainant's own receiver.

In the previous year, the proportion was 35 per cent., but at that time only meagre details of each complaint were then available, no set form of questions having been framed. Nowadays every correspondent who complains of local



WHERE THE SUN STILL SHINES. A glimpse of the Juan les Pins broadcasting station at Nice, which sometimes can be heard in England, though the power is only 0.5 kilowatt. The wavelength is 245 metres.

oscillation receives a questionnaire in which every available detail can be tabulated.

o o o o

Fractious Christmas Presents.

The total number of complaints dealt with by the B.B.C. during the past year was 9,006. The "curve" was at its highest in January and February, which suggests that new listeners were experiencing difficulty in operating their Christmas presents. The lowest mark was reached at holiday time in July and August.

The number of anti-oscillation pamphlets issued up to the present is 822,529.

o o o o

Gael Warning.

The Glasgow Gaelic Choir will be heard in a National Gaelic Concert which the B.B.C. is broadcasting from all its Scottish stations on January 9th.

o o o o

Signs of Life.

The hoarse cry of the housebreaker can still be heard on the Portland Place site, but last time I visited the spot there were already signs of better things to be. A new hoarding has been erected, with no chinks in it.

It is unlikely that constructional work will actually begin for at least two months, and I understand that a tremendous amount of work must be done before the foundation stone can be laid. As is generally the case, the "foundation" stone will be situated on ground level and must await the completion of the foundations.

o o o o

No Foundation Stone?

Whether or not an elaborate foundation ceremony will be arranged is not yet decided upon. A rite of this kind should afford an opportunity for a good "O.B." However, it rests with the owning syndicate to say whether they desire the name of the B.B.C. to be perpetuated on what is not B.B.C. property. Perhaps there will be no foundation stone, save the integrity of the contracting parties.

o o o o

Architectural Revisions.

Mr. Tudsbury, the B.B.C.'s civil engineer, is in close touch with the architect, Colonel Van Myer, and already several alterations in the original design have been agreed upon. In the first place the rather

diminutive entrance way shown in the architect's drawing is to be widened and extended in height to the top of the first floor. More windows are to be added at the top of the central block.

It has been suggested that the basement should form a large garage for the cars of artists and Corporation officials. A garage of some sort certainly seems called for, as anyone will agree who has had to thread his way through the variegated collection of cars which is never absent from the cramped little streets around Savoy Hill.

o o o o

European Visitors.

London rose to the occasion a few days ago when members of the Union Internationale de Radiophonie held their December meetings at B.B.C. headquarters. An especially interesting demonstration staged for their benefit was the production of a radio play, using the drama control board which has proved so valuable in plays like "Speed," "Love," and others entailing the use of many studios. There is no similar control board in existence either in Europe or America.

o o o o

Radio Drama

The primary business of the delegates was concerned with the compilation of programmes, statistics, and the exchange of information regarding dramatic works suitable for broadcasting. The meetings were under the chairmanship of M. Oscar Geiga (Austria), the other delegates being Professor Dr. Richtera (Austria), M. Hubert (Belgium), M. Pollock (France), Major Atkinson (Great Britain), M. Szoets (Hungary), and M. Chamiec (Poland). There were also present Dr. Sourek (Czecho-slovakia), President of the Juridical Commission of the Union, and Mr. Arthur Burrows (Secretary-General of the Union).

o o o o

A Schools Demonstration.

Special attention was given to the study of broadcasting to schools, and a Council school in London was visited during an actual transmission. I hear that this part of the programme produced a great impression.

The next meetings of the Union will be held in Geneva in February.

o o o o

The Bells, Bells Bells.

Whether or not Tennyson set the vogue may be doubtful, but bell ringing seems to take an indissoluble part in all celebrations for welcoming the New Year. On the night of December 31st and January 1st the B.B.C. will help the wild bells to ring out farther than they did in Tennyson's time. At 11.55 p.m. we shall hear the muffled bells of St. Michael's, Cornhill, rung by the Ancient Society of College Youths. Then, at midnight, Big Ben will be heard, and after the last reverberations have died away the unmuffled bells of Southwark Cathedral will burst out with a merry welcome for 1929.

o o o o

A Queer Kink

Bells, and, indeed, all percussion instruments, come through with astonishing realism. Apparently they can be more than real to some people, for I have just heard of a listener on the South Coast who suffers with a morbid dread of hearing Big Ben. He cannot account for this little mental "kink," but confesses that as midnight approaches he has an uncontrollable desire to switch off the dance music before the first stroke from Westminster.

o o o o

Fodder for Radio Drama.

I suppose a psycho-analyst would suggest that it is all due to an anti-Government complex, the patient being subconsciously aware that the chime proceeds from the building in which (he thinks) the country's affairs are being so badly managed. Be that as it may, there are other likely causes, but I leave their identification to would-be radio dramatists who are searching for something bizarre and sepulchral.

o o o o

FUTURE FEATURES.

London and Daventry.

DECEMBER 30TH.—Service from Whitefield's Tabernacle, Tottenham Court Road.
DECEMBER 31ST.—"1928-1929."
JANUARY 2ND.—"The Passing of the Third Floor Back."
JANUARY 3RD.—"Bethlehem," a nativity play by Laurence Housman, music by Joseph Moorat.
JANUARY 4TH.—"The Charcoal Burner's Son," an operetta by L. du Garde Peach, music by Victor Hely-Hutchinson.

Daventry Exp. (5GB).

DECEMBER 31ST.—New Year's Party, relayed from Pattison's Café Restaurant, Birmingham.
JANUARY 1ST.—"The Passing of the Third Floor Back."
JANUARY 3RD.—Selections from "Falka," Chassaigne's comic opera.

Cardiff.

JANUARY 5TH.—A Concert for Blind and Disabled Soldiers and Blind Workers, provided by the Marquis and Marchioness of Bute.

Manchester.

JANUARY 1ST.—Programme to celebrate the 35th Anniversary of the Manchester Ship Canal.
JANUARY 5TH.—A Musical Tour of Europe.

Newcastle.

DECEMBER 31ST.—"Do You Remember?" a comedy by E. A. Bryan.

Glasgow.

DECEMBER 31ST.—"Hogmanay," a play by Joe Corrie.

Aberdeen.

JANUARY 1ST.—"1928," a "memories" programme.

Belfast.

DECEMBER 31ST.—Reminiscences of 1928.
JANUARY 4TH.—Versailles, "Théâtre de la Petite Galerie."

Strange Saturdays.

A man whose job is a very dull one all the week advertises in the personal columns of the newspapers his willingness to "go anywhere and do anything" between noon and midnight on Saturdays. The results are embodied in a series of light-hearted stories entitled "Six Strange Saturdays." The author is Holt Marvell, and the first of the series is to be broadcast on January 12th.

o o o o

"Carnival."

Compton Mackenzie, who is already an ardent listener and a gramophile, has succumbed to the spell of radio drama. His most famous novel "Carnival" has been adapted to the microphone by Holt Marvell, with the assistance of the novelist himself.

The "first night" will be on January 8th, when "Carnival" will be broadcast from 5GB. On the following evening it will go out from 2LO, 5XX, and other stations.

Episodes of the story will be linked up by narrative much in the same way as in Conrad's "Lord Jim," but in this case Mr. Compton Mackenzie will be his own narrator.

o o o o

Forty Characters.

"Carnival" treats of the life of Jenny Raeburn, who appears in every scene and has about half of the entire dialogue. The part of Jenny will be taken by Elsa Lanchester. Another favourite in the caste will be Mabel Constanduros.

Altogether there will be about 40 characters, which must be something of a record in radio plays.

o o o o

Time Signals.

The B.B.C. time signals are to follow a new schedule as from January 1st. Here is the revised table :—

Week-days : 10.30, 1.0, 4.45, 6.15, 10.0.
Sundays : 10.30, 3.30, 9.0, 10.0.
Gale Warnings.—Week-days : 1.0, 4.45, 6.15; Sundays : 3.30.

o o o o

An Elder o' the Kirk.

Anyone interested in Scottish drama knows that the first performance of a new work by Murray McClymont is something to look forward to, and there are sure to be many listeners in the North of Scotland who will make a special point of having their sets tuned in to Aberdeen on January 7th to hear the first broadcast of his "Cupid and the Kirk." In this one-act Scots comedy Mr. McClymont is in lighter vein than in his biggest works, and he makes most amusing play with the story of how an elder o' the Kirk deals firmly but humorously with the petty intrigues of a lowland village. The elder is played by Arthur Black.

o o o o

Teaching a Difficult Art.

Billy Mayerl and Jack Payne, with the B.B.C. Dance Orchestra, are co-operating on January 10th in an illustrated talk from 2LO on "How to Play Syncopated Music."

o o o o

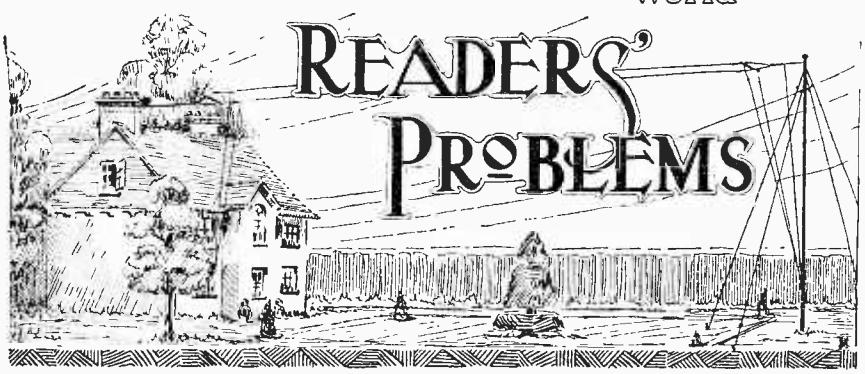
A Rugger Relay.

The rugger match between England and The Rest at Twickenham on January 5th will be the subject of a running commentary broadcast through 2LO and 5XX.

o o o o

A Great Octogenarian.

Sir Alfred Yarrow, the great shipbuilder and head of Yarrow and Co., the makers of the Yarrow boiler now generally adopted by the navies of the world, will give listeners his "Memories of Eighty Years" in a broadcast from the London studio on January 1st. Sir Alfred was born in 1842.



"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 Sensitive Pick-up.

Why is it that I get a shock from the loud-speaker terminals of my receiver (1-v-2) when using a gramophone pick-up, which is connected in the grid circuit of the detector valve? The effect is not present when the set is tuned to wireless signals.

C. B. K.

We can only assume that the input from your pick-up is very much greater than anything you are able to get from the ether. You must remember that for gramophone reproduction you are using three L.F. stages, so that the amplification is greater than when the set is performing its normal function. Incidentally, we would suggest that your H.F. amplifier is probably not pulling its weight; in your locality it should be possible thoroughly to overload each valve from the detector onwards on signals from either of the Daventry transmissions.

oooo

The Aerial Down Lead.

I am told that the down lead of my aerial, which at present consists of bare copper wire, as used for the horizontal portion, should be of rubber-covered wire. Is this correct? R. L. S.

We know that this fallacious idea exists; it would be interesting to know how it gained currency. There is no need whatsoever to use insulated wire for any part of the aerial up to the point where it enters the building. Even if it is necessary to attach a guy rope to the down lead, the necessary isolation can best be obtained by using an ordinary insulator.

oooo

Modified H.F. Transformers.

Please describe the method of adding a primary winding to a Litz secondary in order to make a transformer suitable for use with a screened grid H.F. valve. T. C.

We assume that you refer to a single-layer solenoid winding, as used in a number of transformers described in this journal. Probably the simplest and most effective way of converting this for use with screened valves is to adopt the usual type of primary winding, with spacing both between turns and between windings. For an average valve, we suggest a primary of 35 turns of No. 40 wire, spaced out to occupy about one half of the secondary winding length. The average spacing between primary and secondary should be

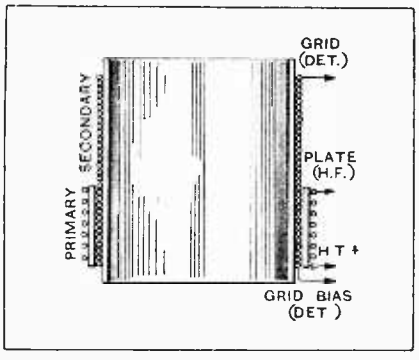


Fig. 1.—Windings and connections of an H.F. transformer for screened grid valves.

from $\frac{1}{32}$in. to $\frac{1}{16}$in. The disposition of the windings and the external connections of the transformer are given in Fig. 1.

oooo

A Charge-discharge Meter.

With reference to the article on "A Safe H.T. Supply" in your issue for December 5th, is it possible to change the position of the milliameter shown in circuit (b) so that it indicates the current taken from the battery when it is working, as well as the current flowing when it is on charge? D. C. B.

Yes, you can do this by inserting the meter in the lead from the switch to the negative terminal of the battery; but unless you obtain an instrument with a centre zero, it will be necessary to fit a reversing switch for it.

It may be added that we do not greatly care for the practice of keeping a meter permanently in circuit with an H.T. accumulator battery on discharge as its resistance is often quite enough to give rise to a certain amount of low-frequency reaction.

Grid Detection and Flat Tuning.

Why is it that the grid circuit of a "leaky grid" detector valve is more flatly tuned than when the anode bend system is used? I have heard it ascribed to the fact that the leak is damping the tuning coil, but this does not seem to be correct, as when I join a 2-megohm resistance across the input circuit of an anode bend detector, there is no noticeable change in sharpness of tuning. Again, it is said that flatness is due to the flow of grid current, but this I cannot understand; will you please explain? E. S. P.

As you say, these explanations are not quite satisfactory. The fact is that a valve operating as a grid circuit detector actually takes energy from the circuit across which it is connected during the time that the grid is made sufficiently positive (by the application of signal voltages) to pass a current.

oooo

How to Neutralise.

I have been attempting to balance a single-stage H.F. amplifier by following the instructions given from time to time, to the effect that the filament circuit of the valve should be broken. Unfortunately, at this distance from the transmitting station it is impossible to hear any signals unless the H.F. valve filament is glowing. Can you suggest an alternative method of procedure? S. G. R.

The operation of balancing a receiver is, thanks to modern improved methods, a comparatively simple task, and there is no need to extinguish the H.F. valve filament. All you have to do is to bring the tuned circuits near the point of resonance, when oscillation will normally be produced. Now rotate the balancing condenser until it ceases; readjust both tuning controls until signals are at maximum, and if self-oscillation is still present, make a further slight adjustment of the balancing condenser. The set should now be stable, but if there seems to be a tendency towards oscillation on another wavelength setting, it may be necessary to make still another small adjustment of balancing capacity.

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.

Filament Wattage

It has often been stated that valves with 2-volt filaments are slightly less efficient than their counterparts with a higher filament rating. Does this apply to screened grid valves?

N. V.

As with triodes, the efficiency of screened grid valves will be determined to a certain extent by the filament wattage, and, all other things being equal, those with the higher voltage rating will be the better. With modern valves the difference is not very great, and, indeed, it may be non-existent if the filament wattage of low-voltage valves is increased by designing them to take a heavier current than those rated at higher L.T. voltages.

oooo

Reception on Headphones.

Will you recommend the best circuit for phone reception of the local station (about three miles away) on an indoor aerial? H. B. L.

No very elaborate set will be required for this purpose, and we suggest that a detector valve with leaky grid condenser rectification and reaction will be quite adequate. Maximum sensitivity will hardly be necessary, so no special precautions need be taken to choose the most effective form of reaction control.

oooo

An Invariable Rule.

In a skeleton circuit diagram it seems customary to mark the connection to the negative side of the grid bias battery, but the point to which the positive terminal of this battery is joined is often omitted. Can it be assumed that it will always be connected to L.T.? S. D. G.

Yes, the positive side of the G.B. battery is always connected to the common negative bus-bar In certain cases, where special precautions are necessary to avoid stray couplings, you will find that it is connected directly to the negative terminal of the valve; this only applies when a separate battery is used for an individual valve.

oooo

Two-Station Switch-over.

Have you published a description of a three-valve set which would be suitable for reception of the two Daventry transmissions, and with provision for changing from one to the other by means of a simple switch? If so, will you please refer me to the back number in which the description appeared? N. M.

We think that the "Quick Change Broadcast Receiver" described in *The Wireless World* for February 16th should meet your needs, as it has separate tuned circuits for the two wavebands, with provision for connecting either at will by operation of a switch. At extreme ranges the reaction control, which in this set is common to both wavebands, would not hold good with a single setting, but in your locality little or no reaction should be necessary for reception of the desired stations, and we do not think any difficulty will be experienced on this score.

The Best Wavetrap.

The selectivity of my "Everyman Four" receiver was adequate when I lived ten miles from the local station, but now, at a distance of 2½ miles, I find that the number of stations receivable without interference is very much reduced—this in spite of the fact that I am using a high-impedance, high-magnification valve as an H.F. amplifier. It is realised that the addition of an extra H.F. amplifier would overcome the difficulty, but this would mean rebuilding the set, and I should prefer to add a wavetrap. Will you recommend the best type?

J. W. McM.

There can be little doubt that the absorption wavetrap is the most suitable in cases where it is desired to eliminate the signals of a single station. The necessary additions are shown in the

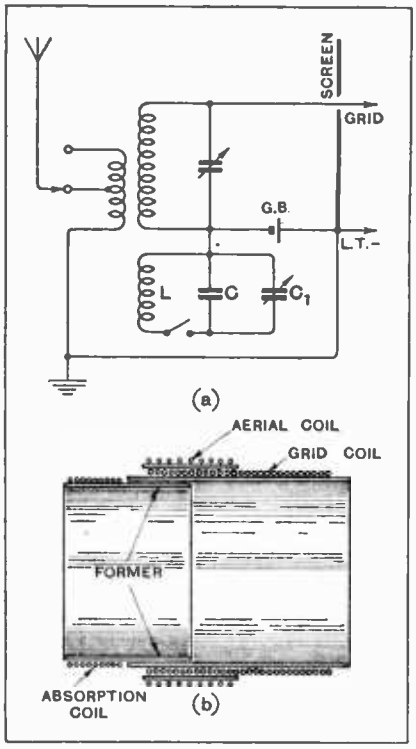


Fig 2.—Connections of an effective absorption wavetrap; below; a suggested method of coupling the coil to an aerial-grid transformer.

skeleton diagram given in Fig. 2 (a), from which you will see that a tuned circuit (L, C, C_1) is coupled to the low-potential end of the aerial grid transformer. It is important that this circuit should have low resistance, and it should be arranged to tune to the wavelength of the interfering transmission with a comparatively high ratio of capacity to inductance; thus we suggest that C should be a fixed air dielectric condenser of 0.0005 mfd. in parallel with a variable, C_1, of the same capacity; of course, a variable condenser of 0.001 mfd. could be used if preferred.

The coil L may have about 30 turns of No. 24 D.C.C. wire, preferably wound on a former of such a size that it may slide into the existing aerial-grid coil former. These details are shown in Fig. 2 (b).

By varying the position between absorption and grid coils, it will be possible to find a point where interfering signals are "absorbed" over the desired band of wavelengths; it is not a difficult matter to decide on the best practical coupling by trial.

You will note that a switch is connected in series with the tuned absorption circuit, in order that it may be cut out when required.

oooo

Long-wave Instability.

My receiver, with a single H.F. stage, is perfectly stable on the medium broadcast waveband, but on the long waves I find it impossible to obtain a "balance." The H.F. transformers, which are of the interchangeable type are carefully constructed and appear to be in perfect order. Can you suggest any reason for my failure? N. W. T.

We think it almost certain that your trouble may be traced to imperfect separation of H.F. and L.F. oscillatory currents in the coupling between the detector valve and the L.F. amplifier. If you have not taken the usual precautions, we recommend you to do so. If you have, you should assure yourself that the components used as H.F. stoppers are in order. For instance, a resistance may possibly have a lower value than that at which it is rated. An H.F. choke used for this purpose should be of reasonably efficient design, and you should assure yourself that none of its sections is short-circuited. By-pass condensers also play an important part in separating H.F. and L.F. currents, and you should make sure that one of these has not an internal disconnection.

oooo

Eliminating Morse Interference

As you are probably aware, Morse interference is a very serious proble in this part of the world. In an effort to eliminate it, would it be really worth my while to rebuild my receiver, adding a second H.F. stage?

W. R.

The extra selectivity afforded by another H.F. stage will certainly bring about an improvement, but, we fear, only to an extent which you will find disappointing. The trouble is that spark transmission—which is probably responsible for the majority of the interference on the medium broadcast waveband — is flatly tuned, and cannot be completely eliminated by selective circuits. In any case, we recommend you to concentrate your efforts very largely on the longer broadcasting wavelengths; admittedly they are not free from Morse interference, but the majority of transmitters on these wavelengths make use of the continuous wave system, which is not responsible for so much interference as the spark stations, most of which operate on shorter waves.