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CONTENTS OF THIS ISSUE.

MARCONI PATENTS.

The Present Position.

CONSIDERABLE doubt appears to exist in the minds of manufacturers of wireless receiving sets and others concerned with Marconi patents as to what exactly is the present liability in respect of royalties, and so many enquiries are received on the matter that we propose to outline briefly the present position. Certain aspects of this matter are now *sub judice*, but a review of the facts in order of sequence may help to clarify the position.

Formerly there was a recognised flat rate of 12s. 6d. per valve stage payable to the Marconi Company under the so-called "A2" agreement, this amount being based on the use of all or any of some thirteen patents relating to broadcast receivers.

A few months ago action was taken against the Marconi Company by The Brownie Wireless Company, who alleged an abuse of the patent monopoly and asked for relief in the form of a compulsory licence in respect of two particular patents necessary for the manufacture of ordinary broadcast receivers. About the same time a similar action was instituted by the Loewe Radio Company, asking for a compulsory licence to use certain other Marconi patents, but as the "user" in this case was restricted to the Loewe multi-stage valves, the issues involved were of somewhat less general interest.

The Comptroller-General of the Patent Office ruled against the Marconi Company in both actions. In the case of the Brownie Company a compulsory licence was granted to use the circuits of the two patents in question, on the basis of a royalty of 10 per cent. on the wholesale selling price of each broadcast receiver, subject to a minimum charge of five shillings on the first valve holder and two shillings and sixpence for each additional valve.

The Effect of the Decision.

Two points must be borne in mind in considering the effect of this decision. In the first place the Marconi Company have now entered an appeal against it in the High Court, which is the final tribunal for actions of this sort.

In the second place the Comptroller's decision was based, at least in part, upon certain special circumstances peculiar to the Brownie Company. This is emphasised by the following extract from the official ruling: "Although the conclusion at which we may arrive may logically involve the implication that the applicants (the Brownie Company) have established the general case of prejudice to the trade of a class of persons, as well as prejudice to their own trade, we have in fact only one specific application to deal with, and this decision can go no further than to define the relief to which the applicants themselves may be entitled."

Implications apart, the legal effect of this is quite clear and explicit. The ruling given in favour of the Brownie Company cannot be applied to an entirely independent contract, such as the A2 agreement, in which the parties, the circumstances, and the considerations involved are different from, and wider than, those brought into issue during the hearing at the Patent Office.

For instance, one of the points on which the Brownie Company relied was the fact that under the A2 agreement (which was offered them by the Marconi Company) they were required to pay a 12s. 6d. royalty on all valves, including those used for low-frequency amplification—which does not fall under any Marconi patent. As the Brownie Company were already large

manufacturers of this type of amplifier, it is obvious that such a condition would press hard upon them. This argument, which undoubtedly helped to influence the decision in their favour, could hardly be urged with equal force by all the other licencees who have signed the A2 agreement.

Finally, the Brownie Company fought their case on two patents, and two alone, namely No. 13,636 of 1913, known as the "high-frequency reaction" patent, and No. 147,148, covering the principle of grid-leak rectification. The compulsory licence which they have gained (pending the result of the appeal to the High Court) therefore applies only to the two patents specifically brought into question. Before it can be extended to cover any or all of the other patents contained in the A2 agreement, a number of other considerations must be brought into account. If and when this is done, it may be found that arguments which have been held sufficient to justify the issue of compulsory licences with respect to the two particular patents in question will not necessarily apply with equal force to all the other patents embodied in the general Marconi licence.

On the whole, therefore, it would seem that the decision of the Patent Office Court, apart from any influence it may have on the result of future litigation, or as forming a possible basis for a new agreement by compromise between the Marconi Company and its licencees as a body, cannot so far be held to have avoided the legal obligation of the signatories of the original A2 agreement to pay patent royalties on the scale set out in that document. Pending any further developments the Marconi Company, we understand, are declining to accept payment of royalties on any but their old basis of 12s. 6d. per valve stage

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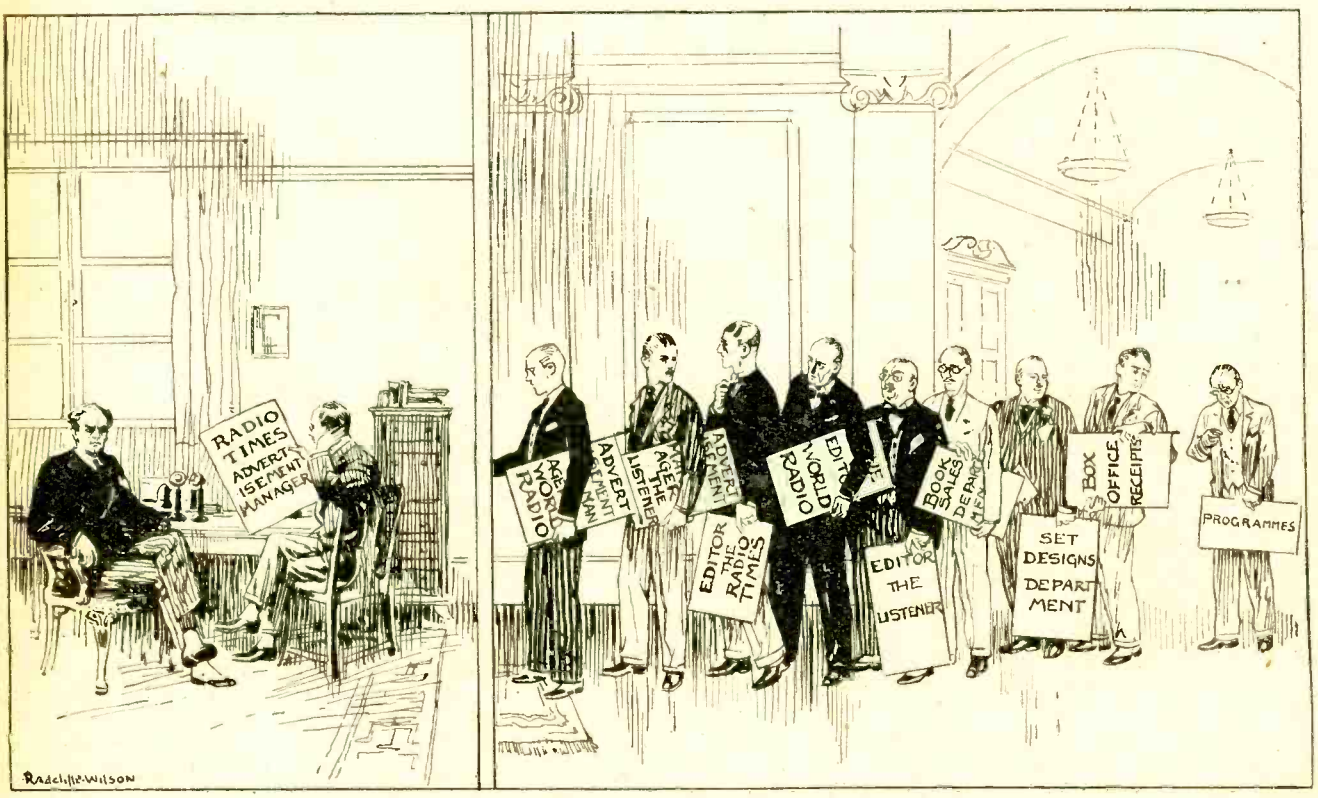
ETHER CONGESTION.

Suggesting an Alternative Remedy.

IN our last issue we referred to the proposals which had been put forward for the special design of aerials for broadcasting stations so as to endeavour to concentrate radiation within the neighbourhood of the transmitter, and we suggested that many of our readers might consider that any advantages so gained would be offset by the disadvantages of inability to receive distant stations, in the event of such a scheme being found practicable and coming into use generally.

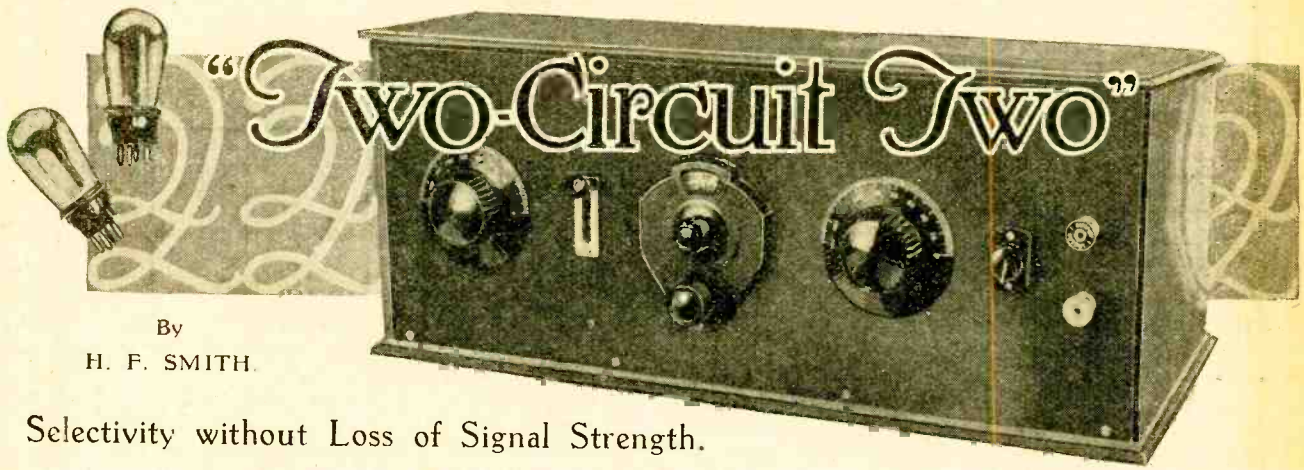
It would seem to us that if the number of stations in Europe is the cause of the present congestion, then we should endeavour to reduce the number and permit an increase in power of the remaining stations. By so doing, and provided that the power was adequate, it would surely be possible to give alternative British programmes to this country, whilst leaving the foreign stations free of interference so that they also could be listened to if desired.

WHAT'S WRONG WITH THE PROGRAMMES?



Our artist suggests an answer to the question.

"Two-Circuit Two"



By H. F. SMITH.

Selectivity without Loss of Signal Strength.

IN the design of sets for amateur construction, there is too often undue reluctance to introduce refinements, which, though desirable in themselves, may tend slightly to increase operating difficulties. It is not the purpose of this article to enter a plea for complicated receivers: on the contrary, the writer holds that no effort should be spared to eliminate every complexity that fails to justify itself by conferring a definite and clearly perceptible benefit. As the well-informed readers of this journal are aware, there is no royal road to better reception; improved results must be paid for, either in hard cash or in some other way. To take the question of selectivity—an acute problem to the average wireless user—there is probably no better way of improving the performance of any set than by fitting a loosely coupled and separately tuned aerial circuit, which was included almost as a matter of course in apparatus intended for serious work up to the broadcasting era.

An Extra Filtering Circuit.

It is an unfortunate fact that the reacting detector-L.F. receiver, which suffers most from lack of selectivity, lends itself less readily to improvement in this way than does the more ambitious type of set. Indeed, it was at one time rightly considered that the combination of loose coupling and regenerative detector was impracticable, in view of operating difficulties. Now, thanks largely to improved methods of reaction control, it is possible to put forward a design for a set of this class that has demonstrable advantages over the conventional "untuned aerial" arrangement, and which, while perhaps hardly suitable for those without some experience, is reasonably easy to operate.

With a few exceptions, the set is built with components to be found in the average detector-L.F. combination, and thus the design may serve as a basis for reconstruction of receivers with inadequate selectivity. It includes a waveband change-over switch, semi-adjustable aerial coupling, throttle reaction control, and, perhaps most important of all from the beginner's point of view, facilities for reverting to a simple "untuned" aerial coupling when making initial adjustments and gaining experience in tuning.

A simplified version of the theoretical diagram, omitting waveband switching, is given in Fig. 1. Ignoring aerial connections, the grid circuit will be recognised as the popular combination of "Hartley" detector and throttle reaction. Sensitivity is determined by the relative values of the semi-variable feed condenser and the reaction control capacity R.C.; as the latter is reduced a greater proportion of the total oscillatory energy in the anode circuit is passed back to the grid, thus stimulating reaction. The aerial circuit comprises the loading coil L and the coupling turns between the tapped connection on L_1 and its earthed centre point; these turns are common to both aerial and grid circuits, and the coupling between them is loosened or tightened as they are decreased or increased in number. In order that the amount of energy transferred from L to L_1 may be fully under control, an earthed metallic screen is interposed between the coils. An aerial tuning condenser is shunted across the combined inductance of loading coil and coupling turns.

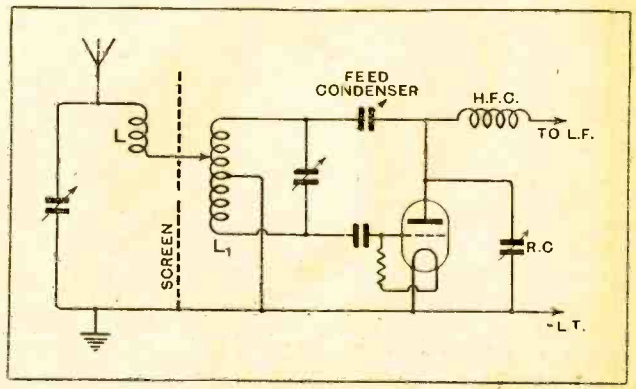


Fig. 1.—Simplified circuit diagram, showing tuned auto-transformer aerial coupling.

Fig. 2 shows the actual circuit arrangement of the receiver; it will be seen that a semi-variable capacity in series with the aerial is added. The left-hand pair of switch blades are arranged to place in circuit either of the loading coils—L for medium waves and L_1 for long waves—while the middle blade makes the appropriate change-over of the aerial coupling tapping. The remaining pair of contacts are arranged to short-circuit the long wave grid coil L_3 when the switch is in the medium-wave posi-

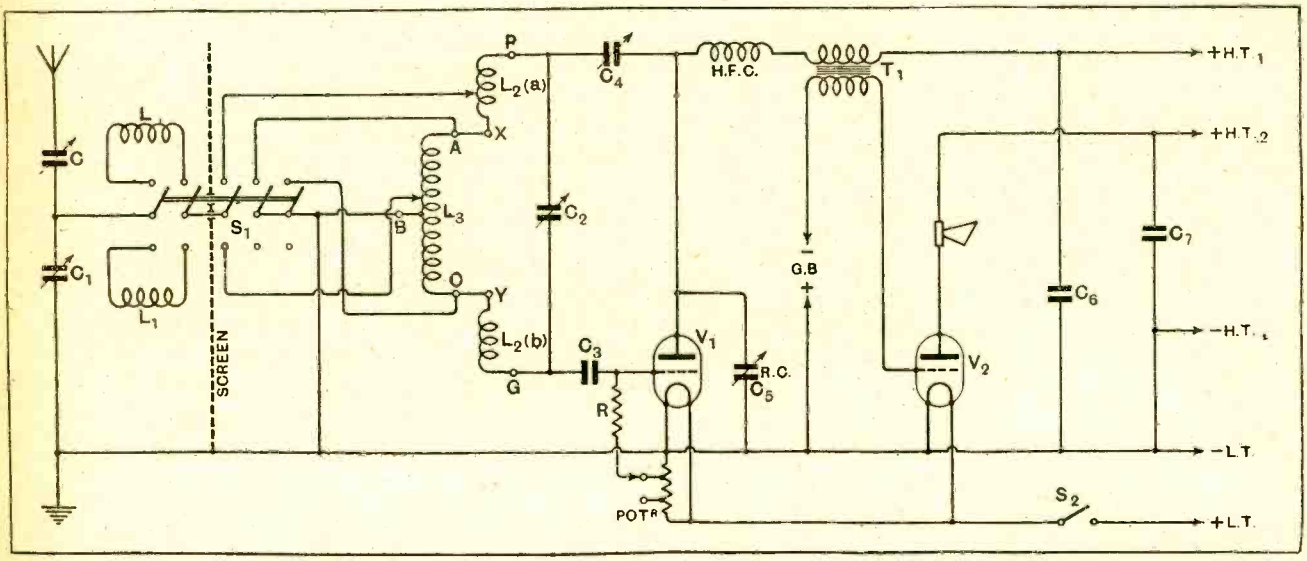


Fig. 2.—Complete circuit diagram. C, semi-variable condenser, 0.00027 mfd.; C_1, aerial tuning condenser, 0.0005 mfd.; C_2, grid tuning condenser, 0.0003 mfd.; C_3, 0.0003 mfd.; C_4, reaction feed condenser, 0.000065 mfd.; C_5, reaction control condenser, 0.0005 mfd.; C_6, 1 mfd.; C_7, 2 mfds.; R, 2 megohms.

tion. This part of the circuit is not difficult to understand when it is realised that the medium-wave coil is wound in two sections (L_2 (a) and L_2 (b)), and that the long-wave winding is inserted in the break between the sections. The L.F. side of the receiver is so completely conventional that it does not call for comment.

Ordinary plug-in coils of any good make may be used for aerial loading, but special windings are needed for the grid circuit. The two coils are assembled together in the manner shown in Fig. 3. The method of winding is indicated in Fig. 4. For the medium-wave coil, a total of 68 turns of No. 26 D.C.C. wire is wound on a tubular former 3in. in diameter and 3½in. long; there are two single-layer sections, each with 34 turns and a spacing of ⅛in. between them. Starting at the point marked G—the lettering indicates ultimate connections of the various ends, and corresponds to that appearing in the other diagrams—wind on the full 34 turns, passing the end of the wire (marked Y) through two holes bored in the tube and leaving a length of 5 or 6in. Two more holes are now drilled at a distance of ⅛in. for anchoring the start of the next section, which is tapped at the 2nd, 3rd, 5th, and 12th turns from the end X, by twisting and baring the conductor, or in any other convenient manner. It is essential that the two sections should be wound in the same direction. Anchorages for the outer ends marked G and P may conveniently be provided by small bolts passed through the tube in positions as indicated in Fig. 3.

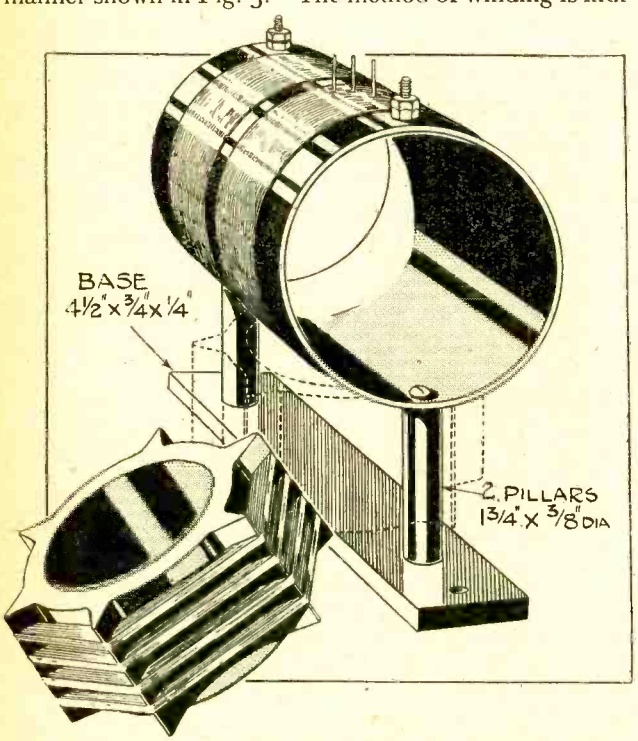


Fig. 3.—The grid coil assembly. Final position of long-wave inductance is shown in dotted lines.

Details of Long-wave Coil.

A short length of ribbed ebonite former must now be prepared for winding the long-wave coil, which consists of 220 turns of No. 32 D.S.C., equally divided between four sections. Positions of the slots to take these windings are as shown, but it should be pointed out that the width of $\frac{1}{16}$in., as given, is slightly larger than that normally required. Thickness of wire covering varies slightly, and it is best to start with a narrower slot, enlarging it if necessary, so that it is just filled with the winding of 55 turns. Referring again to Fig. 4, two full sections should be completed, starting from point C. Now bend the free end of the wire back on itself, allowing a length of 6in., and twist together, thus providing the connection marked B, which will be joined to the common negative lead and to earth. Without interrupting electrical continuity, and still winding in the same direction, proceed to fill the third slot, making tappings (by twisting the wire) at the 6th, 8th, 10th and 40th turns

"Two-circuit Two."—

from the start. Carry on with the fourth and last slot, then terminating the outer ends of the winding to screws passed through ribs of the former, which is then mounted in position under the medium-wave coil, care being taken that the tappings are in such a position that they will be accessible. The assembly is completed by connecting the inner ends of L_2(a), L_2(b) marked X and Y to, respectively, the outer ends of L_3 marked A and C.

The general arrangement of the metal screen is shown in the drawings and photographs, but as considerable latitude is permissible in the layout of the receiver under discussion, it is considered unnecessary to give detailed instructions. Its front edge must be cut away to accommodate the switch, which is mounted in such a way that two of its left-hand sets of contacts project into the "aerial" compartment.

Choice of Components.

In a modified "Hartley" circuit of this type, both moving and fixed vanes of the main tuning condenser are at high oscillatory potential, and all traces of hand-capacity effect may best be obviated by using a Burndept condenser with insulated shaft, as in the present case. An ordinary component will serve quite well, however, particularly if the dial is so constructed that the operator's hand is not unduly close to the "live" spindle. A slow-motion control, if not essential, is of distinct advantage in this position, but direct drive is really more convenient for aerial and reaction condensers.

It will be seen that a semi-fixed potentiometer is fitted in the detector grid circuit: by connecting the low-potential end of the leak to a suitable point, it is possible to make a satisfactory compromise between best rectification and best reaction control. This is a recommended refinement, but, again, is not essential to the design, and is generally least useful with 2-volt valves.

In mounting the components, care should be taken to follow fairly closely the relative positions of coils and screen, but rearrangement of L.F. components is permissible, should the use of different components make this necessary. Space may be saved by mounting the grid condenser C_3, its leak, and the potentiometer under the main tuning condenser.

A small ebonite terminal panel or some similar device must be provided as a point of attachment for aerial and earth leads.

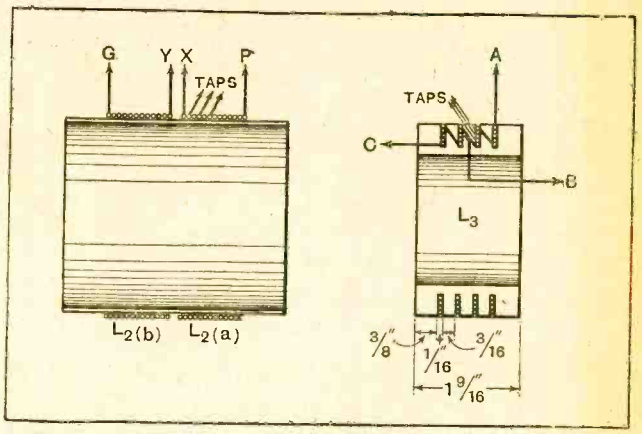
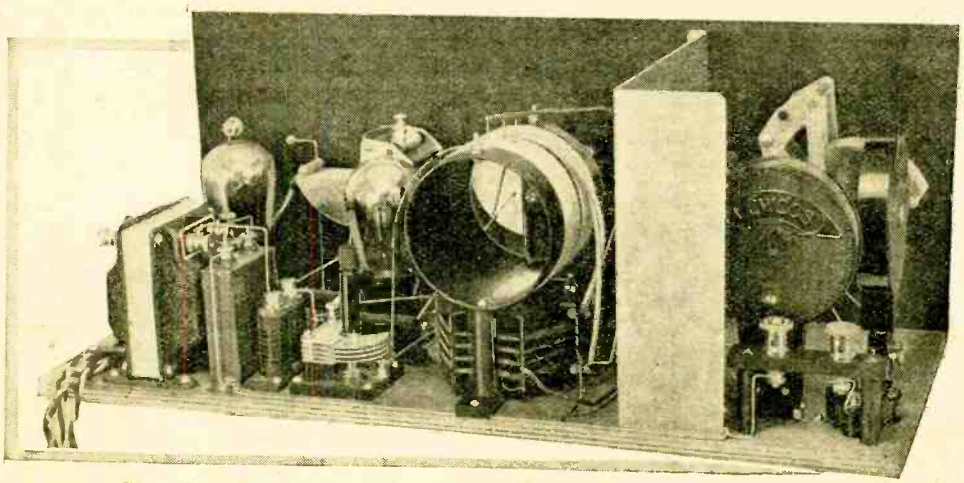


Fig. 4.—Details of grid coils.

Tinned copper wire, No. 18 or 20 gauge, can conveniently be used for all connections except those from the grid leak to the potentiometer and from the switch to the medium- and long-wave coil tappings, for which purpose lengths of rubber-covered flexible wire are preferable. The latter leads may with advantage be fitted with "crocodile" spring clips, at any rate as a temporary measure, so that experimental alterations in coupling may easily be tried.

It is best to carry out initial adjustments without the added complication of a coupled aerial circuit. This may be done by short-circuiting the condenser C, removing the connection from the fixed vanes of C_1 and short-circuiting both the coil sockets for L and L_1. The top middle contact of the switch is joined to the tap at the 12th turn from the centre point of the medium-wave coil and the corresponding lower contact to the 40th turn of the long-wave coil.



View of receiver from the rear. Note position of tappings on long-wave coil.

With the condensers C_2 and C_5 set at about half their maximum capacity, the first step is to increase the capacity of the feed condenser C_4 till the valve is on the verge of oscillation. This setting should not need further adjustment, and reaction is now controlled by operation of C_4, sensitivity being increased by reducing its capacity.

Having mastered the operation of the set in its simplified form, a start should be made with the tuned aerial circuit. Contrary to the usual procedure, it is recommended that initial tests be carried out with a very loose

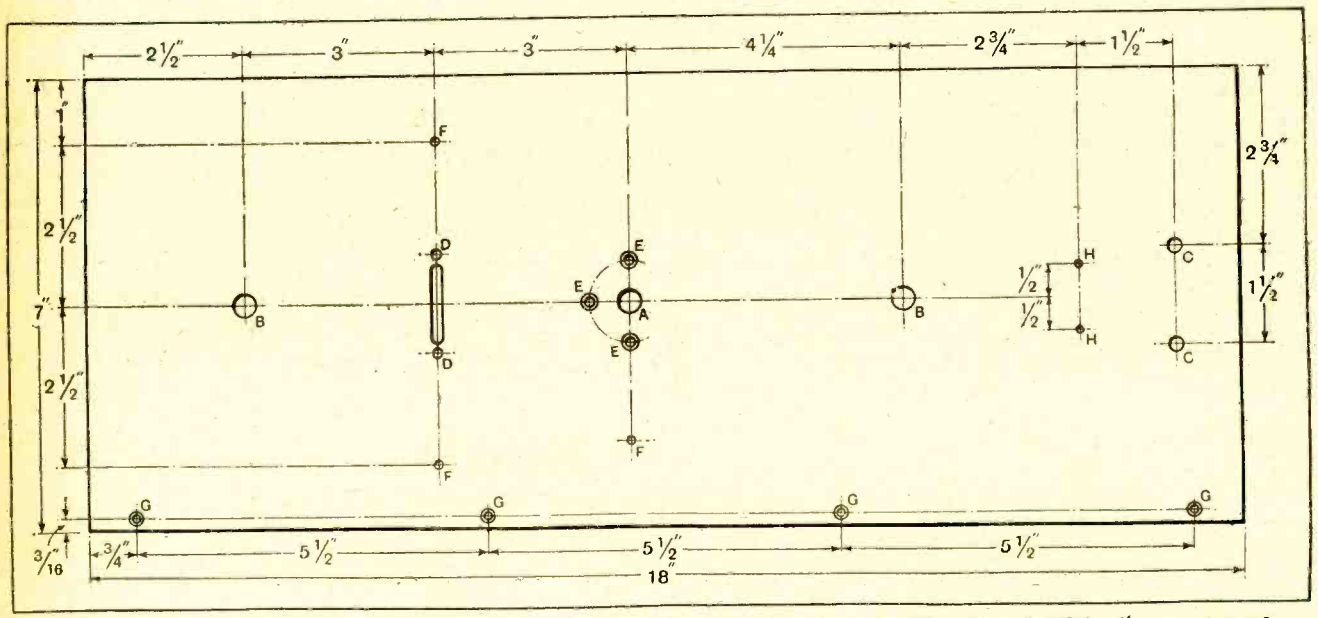


Fig. 5.—Drilling details of front panel. A, 3/8in. dia.; B, 11/32in. dia.; C, 7/32in. dia; D, 5/32in. dia.; E, 5/32in. dia., countersunk; F, 1/8in. dia.; G, 1/8in. dia., countersunk; H, 3/32in. dia.

coupling, so the 2nd and 6th taps on medium- and long-wave coils respectively should be connected up. Insert a No. 60 coil in holder L and a No. 200 in L_1; these values are approximate, but will generally be correct, as the effect of aerial capacity can be reduced at will by adjustment of the semi-variable condenser C, which should be set at about half its maximum capacity. Before beginning a search for signals, adjust the reaction condenser so that oscillation is just *not* produced at any setting of C_2. Now, ignoring reaction control for the moment, rotate C_2 slowly through a few degrees, following it by wider movements of the aerial condenser C_1. As soon as a signal is heard, adjust this for maximum intensity; it will not be necessary to touch it again, as the circuit of which it forms a part is practically unaffected by other adjustments. The next step is accurately to tune the grid circuit (C_2), and then, if necessary, to bring up signal strength by reducing the capacity of R.C. It is almost true to say that this adjustment has no effect on tuning, but where a considerable change in reaction is made, a minute readjustment of C_2 will be required.

When a station is once tuned in, make a note of dial

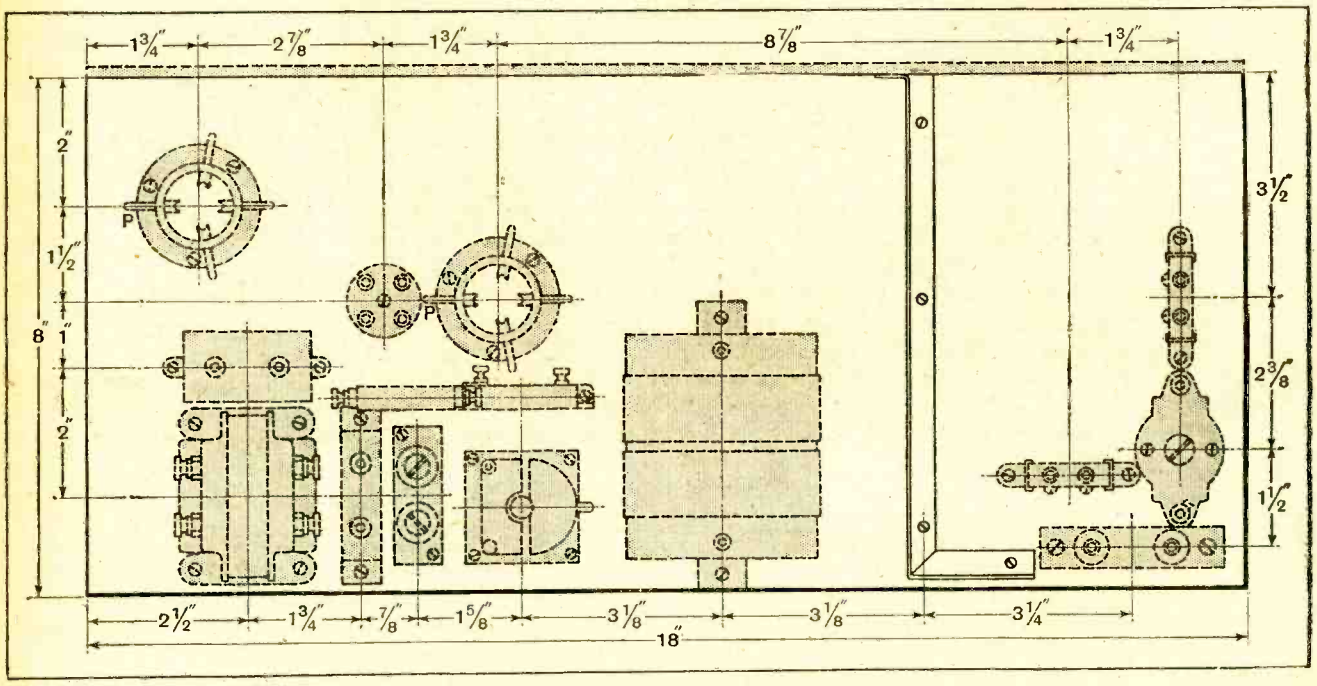


Fig. 6.—Disposition of components on the baseboard.

LIST OF PARTS.

2 Variable condensers, 0·0005 mfd. (Lotus).
2 Plain dials for do.
1 Variable condenser, 0.0003 mfd. logarithmic (Burndept).
1 Slow-motion dial (Brownie).
1 Balancing condenser, 0·000065 mfd., baseboard mounting type (Bulgin).
1 Semi-variable condenser, 30-270 micro-microfarad (Igranic "Preset").
1 Fixed condenser, 0·0003 mfd. (Graham-Farish).
1 Condenser, 2 mfd. (T.C.C.)
1 Condenser 1 mfd. (T.C.C.)
1 Switch, 5-pole change-over, lever pattern (Utility).
2 Single coil holders (Lotus).
1 H.F. choke (McMichael; "Junior" type).
1 L.F. transformer (Telsen; "Radiogrand").
1 Grid leak, 2 megohms (Graham-Farish).
2 Valve holders (Excelsior).
1 Insulating tube, 3½in. by 3in. dia. (Clarke Atlas "Pirtoid").
1 Ribbed ebonite former, 1.9/16in. by 3in. dia. (Becol).
1 Tapped grid potentiometer (Polar).
1 Toggle switch (Wearite).
4 Terminals, "Aerial," "Earth," "Output +," "Output −" (Eelex).
1 Baseboard, 18in. by 8in.
1 Ebonite panel 18in. by 7in.
2 Spade ends and 5 wander plugs (Clix).
Aluminium sheet for screen, wire, screws, ebonite, etc.

Approximate cost, without cabinet or accessories, £5 : 2 : 6.

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.

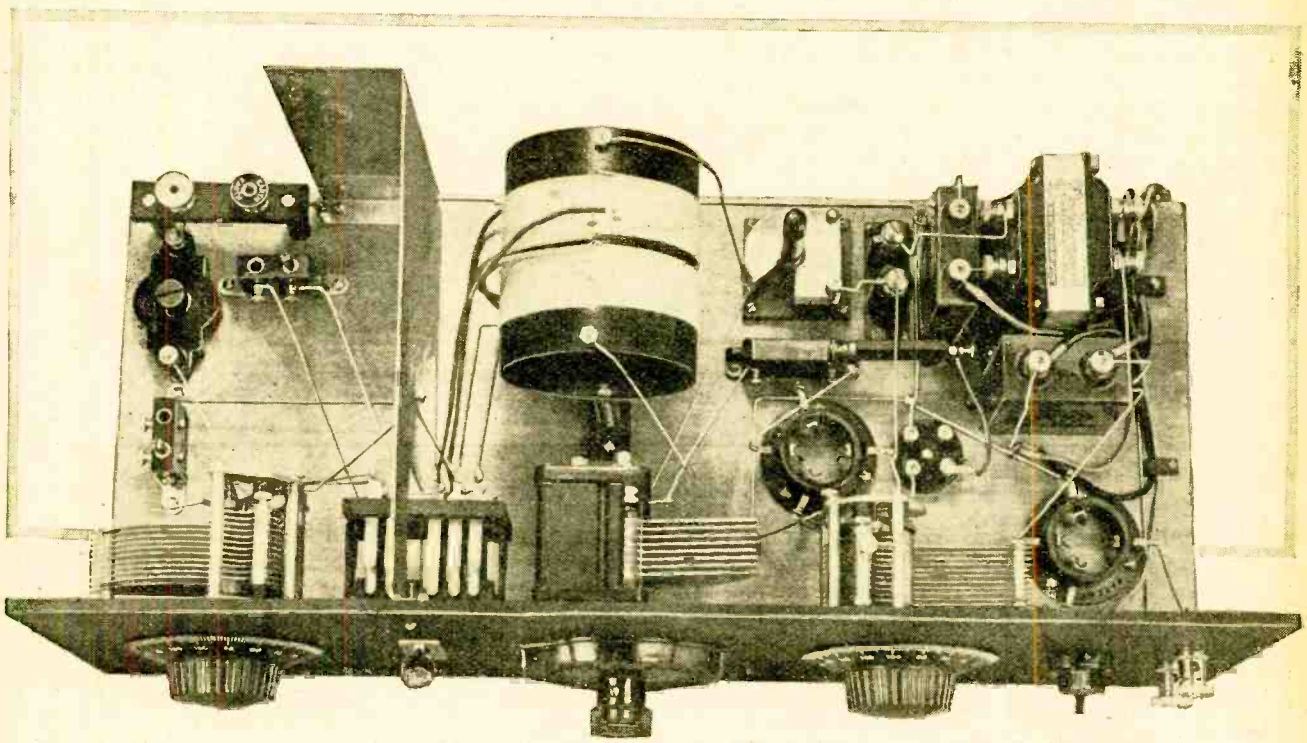
readings for future reference, and, above all, do not make any change in aerial condenser setting without reducing reaction very considerably. The reason for this is that slight mistuning of the aerial will reduce its loading effect on the grid circuit, with the result that the valve will go into oscillation if much reaction is applied. This is the one real "snag" in a receiver of this kind, but it need not be serious if it is properly appreciated.

Lastly, aerial coupling on both long and short waves may be finally fixed; possibly it may be necessary to tighten it by including more common turns (by moving the tap connection farther away from the earthed centre), but this should on no account be carried to the point where a station is receivable at two distant settings of one of the tuning dials. Generally speaking, a very loose coupling is best, and this is essential where interference is serious.

Selectivity is, of course, hardly up to the standard of a really first-class set with a single H.F. stage and "untuned" aerial, but it is of a distinctly higher order than that of an indifferent circuit arrangement of this kind, even if matters are not improved in this respect by loosening aerial coupling beyond the point giving loudest signals.

In the interest of easy operation, it is desirable that a set with a tuned aerial circuit should be reasonably sensitive without the need for excessive reaction, and it will obviously be easier to pick up a weak transmission if a second L.F. stage is added; this is true of any detector-L.F. receiver. Although the tuning of a two-circuit set is certain to be more difficult than when there is but a single dial, it is easy enough to make final adjustments when the desired signal is once heard, however weak it may be.

It is always convenient that tuning dials—when a



Plan view of the receiver. Note that the screen is cut away to clear the wave-change switch.

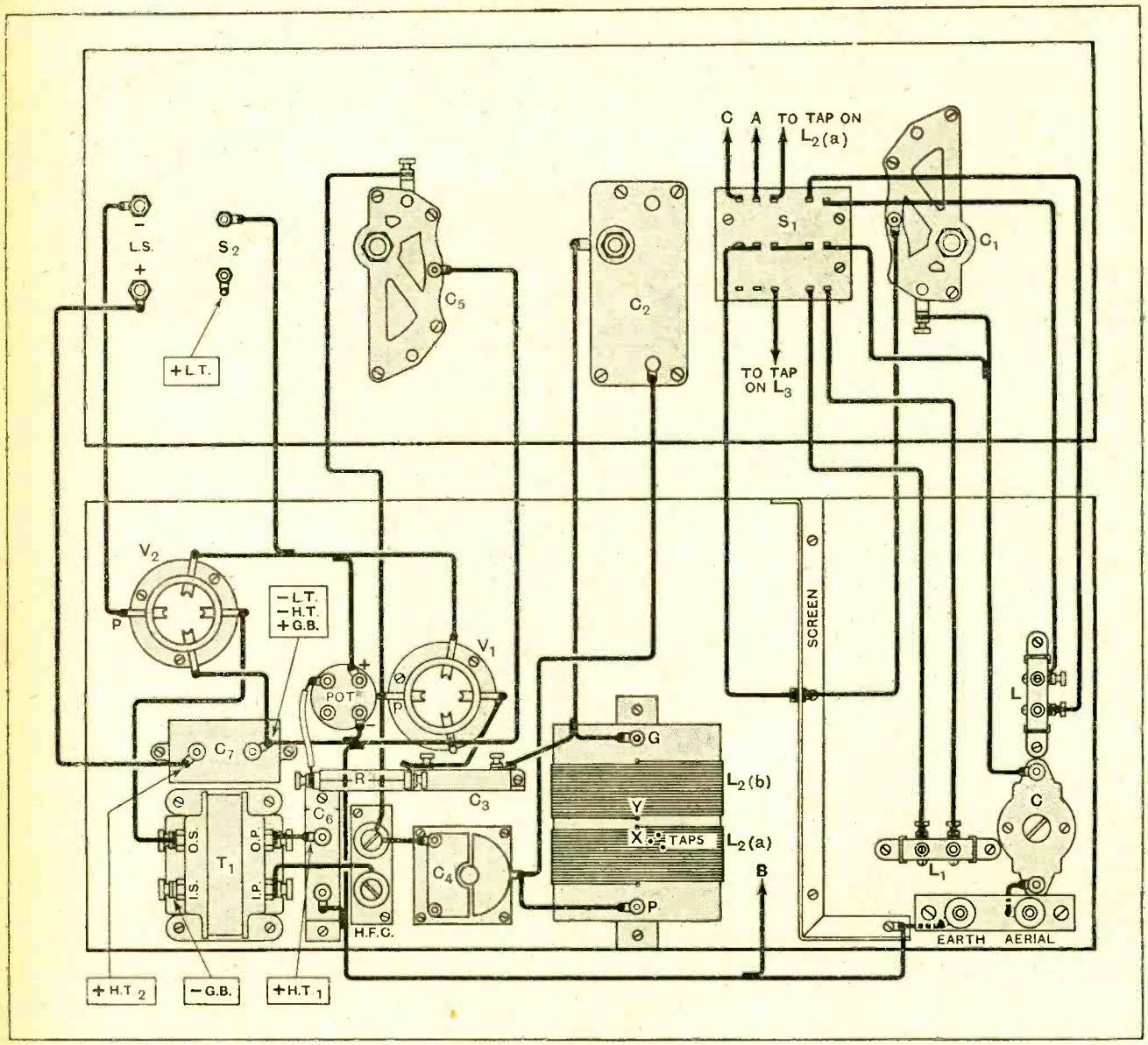


Fig. 7.—Practical wiring plan. Points X and Y on medium-wave coil are joined, respectively, to A and C on the long-wave coil, mounted below.

receiver includes more than one—should be arranged to keep more or less "in step" over the wave range covered, if only for the reason that a single number is more easily memorised. In the present receiver it is possible, up to a point, to do this by juggling with the inductance value of the aerial loading coil and the capacity of the series aerial condenser. As far as the latter is concerned, an adjustment will hold good only on one of the two wavebands covered, but, if the matter is regarded as being of great importance, it is easy enough, by adding another pole to the switch, to throw separate condensers into circuit. It may be pointed out that selectivity will be highest when the series condenser is small and the parallel tuning capacity (C_1) comparatively high.

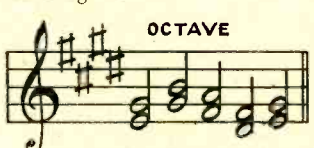
WHO'S WHO IN THE ETHER.

A Guide to Distant Reception, Comprising a List of European Broadcasting Stations with their Wavelengths, Call-Signs, and Identification Signals.

Station.	Metres.	Kc.
AUSTRIA.		
Vienna	519.2	577
Call: "Hallo! Hier Radio Wien" (pronounced Veen). Interval signal: metronome; 264 beats per minute. *Relays:*		
Graz	354.2	847
Interval signal (when own transmission): Morse letter K(— • —).		
Innsbrueck	283	1060
Klagenfurt	219	1370
Linz	250	1200
BELGIUM.		
Brussels	511.9	586
Call: "Allo! Ici Radio Belgique." Interval signal: tuning note.		
Châtelineau	220	1360
Ghent	275	1090
Schaerbeek	329.7	910
CZECHO-SLOVAKIA.		
Prague	343.2	874
Call: "Allo! Praha" (the native name of the city).		
Bratislava	276	1086
Call: "Radio Journal Bratislava." Interval signal: Four notes (bells): F.A.C.C.		
Brunn	432.3	694
Call: "Hallo! Radio Journal Brno" (native name of city).		
Kosice	265	1130
Call: "Hallo! Radio Journal Kosice" (pronounced Kos-it-see). At 7 p.m. G.M.T. Chimes relayed from the Church Tower.		
DENMARK.		
Copenhagen	339.8	883
Call: "Kjobenhavn-Kalundborg." Opening and closing signal: three strokes on gong. At 7 p.m. and 11 p.m. G.M.T. Chimes and time signal from the Guildhall. *Relay:*		
Kalundborg	1153.8	262
ESTHONIA.		
Reval	408	735
Call: "Radio Tallinn." Opening signal: rapid ringing of bell. Interval signal: gong.		
FINLAND.		
Helsingfors	374	802
Call: "Huomio! Huomio! Radio Helsinki." Interval signal: gong.		
Lahti	1504	199
FRANCE.		
Paris (Radio)	1744	172
Call: "Allo! Ici les émissions Radio Paris." Westminster chimes from studio clock before main transmission.		
Eiffel Tower	1488.5	202
Call: "Allo! Ici Poste Nationale de radio diffusion de la Tour Eiffel" (pronounced F L).		
Ecole Superieure. P.T.T.	449.8	668
Call: "Allo! Ici poste Radiotéléphonique de l'Ecole Superieure des Postes et Telegraphes de Paris."		
Radio LL	244	1230
Call: "Ici Compagnie Nationale de Radiodiffusion."		
Petit Parisien	301	997.4
Call: "Ici Petit Parisien, Paris." Announcements are made in French and English.		
Vitus	310	968.1
Call: "Ici Radio Vitus, Paris." Opening signal: metronome. P.T.T. Relays:		
Bordeaux-Lafayette	301	997.4
Grenoble	416.6	720
Call: (when own transmission): "Ici Emissions des Alpes Maritimes Grenoble."		
Limoges	273	1100
Lille	269	1116
Call (when own transmission): "Ici Radio PTT du Nord, Lille."		
Lyons	476	630
Interval signal (when own transmission): metronome, 192 beats per minute.		
Marseilles	305	892
Rennes	280	1070
Toulouse	254	1180
Call: "Ici Toulouse-Pyrénées."		
Provincial Stations.		
Agen	305	892
Béziers	211.3	1420
Interval signal: Metronome.		
Bordeaux	449.8	668
Call: "Ici Radio Sud-Ouest-Bordeaux." Announcements are made in French and Spanish.		
Fécamp	212	1415
Call: "Ici Radio Normandie."		
Lyons (Radio)	291.3	1190
Mont-de-Marsan	230.8	1300
Montpellier	252	1190
Nice-Juan-les-Pins	252.1	1190
Call: "Ici le Poste de Radiodiffusion de Nice-Juan-les-Pins, Emissions Radio L.L. de la Côte d'Azur."		
Toulouse (Radio)	384	780
Call: "Ici Radio Toulouse, Radiophonie du Midi."		
Strasbourg (testing)	1080	277.6
NORTH AFRICA.		
Algiers	354	846.7
Call: "Ici Radio Alger."		
Maroc (Rabat)	414	724
Call: "Emissions Radio Maroc. Poste de Radiodiffusion de Rabat."		
GERMANY.		
Berlin	475.4	631
Call: "Achtung! Berlin, Zeesen und die Gleichwellensender." At 7.55 a.m., Chimes from Potsdam Garrison Church (Sundays only). Interval signal: metronome: 80 beats per minute. *Relays:*		
Berlin (East)	283	1061
Madgeburg	283	1061
Stettin	283	1061
Zeesen	1648.3	182
Call (when own transmission): "Achtung! Hier Deutschlandsender."		
Provincial Stations.		
Breslau	321.2	937
Call: "Achtung! Hier Ostdeutscher Rundfunk Breslau und Gleiwitz." Interval signal: metronome: 240 beats per minute. On Sundays chimes are relayed from Christ Church at 8.15 a.m. *Relay:*		
Gleiwitz	326.4	919

WHO'S WHO IN THE ETHER.

Station.	Metres.	Kc.
Cologne	263.2	1140
Call : "Achtung! Hier Westdeutscher Rundfunk."		
Interval signal : chimes from the studio.		
Relays :		
Aachen (Aix-la-Chapelle)	455.9	654
Langenberg	462.2	649
Muenster	267	1124
When own transmission, interval signal : Morse letters MS (— — • • •) also uses gong.		
Frankfurt-am-Main	421.3	712
Call : "Achtung! Frankfurt - am - Main und Cassel." (Occasionally a lady announcer.)		
Interval signal : metronome, 192 beats per minute, and Morse letter F (• • — •)		
Relay :		
Cassel	250	1200
When own transmission, a lady announcer.		
Hamburg	391.6	766
Call : "Achtung! Hier die Norag Sender."		
Interval signal : Morse letters HA(• • • • •—) Also uses gong.		
Relays :		
Bremen	387.1	776
Interval signal (when own transmission) : Morse letters BMN (— • • • — — —•)		
Flensburg	219	1370
Hanover	566	530
When own transmission, a lady announcer.		
Interval signal : Morse letters HR (• • • • •—•)		
Kiel	250	1200
Interval signal (when own transmission) : Morse letters KL (— • — •—• •) and gong.		
Koenigsberg	280.4	1070
Call : "Achtung! Hier Koenigsberg und Danzig."		
Interval signal : 2 bells ; A flat ; D flat (a perfect fourth) ; also metronome, 240 beats per minute.		
Relay :		
Danzig	272.7	1100
Call : (when own transmission) : "Achtung! Hier Freistaat Danzig."		
Leipzig	361.9	829
Call : "Achtung! Hier Mitteldeutschesender Leipzig und Dresden."		
Interval signal : metronome.		
Relay :		
Dresden	387.1	776
Interval signal (when own transmission) : Morse letters DR (— • • • —•)		
Munich	536.7	559
Call : "Achtung! Hier Deutsche Stunde in Bayern, Munich, Nurnberg, Kaiserslautern und Augsburg."		
Interval signal : a metronome-like instrument (60 beats per minute) followed by siren (deep G).		
On Sundays at 10 a.m., chimes are relayed from the Guildhall.		
Relays :		
Augsburg	566	530
Kaiserslautern	272.7	1100
Nurnberg	240	1250
When own transmission, a lady announcer.		
Stuttgart	374.1	802
Call : "Achtung! Hier Stuttgart und Freiburg im Breisgau."		
Interval signal : three notes (C.D.G.), produced by oscillating valves.		
Relay :		
Freiburg	577	520
HOLLAND.		
Hilversum	1071	280
Call : "Hier Hilversum, Holland."		
Huizen (from 5.40 p.m. and on Sundays)	1852	161
(until 5.40 p.m. weekdays)	337	889.8
Call : "Hier Huizen" (pronounced Hoizen) Holland, followed by name of Society giving the entertainment.		
HUNGARY.		
Buda-Pest	554.5	541
Call : (occasionally a lady announcer) : "Hallo! Hall itt Buda-Pest."		
Interval signal :		



PLAYED ON MUSICAL BOX

IRELAND.		
Dublin	411	730
Opening signal : tuning note.		
Relay :		
Cork	222.2	1350
Announcements are made in English and Erse.		
ITALY.		
Rome	443.8	676
Call : "Radio Roma" (a lady announcer).		
Bolzano	455.9	658
Genoa	389	770.4
Call : "Radio Genova."		
Milan	504	595
Call (a lady announcer) : "Radio Milano."		
Naples	333	901
Call (a lady announcer) : "Radio Napoli."		
Opening signal : tuning note.		
Interval signal : metronome.		
Turin	275	1090
Call : "EIAR, Stazione Experimentale di Radio Torino."		
JUGO-SLAVIA.		
Zagreb (Agram)	308.3	973
Call : "Radio Zagreb."		
Interval signal : bell struck twice.		
Opening signal : metronome ; 100 beats per minute.		
Laibach (**Ljubljana**)	529	566.9
Call : "Radio Ljubljana" (pronounced Liubliana).		
Interval signal : cuckoo call.		
LATVIA.		
Riga	528.2	568
Call : "Riga Radio."		
Interval signal : gong.		
LITHUANIA.		
Kovno	2000	150
Call : "Alio! Radio Kaunas."		
Interval signal : gong.		
NORWAY.		
Oslo	496.7	604
Call : "Halloo! Oslo."		
Relays :		
Aalesund	456	658
Frederiksstad	387	775
Hamar	566	350
Notodden	297	1010
Porsgrund	455.9	660
Rjukan	242	1240
Tromsoe	500	600
Bergen	365.9	820
Call : "Halloo! Bergen her."		
POLAND.		
Warsaw	1401	214.1
Call : "Hallo! Polskie Radio Varschava." A lady announcer.		
Opening signal : Morse letter W (•— —).		
At 7 p.m., Time Signal. Hooter, followed by dash and one dot, dash and two dots, etc., up to seven dots, the last one indicating the 60th second of the last minute of the hour.		

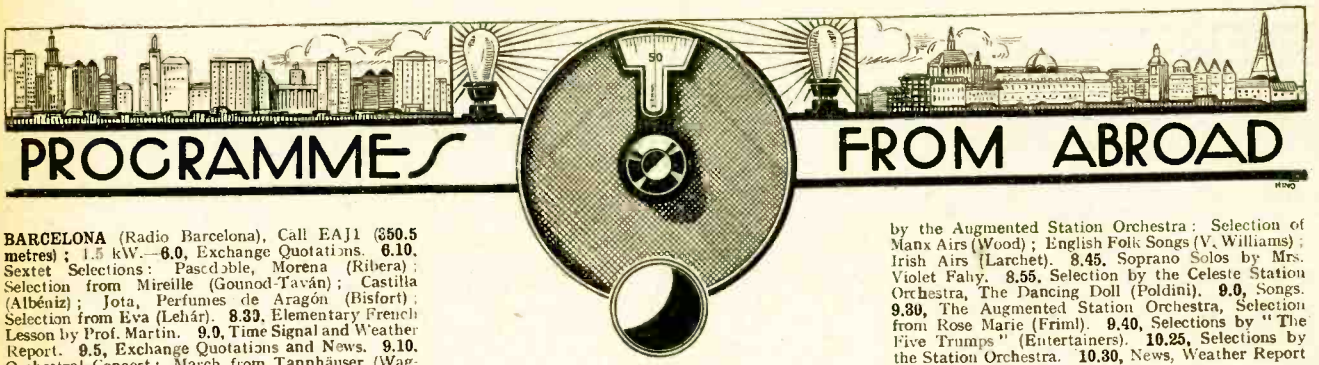
WHO'S WHO IN THE ETHER.

Station.	Metres.	Kc.
Relays :		
Cracow	314	955
Call (when own transmission) : "Hallo ! Polskie Radio Cracov." Interval signal : sledge bells, and occasionally uses metronome. A lady announcer at times.		
Kattowitz	416.1	721
Call (when own transmission) : "Hallo ! Polskie Radio, Kattowice" (pronounced Kat-o-vit-see). A lady announcer. Interval signal : hammer strokes on an anvil, also metronome.		
Posen	246	1200
Call (when own transmission) : "Hallo ! Radio Posnan." A lady announcer. Interval signal : metronome. Opening signal : chimes from the Guildhall.		
Wilno	314	955
Call (when own transmission) : "Hallo ! Radio Wilno." A lady announcer. Interval signal : Cuckoo call.		
ROUMANIA.		
Bucharest	396.3	757
Call : "Radio Bucuresci."		
RUSSIA.		
Moscow (Comintern)	1443	207.9
Call : "Hallo ! Radio Moskva." Daily at 10 p.m., chimes from the Tower of the Kremlin.		
Kiev	775	387
Moscow PTT	825	363.5
Homel	925	326
Kharkov	1680	178
Leningrad	1000	300
Call : "Hallo ! Covorit Leningrad." Opening signal : gong.		
SPAIN.		
Madrid (EAJ7)	426.7	703
Call : "Union Radio Madrid EAJ7" (pronounced Eh-ah-hota-see-et-eh). Chimes and time signal at midnight.		
Relays :		
Salamanca (EAJ22)	405	740
Call (when own transmission) : "Union Radio Salamanca."		
San Sebastian (EAJ8)	400	750
Call (when own transmission) : "Union Radio San Sebastian."		
Seville (EAJ5)	369.9	811
Call (when own transmission) : "Union Radio Sevilla."		
Barcelona (EAJ1)	350.5	856
Call : "Radio Barcelona EAJ1" (pronounced Eh-ah-hota-oono). Occasionally a lady announcer.		
Barcelona (EAJ13)	285	1050
Call : "Radio Catalana Barcelona EAJ13" (pronounced Eh-ah-hota-tretheh).		
Radio Espana, Madrid (EAJ2)	404	744
SWEDEN.		
Stockholm	438	685
Call : "Stockholm Rundradio." Opening signal : strokes on bell to indicate time. Interval signal : rapid ringing of bell.		
Relays :		
Boden	1200	250
Boras	230	1300
Eskilstuna	250	1200
Falun	333	901
Gävle	204.1	1470
Goeteborg	346.8	865
Halmstad	215.8	1390
Helsingborg	229	1310
Hoerby	260.9	1150
Hudiksvall	275.2	1090
Jonkoeping	201.3	1490
Kalmar	250	1200
Karlskrona	196	1530
Karlstad	219	1370
Kiruna	238.1	1260
Kristinehamn	262.7	1480
Malmberget	438	685
Malmo	229	1310
Motala	1370	218.9
Norrkoeping	275.2	1090
Orebro	236.2	1270
Ornskoldsvik	219	1370
Ostersund	770	390
Saffle	250	1200
Sundsvall	545	550
Trollhattan	265.5	1130
Uddevalla	285.7	1050
Umea	229	1310
Uppsala	455.9	658
Varberg	300	1000
SWITZERLAND.		
Berne	406	739
Call (a lady announcer) : "Hier Radio Bern" (pronounced Bairn). Announcements are made in German and French.		
Basle	1010	297
Call : "Hallo ! Radio Basel." Announcements in German. Frequently relays the Berne transmissions.		
Geneva	760	396
Call : "Allo ! Ici Radio Geneve." Opening and interval signal : three whistles. All announcements are made in French.		
Lausanne	680	441
Call : "Ici émissions Radio Lausanne de la Société Romande." All announcements are made in French.		
Zürich	489.4	613
Call : "Allo ! Hier Zürich (phonetic) Zierich." Interval signal : gong. All announcements are made in German.		
TURKEY.		
Angora	1600	187
Stamboul	1200	250
Call (in Turkish) : "Allo ! Telsiztelegrafie Istamboul" ; (in French) : "Ici Poste Radiophonique de Stamboul." Announcements are made in Turkish, French and German.		

WHO'S WHO IN THE ETHER.

IN view of the growing interest in distant reception we have devoted the foregoing pages to providing a list of the European broadcasting stations, giving, in addition to their wavelengths, as much information as can be included in a reasonable space, to assist readers in identifying the stations they hear. It is recognised that from such particulars alone it is by no means easy to identify all the stations which are heard, and we therefore invite readers wishing to identify a station which they have heard to write to us, giving as many particulars as possible to assist us in indentification. Replies to readers' queries will be inserted as promptly as possible under this heading week by week.

We are fortunate in having secured the services of "Jay Coote" to conduct this section for *The Wireless World*. "Jay Coote" has for many years specialised in station identification, and before joining *The Wireless World*, was conducting a similar service on behalf of the B.B.C. publication, *World Radio*.



SATURDAY, FEBRUARY 9th.

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

BARCELONA (Radio Barcelona), Call EAJ1 (**350.5 metres**); 1.5 kW.—**6.0,** Exchange Quotations. **6.10,** Sextet Selections: Pasodoble, Morena (Ribera); Selection from Mireille (Gounod-Taván); Castilla (Albéniz); Jota, Perfumes de Aragón (Bisfort); Selection from Eva (Lehár). **8.30,** Elementary French Lesson by Prof. Martin. **9.0,** Time Signal and Weather Report. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Concert: March from Tannhäuser (Wagner); Danse des Bohémiens (Godard-Mouton); Selection from El barberillo de Lavapiés (Barbieri); Waltz, Estudiantina (Waldteufel); Trio Selection, Polo gitano (Bretón); March, The Crown of India (Elgar-Winter). **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**365.9 metres**); 1.5 kW.—**5.30,** Programme for Children. **6.0,** Programme for Girls. **7.0,** Orchestral Concert. **7.50,** Topical Talk. **8.0,** Song Recital. **8.30,** Talk by Erling Lauhn. **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1648.3 metres**); 40 kW.—**12.45,** Phototelegraphy Transmission. **1.30,** Programme for Children by Ursula Scherz. **2.0,** Herr B. K. Graef, Talk: Elocution. **2.30,** Weather Report and Exchange Quotations. **2.40,** Talk for Women. **3.30,** Programme relayed from **Hamburg.** **4.30,** Talk by Herr Winters. **5.0,** Dr. Walther Pahl, Talk: Educational Travels abroad for Young Workers. **5.30,** Elementary Spanish Lesson. **5.55,** Hauptmann Rohde, Talk: Morocco, the Country and the People. **6.20,** Dr. Fritz Klatt, Talk: The Necessity of Recreation for Professional People. **7.0,** "Die Medaille": Comedy in One Act (Thoma), followed by Programme from **Voxhaus.**

BERLIN (Voxhaus) (**475 metres**); 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0,** 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 P. V. Metzelthin. **3.0** Herr M. Lippmann, Talk: Felix Dahn. **3.30,** Readings by Gert Fricke. **4.0,** Orchestral Concert, followed by Announcements. **5.10,** Dietrich Mayborn, Talk: Expeditions in Frozen Seas. **5.35,** Prof. Esau, Talk: The Technique of Short Waves. **6.0,** Legal Talk by Prof. Ed. Heilfron. **6.30,** Dr. Marie-Elisabeth Lüders, Talk: The Woman in Professions. **7.0,** Programme of Marches: Präsentiermarsch; Der Torgauer (Frederick the Great); Coronation March from Die Folkunger (Kretschmer); Wedding March from A Midsummer Night's Dream (Mendelssohn); Brandenburger Reitermarsch (Schmidt); Parade March of the 18th Hussars (Müller); Reitermarsch (Harmens); Heeresmarsch No. 2, 113; Heeresmarsch No. 2, 145 (Joh. Strauss); Das blaue Regiment (Schrader); Alte Kameraden (Teike); Florentine March (Fucik); Komm mit (Rockert); followed by Orchestral Music from the Hotel Kaiserhof, Weather Report, News, Time Signal, Sports Notes and Dance Music. **9.45.** Programme from the Marble Hall of the Zoo: Orchestral Concert: March from Aida (Verdi); Slavonic Dance Op. 46 No. 8 (Dvorák); Variation No. 12 (Polonaise) from the Third Suite in G Major Op. 55 (Tchaikovsky); followed by Dance Music. **10.30,** Concert from the Blue Hall of the Zoo: Ein Fest beim Prinzen Orlofsky; Selection from Die Fledermaus (Strauss), followed by Dance Music. **11.30** (approx.), Close Down.

BERN (**407 metres**); 1.5 kW.—**3.30,** Programme for Children. **4.0** Concert by the Kursaal Orchestra. **6.29,** Time Signal and Weather Report. **6.30,** Talk: How do I listen to Music? **7.0,** Symphony Concert from the Works of Beethoven, Weingartner and Liszt, relayed from Basle (1,034 metres). **9.0,** News and Weather Report. **9.15,** Selections by the Kursaal Orchestra. **9.35,** Programme of Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**321.2 metres**); 4 kW.—**2.50,** Review of Books by Dr. Eberhard v. Wiese. **3.20,** Concert: Overture to Prince Carnival (Blasius); Carnival Suite (Siede); Waltz, Karnevals-Botschafter (Joh. Strauss); Ich weiss ein Fass in einem tiefen Keller (May): Selection from Sibyll (Doelle); Selection from Die Tanzgräfin (Stolz); Ein Prosit der Liebe (Profes); Annekin, drück' doch mal! (Bendix); Trinklieder-Potpourri (Rhode); Heut gehn wir morgen erst ins Bett (Nelson). **4.50,** Weekly Film Review by Dr. Heinz Hamburger and Herr M. Lippmann. **5.30,** Hans Joachim Plehn, Talk in Esperanto: The Silesian Plant World. **5.40,** Dr. v. Zalewski, Talk: The Worker and the Machine, relayed from **Gleiwitz** (326.4 metres). **6.25,** Shorthand Lesson. **6.50,** Topical Debate. **7.15.** "The Start"—Recitation on a Sporting Subject, by Herbert Brunar. **7.50,** Vocal and Instrumental Concert. **9.0,** News and Announcements. **9.30,** Dance Music from the Messehof.

BRÜNN (**432 metres**); 2.5 kW.—**4.0,** Reading by Ernest Thomson-Seton. **4.15,** Talk on Books. **4.30,** Prof. Bukacek, Talk: Italian Literature—Alessandro Manzoni and his Followers. **4.45,** German Transmission. **5.15,** Talk for Journalists. **6.0,** Programme from **Prague.** **6.30,** Talk on Housing Reform by Dr. Babanek. **6.45,** Pianoforte Recital: Pictures (Gretchaninoff); Nocturne (Liadoff); Waltz; Mazurka. **7.0,** "Life"—Comedy in One Act (Vrchlivky). **7.45,** Cabaret Programme. **9.0,** Programme from **Prague.** **9.25,** Programme from **Prague.**

BRUSSELS (**512 metres**); 1.5 kW.—Experimental Transmission on a High Power.—**5.0,** Orchestral Concert from the Palace Hotel. **6.0,** Elementary and Advanced English Lessons. **6.45,** Pianoforte Recital. **7.0,** Gramophone Selections of Dance Music. **7.30,** "Radio-Chronique." **8.15,** Concert of Operatic Music, arranged by "La Meuse," "L'Antenne" and "Radio-vision." In the Interval, Topical Talk. **10.10,** News and Esperanto Announcements. **10.25,** Gramophone Selections. **11.0,** Relay of the Bal de la Monnaie and Commentary by M. Fleischman. **1.0 a.m.** (approx.), (Sunday), Close Down.

BUDAPEST (**555.5 metres**); 20 kW.—**3.45,** Time Signal, Weather and Tide Reports and News. **4.0,** Reading from Benö Zsoldo's "Great Law Suits of Former Times before the English Parliament." **4.30,** Concert relayed from the High School for Music. **6.30,** Opera Programme Announcements, followed by Relay of First Performance of "Der Tenor"—Opera Three Acts (Dohnányi). **9.20,** Time Signal, Weather Report and News, followed by Tzigane Music from the Café Emke.

CRACOW (**566 metres**); 1.5 kW.—**4.0,** Mr. A. Mueller, Talk: The Importance of Polish Peasant Emigration to Canada. **4.25,** Review of French Publications by Mme. Marie Krzetuska. **4.55,** Dramatic Programme for Young People. **5.50,** Miscellaneous Items and News. **6.10,** Programme relayed from **Kattowitz.** **6.58,** Time Signal from the Astronomical Observatory. **7.0,** Chimes from the Church of Notre Dame. **7.5,** Review of the Week's Foreign Politics by Mr. J. Regula. **7.30,** Programme relayed from **Warsaw.** **9.0,** Programme relayed from **Warsaw.** **9.30,** Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**411 metres**); 1.5 kW.—**1.30,** Weather Report and Concert of Gramophone Selections. **7.20,** News. **7.30,** Reading by Frank Fay. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Pib Uilleann by Seamus MacAonghusa. **8.15,** Selections by the Augmented Station Orchestra; Selection of Manx Airs (Wood); English Folk Songs (V. Williams); Irish Airs (Larchet). **8.45,** Soprano Solos by Mrs. Violet Fahy. **8.55,** Selection by the Celeste Station Orchestra, The Dancing Doll (Poldini). **9.0,** Songs. **9.30,** The Augmented Station Orchestra, Selection from Rose Marie (Friml). **9.40,** Selections by "The Five Trumps" (Entertainers). **10.25,** Selections by the Station Orchestra. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**421.3 metres**); 4 kW.—**2.55,** Hints for the Housewife by Fini Pfannes. **3.35,** Selections of Old Dance Music by the Station Orchestra. In the Interval: News and Announcements. **5.10,** Readings from "Ein Verbrecher aus verlorener Ehre" (Schiller), by O. W. Studtmann. **5.30,** "The Letter Box." **5.45,** Esperanto Lesson by Herr W. Wischhoff. **6.15,** Chess Lesson for Beginners by Prof. N. Mannheimer. **6.45,** Dr. Doris Dauber, Talk: Epochs of World History. **7.15,** Carnival Programme, followed by Dance Music from **Voxhaus.** **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**392 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. **11.40 a.m.,** Concert relayed from **Hanover** (566 metres). In the Interval at **11.55 a.m.,** Time Signal. **12.10,** News and Snow Report. **1.40,** Exchange Quotations. **2.30,** Review of Books. **3.0,** Illustrated Music Talk by Dr. Wilh. Heinitz. **3.30,** Concert of Chamber Music. **4.30,** Request Concert by the Station Orchestra. **5.30,** Georg Borchardt, Talk: The Labour Movement. **5.50,** Herr Paul Koch, Talk: Diving Experiences. **6.20,** Weather Report. **6.25,** "Louise": Opera in Four Acts (Charpentier). **9.45,** Weather Report, News Sports Notes and Programme Announcements. **10.0,** Concert from the Ostermann Restaurant. **10.50,** North Sea and Baltic Weather and Ice 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,** Concert relayed from the Tuschinski Theatre, **Amsterdam,** under the direction of Mr. Max Tak, with Pierre Palla (Organ). **3.40,** Italian Lesson by Mr. Giovanni Rizzini. **4.40,** French Lesson by Mr. Raymond Lafont. **5.40,** Time Signal. **5.41,** Concert of Trio Music. **6.25,** German Lesson. **7.25,** Police Announcements. **7.40.** Programme arranged by the Workers' Radio Society: Concert and Talk. **11.15** (approx.), Close Down.

HUIZEN (**336.3 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. Roosmalen. **6.30,** Catholic Bulletin. **6.40,** English Lesson. **7.10,** Dressmaking Lesson. **7.40,** Talk by Dr. Auseins. **8.0,** Choral and Orchestral Concert.

KALUNDBORG (**1,153.8 metres**); 7 kW.—Programme also for **Copenhagen** (339.8 metres).—**6.30 a.m.,** Morning Gymnastics. **10.0 a.m.,** Weather Report. **12.15,** Educational Talk. **2.0,** Programme for Children. **2.30,** Instrumental Concert: Overture to Raymond (Thomas); Waltz, La plus belle (Waldteufel); Gavotte d'amour (Wendsey); Gipsy Melody (Dvorák); Waltz from The Dollar Princess (Fall); In the Interval: Reading by Thomas P. Hejle; Russian Folk Music (Bernard); Selection from Lucia di Lammermoor (Donizetti); Norwegian Dance in A Major (Grieg); Sonata No. 4 in D Major for Two Violins (Corelli); Turkish March from The Ruins of Athens. (Beethoven). **5.20,** Talk by Sophie Petersen. **5.50,** Weather Report. **6.0,** News and Exchange Quotations. **6.15,** Time Signal. **6.30,** Dr. M. Neiiendam, Talk: Danish Church History. **7.0,** Chimes from the Town Hall. **7.2,** Vocal Concert: Danish Birds in Literature and Music; Talk by Ingvald Lieberkind; Spurven sidder stum bag Kvist (Nielsen); Tulte var en Höne (Hytten); Storken sidder paa Bondens Tag (Weyse); Svalen (Nielsen); Nys vaagnet er den unge Vaar (Andersen); Jeg ved en Laerkerede (Nielsen); Staeren (Seligmann); Nattergalen (Andersen). **8.0,** (approx.), News. **8.15,** Concert of Modern Dance Music. **10.0,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

Programmes from Abroad.—

KATTOWITZ (416.1 metres); 10 kW.—**3.0,** Concert of Gramophone Selections. **4.0,** Music Lesson by Prof. F. Salsc. **4.25,** Children's Letter Box. **4.55,** Programme for Children. **5.50,** Announcements. **6.10,** Talk by Mr. K. Zienkiewicz. **6.56,** Time Signal. **7.0,** Talk by Mr. K. Rutkovsky. **7.30,** Programme relayed from **Warsaw.** **9.0,** Weather Report and News. **9.30,** Dance Music.

KAUNAS (2,000 metres); 7 kW.—**3.45,** "Radio Patarejas." **4.30,** Announcements. **5.0,** Weather Report and News. **5.15,** Agricultural Report. **6.0,** Talk on Aviation. **6.20,** Evening Entertainment.

LAHTI (1,504 metres); 35 kW.—**4.0,** Recitation by Arvi Mansikka. **4.35,** Talk. **4.57,** Time Signal and Weather Report. **5.10,** Press Review. **5.15,** Song Selection. **5.40,** Talk. **6.0,** Vocal and Instrumental Concert from the Works of Sulho Rante. **7.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres), and **Münster** (265.5 metres).—**12.5,** Concert from the Hotel zur Post, Elberfeld: Overture to Die Fledermaus (Joh. Strauss); Waltz, Jungherrntänze (Gungl); Fantasia on Slavonic Themes, Old Russia (Leuschner); Violin Solo, Liebeslied (Josef); Two Selections from Die Tugendprinzessin (Zorlig); Potpourri of Viennese Folk Songs, Vindobona (Leopold); Venice (Popy); It Was a Dream (Lincke); March, Flott durchs Leben (Richter). **1.30,** Household Hints. **2.0,** Programme for Children by Els Vordemberge. **2.30,** Economic Report. **2.40,** Herr P. Brüls, Talk: The Bases of Wireless Technique. **3.5,** Trude Rosenthal, Talk for Women: Dancing and the Dancer. **3.30,** Dr. Kurt Kersten, Talk: The Year 1910. **4.0,** Hans Brainkamp, Talk: The Life of a Small Town. **4.20,** English Lesson by Prof. Hase. **4.45,** Selections of Gramophone Records. **5.30** Dr. Wilhelm, Talk: Religious and Intellectual Life in China. **5.50,** Economic Notes, Weather Report and Sports News. **6.15,** Dr. Wieruszowski, Legal Talk: Personal Rights. **6.40,** Prof. Hessen, Talk: What do we know of the Soul? **7.0,** Variety Concert, followed by News, Sports Notes, Business Announcements, Orchestral Selections and Dance Music. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—**3.30,** Concert by the Station Orchestra. **4.45** Wireless News and Talk. **5.20,** Weather Report and Time Signal. **5.30,** Programme relayed from **Königswusterhausen.** **6.0,** Prof. Georg Witkovsky, Talk: Lessing, the Critic of Religion. **6.30,** Dr. Fritz Kaphahn, Talk: The Sentiment of Europeanism in Western Europe of the 19th Century. **7.0,** Humorous Rhine Programme: Orchestral Selection, the Rhineland Suite (Lüling); Recitation; Orchestral Selection, Rheinischer Sang (Hannemann); Two Songs; Orchestral Selection, Vom Rhein zur Donau (Rhode); Recitation; Orchestral Selection, So singt man am Rhein (Haseloff); Two Songs; Orchestral Selection, Beim Rheinwein sollst du mein sein (May); Recitation; Orchestral Selection, Mainzer Narrhalla Marsch (Zulehner); Two Songs; Orchestral Selection. **9.0,** Labour Market Report, Weather, News, Programme Announcements and Sports Notes. **9.30** Dance Music relayed from **Voxhaus.**

MADRID (Union Radio), Call EAJ 7 (427 metres); 3 kW.—**7.0,** Chimes, Exchange Quotations and Dance Music. **8.0,** Dr. Zito, Talk: Inventions and Inventors. **8.25,** News and Announcements. **9.45,** Weekly Agricultural Report. **10.0,** Chimes and Time Signal. **10.5,** (approx.), "Die geschiedene Frau"—Operetta (Leo Fall). In the Interval at **12.0 Midnight** (approx.), News. **12.30 a.m.** (approx.), (Sunday) Close Down.

MILAN, Call 1MI (504.2 metres); 7 kW.—**7.30,** Time Signal and Announcements. **7.45,** Mr. G. Ardau, Talk: Industrial Review. **8.0,** Relay of an Opera from the Scala Theatre. In the Intervals, Talk on Verdi by G. M. Ciampelli, with Pianoforte Illustrations by C. Vidussa; Reading by Angelo Sodini, and News and Economic Notes. **10.30** (approx.), Close Down.

MOTALA (1,365 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Hör y** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.5 metres).—**4.0,** Concert of Light Music, relayed from **Göteborg.** **5.0,** Programme for Children, relayed from **Boras** (230 metres). **5.30,** Programme of Old Time Dance Music, relayed from **Göteborg.** **6.15,** Reading. **6.45,** Sonata No. 1 in A Major for Violin and Pianoforte (Mozart). **7.0,** Cabaret Programme. **8.0,** Topical Talk. **8.15,** News and Weather Report. **8.45,** Dance Music from "The Sphinx." **10.0,** Dance Music by John Malms' Orchestra. **11.0** (approx.), Close Down.

Saturday, February 9th.

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

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres). **4.30,** Review of Books **5.0,** Concert of Light Music: March, Wiener Künstler (Schrammel); Waltz, Ein Sommerabend (Waldteufel) Gavotte, Herz an Herz (Latann); Märchen und Träume (Holländer); Tango, Hano (Meisel); Wens die Geigen hamlich streicheln (Kronegger); Ich küsse Ihre hand, Madame (Erwin); March, Stars and Stripes (Sousa). **5.35,** Labour Market Report. **6.0,** "The Letter Box." **6.30,** Lute Recital by Hans Neemann: Sonatina (Reusner); Minuet (Bach); Campanella (Kellner); Sarabande (Weiss); Euge (Falckenhagen). **7.0,** Humorous Programme. **9.5,** Dance Music from the Odeon Casino, Munich. **9.20,** News.

NAPLES, Call 1NA (333 metres); 1.5 kW.—**7.30,** Wireless Talk, Announcements, News and Harbour Notes. **8.0,** Time Signal. **8.2,** A Comedy with Orchestral and Solo Interludes: Orchestral Selection, Overture to Pique Dame (Suppé); "La Danza dei Sette Veli"—Comedy in Three Acts (Bernard and Frement); in the First Interval, Violin Solos, (a) Berceuse de Jocelyn (Godard), (b) Serenade (Drdla); In the Second Interval, Violin Solos, (a) Madrigale (Simonelli), (b) Mazurka Op. 50, No. 2 (Chopin). **9.0,** Review of the Week. **9.50.** News. **9.55,** Calendar and Programme Announcements. **10.0** (approx.), Close Down.

OSLO (497 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres). **5.0,** Programme for Children. **6.15,** Weather Report and News. **6.30,** M. Johs. Löken, Talk: Shoes and the Shoemaker in Olden Times. **7.0,** Time Signal. **7.2,** Orchestral Concert: Military March (Lundvall); Selection from The Gipsy Princess (Kálmán); Clair de Lune (McDonald); Carmencita (Ancel); La paix du soir (Melling); Feuillet d'album (Melling); Rose Marie; Un Soir d'été à Aalesund (Bolstad); Waltz, Frühlingsstimmen (Strauss); Dance of the Cossacks (Gilbert); Intermezzo and Barcarolle from The Tales of Hoffmann (Offenbach); Humorous Variations on A Carnival in Venice (Ritzau). **8.30,** Weather Report and News. **8.45,** Topical Talk. **9.0,** Gramophone Selections of Dance Music. **9.45,** Popular Songs by "The Three Black Cat Singers." **10.15** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres); 5 kW.—**5.0,** Pasdeloup Concert. **7.10,** Weather Report. **7.20,** "Le Journal Parlé." **8.50** (approx.), Close Down.

PARIS (Petit Parisien), (336 metres); 0.5 kW.—**8.45,** Gramophone Selections, followed by Talk and News. **9.0,** Concert: Overture to Mignon (Thomas); Selection from Coppélia (Delibes). **9.25,** News and Announcements. **9.30,** Symphony Concert: Finale from the Fourth Symphony in E Flat (Glazounoff); Nocturne Op. 15 (Chopin); Tarantella Op 3. (Chopin). **10.0,** News and Concert: Symphonic Poem, Vitava (Smetana); Burlesque Serenade (Schmitt); Hungarian Dance.

PARIS (Radio Paris), Call CFR (1,769 metres); 15 kW.—**12.30,** Concert of Dance Music. In the Interval: News. **2.0,** Exchange Quotations, Market Prices and Religious Information. **3.30,** Exchange Quotations and Market Prices. **3.45,** Dance Music by the Joss Ghisiery Symphonians. **4.50,** Exchange Quotations, Market Prices, News and Announcements. **6.30,** Agricultural Report and New York Exchange Rates. **6.45,** Programme of Gramophone Selections: Le tambour de Beçon (Borel-Clerc); Together (De Sylvia-Brown-Henderson); Soprano Air from La Périchole (Offenbach), by Mlle. Jane Cros; Tenor Solo from Werther (Massenet), by M. Villabella; 'Cello Solo from Werther (Massenet), by M. Boulme; Neapolitan Song, O sole mio (Di Capua), by Ballarini (Baritone); Danse Macabre (Saint-Saëns); 'Cello Solo, Le Cygne (Saint-Saëns), by M. Lopes. **7.30,** Pianoforte Lesson by M. Lucas. **8.0,** M. Jacques Sicre, Talk: The Dances of Cambodia, followed by Exchange Quotations, Market Prices and News. **8.15,** Symphony Concert organised by "Le Matin" with Vocal Selections by Mme. Andrée Gerard. In the Intervals News.

POSEN (336.3 metres); 1.5 kW.—**4.15,** Talk on Scouts. **4.30,** English Lesson. **4.55,** Programme from **Cracow.** **5.50,** News from the Universal Exhibition of Home Industries. **6.15,** Vocal Concert: Air from Copiana (Zelensky); Serenade and Month of May (Gall); Spirito santo (Loewe); The Bird of Passage and Song of Farewell (Moniuszko). **6.45,** Programme for Women. **7.0,** Miscellaneous Items. **7.30,** "Gasparone": Operetta (Millöcker), relayed from the Municipal Theatre, Bydgoszcz. **9.0,** Time Signal and News. **9.30,** Cabaret Entertainment. **11.0,** Concert arranged by the Maison Philips. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (343 metres); 5 kW.—**4.30,** Dr. Fischer, Talk: Goethe's Faust. **4.50,** Agricultural Report. **5.0,** German Transmission: News and Talk: "Dialogue and The Art of Speaking." **6.0,** Time Signal and News. **6.5,** Talk on Dances of Old Prague. **6.30,** "Lilac Time": Operetta (Schubert-Berté), relayed from the National Theatre, **Bratislava** (278 metres). **9.0,** Time Signal, News and Theatre Notes. **9.25,** Dance Music. **10.0,** Time Signal.

RIGA (528 metres); 4 kW.—**3.0,** Programme of Gramophone Records. **4.0,** Programme of Talks. **5.30,** French Lesson. **6.0,** Orchestral Concert under the direction of M. A. Parups, followed by News. **9.0,** Weather Report. **9.30,** Concert from the Café de l'Opera.

ROME, Call 1RO (443.8 metres); 3 kW.—**6.50,** Topical Talk, Sports Notes, News, Exchange Quotations and Weather Report. **7.29,** Time Signal and Report of the International Labour Office, Geneva. **7.45,** "The Daughter of the Regiment": Opera (Donizetti). In the Intervals: Topical Talk, Fashion Review and Talk: The World of Literature and Art. **9.50,** Topical Talk, News and Close Down.

STAMBOUL (1,200 metres); 5 kW.—**5.0,** Concert of Turkish Music. **7.40,** Orchestral Concert: Dance from The Bride of Kashmir (Rubinstein); Romance sans paroles (Rebikoff); Potpourri, Eine Ballnacht (Strauss); Rêverie interrompue (Tchaikovsky); Scènes pittoresques (Massenet). **9.30.** News and Close Down.

STUTTGART (374.1 metres); 4 kW.—**1.0,** Programme for Children by Elsa Pfeiffer, Karl Köstlin and the Station Orchestra. **2.0,** Concert of Airs and Duets. **3.30,** Concert of Dance Music from the Cafaso Café, **Mannheim.** **5.0,** Time Signal and Weather Report. **5.15,** Herr L. Leibfried, Talk: The Bill of Exchange and the Cheque from the Legal Point of View. **5.45,** Herr Schwaebsch, Talk: Trade-marks and Patents as Factors in Economic Competition. **6.15,** Dr. Wolf, Lesson in Book-keeping. **6.45,** Time Signal and Sports Notes. **7.0,** Symphony Concert relayed from **Basle** (1,034 metres): Overture to Egmont (Beethoven); Piano Sonata, arranged for Orchestra (Beethoven); Violin Concerto in C Major (Weingartner); Symphonic Poem, Tasso (Liszt). **9.0,** "The Discovery of Mars"—Farce (Carl Struve); followed by News and Dance Music.

VIENNA (520 metres); 15 kW.—**2.0,** Phototelegraphy Transmission. **2.30,** "The Care-free Miller"—Fairy Play for Children from a Swedish Source (Elizabeth Boehmer v. Brandis). **3.30,** Talk on Dramatic Music by Dr. Rinaldini. **4.0,** Franz Adamus (Ferdinand Bronner) in Selections from his own Works. **4.45,** Concert of Chamber Music from the Works of Mendelssohn: Trio for Violin, 'Cello and Pianoforte in D Minor; Pianoforte Solo from the Songs without Words; Hear, Oh Israel! from Elijah. **5.30,** Prof. Wilhelm Neumann, Talk: German Culture in France. **6.0,** Dr. Leo Klemensiewicz, Talk: The Austrian Week. **6.15,** Karl E. Baumgärtl in Selections from his own Works. **7.10,** Time Signal and Weather Report. **7.15,** "Die Frau ohne Kuss"—Musical Comedy (Kollo), followed by Phototelegraphy Transmission.

VILNA (426.7 metres); 1.5 kW.—**3.35,** Talk. **4.0,** Mlle. H. Falewicz-Sztukowska, Talk: Prison Life. **4.25,** Recital of Soprano Songs by Mme. Helene Dal. **4.55,** Programme for Children, relayed from **Cracow.** **5.50,** Topical Talk. **6.10,** Programme relayed from **Warsaw.** **6.35,** News and Time Signal. **7.0,** Humorous Selections by Mr. Leon Wollejko. **7.30,** Programme relayed from **Warsaw.** **10.30** (approx.), Close Down.

WARSAW (1,385.7 metres); 10 kW.—**4.0,** Talk. **4.25,** Talk by Dr. M. Henzel. **4.55,** Programme for Children, relayed from **Cracow.** **5.50,** Miscellaneous Items. **6.10,** "Radio-Chronique" by Dr. M. Stepovsky. **6.35** News. **6.56,** Time Signal. **7.30,** "The Circus Princess"—Operetta in Three Acts (Kálmán). In the Interval, Theatre Notes. **9.0,** Weather Report. News, Police Announcements and Sports Notes. **9.30,** Dance Music from the Oaza Restaurant. **10.30** (approx.), Close Down.

ZURICH (489 metres); 1 kW.—**6.17,** "Die Alpenrose" Songs and Recitations (Krenger). **7.15,** Selections by Mandoline Orchestra. **8.0,** Concert by the Jodel Double Quartet. **9.0,** Weather Report and News. **9.10,** Gramophone Selections of Dance Music.

Programmes from Abroad.—

ALGIERS, Call PTT (353 metres); 1 kW.—12.30, Concert of Instrumental Music. The Wireless Orchestra conducted by C. Cerlini. 'Cello Solo by M. J. Ortiz.

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—11.0 a.m., Chimes relayed from the Barcelona Cathedral. 11.5 a.m., Weather Report from the Provincial Service, with Aviation Route Report. 1.30, Light Music by the Iberia Trio with Gramophone Records in the intervals. 2.45 to 6.0, No Transmission. 6.0, Opening Signal and Exchange Quotations and Market Report. 6.10, Concert by the Barcelona Wireless Orchestra, with Vocalists. Tenor Solos by Señor Jose Bruna. 8.20, Orchestral Concert. 8.40, Sports News. 9.0 (approx.), Close Down.

BASLE (1,034 metres); 0.25 kW.—6.30, Time Signal and Weather Report and Forecast. 6.35, Readings by Bertel Seiler Bihler. 7.15, Concert or Play. 9.0, Late News Bulletin and Weather Report. 9.30 (approx.), Close Down.

BERGEN (365.9 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, Concert by the Bergen Station Orchestra. 6.30, "The Barber of Seville," Opera by Rossini. 9.0, Weather Report and Forecast, Late News Bulletin and Time Signal. 9.15, Popular Dance Music. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1648.3 metres); 40 kW.—7.55 a.m., Chimes relayed from the Garrison Church at Potsdam. 8.0 a.m., Concert with Address relayed from **Voxhaus,** and followed by Berlin Cathedral Chimes. 10.30 a.m., Concert relayed from **Voxhaus.** 12.45 to 1.15, Experimental Picture Transmission. 1.30 to 2.25, Three Agricultural Talks from **Voxhaus.** 2.30, Reading. 3.0, Talk. 3.30, Concert. 4.0, Relay of Carnival Programme from **Cologne.** 7.0, Concert or Play, followed by News from the Press and Dance Music. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475 metres); 4 kW.—7.55 a.m., Garrison Church Chimes from Potsdam. 8.0 a.m., Recital of Vocal and Instrumental Music and Address in the interval, followed by Chimes from Berlin Cathedral. 10.30 a.m., Musical Programme. 1.30 to 2.25, Three Talks for Farmers. 2.30, Children's Stories. 3.0, Talk. 3.30, Orchestral Selection. 4.0, Carnival Programme relayed from **Cologne.** 7.0, (approx.), Concert or Play followed by Weather Report and Late News Bulletin, Time Signal and Sports Results. 9.30, Dance Music. 11.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—9.30 a.m. to 10.30 a.m., Catholic Sermon. 12.0 Noon, Time Signal and Weather Report. 12.5, Orchestral Concert. 2.0, Concert. 6.29, Time Signal, Weather Report and Football News. 7.0, Carnival Revue. 8.45, Sports Notes, Late News Bulletin and Weather Report and Forecast 9.0, The Kursaal Orchestra, in Selections of Light Music. 9.35 (approx.), Close Down.

BRESLAU (321.2 metres); 4 kW.—Programme relayed by **Gleiwitz** (326.4 metres).—8.15 a.m., Christ Church Chimes. 11.0 a.m. (approx.), Programme of Music. 7.15, Carnival Evening with Selections by Robert Koppel. 9.0, Weather Report and Forecast and Late News Bulletin, followed by Dance Music. 11.0 (approx.), Close Down.

BRÜNN (432 metres); 2.5 kW.—8.0 a.m., Sacred Concert. 9.0 a.m., Talk for Farmers. 9.30 a.m., Agricultural Report. 3.30, Popular Concert. 4.30, Relay from Prague. Lecture for Workers. 5.0, Transmission for German Listeners. 6.0 (approx.), Concert. 9.20, Light Music. 10.30 (approx.), Close Down.

BRUSSELS (512 metres); 1.5 kW.—5.0, Programme relayed from the Armenonville Tea Rooms. 6.0, Children's Corner, under the auspices of the Théâtre des Enfants, and conducted by M. Léon Leroy. 6.30, Concert by the Wireless Trio. 7.30, "La Radio Chronique." 8.15, Concert or Operatic Relay, followed by Late News from the evening papers. 11.0 (approx.), Close Down.

BUDAPEST (555.5 metres); 20 kW.—8.0 a.m., News from the Press and Talk for Women. 9.0 a.m., Relay of Church Service. 2.30, Talk for Farmers. 9.30, Relay of Programme by Tzigane Orchestra.

COLOGNE (263.2 metres); 4 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Langenberg** (462.2 metres) and **Münster** (265.5 metres).—6.45 a.m., Boxing Lesson by Dr. Ludwig Bach. 7.5 a.m., German Shorthand Instruction by Hans Molitor. 7.25 a.m., Lesson in Esperanto by Alfred Dormanns. 7.45 a.m. to 7.55 a.m., Comments on the Week's

SUNDAY, FEBRUARY 10th.

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Programmes (in Esperanto) by Alfred Dormanns. 8.0 a.m., Church Chimes. 8.5 a.m., Recital of Music, with Address in the interval. 12.0 Noon, Orchestral Concert. 5.30, Talk on "How Animals find their Way." 7.0, Carnival Ball, under the direction of Herr Kühn. Old and Modern Dances, with Musical Comedy in the Interval, followed by General News Bulletin, Sports Notes and Light and Dance Music. 11.0, (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—8.30, Vocal and Instrumental Concert. 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 10.30 a.m., Relay of Cathedral Service from **Vilna.** 10.30 a.m. to 1.30, Relay of Proceedings at the International Ski-ing Contests at Zakopane: Resumée of Events during the previous days; Running Commentary; Speech by the President of the Polish Ski-ing Federation; Singing of the Polish National Anthem; Announcement of Results and Speeches by the Polish and Foreign Competitors. 2.10, Weather Report and Forecast. 2.15, Philharmonic Concert relayed from **Warsaw.** 6.0, Variety. 6.20, Talk. 6.56, Time Signal, relayed from the Observatory. 7.0, Fanfare relayed from the Church of Notre Dame. 7.15, Sports News. 7.30, Vocal and Instrumental Concert. 9.0, Programme relayed from **Warsaw.** 9.30, Light Music by the Orchestra at the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—8.30, Concert Programme relayed from **Cork**; Concert of Vocal and Instrumental Music. 11.0, National Anthem and Weather Report and Forecast. 11.15 (approx.), Close Down.

FRANKFURT (421.3 metres); 4 kW.—Programme relayed by **Cassel** (252.1 metres).—7.30 a.m. to 8.30 a.m., Concert of Sacred Music with Address. 11.0 a.m., Musical Programme. 7.30 (approx.), Programme of Music or Literature, followed by Dance Music. 11.30 (approx.), Close Down.

GENEVA (760 metres); 1.5 kW.—9.0 a.m., Morning Service and Address relayed from the Victoria Hall. 2.0, Concert arranged by Philips Lamps, Geneva, relayed from the Plainpalais Hall: Selections by the Orchestra under the direction of M. Fernand Closset; Schéhérazade, Symphonic Suite (Rimsky-Korsakoff), (a) La mer et le vaisseau de Sindbad, (b) Le récit du prince Kalender, (c) Le jeune prince et la jeune princesse, (d) Fête à Bagdad, La mer, Le vaisseau sombre sur un écueil présentant l'aspect d'un guerrier d'airain. 7.15, Talk or Musical Programme. 8.0, Recital of Music. 9.30 (approx.), Close Down.

HAMBURG, Call HA (in Morse) (392 metres); 4 kW.—Programme relayed by **Bremen** (273 metres), **Flensburg** (219 metres), **Hanover** (566 metres), and **Kiel** (250 metres).—7.20 a.m., Time Signal. 7.25 a.m., Weather Report and Forecast followed by General News Bulletin. 7.40 a.m., To-day's Problems in Industry. 8.0 a.m., Law Talk. 8.15 a.m., Concert. 10.0 a.m., Talk. 11.55 a.m., Relay of the Time Signal from **Nauen.** 12.05 (For **Flensburg, Hamburg** and **Kiel**): Concert. 12.05 (For **Bremen**): Musical Programme. 12.05 (For **Hanover**): Gramophone Records. 1.0, Funkheinzelmann's Entertainment for Children. 6.0, Talk. 6.30, Talk arranged by the School of Physical Training. 6.40, Sports Results. 6.55, Weather Report and Forecast. 7.0, Concert or Dramatic Programme. 10.50 (For **Hamburg, Bremen, Flensburg** and **Kiel**): Weather Report and Forecast, for the North Sea and Baltic. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—11.40 a.m., Hints for the Chess Player by Mr. S. Davidson. 12.10, The Wireless Trio in Musical Selections. 1.40, Talk or Music. 3.10, Concert by the Hilversum Station Orchestra conducted by Nico Treep. 7.40, Time Signal and General News Bulletin. 7.50, Concert. 11.10 (approx.), Close Down.

HUIZEN (336.3 metres); 4 kW.—Transmits from 5.40 on 1,852 metres.—8.5 a.m., Religious Address. 9.30 a.m., Relay of Morning Service from **Halfweg,** with Sermon by the Minister, the Rev. E. A. Groenewegen, on the text St. Matthew VII, verses 24–27. At the Organ: G. Kampen-Verhoog. 12.10, Programme by the K.R.O. Trio. 1.10, Talk. 1.40, Talk. 5.20, Relay (on 1,852 metres) of Evening Service. 10.25, Choral Epilogue. 10.40 (approx.), Close Down.

JUAN-LES-PINS (Radio L.L.) (245 metres); 1.5 kW.—1.0, Concert by the Orchestra. 2.0 to 8.30, No Transmission. 8.30, General News Bulletin and Sports Notes. 8.45, Programme of Popular Gramophone Records. 10.30 (approx.), Close Down.

KALUNDBORG (1153.8 metres); 7 kW.—Programme also for **Copenhagen** (339.8 metres).—9.0 a.m., Morning Service relayed from **Copenhagen.** 10.30 a.m. to 10.40 a.m. (**Kalundborg** only): Weather Report and Forecast from the **Copenhagen** Meteorological Institute. 1.0, Relay of Divine Service from **Copenhagen.** 2.30, Orchestral Concert. 5.50 (**Kalundborg** only): Weather Report from the **Copenhagen** Meteorological Institute. 6.0, News from the Press. 6.15, Time Signal. 6.30, Talk. 7.0, Town Hall Chimes relayed from **Copenhagen.** 7.2, Concert. 9.15, Relay of Foreign Stations. In the interval at 11.0, Town Hall Chimes relayed from **Copenhagen.** 11.30 (approx.), Close Down.

KATTOWITZ (416.1 metres); 10 kW.—2.15, Symphony Concert relayed from **Warsaw.** Artistes: The Philharmonic Orchestra conducted by B. Szulc, J. Turczynska (soprano): and R. Lanes ('cello). 6.0, Announcements. 6.20, Talk. 6.56, Time Signal. 7.0, Talk. 7.30, Concert. 9.0, Weather Report, Press News and Sports Results. 9.30, Dance Music. 10.30 (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—2.30, Children's Corner. Songs and Stories. 3.0, Young People's Half-hour. 3.30, Health Talk by Doctor Jurgelionis. 4.0, J. Ardickas, Talk: Economics in Daily Life. 4.55, Weather Report and Forecast and News from the Press. 5.0, Vilna Half-hour. Talks in Lithuanian and Polish. 6.0, O. Masiotiene, Talk: Woman and the Home. 6.30, Evening Concert. 8.30 (approx.), Close Down.

KÖNIGSBERG (280.4 metres); 4 kW.—Programme relayed by **Danzig** (456 metres).—8.0 a.m., Morning Concert of Choral and Instrumental Selections, with Address in the interval. 9.56 a.m. (**Danzig** only), Weather Report and Forecast. 10.0 a.m. (**Königsberg** only), Weather Report. 10.05 a.m., Recital of Music. 11.55 a.m., International Time Signal, relayed from **Nauen,** followed by Weather Report and Forecast. 12.0 Noon, Programme relayed from the Central Hotel, Königsberg. Selections by the Scheffler Orchestra. 1.0, P. S. Leonhardt: Hints for Chess Players. 7.0, "Liebe im Schnee"—Operetta in Three Acts by Ralph Benatzky and Willy Prager. Libretto by Ralph Benatzky. Produced by Kurt Lesing and under the musical direction of Karl Hrubetz. Followed by Late News Bulletin and Sports News. 9.30, Orchestral Programme. 11.0 (approx.), Close Down.

LAHTI (1,504 metres); 35 kW.—Programme also for **Helsingfors** (374 metres).—7.0 a.m., Relay of Morning Service (in Finnish). 9.50 a.m., News from the Press. 10.5 a.m., Orchestral Concert. 10.50 a.m., Weather Report and Time Signal. 11.0 a.m., Relay of Divine Service (in Swedish). 4.57, Time Signal and Weather Report. 5.10, History Talk. 5.40, Concert. 7.0, Pianoforte Recital by Hedwig Rotkirch and Ann-Marie Jägerskiöld. 7.45, Late News Bulletin given in Finnish. 8.0, Late News Bulletin in Swedish. 8.30 (approx.), Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres) and **Münster** (265.5 metres).—6.45 a.m., The Art of Self Defence by Dr. Ludwig Bach. 7.5 a.m., German Shorthand, instruction by Hans Molitor. 7.25 a.m., Esperanto Lesson by Alfred Dormanns. 7.45 a.m. to 7.55 a.m., Programme Notes in Esperanto by Alfred Dormanns. 8.0 a.m., Relay of Chimes. 8.5 a.m., Recital of Choral and Instrumental Music. Address in the interval. 12.0 Noon, Concert of Orchestral Music, directed by Herr Eysoldt. 4.0, Programme relayed from **Cologne.** Carnival Procession. 5.30, Doctor Harnisch, Talk: "How Animals find their Way." 7.0 (approx.), Musical Programme, followed by Late News Bulletin, Sports Notes and Light and Dance Music. 11.0 (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—Programme relayed by **Dresden** (276 metres). 7.30 a.m., Organ Recital. 8.0 a.m., Vocal and Instrumental Programme. 10.0 a.m., Talk. 3.0, Literary or Dramatic Programme. 5.30, Talk. 6.0, Talk. 6.30, Programme relayed from the Staatsoper, **Dresden**: (a) I Pagliacci (Leoncavallo) and (b) Cavalleria Rusticana (Mascagni). 9.0, Late News Bulletin and Sports News. 9.30, Dance Music relayed from **Berlin.** 11.30 (approx.), Close Down.

Sunday, February 10th.

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

Programmes from Abroad.—

LYONS (Radio Lyon) (**291 metres**) ; 1.5 kW.—**7.30,** "Le Journal Parlé," with General News Bulletin, News from the Press and Announcements. **8.0,** Instrumental Concert, with the collaboration of Madame Ducharne (pianoforte) of the Lyons Conservatoire; Monsieur Camand (violin), and M. Testanière ('cello). **10.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**427 metres**) ; 3 kW. — Programme relayed by **Salamanca** (EAJ22) (455.9 metres).—**2.0,** Relay of Chimes, followed by Time Signal. **2.5,** Concert by the Union Radio Orchestra. **3.30 to 7.0,** No Transmission. **7.0,** Relay of Chimes. **7.5,** Popular Dance Tunes. **8.0,** Descriptions of Famous Journeys. **8.30 to 10.0,** No Transmission. **10.0,** Chimes and Time Signal. **10.5,** Popular Concert by the Station Orchestra, with Songs by Luisa Osma (Soprano) and Jose Angerri (Baritone). **12.0 Midnight,** Relay of Dance Music by the Palermo Orchestra, playing at the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, 1MI (**504.2 metres**) ; 7 kW.—**9.0 a.m.,** Opening Signal, followed by Lesson in English. **9.30 a.m. to 10.15 a.m.,** Vocal and Instrumental Concert of Sacred Music. **11.30 a.m.,** Time Signal. **11.32 a.m.,** The Wireless Quartet. **3.0,** Opening Signal and Variety Concert by the Wireless Quintet. **4.15,** Concert by the Tzigane Orchestra, playing at the Fiaschetteria Toscana. **5.0 to 7.5,** No Transmission. **7.5,** Opening Signal and News. **7.15,** History Talk. **7.25,** Sports Notes. **7.30,** Time Signal. **7.35,** Relay of the Opera "Orfeo," by Gluck. At the end of Act One: Talk by Ulderico Tegani on "Town and Country." At the end of Act Two: Sports Results and News from the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (**1,365 metres**) ; 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Hörby** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.5 metres).—**10.0 a.m.,** Relay of Morning Service from **Stockholm. 3.0,** Children's Corner. **4.0,** Relay of Evening Service from **Stockholm. 4.55,** Relay of Carillon from the Town Hall at **Stockholm. 5.0,** "Wallenstein," Drama by Schiller. **8.15,** Late News Bulletin and Weather Report and Forecast. **8.40,** Instrumental Concert. **10.0** (approx.), Close Down.

MUNICH (**536.7 metres**) ; 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres) and **Nuremberg** (240 metres).—**10.0 a.m.,** Relay of the Town Hall Chimes. **10.10 a.m.,** Transmission of the Wireless Weather Chart for Bavaria, followed by Time Signal and Weather Forecast. **7.5,** Relay of Munich Carnival. **9.30,** Late News Bulletin. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333 metres**) ; 1.5 kW.—**8.30 a.m.,** French Lesson by Professor Etienne Verdier. **9.0 a.m.,** Sacred Recital. **3.45,** Children's Corner. **4.0,** Concert. **4.30,** Time Signal. **7.30,** Topical Notes. **7.55,** Naples Harbour Report. **8.0,** Time Signal. **8.02,** Operatic Concert: "Sei vendicata assai" from Diuorah (Meyerbeer), Sung by Raffaele Aulicino (baritone) with pianoforte accompaniment. **9.0,** Sports News. **9.5,** Calendar and Announcements on To-morrow's programmes. **10.0** (approx.), Close Down.

OSLO (**497 metres**) ; 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**9.50 a.m.,** Carillon. **10.0 a.m.,** Relay of Morning Service from the Garrison Church. **6.15,** Weather Report and Press News. **8.30,** Weather Report and Forecast and News from the Press. **8.45,** Talk by a Journalist on a current topic. **9.15** (approx.), Dance Music. **11.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**1,488 metres**) ; 5 kW.—**7.56 a.m.,** Time Signal on 32.5 metres. **9.26 a.m.,** Time Signal on 1,488 metres. **5.0,** Relay of Pasdeloup Concert. **7.10 to 7.20,** Weather Report and Forecast. **7.20,** Le Journal Parlé with Talks by regular contributors, including Police Memoirs by Detective Ashelbé. **7.56,** Time Signal on 32.5 metres. **8.0 to 8.50,** Instrumental Concert. The Orchestra, Suite funambulesque (Busser). **10.26,** Time Signal on 1,488 metres.

PARIS (Petit Parisien) (**336 metres**) ; 0.5 kW.—**8.45,** Gramophone Records. **8.50,** Talk. **8.55,** Press News. **9.0,** Concert by well-known artistes from the Opéra and Opéra-Comique. **9.25,** General News Bulletin. **9.30,** The Symphony Half Hour. **10.0,** Late News Bulletin. **10.15,** Orchestral Concert, Orchestral Suite, No. 2, by Guiraud. **11.0** (approx.), Close Down.

PARIS (Radio L.L.) (**370 metres**) ; 1 kW.—**12.30,** Transmission arranged by Radio Liberté with Topical Talk, News and Announcements and Instrumental and Vocal Concert: Solos by Charles Séringes (Violinist), Edouard Flament (Pianist) and M. Bergmann ('Cellist). **1.0,** Carillon de Fontenay. **2.30,** Report of the "Radio Agricole Française." **3.0,** Selections of Popular Dance Music arranged by "Les Etablissements Radio L.L." **9.0,** Concert arranged by the "Journal des Débats." Songs by Madame Decrais Lamgée of the Opéra-Comique, accompanied on the piano by the composer, André Birabeau. **10.0,** Carillon de Fontenay. **10.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (**1,769 metres**) ; 15 kW.—**8.0 a.m.,** General News Bulletin and Press Review. **8.30 a.m.,** Physical Instruction by Doctor Diffre. **12.0 Noon,** Religious Talk and Recital of Instrumental and Choral Sacred Music. **12.30,** News from the Press. **12.45,** Musical Selections by the Albert Locatelli Orchestra with Selection by Bilboquet in the interval. **4.30,** Gramophone Concert arranged by "L'Industrie Musicale." with News in the interval. **6.30,** Agricultural Notes. **6.45,** The Pathé Half Hour. **7.30,** Press News. **7.45,** The Radio Paris Circus. **8.15,** Concert. **9.30,** Programme by Mario Cazes and his Orchestra. Late News Bulletin in the intervals **10.30** (approx.), Close Down.

PITTSBURGH, Call KDKA (**63 and 27 metres**) ; 25 kW.—**4.0,** Sessions Clock Chimes and Church Service. **7.0,** The Roxy Symphony Concert, relayed from **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 by the Orchestra at the William Penn Hotel, Pittsburgh. **11.30,** Concert by the Whittall Anglo-Persians, relayed from **New York. 12.0 Midnight,** Sessions Clock Chimes, followed by Service at the Calvary Protestant Episcopal Church at **Pittsburgh,** with Sermon by the Minister, the Rev. E. J. Van Etten. **1.0 a.m.** (Monday), Enna Jettick Melodies, relayed from **New York. 1.15 a.m.,** Collier's Radio Hour, relayed from **New York. 2.15 a.m.,** Programme by the Utica Jubilee Singers, relayed from **New York. 2.45 a.m.,** El Tango Romantico, relayed from **New York. 3.15 a.m.,** Longine Time from **New York. 3.30 a.m.** (approx.), Close Down.

POSEN (**336.3 metres**) ; 1.5 kW.—**9.15 a.m. to 10.45 a.m.,** Relay of Cathedral Service. **10.30 a.m.,** Programme relayed from **Warsaw.** Broadcasting of proceedings at the International Ski-ing Contests at Zakopane: Summary of preceding days' events and Running Commentary on the contests of the day; Address by the President of the Polish Ski-ing Federation; Singing of the Polish National Anthem; Announcement of Results and short speeches by Polish and Foreign Competitors. **2.15,** Relay of Warsaw Philharmonic Symphony Concert. **4.30,** Talk by Mr. Winiewicz. **4.50,** Children's Corner. **5.20,** Instrumental Concert. **6.0,** Transmission arranged by the League of Polish Youth. **6.20,** Talk relayed from **Warsaw. 6.45,** Talk. **7.30,** Concert relayed from **Warsaw.** In the interval from **8.0 to 8.15,** Literary Selection. **9.0,** Time Signal. **9.5,** Late News Bulletin. **9.20,** Dancing Lesson, conducted by Mr. Starski. **9.40,** Outside relay of Dance Music. **11.0** (approx.), Close Down.

PRAGUE (**343 metres**) ; 5 kW.—**8.0 a.m.,** Sacred Recital. **9.0 a.m. and 9.30 a.m.,** Agricultural Talks. **12.0 Noon,** Commercial Notes. **12.15,** Sociological Talk. **3.30,** Light Music. **4.30,** Talk for Workers. **5.0,** Transmission in German. News and Concert. **6.30,** Concert. **9.0,** Time Signal and Late News Bulletin. **9.15** Theatre Notes. **9.20,** Musical Programme. **10.30** (approx.), Close Down.

ROME, Call 1RO (**443.8 metres**) ; 3 kW.—**8.30 a.m.,** Opening Signal. **8.32 a.m.,** German Lesson. **9.0 a.m.,** Sacred Vocal and Instrumental Recital. **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,** Variety Concert. **6.50,** News and Agricultural Notes. **7.15,** Sports Results and Notices. **7.29,** Time Signal. **7.31 to 7.40,** Topical Notes. **7.45,** Il Marchese del Grillo, Operetta in Three Acts. Libretto by Mascetti. **9.50,** Late News Bulletin. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (**19.56 metres**) ; 30 kW.—**3.30,** Relay of Church Service. **6.30,** The Peerless Reproducers in their Repertoire, relayed from New York. **8.30,** Organ Recital, relayed from the Union College Memorial Chapel, **Schenectady, N.Y.** Organist: Elmer A. Tidmarsh. **9.0,** Talk arranged by the Y.M.C.A. Speaker: Doctor S. Parkes Cadman. Relayed from **New York. 10.30.** Violin Recital by Arcadie Birkenholz, relayed from **New York. 11.0,** Concert by the American Legion Band, relayed from **Boston, Mass. 11.30,** The Acousticon Half-hour from **New York. 12.0 Midnight,** The Old Company's Programme with Baritone Songs by Reginald Werrenrath, relayed from **New York. 12.30 a.m.** (Monday), Relay of Capitol Theatre Programme from **New York. 2.0 a.m.,** Talk relayed from **Washington, D.C.,** David Lawrence, Editor of "The United States Daily": The American Government. **2.15 a.m.,** The Atwater Kent Hour from **New York. 3.15 a.m.,** Correct Time. **3.16 a.m.,** Relay of Performance by 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.

STAMBOUL (**1,200 metres**) ; 5 kW.—**5.0,** Concert of Turkish Music. **7.0,** Concert of Orchestral Music. **9.30,** Late News Bulletin and Announcements. **9.45** (approx.), Close Down.

STUTTGART (**374.1 metres**) ; 4 kW.—Programme relayed by **Freiburg** (577 metres).—**10.15 a.m.,** Morning Recital of Vocal and Instrumental Items, followed by Musical Selections. **1.0,** Funkheinzelmann's Programme for Children. **2.0,** Talk. **2.30,** Concert. **4.0,** Carnival Programme relayed from **Cologne. 7.0** (approx.), Concert or Play followed by Late News Bulletin and Sports News. **9.30** (approx.), Light Music. **10.30** (approx.), Close Down.

TALLINN (**408 metres**) ; 2.2 kW.—**8.30 a.m.** (approx.), Relay of Morning Service. **12.30,** Concert by the Station Orchestra. **1.30,** Agricultural Talk. **5.15,** Press News. **7.0,** Concert. **9.0** (approx.), Close Down.

VIENNA (**520 metres**) ; 15 kW.—Programme relayed by **Graz** (354.2 metres), **Innsbruck** (455.9 metres), **Klagenfurt** (455.9 metres), and **Linz** (250 metres).—**9.20 a.m.,** Programme of Music. **2.15,** Experimental Transmission of Pictures. **6.30,** Concert of Vocal and Instrumental Viennese Music. **7.0,** Time Signal followed by Weather Report and Forecast. **7.5,** Play, followed by Dance Music and Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

VILNA (**426.7 metres**) ; 1.5 kW.—**9.10 a.m. to 10.45 a.m.,** Relay of Cathedral Service. **10.56 a.m. to 4.30,** Programme from **Warsaw. 2.15,** Relay of **Warsaw** Philharmonic Symphony Concert, Soprano and 'Cello Solos. **4.55,** Talk relayed from **Warsaw. 5.20,** Musical Programme. **6.20,** Talk relayed from **Warsaw. 6.45.** Late News Bulletin. **7.30,** Concert. **9.0,** Aviation Route Report and Weather Forecast and Late News Bulletin relayed from **Warsaw. 9.30,** Relay of Dance Music from the "Oaza" Restaurant, **Warsaw. 10.30** (approx.), Close Down.

WARSAW (**1385.7 metres**) ; 10 kW.—**9.15 a.m. to 10.30 a.m.,** Relay of Cathedral Service. **10.30 a.m. to 1.30,** Relay of Events at the Ski-ing Contests at Zakopane arranged by the International Federation: Programme including a Running Commentary, Speeches by the President of the Polish Ski-ing Federation and Polish and Foreign Competitors, and Announcement of Results. **2.15,** Symphony Concert by the Philharmonic Orchestra with Vocal and Instrumental Solos. **4.30,** Talk. **4.55,** Talk. **5.20,** Popular Concert. **6.0,** Twenty Minutes Variety. **6.20,** Professor B. Richter continues his series of Talks on "The Land of the Sphinx and the Pyramids." **6.45,** General News Bulletin. **6.56,** Time Signal. **7.0 to 7.25,** Lieut. C. Jablonowski, "Distractions intellectuelles." **7.30,** Concert. **9.0,** Aviation and Weather Report and Forecast. **9.5,** Late News Bulletin. **9.20,** Police Notices and Sports Results. **9.30,** Dance Music by the Orchestra at the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (**308.3 metres**) ; 0.7 kW.—**10.30 a.m.,** Concert of Orchestral Selections. **4.0,** Popular Dance Music. **5.30,** Travel Talk. **6.45,** Talk. **7.0,** Relay of an Opera from the Zagreb National Theatre. In the interval at **8.50** (approx.), Late News from the Press and Weather Report and Forecast. **10.0** (approx.), Close Down.

ZÜRICH (**489 metres**) ; 1 kW.—**10.0 a.m.,** Concert by the Wireless Orchestra. **11.29 a.m.,** Time Signal and Weather Report and Forecast. **11.30 a.m.,** Popular Gramophone Records. **3.0,** Orchestral Concert relayed from the Carlton Elite Hotel. **6.30,** Time Signal followed by Weather Report. **6.33,** Protestant Address. **7.0,** Programme relayed from **Basle**: Tenor Solos by Joseph Cron. **7.30,** Concert. **9.0,** Weather Report and Late News Bulletin, and Communications from the Neue Züricher Zeitung. **9.40** (approx.), Close Down.

VALVES we have TESTED

The Mazda Series of 4-volt Valves.

WITH but one exception all valves in this series operate with a filament current of 0.075 ampere, the exception being the output valve, which requires a current of 0.15 amp. Although the current passed is less than in the case of the 2-volt series recently reviewed, the watts dissipated are actually greater, so it is only reasonable to expect that the 4-volt type should show a slightly better average efficiency than the 2-volt counterparts. By comparing the characteristics it will be seen that in general the 4-volt series all show slightly higher mutual conductances.

Although each valve has been designed to perform a specific function, certain types can be employed with advantage in more than one position in a receiver. The H.F.407 valve, for example, is primarily intended for use as an amplifier in neutralised H.F. circuits, but as this is a medium impedance valve its usefulness is not restricted to this position only, as with suitable coupling arrangements it can be employed as either a detector or a first stage L.F. amplifier.

H.F.407.
Characteristics at Zero Grid Bias and 100 Volts H.T.

H.F.407.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	18.0	21,000	0.85
Specimen 1 ..	20.8	21,800	0.95
Specimen 2 ..	20.8	22,700	0.92

Both specimens tested proved to have higher amplification factors than the maker's rating, but as these were accompanied by a slight increase in the A.C. resistances in both cases the mutual conductances were sensibly of the same order. Under normal operating conditions, particularly when used as an amplifier with 120 volts H.T. and −1.5 volts grid bias, the average values were found to be: Amplification factor 20 and the A.C. resistance 25,800 ohms, giving a mutual conductance of 0.78 mA. per volt.

R.C.407.
Characteristics at Zero Grid Bias and 100 Volts H.T

R.C.407.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	40	100,000	0.4
Specimen 1 ..	37	95,000	0.37
Specimen 2 ..	39	104,000	0.38

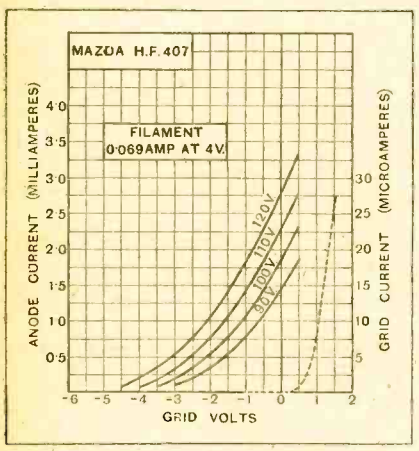
Should the H.F.407 be used as a grid detector it may be followed by either resistance-capacity coupling or a transformer. If the first-mentioned arrangement is adopted the anode resistance should be kept reasonably low; about 60,000 ohms would appear to be suitable, and the H.T. restricted to about 60 to 80 volts.

Grid current commences at 0.2 of a volt positive grid bias, and careful tests failed to reveal any trace of reversed grid current, showing that the vacuum is of a high order.

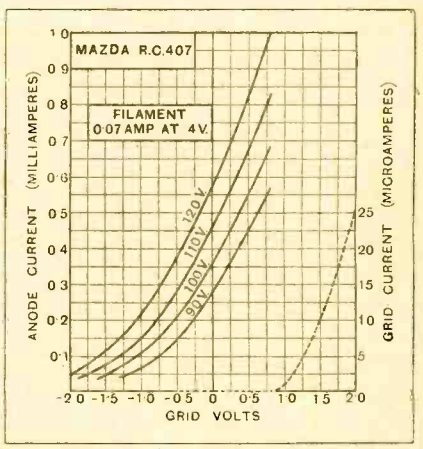
The particular function of the R.C.407 valve is that of an amplifier followed by resistance capacity coupling.

The measured amplification factors and A.C. resistances of the two specimens tested agreed reasonably well with the maker's rating, the mutual conductances in both cases being of the same order. Under normal operating conditions—that is to say, with 120 volts H.T. and zero grid bias—the amplification factor was found to be 36, the A.C. resistance 81,600 ohms, giving a mutual conductance of 0.44 mA. per volt.

The principal use to which a valve of these characteristics is put in the majority of modern sets is that of an anode-bend detector followed by a relatively high resistance in the anode circuit. The makers recommend a 2-megohm resistance for this



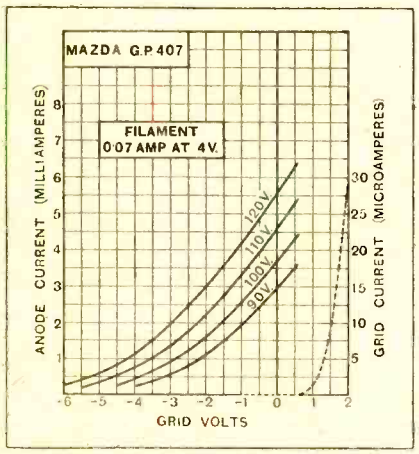
Average values under working conditions: A.C. resistance, 25,800 ohms; amplification factor, 20; mutual conductance, 0.78 mA/volt.



Average values under working conditions: A.C. resistance, 81,600 ohms; amplification factor, 36: mutual conductance, 0.44 mA/volt.

Valves We Have Tested.—

purpose, but as this demands a rather high battery voltage to compensate for the volts absorbed in the resistance, we think that in such cases, where the voltage of the H.T. battery



Average values under working conditions: A.C. resistance, 11,400 ohms; amplification factor, 13.3; mutual conductance, 1.17 mA/volt.

is below 150, it would be admissible to employ a lower value. It would not be advisable to reduce this below 0.5 megohm, as the A.C. resistance of the valve will rise considerably when it is biased sufficiently to bring the working point well down on the bend of the curve.

The specimens tested proved to be dead hard, not the slightest trace of reversed grid current being noticed. Grid current does not commence until 0.8 of a volt positive is applied to the grid, so that for amplification purposes the valve can be operated at

G.P.407.
Characteristics at Zero Grid Bias and 100 Volts H.T.

G.P.407.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	14.0	14,000	1.0
Specimen 1 ..	14.7	11,350	1.3
Specimen 2 ..	13.3	11,600	1.15

zero grid volts, provided the grid swing does not exceed 1.6 volts. Should it be desired to deal with a slightly larger input than this, the grid may be given a small negative bias—about 0.5 of a volt will be sufficient. This will have the effect of increasing the permissible grid swing to about 2 volts, but as this requires fitting a potentiometer as well as a grid cell, it would be worth while to ascertain first that the voltage applied to the grid is sufficient to cause grid current to flow.

The G.P.407 is a medium-impedance valve with a stated A.C. resistance of 14,000 ohms and an amplification factor of 14. It has not been designed to fulfil any one function, but is suitable for use as either an H.F. amplifier, grid detector, or first stage L.F. amplifier. As the H.F.407 adequately fills the *rôle* of an H.F. amplifier, and, moreover, the operating conditions as far as H.T. and grid bias are concerned will be sensibly the same whether the valve is dealing with H.F. or L.F. currents, we will limit the discussion to its use in detector and L.F. stages.

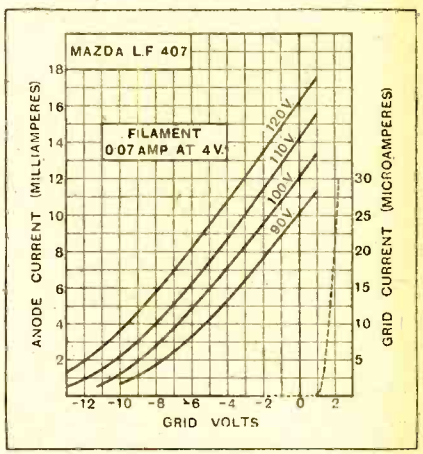
Taking these in the order named; as a detector it is perhaps better suited for employment as a grid rectifier, in which case the grid return should be connected to the positive leg of the filament and the anode potential kept below 80 volts; the reason being that with higher

L.F.407.
Characteristics at Zero Grid Bias and 100 Volts H.T.

L.F.407.	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	8.0	5,700	1.4
Specimen 1 ..	6.6	4,800	1.38
Specimen 2 ..	7.0	6,000	1.17

values of H.T. the anode current may reach a value more than sufficient to saturate the magnetic circuit of the transformer, which it is assumed will naturally follow a valve of this type. Resistance capacity coupling is not recommended in this case, although, of course, there is no serious objection to adopting this method if the requirements of the circuit necessitate fitting a coupling of this nature.

As an L.F. amplifier the normal operating conditions will be about 120 volts H.T. and minus 1.5 volts grid bias. This, relatively speaking, small value of grid bias is permissible in view of the fact that grid current does not commence until the grid is 0.6 of a volt positive. The anode current with this adjustment will be in the order of 3.5 milliamps, but if this value is found to be in excess of the safe current that is permissible with the transformer or other coupling device in use, it would be quite safe to increase the bias to −3 volts. This brings the operation point rather low down on the curve, and it will be necessary to provide some means of controlling the input if rectification is to be avoided. Under the recommended operating conditions, namely, 120 volts H.T. and −1.5



Average values under working conditions; A.C. resistance, 5,000 ohms; amplification factor, 6.25; mutual conductance, 1.25 mA/volt.

volts grid bias, the average characteristics were found to be: A.C. resistance, 11,400 ohms; amplification factor, 13.3; and mutual conductance, 1.17.

The L.F.407 is essentially a low-frequency amplifier, being intended primarily for use following the detector valve, for which position it is best suited. It can, however, be employed in the last position in a 2 or 3-valve set when a large power output is not required. It will satisfactorily operate small, sensitive loud speakers at medium strength, but if

P.415.
Characteristics at Zero Grid Bias and 100 Volts H.T.

P.415.	Amplification Factor	A.C. Resistance (Ohms).	Mutual Conductance (mA/Volt).
Maker's rating	5.5	2,900	1.9
Specimen 1 ..	5.0	3,500	1.45
Specimen 2 ..	4.8	3,250	1.5

large outputs are desired, a power valve should be employed. With 120 volts H.T. and −6 volts grid bias, this valve will handle a grid swing of approximately 12 volts without overloading.

With this value of H.T. and grid bias the anode current was found to be in the order of 8 mA.; this, however, can be reduced to about 6.5 mA. by increasing the bias to 7.5 volts. Under amplifying conditions

Valves We Have Tested.—

the average A.C. resistance was found to be 5,000 ohms, the amplification factor 6.25, giving a mutual conductance of 1.25 mA. per volt.

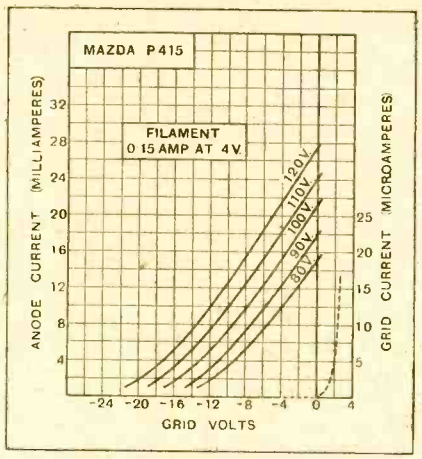
Grid current commenced at 0.8 of a volt positive grid bias. Not the slightest trace of reversed grid current could be found, showing that the valves tested were dead hard.

P.415.

H.T.	Grid Bias.	Anode Current.	
		Maker's Rating.	Measured.
80	— 6	6 mA.	7.5 mA.
100	— 9	7 ,,	8.5 ,,
120	—12	8 ,,	10.0 ,,

The P.415 is a power output valve for use with a 4-volt accumulator, and requires 0.15 amp. to heat the filament. It is particularly suitable for operating cone, horn, or moving-coil loud speakers at sufficient volume for practically all normal requirements.

Under average amplifying conditions with 120 volts H.T. and —10.5 volts grid bias the A.C. resistance



Average values under working conditions: A.C. resistance, 3,650 ohms: amplification factor, 4.9; mutual conductance, 1.35 m.A/volt.

was found to be 3,650 ohms, the amplification factor 4.9 and the mutual conductance 1.35 mA. per volt.

The anode current taken is within the capacity of the larger type H.T. batteries, and these will provide an economical source of high tension if supply mains are not available.

As the anode current will be in all probability somewhat in excess of that which can be safely passed through the windings of the average loud speaker, it is suggested that either a transformer or a choke capacity output circuit should be fitted. If the latter arrangement is adopted the connections most likely to ensure immunity from "motor-boating" and other L.F. troubles are strongly recommended.

With the particular specimen from which the characteristic curves were obtained, grid current commenced at zero grid bias. Careful tests failed to reveal any trace of reversed grid current, showing the valve was dead hard.

In order to ensure a long working life the valve should be treated with care, and under no circumstances should the grid bias be adjusted without first switching off the H.T. The bias batteries should be tested from time to time to ensure that the voltage has not dropped, thereby permitting an excessive anode current to flow.

WHAT GAUGE IS IT?

IT often happens that the experimenter, wishing to use some fine copper or resistance wire for a job in hand, finds that the only fine wire in his possession is in the windings of some discarded component. The question that at once arises is, "What gauge is it?" Most of the wire gauges obtainable do not pretend to measure wire finer than about 36 s.w.g., so that in such a case they are useless, even if available. If wire tables are available, the difficulty of finding the gauge can be overcome by measuring, not the diameter of the wire, but its electrical resistance, when reference to the table will give the gauge.

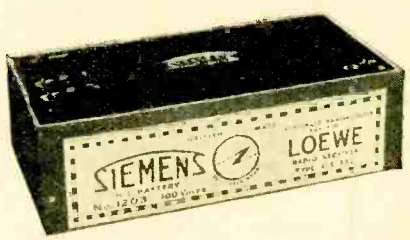
RESISTANCE OF WIRE IN OHMS. PER YARD.

Standard Wire Gauge.	Copper.	Eureka or Constantan.
38	0.85	23.8
39	1.13	31.6
40	1.33	37.2
41	1.58	44.2
42	1.91	53.5
43	2.36	66.0
44	2.98	83.4
45	3.90	109
46	5.31	148
47	7.64	214
48	11.9	333
49	21.2	594
50	30.6	856

The simplest way of making the very approximate estimate of resistance required for the purpose in hand is to measure off a known length of the wire to be tested, taking a yard if the wire is very fine, or ten yards if it seems to be about 40-gauge. This length of wire is then connected to an accumulator cell, with an ammeter in the circuit to read the current that flows. Dividing the voltage of the accumulator, reckoned at two volts per cell, by the current flowing gives the resistance in ohms of the length taken. Looking up this value of resistance in the table herewith (or one-tenth of it, if ten yards have been taken for the test) the gauge can immediately be found.—A. L. M. S.

THE LOEWE TYPE O.E. 333 RECEIVER.

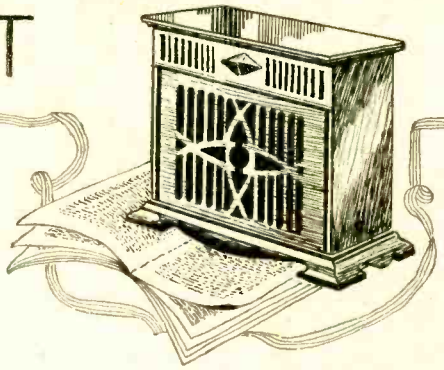
IN reviewing this receiver in the January 16th issue of this journal it was mentioned that the system of battery connections recommended by the makers, in which the grid bias is derived from the H.T. battery, involves a reduction of the H.T. voltage by an amount equal to the grid bias and that the H.T. available from a 90-volt battery would be only 82½ volts. Messrs. Siemens Bros., and Co., Ltd., who are making a special battery for the Loewe set, point out that the total voltage of their battery has been increased to 100, so that the effective maximum H.T., after deducting the 7½ volts for grid bias, is 92½ volts.



Siemens type No. 1203 battery for the Lœwe set. Provision is made for 92½ volts. H.T. and grid bias up to 7½ volts, giving a total of 100 volts.

The price of the type O.E.333 set, including the multiple valve, has now been reduced to £3 3s., and the cost of repairing burnt-out valves has been fixed at 16s. 6d. It will be remembered that the makers undertake to repair burnt-out filaments at this price only if the glass bulb and internal structure are mechanically undamaged.

CURRENT TOPICS



News of the Week

MORE AND STILL MORE LISTENERS.

In the House of Commons, in a reply to a question, Lord Wolmer, the Assistant Postmaster-General, gave the following figures for wireless receiving licences :—

December 31st, 1926, 2,178,430; December 31st, 1927, 2,395,106; and on December 31st, 1928, 2,628,000.

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THE B.B.C. AND SCHOOLS.

From Blackburn we learn that the B.B.C. has arranged to give a demonstration of broadcasting in relation to schools on Monday, February 11th. The head teachers of all the senior schools have been invited to be present.

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WIRELESS AT THE B.I.F.

Wireless will have a larger representation at the 1929 British Industries Fair than in previous years. The Fair, which is held simultaneously in London and Birmingham, will be opened on February 18th, next.

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COMMANDER BYRD'S AEROPLANE WIRELESS RECORD.

What is considered to be a record for communication between an aeroplane in flight and a ground receiver has been carried out between Commander Byrd's aeroplane "Stars and Stripes," flying over the Antarctic, and a wireless station in New York. The distance between the receiver and the aeroplane at the time was 10,000 miles. Greetings and messages were exchanged. The wavelength used was 34 metres.

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B.B.C. CHAIRMAN'S NEW POST.

The nomination of the Earl of Clarendon, the chairman of the B.B.C., to the directorate of the new Communications Company has given rise to speculation as to whether this appointment will mean that his position as chairman of the B.B.C. will have to be relinquished.

It will be recalled that the special Commission which advised the change-over from the British Broadcasting Company to a corporation recommended that the board of governors should be men and women "free of other commitments," and in view of this recommendation it has been suggested that the acceptance of a new appointment may mean resignation from the position held with the B.B.C.

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RADIO AND TELEVISION.

This is the title of a lecture to be given this evening, February 6th, by Mr. H. A. Hankey, before the Queen's Park and District division of the Wireless League at St. Jude's Institute, Harrow Road.

THE NEW WAVELENGTHS.

It cannot be said that Europe has yet settled down contentedly to the new wavelengths which came into operation on January 13th. A number of complaints have been made on the Continent and, in addition, 2LO, 5GB, and 5XX, all three suffer, though slightly, from interference.

A further enquiry from Keston, however, was reassuring, for there at the B.B.C. listening post it was considered that matters were already better than before the change, and it was anticipated that as stations settled down to the new wavelengths a very definite improvement upon the old *régime* would be noticed.

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BROADCASTING EDUCATION TO MR. ATKINS.

The War Office has apparently taken interest in the educational facilities offered by broadcasting and has communicated with the various commands, suggesting that commanding officers should investigate the matter with a view to arranging for broadcast listening classes.

in Brief Review.

WIRELESS IN THE R.A.F.

Six hundred aircraft apprentices between the ages of 15 and 17 are required by the Royal Air Force. Among the trades open to boys is that of wireless operator-mechanic. Full information is obtainable from the R.A.F., Gwydyr House, Whitehall, London, S.W.1.

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£130,000,000 ON WIRELESS SETS.

1928 has proved to be the biggest wireless boom year yet experienced in the United States. The sale of wireless sets and parts during the year amounted in value to £130,000,000, this being an increase of £45,000,000 over the previous year. The number of listeners has increased to 35,000,000, as compared with an estimated number of 26,000,000 at the beginning of the year.

In 1922 the total of listeners was in the neighbourhood of 7½ millions, and business in every direction appears to have grown in proportion to the increase in the number of listeners.

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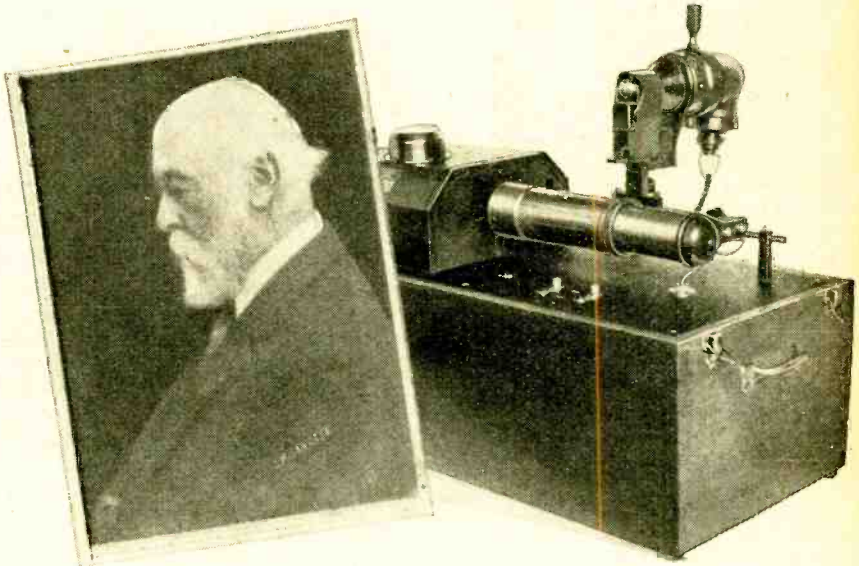
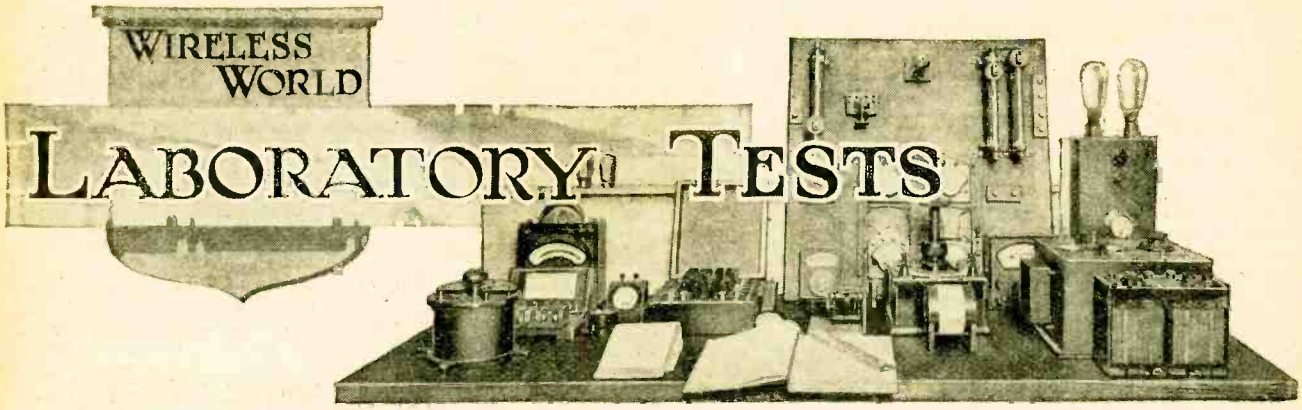
I.E.E. WIRELESS SECTION MEETING.

This evening, Wednesday, at 6 p.m., at the Institution of Electrical Engineers, a paper will be read by Dr. B. Hodgson, O.B.E., D.Sc., L. S. Harley, B.Sc., and O. S. Pratt, B.A., on "The Development of the Oxide-Coated Filament," to be followed by a discussion.



NEW PICTURE BROADCASTING EQUIPMENT. Sharper definition and better gradation of light and shade will shortly be observed in the Daventry transmitted pictures. This will result from installing the photoelectric equipment shown here in place of the present copper foil form of transmitter. The portrait of Sir Oliver Lodge is a product of this new transmitter.



A Review of Manufacturers' Recent Products.

MARCONIPHONE UNIVERSAL OUTPUT TRANSFORMER.

This transformer is provided with a centre tapped primary winding and a secondary tapped to enable the best results to be obtained from loud speakers of different impedances. This enables a choice of ratios to be obtained, and by adopting suitable connections the impedances of valves and loud speakers can be matched to give the best results. Furthermore, a transformer protects the user against shocks when very high voltages are used, and it is specially recommended when the supply mains are utilised as a source of high tension.

Marconiphone Universal output transformer.

If used to follow a valve of low A.C. resistance, one-half only of the primary will be required, but if preceded by a pentode output valve the whole of the winding should be included in the anode circuit.

The secondary winding, being symmetrically tapped, enables loud speakers of widely different impedances to be employed to the best advantage. For example, one with a resistance of between 500 and 750 ohms should be connected between terminals S1 and S2, whereas if the resistance lies between 1,000 and 1,500 ohms that portion of the winding between terminals S2 and S3 would be most suitable, and for loud speakers of 2,000 ohms the makers' recommend the whole of the secondary.

The policy of tapping the primary at its centre confers a further advantage in that it enables the component to be employed as an output transformer in push-pull amplifiers.

The price has been fixed by the makers, the Marconiphone Co., Ltd., 210-212, Tottenham Court-rd., London, W.1, at 20s.

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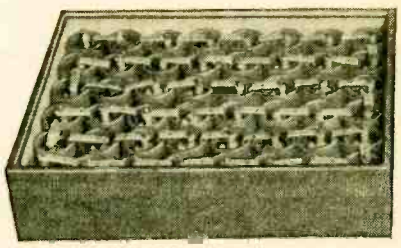
ETON PRIMARY H.T. BATTERY.

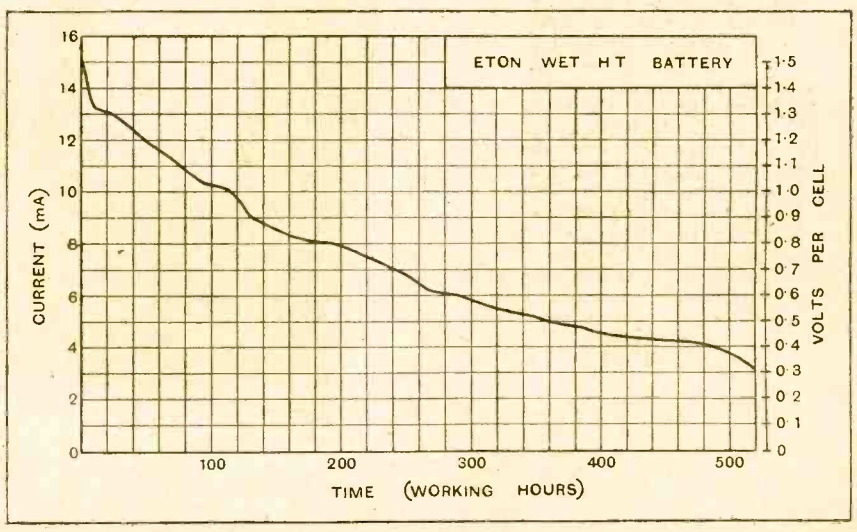
The type S1 battery tested was the larger of the two sizes manufactured by the Leyton Battery Co., 305, Church Road, Leyton, London, E.10. The glass jars in this battery are $1\frac{5}{8}$in. square by $2\frac{1}{2}$in. high, and are made from specially prepared metal-free glass having high insulating properties. The rim of each jar is dipped in red wax to prevent creeping of the electrolyte and waxed cardboard separators are inserted between the cells in the tray.

The zincs are of pure metal, and give satisfactory service without amalgamation. If specially ordered, amalgamated zinc can be supplied at a slightly higher cost. The cells actually tested were fitted with sac positive elements, but porous pots are also available.



Eton primary H.T. battery with size S1 cells.

A comprehensive and well-written handbook gives full details of all component parts together with prices, and contains much useful information on the care and maintenance of wet H.T. batteries. Complete batteries are supplied.



Discharge curve of the type S1 Eton primary H.T. battery.

The type S1 battery is recommended for three and four-valve sets, and the discharge was commenced at about 15 milliamperes At this current the initial terminal voltage was 1.51 per cell. Throughout the test the cells were discharging into a constant resistance, so that as the E.M.F. fell the current was also reduced. This approximates to the conditions prevailing when the battery is connected to a wireless set. The battery was discharged for periods of four hours each with four hours' rest for recovery, but in plotting the curve only the consecutive working hours were taken into account. It will be seen that the fall in voltage and current, after the usual initial drop, is fairly regular, the flattening which frequently occurs over the first hundred hours or so being absent. If 0.9 volt per cell is decided on as the end point, the useful life would be 130 working hours. After 220 hours, the E.M.F. is 0.75 volt per cell, and beyond this point it would be necessary either to add fresh solution or replenish the sacs, zincs and electrolyte to maintain good quality of reproduction. Actually, the test was continued for over 1,000 hours, and when taken off the battery was still giving about 1 mA. of current.

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IGRANIC L.F. CHOKE.

The Type "F" Igranic choke can be used either for coupling low-frequency amplifying valves or as an output choke in a filter circuit. The winding consists of two sections which can be connected in series or parallel by means of terminals fitted to a moulded terminal block on the top of the case. In general the parallel

Igranic Type "F" choke with series-parallel connections.

connection should be used where low inductance and high direct current-carrying capacity are required, as would be the case if the component is used as an output choke following a low impedance power valve. The series connection will give excellent results when the choke is used for coupling high impedance L.F. amplifying valves.

The inductance readings for various values of direct current flowing through the windings are given by the makers as follows :—

Direct Current. (mA.)	Inductance (Henrys). Parallel.	Series
1	21	73
4	18	63
6	16	51
8	14	39
10	12	36
15	11	34
20	10	27
27	8	—

As a check the inductance of the choke was measured with the windings in parallel, and came out at 22.4 henrys. With the windings in parallel, the measured D.C. resistance was 230 ohms and in series 920 ohms, which is in good agreement with the makers' figures submitted.

The component is well suited to its work, and should satisfy all normal requirements, whether used as a coupling choke or as an output feed choke. The price is 15s.

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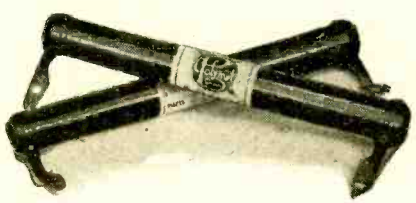
WIRE-WOUND RESISTANCES.

In cases where a relatively heavy current is passing, the familiar cartridge type of resistance is not always satisfactory, and a component designed on more robust lines is desirable. In the "Polymet"



A range of wire-wound tubular resistances. "Polymet" products.

resistances the wire is wound on a porcelain tube 1.5 cm. in diameter, the length varying with the value of the resistance. For example, a 20,000 ohms resistance is 10.25 cm. (4⅛in.) long and a 100,000 ohms 15.5 cm. (6in. approx.). The wire is wound on in a single layer, allowing rapid radiation of heat, and therefore a high current-carrying capacity. The models illustrated are rated to dissipate 10 watts and are accordingly most suitable for use in heavy duty battery eliminators, transmitting sets or in any circuit required to pass relatively large currents.

A few samples were tested and the measured resistances were found to be within 10 per cent. of the marked values, the smaller resistances being more accurate than the higher values. For example, the 100,000 ohms resistance when measured was 9 per cent. high, but the 20,000 ohms was only 4.3 per cent. in excess of the marked value. The resistance wire is protected by a coating of special enamel which, after baking, dries hard but does not chip or flake. For connections, soft metal tags tinned to facilitate soldering are fitted, and being very pliable will not break when bent to form supports for mounting on a baseboard or panel. The prices vary with the value of resistance, the 20,000 ohms unit being 5s and the 100,000 ohms 7s. 6d. Resistances of this type as low as 750 ohms are also available, costing only 3s. 6d.

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HELLESEN BATTERIES.

Messrs. Hunt's have for long been known as the sole distributors in this country of the Hellesen dry batteries. These are made in various sizes ranging

Hellesen grid-bias batteries. The larger is the 15-volt unit.

from single cells to batteries of 120 volts. Included in these must not be forgotten grid-biasing batteries, and the illustration shows two popular types, namely, a 9-volt unit tapped in 1½-volt stages, and the 15-volt battery also similarly tapped. The popular 9-volt size measures 4⅞in. × 3in. × ⅞in., and costs 2s.; the dimensions of the 15-volt unit are 8⅛in. × 3⅛in. × ⅞in., and the price is 3s. 3d.

The address of Messrs. A. H. Hunt, Ltd., the sole distributors of Polymet and Hellesen products in this country, is H.A.H. Works, Tunstall Road, Croydon, Surrey.

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TRADE NOTES.

Messrs. Jackson Bros., makers of the "J.B." products, have now moved to new premises at 72, St. Thomas' Street, London, S.E.1. The telephone number is Hop 1837.

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Messrs. Burne-Jones and Co., Ltd., have acquired extension of accommodation at Magnum House, 296, Borough High Street, London, S.E.1, and all departments have now been centralised under one roof. Their telephone number is Hop 6257 (two lines).

ONE METER MANY PURPOSES.

The Use of Commercial Resistances for the Higher Voltage Ranges.

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

(*Concluded from page 133 of last week's issue.*)

THE shunt described at the end of the second instalment of this article in last week's issue was wound on a bobbin in the manner already detailed and mounted on a carrier with two terminals.

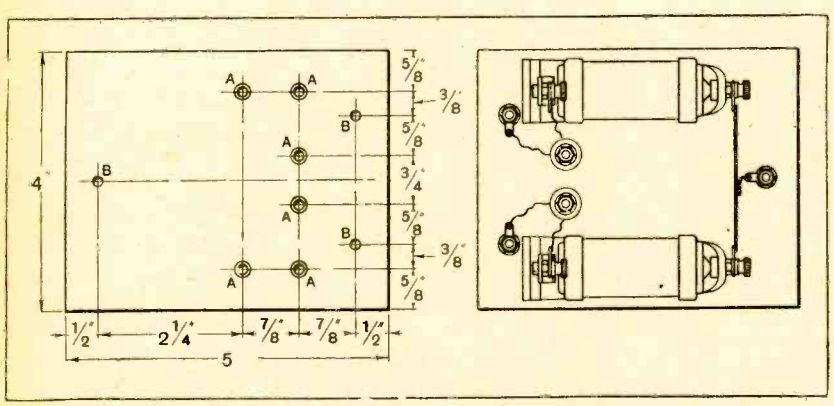
With the newly constructed voltmeter the voltage of two cells was taken; the sum of the two was 4.290 volts. The resistance of the meter, with shunt, would be the meter resistance, 44.7 ohms, divided by the shunt power, 2.465, or $\frac{44.7}{2.465} = 18.13$ ohms. This in series with the 200-ohm resistance would give on 4.290 volts a current of $\frac{4.290}{218.1} = 0.0197$ amp., or 19.7 milliamps. This arrangement was then connected up, as in Fig. 5, the shunt being first clipped to T_1 and T_2, and then the meter as a whole connected in circuit by the terminals on the shunt itself. Since the shunt had too high a resistance, the reading on first testing was well over 20, but by cautiously shortening the shunt, as had been done with the series resistance, the reading was brought down to exactly the figure required, 19.7. On checking, the error appeared to be of the order of 1 per cent., but as the writer has no instrument guaranteed to a less error than this, the check served only to show that the error was small, and could not assess it accurately.

In shortening a shunt it is, of course, essential to disconnect the battery before cutting the shunt wire, as otherwise the meter will be heavily overloaded and probably damaged. It will be found that the final adjustment is best made when the desired reading is nearly attained, by baring a little more of the resistance wire instead of cutting it, and extending slowly the length of the soldered joint by adding tiny touches of additional solder. In this way barely readable differences in the deflection of the meter can easily be made, with the comfortable feeling that if the mark should be overshot slightly it is easy to unsolder the last eighth of an inch soldered up. When the exact adjustment is found, a scrap of insulating tape wrapped round the bared part of the wire will ensure that there is no contact between the two halves until the actual join is reached. The wire is then protected as before by a turn or two of insulating tape wound into the bobbin on top of it.

It would be wearisome, without being helpful, to go through, in detail, all the operations of making every one of the remaining shunts, but as two new operations were involved in making the next shunt on the list some part of the figures involved must be given. This next shunt was for 100 milliamps.; that is, a multiplying power four times greater than the last, or $2.465 \times 4 = 9.86$. Its resistance had therefore to be $\frac{1}{8.86}$ of that of the meter, i.e., $\frac{44.7}{8.86}$, or just over 5 ohms. A yard of 30-gauge Eureka wire was measured off and mounted as before on a shunt carrier.

Making a Standard Resistance.

In order to get a current somewhere over 50 mA. it becomes necessary, if the L.T. accumulator is still to be used, to have a standard resistance of lower value than the original 200-ohm standard. This new resistance was to pass nearly 25 milliamps. when connected to a single cell, so that $\frac{2}{0.025} = 80$ ohms was required. Since the resistance could readily be measured, no attempt was made to adjust it to 80 ohms exactly, but about 8 yards of 34-gauge Eureka wire was measured off and wound on an odd scrap of ebonite, and soldering tags were affixed to the ends to make the point of contact quite definite. This was then connected across a cell and the voltage of the cell was taken *while delivering the current that would be wanted during the measurement of the resistance.* This turned out to be 2.177 volts. The series resistance was then removed from the meter and the 25 mA. shunt attached, and the newly made resistance and the meter were placed in series across the cell. The current flowing was found to be 21.19 mA. The total resistance in the circuit was therefore $\frac{2.177}{0.022} = 102.8$



Constructional details of the separate voltage range box.

One Meter Many Purposes.—

ohms, of which 18.13 ohms were due to the shunted meter. The resistance of the coil of wire was therefore 102.8 – 18.13, or 84.7 ohms.

For adjusting the shunt, it was intended to connect the shunted meter and this resistance across three cells so that approximately one-third of this resistance, represented by 2½ yards of 34-gauge Eureka, was connected across each cell in turn while reading its voltage. Apart from taking this precaution, the 100-mA. shunt was adjusted in exactly the same manner as was the 25-mA. shunt, so that further details or figures would be superfluous.

By proceeding in this way, making new resistances as required and taking the voltage of the cells while they were on the load that they were expected to deliver during the adjustment of the shunts, the range was extended to 1 amp. The only extra precaution needed for the higher current ranges is to remember that the lengths of copper wire used for the connections begin

A separate voltage range box. Commercial power resistances in series with small home-constructed resistances are used.

to have a resistance that is not quite negligible with respect to the total resistance in the circuit. Sixteen-gauge wire must be used for all connections in the circuit as soon as the current exceeds some 250 milliamps. As this wire has a resistance of only 0.0075 ohms per yard, the contact resistances at the terminals will then be the chief remaining source of error.

In extending the range of the instrument as a voltmeter, the process is simple, as will be seen from the description of the next range resistance made up. This was to be for 10 volts, and as the maximum current of the meter was of the order of 10 milliamps., the resistance required was $\frac{10}{0.010}$, or 1,000 ohms approximately. This, wound with 42 d.s.c. Eureka, just about fills up the little ebonite bobbin; and in this case, owing to the difficulty of measuring out and doubling so great a length (some 25 yards), it was wound straight on from the reel. With the 2½ voltmeter, the voltage of four cells was taken; the total came to 8.732 volts. These four cells were connected in series with the meter and the new resistance, and the latter was adjusted till the meter read exactly 21.83 divisions, this being 2½ times the actual voltage.

So far, so good—but what about the next range? Finer wire would be necessary to get a higher resistance on to another of the little ebonite bobbins; the use of 47-gauge Eureka, with a resistance of some 235 ohms per yard, is a possible solution. Owing to the difficulty of handling such fine wire, this solution of the difficulty did not appeal to the writer, especially as 10 milliamps. is really too high a current to put through wire of this gauge. The only alternative is the use of an external series resistance, not mounted up in shunt fashion, but connected as required to the terminals of the instrument by a piece of wire. Even with this arrangement, which allows the use of thicker wire, space being no longer a consideration, the prospect of winding untold yards of wire for the higher ranges did not appeal, and attention was turned to the high resistances obtainable commercially.

Of these the most suitable for our purpose is the "10-watt Power Resistance," made by Messrs. R.I. and Varley, Ltd., which will carry in safety, and without variation in resistance, fairly heavy currents. They are, however, only guaranteed to be within 5 per cent. of their nominal resistance values, so that without some adjustment they would not be usable for our purpose.

In order that this adjustment can be made it is necessary that the resistance, as purchased, shall be below, and not above, the value required to provide the series resistance calculated for any given range. If, for example, we wish to use a meter reading to 10 milliamps. for measuring voltages up to 200, we shall require a series resistance of value $\frac{200}{0.010} = 20{,}000$ ohms. If the resistance, as bought, turns out to be 19,500 ohms, we can add the odd 500 ohms ourselves, adjusting it to the correct value exactly as in the case of the other series resistances for lower voltage ranges already discussed. If, on the other hand, the purchased resistance is of 20,500 ohms, we are helpless, and can do nothing to make the meter read correctly on the 200-volt range, but must determine, and always apply, some correcting factor.

The Tolerance in Values of Commercial Resistances.

On communicating with the makers of the resistances mentioned, however, it was found that they were willing to pick from their stock those which, while within their usual limits of tolerance, are a little below, and not above, the nominal value, and the writer obtained several resistances answering to this condition. These were sufficiently near to their nominal value to make it unnecessary to wind more than quite a small addi-

One Meter Many Purposes.—

tional resistance to bring the readings of the meter to their correct value.

Others, however, may not be so fortunate—the writer was helped by the fact that his meter required a little more than 10 mA. for full-scale deflection—and if the extra resistance that requires to be added runs into several thousands of ohms it may be more profitable, from the constructional point of view, to adjust the readings by using a shunt rather than by adding extra series resistance.

The easiest way of deciding which course to adopt may best be seen from a concrete example. Suppose a "10-watt" resistance for a 100-volt range has been bought for a 10-mA. meter of internal resistance 50 ohms; the external resistance required will be 10,000 ohms (less the resistance of the meter, which is negligible) in this case. On connecting meter and resistance in series across a high-tension battery whose voltage has been measured in steps using the 10-volt range, it is found that an actual 80 volts registers 84 volts on the meter. It is required to decide whether a shunt or extra series resistance, either of which can be used to decrease the reading to "80," will have the lower resistance, and so be the easier to make.

First, try series resistance. Eighty volts are driving 8.4 mA. through the circuit; the total resistance is therefore $\frac{80}{0.0084} = 9{,}530$ ohms. We shall therefore have to supply $10{,}000 - 9{,}530$, or 470 ohms of extra series resistance. If we elect to make a shunt instead, leaving the series resistance alone, we shall require a multiplying power of $\frac{84}{80} = 1.05$. Its resistance will have to be $\frac{1}{1.05-1} = \frac{1}{0.05} = 20$ times that of the meter, i.e., $20 \times 50 = 1{,}000$ ohms. Clearly, though either mode of adjustment is possible, the addition of extra series resistance will, in this particular instance, involve us in less winding of fine wire.

It will be found, in general, that where the series resistance is very high, as will be the case if the maximum current that the meter will take is small, or the voltage to be measured is high, the shunt will prove the better solution, while in cases such as that taken as an example, where the series resistance is comparatively low, the necessary adjustment will be more easily attained by bringing up the series resistance to the theoretical value.

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.

OBJECTIONS TO THE REGIONAL SCHEME.

Sir,—If I may trespass on your valuable space for a few moments, I should like to express my views on a point which a great number of people seem to have overlooked in regard to the new B.B.C. regional scheme.

Last year when lecturing on this scheme before the Birmingham Engineers' Club, Capt. Eckersley was asked how he proposed to accommodate all these high-powered stations on the narrow waveband allotted, particularly having in mind the great majority of unselective sets in use. His reply was, "These people would have to make their sets selective or buy a wave-trap."

Now, there are thousands and thousands of listeners who cannot afford anything but the least expensive sets, let alone go to the expense of a wave-trap, even if this device works as it should (most of them don't in my experience), so it would seem to me that only a very small amount of the total licence holders (who pay for the B.B.C.) will benefit by the regional scheme as originally conceived, the rest will be worse off, having to listen to perhaps three or four stations at once.

This brings me to the real point, since the inception of the scheme, reproduction in reception has changed from "fairly good" to well-nigh perfect, "*via* moving coil and the latest type of amplification." But to get perfection in reproduction you cannot have selectivity in the present state of the art, owing to, as most people know, the cutting off of the higher and lower frequencies. Now, as most people who can afford a really good set to-day use apparatus of this description, they will be now in the same boat as the man with the simple one- or two-valve set, which is in most cases unselective, the other section of the community, namely, the D.X. hounds, will also bring the position to 100 per cent.

What I should like to ask is, has Capt. Eckersley a solution to the problem; if so, perhaps he will tell us what it is, through the medium of your paper.

I may say in conclusion at the last annual Council meeting of the Wireless League I suggested a possible solution to the problem, and after a special meeting of the London Committee, at which Professor Low was in the chair, it was decided to forward it to the B.B.C. with a strong recommendation for its careful consideration; perhaps Capt. Eckersley can call it to mind.

I trust you will be able to find a little space in your Correspondence for this letter, as I do not think the general public realise exactly what trouble they are in for when the new regional scheme is completed. DEREK SHANNON.

Sutton Coldfield.

INTERFERENCE.

Sir,—The broadcasting situation with regard to interference is, if anything, rather worse in this district than it was before the recent reshuffle of wavelengths, and it is not possible to receive a single station on the 200-500-metre band without interference on a receiver designed for quality reception, in this part of the world. Reception for enjoyment of a programme therefore has been killed here, except from 5XX. The many attempts to accommodate so many stations *indiscriminately* on this 200-500-metre band is, in my opinion, doomed to failure on account of the difficulty of control of so many diverse interests in foreign countries.

I suggest the only rational solution is for each country to agree to work on an exclusive *width* of waveband, to be determined by the number of stations each country now has working. The same number of stations could theoretically be accommodated as at present, but each country could determine for itself how many stations it could work within its own waveband without mutual interference, and it would be sure of having no *foreign* interference out of its own control. It could either have a few powerful stations within its waveband without interference, or, if it allowed a large number of small stations to radiate, the interference would be confined to that country, and it would have to find its own remedy—the important point, however, being that it could not get any *foreign* interference. Unless a determined effort is made to reshuffle the wavelengths in accordance with these principles, broadcast reception will soon be confined to those people living within a few miles of their local station, and the romance of selecting a programme at will and according to individual taste will be killed.

K. YOUNGHUSBAND.

STANDARD FREQUENCY BROADCASTS.

Sir,—I wrote to the B.B.C. on January 3rd putting forward the identical suggestion of broadcasting standard frequencies as set out by Mr. C. R. Mason in *The Wireless World* of January 23rd. This is what the B.B.C., per the Chief Engineer, say in reply, January 15th :—

> In reply we would state that your suggestion is one which has been put to us periodically, but we are afraid that it is not practicable.
>
> The question of radiating the gamut of musical frequencies, as you suggest, is not as simple as it might appear at first sight. For the listener to make a test of any value it would have to be carried out in conjunction with receiving apparatus of varied designs, and with the necessary switching arrangements. It would be perfectly possible for a receiver to "make a noise" when a certain note is played without the fundamental of that note being correctly received; this is due to presence of overtones. You will appreciate that unless there was some form of check it would be impossible for the listener to gauge whether or no his apparatus was reproducing correctly. Moreover, we do not think that there are a sufficient number of listeners interested in the technical performance of their apparatus to make the point worth while.

I believe that the B.B.C. is quite mistaken as to the interest in such a broadcast. For some time past quality of reproduction has been uppermost in the minds of listeners. In many cases the data obtained would be accurate and valuable. Where it proved misleading would not matter; it would please a great many people to think that their sets were better than actually is the case. Some little time ago I carried out some tests with various speakers, and by quick switching over on a sustained note demonstrated that certain very low frequencies were totally inaudible on some loud speakers while being quite clear in a moving-coil instrument. A. C. ARMSTRONG.

London, W.C.1.

Sir,—It may interest your correspondent, Mr. C. R. Mason, to know that I have already put his suggestion to the B.B.C., and received the following reply :—

> [*The quotation from the B.B.C. letter which followed is identical in wording with the quotation given by Mr. A. C. Armstrong above.*—ED.]

I consider this a most unsatisfactory answer to my enquiry; it seems that the B.B.C. find it impossible to credit their listeners with an intelligent desire to obtain better quality reproduction; perhaps they are afraid of us getting our reproduction too perfect. F. C. CLARKE.

Hove, Sussex.

Sir,—I wish to join with Mr. C. R. Mason, who in your last issue asked for assistance from the B.B.C. for the average listener.

Not many can afford or have the ability to carry out full tests on their receivers, but the transmissions of standard frequencies, with equal outputs, would enable a fair comparison of receivers to be made.

It is thought that besides the transmission of definite announced frequencies a continuous run might also be made from the lowest to the highest frequencies, as this often shows up resonances which might otherwise be missed.

Such tests would, of course, give some indication of what frequencies the B.B.C. can transmit.

It might be advisable to warn users of certain types of loud speakers of the advisability of reducing the input to their sets during such tests, or there may be complaints of mechanical breakdown! N. R. BLIGH.

London.

Sir,—The letter from Mr. C. R. Mason in your issue dated 23rd inst., making the suggestion that various instruments should be broadcast from time to time for test purposes, is exceedingly interesting, but Mr. Mason appears to have omitted from his calculations that tremendous factor in these matters, the adaptability of the human ear.

The B.B.C. might produce a bass drum note, and then run up the complete scale of the piano without any defect being noticeable to some listeners who possess receivers with a cut-off of perhaps 200 cycles.

When I had the privilege to broadcast a series of talks on reality in reproduction from 5IT, I made some tests from the studio very similar in nature to those suggested by Mr. Mason, and I asked for reports on the test. In one test I beat a bass drum which was standing handy in the studio, and I informed listeners (perhaps rather foolishly) of the type of drum I was playing. One gentleman wrote to me and stated that he had heard the bass drum perfectly naturally, exactly as it would sound when played in his drawing-room. His receiver, I may say, had two stages of transformer coupling, each with a cut off of well over 200 cycles, and he was utilising a loud speaker attachment, with a home-made trumpet, this trumpet being entirely wrong in cross section in relationship to its length, and having a total length of only 18in. I could cite other examples which would show Mr. Mason the futility of such tests as a method of locating defects in receivers by the average listener.

If the B.B.C. could produce a series of notes of pure sine wave character, with no harmonics, and transmit them in such a manner that at the input end of the receiver one was supplied with such a pure note, then we should all be able to learn easily a good deal about our receivers, and I honestly believe that three minutes a day spent in this manner would be of considerable benefit to manufacturers, traders, experimenters, constructors, and even the listener. At any rate, it appears to me that the people interested are quite sufficient in number to warrant a few minutes occasionally being devoted to such a purpose, and it would seem possible that the apparatus would not be difficult to put into commission, in view of the fact that it is believed that the B.B.C. already use some such apparatus for testing their land lines.

As the avowed object of the B.B.C. is to give entertainment in the most perfect form possible, it would seem that a little trouble spent in this manner towards the end of perfect reception would be well repaid. COLIN H. GARDNER,

Technical Consultant to the Eagle Engineering Co., Ltd

Warwick.

THE KILO-MAG FOUR.

Sir,—I feel I must write and congratulate you on producing such a remarkably efficient set as the Kilo-Mag Four,[1] which has exceeded my wildest expectations. Although wonderfully effective on long-distance stations and very selective, it produces as good a quality on the two Daventrys as if it were designed solely for pure reproduction from the local station. I found it necessary to fit a 50 ohm rheostat in the volume control, as when using a 20 ohm one there was hardly a station one could pick up that was not too loud at the minimum setting.

As an example of its efficiency I may mention that I have had really loud signals from a German station using the four feet of wire between the set and the earthing switch as an aerial.

I only use one stage of low frequency, and find one P625 in conjunction with a moving-coil speaker gives admirable results.

I think you might well have departed from your usual modest custom and have heralded this set with a flourish of trumpets.

Reading. H. O. S.

KDKA ON 9 METRES?

Sir,—I write to ask if any reader can give me the actual wavelength of a KDKA broadcast transmission on about 9 metres. The letter I received from the station confirming reception did not state the wavelength. Possibly I have missed published reports of reception by other readers?

I first received this transmission on October 28th, 1928, and each Sunday I have listened since that date, it has started about 15.50 G.M.T. and continued for about an hour or so (generally the church service). I use a two-valve 0-v-1 receiver, and reception, of course, varies week by week.

Bristol. EDW. W. HOPKINS.

January 17th, 1929.

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[1] Described in October 24th and 31st, 1928, issues of *The Wireless World*.

"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 interests 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 Mixed H.F. Amplifier.

Is there any real reason why an ordinary triode and a screened grid valve should not be used in combination in a two-stage H.F. amplifier? If you do not veto the idea, I propose for the first stage to use the three-electrode valve with a neutralised transformer (I already have the necessary components), and to follow it by the S.G. valve, also transformer-coupled, but, of course, not neutralised. Screening will be complete, and the various decoupling devices which have been suggested in your articles will be included.

H. d'A. E.

There does not seem to be any reason why an amplifier such as that you describe should not be capable of giving excellent results, and, in spite of the fact that the arrangement is unconventional, we think that you will not be disappointed with it. Provided reasonable precautions against instability are observed, the difficulties involved should be no harder to overcome than in the case of any two-stage H.F. amplifier.

o o o o

Lack of Selectivity.

My four-valve receiver, built more or less on the lines of the "New All-Wave Four," but with waveband switching in the manner suggested on one or two occasions in your journal, is quite satisfactory on the medium waves; indeed, the band of interference due to the local station is much narrower than I had hoped for. Contrary to expectations, however, the short-wave station is responsible for very severe interference over the lower part of the long-wave tuning scale, and this cannot be eliminated unless the aerial is tapped to a point so near the earthed end of the coil that signal strength is lost to a great extent. Is there an easy way out of the difficulty without going to the length of adding a coupled circuit?

E. D. H.

We strongly advise you to try the arrangement shown in Fig. 1, which is often effective in obviating shock-excitation of the grid circuit of the H.F. valve under the conditions you mention. Instead of using an auto-transformer arrangement for long-wave reception, you will see that we suggest that the aerial

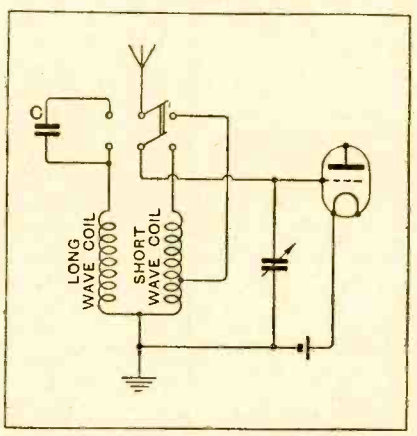

Fig. 1.—Series condenser aerial feed on long waves with auto-transformer coupling for medium-wave reception.

should be coupled to the high-potential end of the inductance through a fixed condenser C, with a capacity of about 0.0002 mfd. This value is best determined by trial, and something considerably smaller may be found to be necessary; it is not a bad plan to use a semi-variable condenser.

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.

o o o o

Milliammeter for the Megavox Three.

I have been given a milliammeter, and should like to fit it permanently to my "Megavox Three" receiver. Will you tell me as simply as possible how it should be joined up?

G. C. L.

Your instrument may most usefully be employed by inserting it in the anode circuit of the output valve. To do this you should break the lead which goes through the baseboard from the low potential end (the end *not* connected to plate) of the choke L_5. The ends of this wire will now be joined to the milliammeter terminals, that marked negative being joined to the wire connected to the choke.

o o o o

Pentode Two Output Circuit.

I am thinking of adding a choke filter output to my "Pentode Two" receiver. Is this addition likely to have any harmful effect? T. M. J.

The use of a choke filter output arrangement in conjunction with this receiver is quite permissible, and, indeed, it is a refinement that can be recommended. If your set is built exactly in accordance with the specification, you will probably find it necessary to mount the choke outside the cabinet.

o o o o

A Rule of Thumb.

Is there any simple rule for determining the number of turns necessary for a frame aerial to cover the broadcast waveband with a 0.0005 mfd. variable condenser? I seem to remember having seen one in your pages, but cannot recollect it. R. W. B.

There is no very simple, but at the same time scientifically accurate, method of determining the winding for a frame; but, provided it is wound in a fairly conventional manner, and is of average dimensions, you will find that the inductance will be sufficiently correct if you use about 75ft. of wire.

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CONTENTS OF THIS ISSUE.

THE VALVE.

IT has frequently been said that the valve is the heart of the wireless receiver, and this is certainly true, for no receiver can be better than the valves which are used with it.

Because of the importance of the valve, the choice of valves in a receiver is one of the first considerations with which both the designer and the user are confronted. First, it is essential that valves should be good specimens of their type, and the product of reliable manufacture. Next, it is absolutely necessary that the right valve shall be used in the right place in a receiver. Such a stipulation may seem an unnecessary piece of advice to offer to our readers, but we must be forgiven if we point out that our experience of technical difficulties and troubles of readers with their sets goes to show that not nearly enough care is exercised by many users in making a correct choice of the valves for the particular purpose to which they are to be put.

We believe that the publication in this issue of a supplement sheet, giving the principal types and characteristics of valves now on the market will prove a valuable source of information to our readers, and the sheet should be kept available for reference when required.

This issue also contains an article specially written with a view to assisting the reader in the task, by no means an easy one, of making sure that each valve in the receiver is of the type best suited for the work it has to perform.

A Step Towards Standardisation.

Fortunately for the user, the manufacturers are now at long last beginning to adopt some form of standardisation, agreed between them, as to how the properties of their various valves are to be indicated to the user. Hitherto there has been practically no uniformity of policy adopted by manufacturers in taking the characteristics of their valves, but it has now been agreed that measurements will be taken on the basis of zero grid bias and an anode potential of 100 volts. In the Data Supplement given in this issue, therefore, the A.C. resistance, mutual conductance, and amplification factor are all taken on the basis of zero grid bias and 100 volts H.T. potential. Perhaps we can be excused if we take some credit to ourselves in the belief that the recommendation made on several occasions in *The Wireless World* that such a policy of uniformity should be adopted has eventually had its effect, and is responsible for having encouraged the manufacturers to come to an understanding on the point.

We believe that we are correct in stating that in no other country is there anything approaching the large choice of types of good valves which are available to users here. This is due to the fact that there is probably more competition between manufacturers, and, therefore, a continual effort is made to produce valves better than those of competitors.

A Sign of Progress.

The mutual conductance of a valve gives the best indication of the all-round efficiency of the design, and in this connection it is interesting to observe that a marked improvement, especially in respect of power valves, has been achieved, and is shown in the characteristics of recent types. In approximately a year the mutual conductance of many power valves has been actually doubled, and this achievement is the more surprising, perhaps, when it is remembered that a year ago it was very generally thought that the technique of the valve was so far advanced as to preclude the probability of any further advances of importance.

The Importance of Selecting the Valve with Reference to the Component in its Anode Circuit.

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

THE number of different valves offered to the user by the various makers does not seem to lessen from year to year, but rather to grow greater with the passage of time. As a result of this, the ordinary listener frequently finds it a matter of very considerable difficulty to decide which, out of the many competing types, is the best to use for any particular purpose.

From the practical point of view, the differences between valves of the same type but made by rival makers may in general be ignored completely. After all, the performance of a wireless set is judged, in the end, by ear, and it must not be forgotten that *small* differences in overall amplification, or in the available output to the loud speaker, pass completely unnoticed by that very easy-going critic. So long, then, as a valve is reasonably well suited to its purpose, and is of a modern "high-efficiency" type, it may be depended upon for admirable results if properly used. It is, therefore, not necessary to take extravagant care in selecting a valve, although an entirely wrong choice will naturally lead to very unsatisfactory reception.

Filament Voltage.

If one is equipping an entirely new receiver, the first point that has to be settled is the filament voltage to be used. Two, four, or six volts? Not so many years ago valves of good performance were only to be found in the six-volt range, those designed for four or two volts lagging very far behind in efficiency. This state of affairs naturally created a very strong tendency to use six-volt valves wherever possible, and many still believe that the difference between the classes is as great now as it has been in the past. The modern two-volt valve, however, is enormously more efficient than its predecessors of a few years ago, and the gap between the classes has closed up to an appreciable extent. Indeed, the user of a two-volt accumulator can nowadays obtain valves that are more efficient than those which originally gave the six-volt class its title to fame. Nevertheless, one gets what one pays for, in valves as in everything else, and the extra wattage consumed by the filaments of valves of the six-volt class is still reflected in a higher efficiency.

Each user must, therefore, decide for himself whether the extra efficiency of the six-volt valve is worth having at the cost of an extra outlay on accumulator cells, higher cost of charging, and a heavier load to carry to the charging-station, or whether, on the other hand, he will accept, for the sake of the greater convenience and economy of the two-volt cell, the inevitable slight falling-off in his results. The four-volt valves, as might be expected, offer a compromise between the two-volt and the six-volt classes.

The modern tendency to charge at home with the aid of a trickle-charger or equivalent device may well result eventually in the wider use of six-volt valves, as no spare accumulator is required, charging costs are very small, and, as the accumulator does not need to be carried about, its greater weight ceases to be of any consequence.

Mains-operated Sets.

Where the filaments of the valves are lighted by alternating current derived from the mains through a step-down transformer, it will, of course, be necessary to choose valves designed to work in this way, and they must, in addition, work at the voltage provided by the transformer. The output valve, however, so long as it will operate at the voltage supplied, need not be specifically designed for alternating current.

Where D.C. mains are used, the filaments of all the valves in the set are usually connected in series. In this case all that matters is that the filament *current* should be the same for all valves; filament *voltage* can here be ignored.

Choosing the Right Valve.—

Apart from these points, the choice of a valve is made exactly as for a set in which the filament supply is drawn from an accumulator.

The Fundamentals of Valve Choice.

When the filament voltage has been decided upon, the field of choice is considerably narrowed, for we are naturally limited to valves suitable for the accumulator we intend to use. The filament current need hardly be taken seriously into consideration, for the modern valve does not take current enough to embarrass even the smallest accumulator. The figures that matter, and on the basis of which our choice must in all cases be made, are those of A.C. resistance (or *impedance,* as it is more usually but less correctly termed) and amplification factor, together with the ratio of these, which is variously called " mutual conductance " or " slope."

A valve may be chosen from either of two points of view. If the set is still to be built, one may choose the valve from which the highest degree of amplification can be extracted, and then design the set to suit it. This, however, is rather an advanced attitude, to deal with which in detail would require a book rather than an article, for it would necessarily involve the whole philosophy of receiver design. The more usual problem, and the one with which this article is concerned, is that of choosing correctly the valves for an existing set.

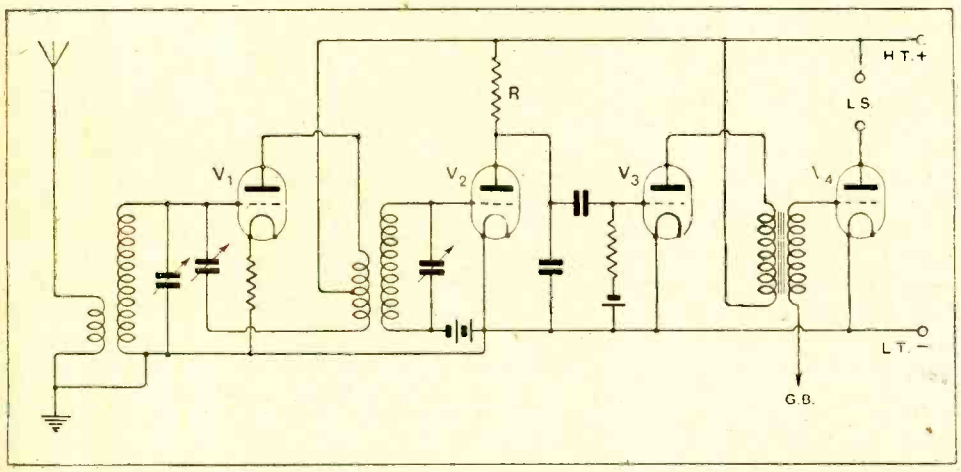


Fig. 1.—A typical four-valve circuit. The valves must be selected with reference to the character of the coupling components in their respective anode circuits.

The problem thus reduces itself to the much more manageable one of selecting a valve to suit the components already in the set. In practice this means that the valve must work correctly with the component in its plate circuit, for the component in the grid circuit of a valve is, comparatively speaking, of no consequence at all. Taking as an example a receiver such as that of which the circuit diagram is shown in Fig. 1, it follows, therefore, that V_1 must be chosen to work with the H.F. transformer, V_2 must be selected with reference to the resistance R, V_3 must be suited to the L.F. transformer, while the loud speaker must determine the characteristics of V_4.

Now the only characteristic of a valve that decides its suitability for working in conjunction with any particular component in its plate circuit is its *impedance.* A valve of the correct impedance will provide, on the low-frequency side, satisfactory quality and output, while on the high-frequency side it will ensure that the energy is correctly handed on to the detector. The fundamental necessity, then, is to choose a valve of the right impedance for the work it has to do.

Nothing has yet been said about the amount of amplification obtained from the valve; this depends upon that other vital figure, the amplification factor. Provided that the impedance is correct, it is always true that the higher the amplification factor of the valve put into the set the greater will be the amplification obtained from the stage in question.

The choice of a valve thus simplifies itself down to two successive operations: first, making the decision as to the impedance that will be required, and then selecting from a list of valves of the right filament voltage the one that, with an impedance somewhere near that required, has the highest amplification factor. A glance, perhaps, at the filament current to ensure that the valve picked out is not unduly extravagant, and one may sally forth and buy the valve selected with full confidence that it will give the best results of which the set is capable.

It will be seen that it is desirable to compile a list of all valves of the filament voltage required so that one may have the necessary data for the choice conveniently laid out. The information required may be obtained from the supplementary valve data sheet which accompanies this issue; with such a compilation before one it is easy to pick out the best valve available when the impedance that is wanted for any particular place in the receiver has been determined. The rest of this article, therefore, will be devoted to discussing the correct impedance to choose for plate-circuit components of different kinds.

High-frequency Amplifiers

If the receiver is a modern one, a stage of high-frequency amplification will be designed either on the neutrodyne principle, using a high-frequency transformer or a screen-grid valve, in which case it will probably employ the tuned-transformer or tuned-anode circuit.

Taking the first-mentioned case, we have to give consideration to the high-frequency resistance of the secondary and the ratio of secondary to primary turns. In the ideal case, the high-frequency resistance of the secondary would be measured carefully, but such a refinement as this is, of course, impracticable. Also it is unnecessary since we have already decided that the

Choosing the Right Valve.—receiver is to please our ears rather than to satisfy laboratory tests. Consequently it will suffice to divide secondaries roughly into two classes, of high and low resistance respectively.

Under the head of "Low-resistance Secondaries" we will include any that are wound in a single layer with fairly thick solid wire or Litzendraht. Into this class come practically all the transformers described in constructional articles in these columns. Provided that the dielectric losses of a tuned circuit, including a coil of this type, are not unduly enhanced by the needless use of synthetic insulating materials in place of ebonite, or by mounting the coil in such a way that the ends of the winding are brought to a mount composed of a poor dielectric, the dynamic resistance of the tuned circuit will probably amount to some 250,000 ohms. On the basis of this figure it is possible to calculate quite easily the impedance required for the high-frequency valve if the step-up ratio of the transformer is known.

This can easily be determined by counting first the number of turns on the secondary, and then the number of turns on the primary, and dividing the latter into the former. Thus, if there were 80 turns on the secondary and 20 on the primary, the transformer-ratio would be 4. Having arrived in this way at the ratio of the transformer, reference to Table I will give at once the value of the impedance that the high-frequency valve should possess.

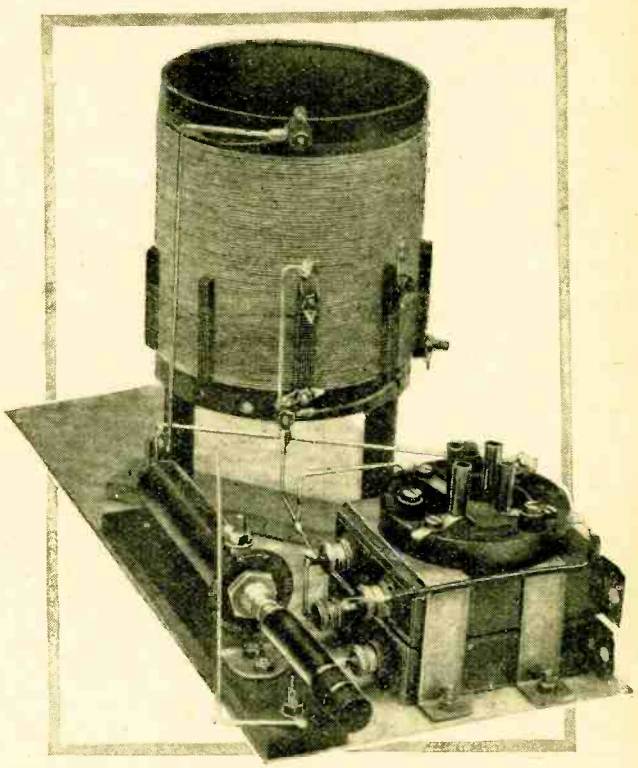
TABLE I.

APPLICABLE TO LOW-RESISTANCE SECONDARIES ONLY.

Transformer Ratio.	Valve Impedance (Ohms).
10.	2,000.
9.	3,000.
8	4,000
7	5,000
6	7,000
5	10,000
4	16,000
3½	20,000
3	28,000
2½	40,000
2	60,000

FROM A GRAPH WE GET.

If the secondary of the transformer is wound with fine wire, is a multilayer coil of any of the usual types, or is surrounded by a close-fitting metal screen or connected in a tuned circuit including a large amount of synthetic insulating material, it must be classed roughly as a high-resistance coil. Into this class must also be put any transformer which, for the broadcast band, is tuned with a condenser of larger maximum capacity than 0.00035 mfd. The dynamic resistance of such a transformer will probably amount to some 75,000 ohms. at the middle of the tuning range, and the various values for valve impedance for different ratios are given, on the basis of this figure, in Table II.



A typical low-resistance high-frequency transformer the secondary of which is wound with Litz wire.

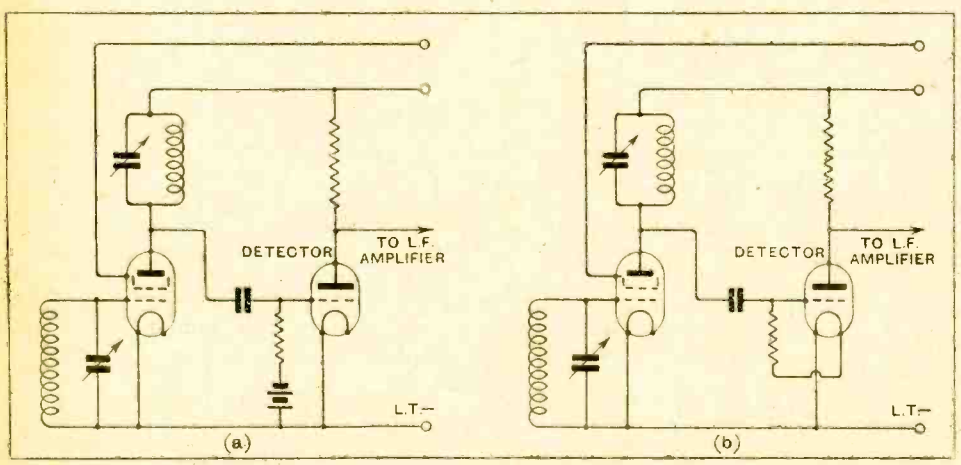


Fig. 2.—In a circuit such as that shown in 2 (a) the presence of a grid-leak and grid-condenser must not necessarily be taken as a proof that grid-rectification is in use. This diagram shows an *anode-bend* detector, as may be recognised from the presence of the negative grid bias. For a grid-rectifier, the grid-leak would be connected to L.T.+, as shown in Fig. 2 (b).

TABLE II.

APPLICABLE TO HIGH-RESISTANCE SECONDARIES ONLY.

Transformer Ratio.	Valve Impedance (Ohms).
5	3,000
4	4,500
3½	6,000
3	8,000
2½	12,000
2	19,000
1¾	25,000
1½	33,000
1¼	50,000

The remarks already made as to the classification

Choosing the Right Valve.—

of secondaries according to their resistance do not apply to transformers used for reception on longer waves (5XX coils); these, owing to the higher ratio of inductance to capacity, may invariably be classed as "low resistance."

Before passing on, the effect upon receiver performance to be anticipated as a consequence of a deviation from the correct value of valve-impedance must be briefly mentioned. The use as high-frequency amplifier of a valve having an impedance higher than that suggested in the tables will usually lead to a slight loss of amplification, and will always provide a gain in selectivity. If the valve chosen has a lower impedance than that suggested, both selectivity and amplification will suffer heavily. It will, therefore, be seen that the figures given are really *minimum* values for valve-impedance, it being sometimes profitable, where selectivity is of the first importance, to use a valve of higher impedance than that specified, but never anything but harmful to the performance of the receiver to use one of lower impedance.

It must not be supposed that the figures given must be adhered to with perfect rigidity, because they are, after all, based on a rough guess as to the properties of the tuned circuit. In any case, a variation from the best value of twenty per cent. or so would hardly alter the performance of the receiver to an extent that could be detected by ear. To take a numerical instance, if the table suggested 20,000 ohms as a suitable impedance, any value between 16,000 and, perhaps, 25,000 (or even 30,000, if extra selectivity was wanted) would be quite satisfactory, so that there would be, possibly, half-a-dozen valves to choose from, each of which has an impedance lying between these limits. Of these, the valve having the highest amplification factor is, as might be anticipated, the one to choose.

Concerning Screen-grid Valves.

Where the receiver is designed for a screen-grid valve the choice is comparatively simple, for valves of this class do not vary very greatly from one another in characteristics. One may give the general rule that if the tuned-anode circuit is of low resistance, as judged by the criteria already described, a valve of high impedance should be chosen, but that if their resistance is high a valve of lower impedance will generally give the greater amplification. The characteristics of screen-grid valves can, however, be varied over such wide limits by manipulation of the operating voltages that these remarks can of necessity carry but little weight. It will in most cases be found best to select the valve with the highest mutual conductance or slope (found by dividing amplification factor by impedance).

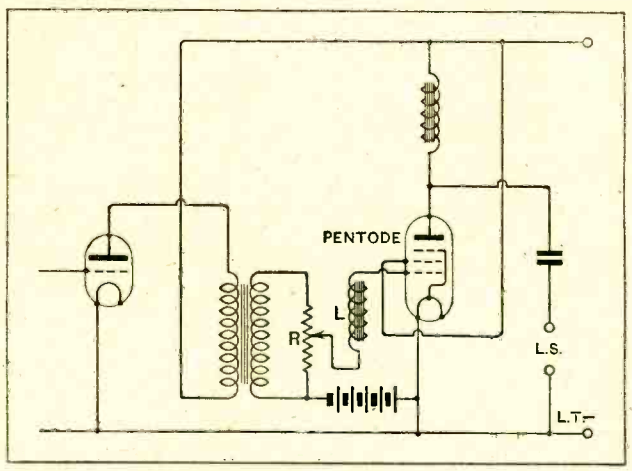


Fig. 3.—A suggested circuit to reduce the input to a pentode valve. R is a high-resistance potentiometer built up of two grid leaks in series. The values should be chosen by experiment; L represents a small iron-core choke of fine wire.

The Detector Valve.

The choice of a valve to fulfil the duty of detector is dependent upon fewer variable quantities, and so is easier to make. If it is an anode detector (which may be recognised, if there is any doubt, by the fact that the grid will be biased negatively to obtain rectification) it will probably be coupled to the next valve by a resistance. In this case the impedance of the valve may very satisfactorily have about one-fifth of the value of the anode resistance. Thus an anode resistance of a quarter of a megohm (250,000 ohms) would work well in conjunction with a valve of about 50,000 ohms impedance. The anode resistance may be tucked away out of sight in the recesses of an R.C.C. unit, so that its value cannot be found; from 50,000 ohms upwards will still be a very suitable figure for the valve.

Sometimes an anode detector is followed by a transformer; in such a case as this a valve of very different type must be employed, and no greater impedance than some 12,000 ohms should be permitted. The very highest amplification factor that is compatible with so low an impedance should be chosen. A transformer of special design is usually adopted.

For the more commonly employed grid detector, valves of very high impedance are not suitable unless a stage of high-frequency amplification precedes. If this is the case, the valve, if followed by a resistance, may have the impedance suggested for anode detection. If, on the other hand, it is followed by a transformer, it may have an impedance of some 15,000 to 25,000 ohms or more, depending to some extent upon the excellence of the transformer in use and the standard of quality required. The higher the impedance of the detector the more sensitive it will be, and the less will be the proportion of low notes in the output to the loud speaker.

If the detector is the first valve in the set, it should not have an impedance greater than some 35,000 ohms, even if followed by a resistance, or difficulty may be found in obtaining reaction effects. Apart from this limitation, the foregoing remarks apply in their entirety.

The Low-frequency Amplifier.

Under this heading we include valves that come between the detector and the output valve, but not the output valve itself. Thus V_3 of Fig. 1, but not V_4, should be chosen on the basis of the considerations in this section.

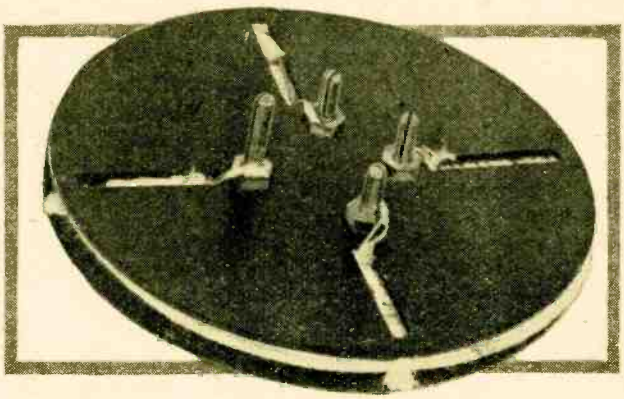
Choosing the Right Valve.—

This understood, there is but little left to say, for the rules that govern the choice are exactly those which govern the choice of a grid rectifier. The restriction ruling out valves of very high impedance is not operative here since we do not expect the valve to supply reaction. For resistance coupling, the valve impedance may be one-fifth or one-quarter of the value of the resistance in its plate circuit; for transformer coupling, 15,000 to 25,000 ohms, as before. In either case, as usual, the valve with the highest amplification factor that can be found in conjunction with the required impedance will give the greatest magnification.

The Output Valve.

The choice of a valve to work the loud speaker depends to some extent upon the loud speaker itself, but more upon the available supply of anode current. For the average "high resistance" speaker, of whatever type, there is no need to use a valve of lower impedance than about 3,000 to 4,000 ohms, nor, if the greatest undistorted output is required, should the valve have an impedance greatly in excess of the latter figure. Such a valve as has been suggested, however, will take a current of about ten to fifteen milliamps. at normal plate voltages, and this current, when added to the plate currents drawn by the rest of the set, will give dry batteries rather a short life. Unless the biggest batteries are used, and their replacement at rather frequent intervals is not objected to, it will be wiser to use a valve of slightly higher impedance—perhaps some 6,000 ohms or so—for the sake of economy in batteries.

If high-tension accumulators or the mains supply the power for the set, these limitations fall away, and a valve of about 3,000 ohms impedance should be given preference. Providing that the receiver can give it the input of signals that it requires, such a valve will give the greatest output attainable with the H.T. voltage in use.



A high-frequency transformer with comparatively large high-frequency resistance.

If the output valves are arranged in "push-pull," each may have with advantage an impedance as low as 1,500 ohms, but in this case much depends upon the design of the output transformer, so that no rules can be laid down. The makers of the transformers would probably supply definite information if any doubt is felt.

The introduction of the pentode valve offers a further variation and the opportunity of a greater output than can be obtained in any normal way from a reasonable high-tension voltage. These valves, however, are but seldom used except in a receiver designed expressly for them, as the amplification attained with them is so high that the detector valve is worked under quite unsuitable conditions if an appreciable amount of low-frequency amplification is in use.

If it is desired, for the sake of the extra output that can be obtained, to use a pentode in a receiver not specifically designed for it, it will be found best to reduce the amplification of the intermediate stages to a low figure. This is most easily done where resistance-coupling is in use, for it is only necessary to substitute a valve of quite low impedance—say, 6,000 ohms or so—for that normally used, replacing the original anode resistance by one of about 25,000 ohms. If the intermediate valve is followed by a transformer, the change is rather more difficult to make without spoiling quality; Fig. 3 offers a possible solution of the difficulty, though one not altogether free from objections. It is, however, the best that has yet occurred to the writer.

The pentode gives of its best when followed by a moving-coil loud speaker with a specially wound coil, but it may be used with considerable satisfaction with loud speakers of other types, especially if the impedance of these is high. It should be noted that an output choke designed for a low-impedance valve may fail seriously when a pentode is used, and it may be necessary to substitute a more heavily built choke of higher inductance.

New Call-signs for Irish Free State Amateurs.

Every licensed transmitting amateur in the Irish Free State has received a letter from the Minister for Posts and Telegraphs setting forth the new conditions fixed by the International Radio Telegraph Convention. A constant reminder of the new regulations is furnished by the call-signs, which have been changed in every case, not only in respect of the intermediate, but the call number itself. We are indebted to the *Irish Radio News* for the following directory of new call signs :—

E12B	(late GW11B) Col. M. J. C. Dennis, C.B. Fortgranite, Baltinglass, Co. Wicklow.
E13B	(late GW12B)
E14B	(late GW13B) The Wireless Society of Ireland, 12, Trinity Street, Dublin.
E15B	(late GW14B) J. P. Campbell, Martello Terr., Sutton, Co. Dublin.
E16B	(late GW16B) H. J. Duncan, 2, Albert Rd., Sandycove, Co. Dublin.
E17B	(late GW17B) W. Warren, Tritonville Av., Sandymount, Co. Dublin.
E18B	(late GW18B) D. M. and D. F. O'Dwyer, 9, Upper Leeson St., Dublin.
E19B	(late GW19B) H. Goldsborough, Shaftesbury House, Fethard, Tipperary.
E12C	(late GW12C) L. H. Carder, Industria Minerals of Ireland, Ltd., Dunsinea, Castleknock, Co. Dublin.
E13C	(late GW13C) E. W. Boursin, The Square, Listowel, Co. Kerry.
E14C	(late GW14C) D. G. Kennedy, B.A., 21, Morehampton Rd., Dublin, S.E.1.
E16C	(late GW16C) G. H. Horrander, 44, Dufferin Av., S.C.R., Dublin.
E17C	(late GW17C) J. B. and R. D. Scott 9, Upper Carville Av., Rathgar, Dublin.
E18C	(late GW18C) W. H. Benson 46, Dufferin Av., S.C.R., Dublin.
E19C	(late GW19C) J. Pennefeather, Cork.
E12D	(late GW11D) T. Fitzpatrick, Railway House, Naas, Co. Kildare.
E13D	(late GW12D) C. U. Burke, 11, Eglinton Rd., Bray, Co. Wicklow.
E14D	(late GW13D) R. N. V. Sadlier, 1, Sommerville Park, Upper Rathmines, Dublin.

APERIODIC H.F. AMPLIFICATION WITH MODERN VALVES.

Suggestions for the Application of Recent Developments in Valve and H.F. Choke Design.

IN designing valve couplings for low-frequency amplification it is necessary to make the impedance connected in the anode circuit of each valve as large as possible, and in any case not less than three or four times the A.C. resistance of the valve itself. The origin of this rule is to be found in the fundamental equation for intervalve couplings, which is quite simple, and may be stated as follows:—

$$A = m.\frac{Z}{R_{A.C.}+Z}$$

where A = amplification derived from the stage m = amplification factor of the valve, $R_{A.C.}$ = A.C. resistance of the valve, and Z = impedance (in ohms) connected in the anode circuit. The formula is of universal application and can be applied without modification to resistance and choke-capacity couplings; in the case of transformer coupling it is necessary to multiply by the step-up ratio of the transformer.

Uniform Amplification of all Frequencies.

It is fully realised that the foregoing method of calculating the amplification per stage is only a first approximation, but it is unnecessary to go in detail into the corrections required to obtain a strictly accurate result, for these are only of secondary importance and do not affect the validity of the general principles involved.

It will be seen by inspection of the formula that when the anode impedance (Z) is equal to the valve resistance ($R_{A.C.}$), the amplification obtained from the stage will be just half the valve amplification factor. By working out the result for progressively larger values of Z the reader can satisfy himself that the greater the value of Z, the more nearly does the amplification obtainable approach the amplification factor of the valve.

In the case of choke-coupled low-frequency amplifiers, in which the impedance Z of the choke increases with frequency, it is necessary to choose a choke of such an inductance that its impedance at the lowest frequency to be amplified is at least three times the valve resistance, otherwise there will be an audible falling off in volume at the lowest frequency. With an anode impedance three times that of the valve, the amplification obtained will be 25 per cent. less than the maximum, and this difference is approaching that which can be detected by the normal ear.

Choke-coupled H.F. Amplifiers.

It is easy to fulfil the foregoing conditions in low-frequency amplifiers, but attempts at aperiodic H.F. amplification with H.F. choke coupling have hitherto met with small success. The amplification on wavelengths above 1,000 metres was quite satisfactory, but between 200 and 500 metres the amplification, if any, was very poor. The reason for this will be readily understood now that figures are available showing the impedance of H.F. chokes of standard make at various wavelengths. The valves usually employed in choke-coupled H.F. amplifiers have an A.C. resistance of not less than 20,000 ohms, yet the impedance of the average choke at 200 metres is only 10,000 ohms; instead of being three times the valve resistance it is only one-half. Above 1,000 metres the impedance of the average choke is 100,000 ohms or more, and this value increases rapidly as the wavelength is raised, until it reaches about 300,000 ohms at the resonant wavelength of the choke. Hence the uniformly high amplification on long waves.

Valves with Low A.C. Resistance and High Amplification.

Of course, it is easy to obtain uniform H.F. amplification from 200 to 2,000 metres by using a valve of, say, 2,000 ohms A.C. resistance, but the amplification factor of such valves is so small that the game is not worth the candle.

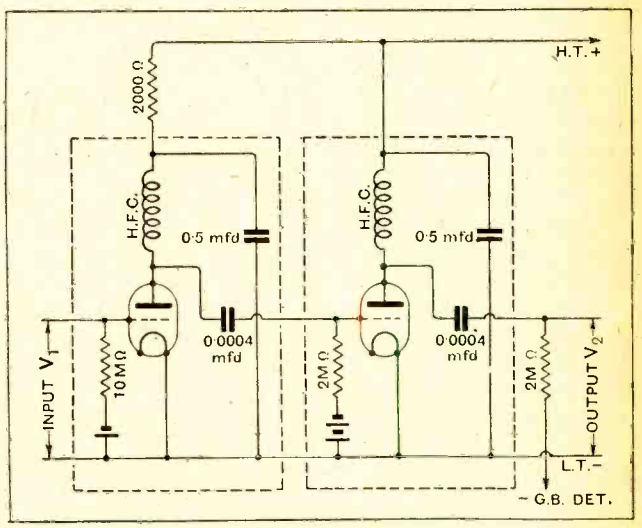


Fig. 1.—Circuit diagram of two aperiodic H.F. stages in cascade; Lewcos chokes, P.M.4D.X. valves, H.T. = 120 volts, grid bias to first valve = 1½ volts and to second valve = 3 volts to increase A.C. resistance to match first valve.

The advent of such valves as the P.M.4D.X., which has a rated amplification factor of 15 with an A.C. resistance as low as 7,500 ohms, and the general improvement in the characteristics of H.F. chokes, make it worth while to reconsider this method of amplification.

Accordingly, a two-stage amplifier was constructed along the lines indicated in Fig. 1, and measurements were made on each stage taken separately and on the

Aperiodic H.F. Amplification with Modern Valves.—two stages in cascade. "Lewcos" chokes and P.M.4D.X valves were employed, and the coupling condensers and leaks were of 0.0004 mfd. and 2 megohms respectively. To eliminate stray couplings the stages were separately screened, and the H.T. supply to the first stage was fed through a 2,000-ohm resist-

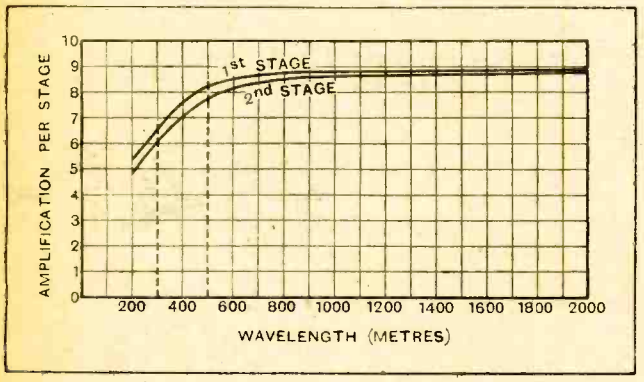


Fig. 2.—Wavelength-amplification curves of each stage taken separately.

ance. In order to compensate for the effect on the valve A.C. resistance of the reduction of H.T. due to the feed resistance, the grid bias was also reduced for this stage. The input and output voltages were measured at various wavelengths, the ratio of the voltages giving the overall amplification.

The curves of Fig. 2 show the characteristics of each stage taken separately. It will be observed that the maximum amplification obtained is less than the rated amplification factor of the valve. This was found to be due to the fact that the amplification factors of the valves under working conditions were less than the rated figures. In the table below the calculated amplification is compared with the measured amplification for each stage. For purposes of comparison the amplification at 2,000 metres has been taken as the maximum.

Wavelength.	Percentage of Max. Amplification.		
	Calculated.	1st Stage.	2nd Stage.
200	64	60.5	55.5
300	77	70.5	70
400	84	86	81
500	88.5	93	89
1,000	97	98	99
2,000	100	100	100

In view of the difficulty of taking measurements at radio frequencies, the agreement with theory is good and the results are sufficient proof of the validity of the ideas involved. The difference in amplification between 300 and 2,000 metres would be *aurally* imperceptible.

As most broadcasting stations fall within this waveband the single choke-coupled stage can be regarded as a true aperiodic H.F. amplifier for broadcast reception.

When we come to investigate the case of two stages in cascade, the results are found to be disappointing. Fig. 3 shows the characteristic of the two stages connected as in Fig. 1. There is a steady increase of amplification over the whole range from 200 to 2,000 metres, and the combination is much more sensitive to long than to short-wave transmissions. The reason for the abnormally high amplification is to be found in the fact that the H.F. chokes are approaching resonance and that through the 0.0004 mfd. condenser the first H.F. choke is effectively coupled to the grid circuit of the second valve.

However, the use of a single aperiodic stage to give a preliminary boost to very faint signals, before passing on to a tuned H.F. stage or reacting detector, should

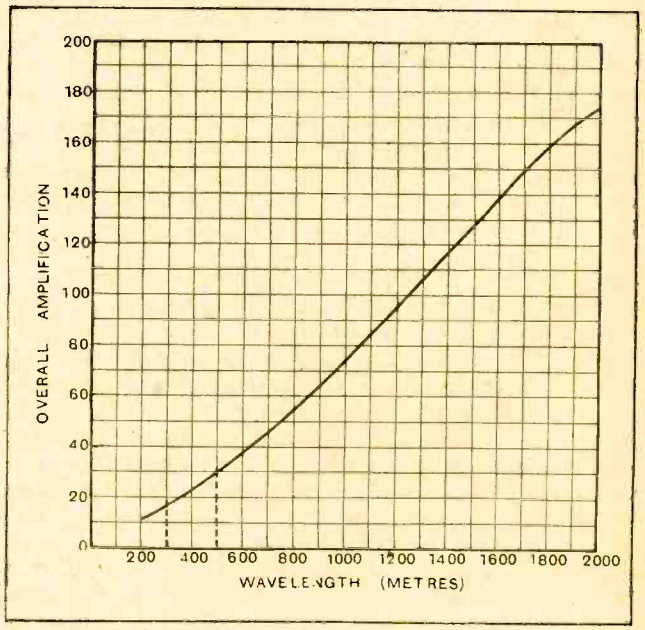


Fig. 3.—Overall amplification characteristic of two stages in cascade.

prove of great value to set designers. The single stage is stable, trouble-free, and uniform in its action, and the additional H.F. amplification preceding the detector is by no means to be despised, particularly in the case of very weak signals. This point has been fully appreciated in the past by designers of superheterodyne receivers, who have very frequently incorporated an H.F. stage before the first detector when receiving on a frame aerial. Similar conditions prevail in the modern portable set, and it is in this direction that the aperiodic H.F. amplifier finds its most useful employment.

F. L. D.

WHICH STATION IS THAT?

The Wireless World gives its readers a station identification service. Details of time, item and approximate wavelength or relative dial settings should be furnished.

INTERPRETING VALVE DATA.

How to Make the Best Use of *The Wireless World* Valve Data Sheet.

ACCOMPANYING this issue is a supplementary sheet giving in tabular form the more important characteristics of some 250 different valves manufactured in Great Britain. Having decided the L.T. voltage to employ and the type of anode supply, the next most important constant is the A.C. resistance of the valve, which should be chosen with reference to the nature of the coupling component in its anode circuit, as explained in an article entitled "Choosing the Right Valve" which appears in this issue. With a given A.C. resistance the greatest overall amplification will be obtained when the figure in the mutual conductance column is greatest. In this connection it should be mentioned that British valve manufacturers have agreed to quote their A.C. resistances, amplification factors, and mutual conductances at zero grid volts and 100 volts H.T., which undoubtedly gives a fair basis for comparison.

When valves are used under amplifying conditions the negative bias employed would result in a lower mutual conductance than when zero bias is used, but it may safely be assumed that a higher H.T. voltage than 100 would be employed, improving the figure for mutual conductance, so that the data given in the three columns concerned strike a fair compromise under working conditions. The grid bias column gives the negative grid potential, in multiples of $1\frac{1}{2}$ volts, that is necessary under amplifying conditions when the maximum permissible anode voltage, as given in the preceding column, is applied. If the same anode potential is applied for anode-bend rectification it is generally safe to bias the valve to about twice the figure shown.

In the case of screen-grid valves, the optimum screen voltage (at maximum H.T.) is quoted because it is somewhat critical owing to the presence of a negative resistance kink in the characteristic, but no attempt has been made to give even an approximate figure for screen current, as this varies so widely according to conditions obtaining in a receiver; in fact, it is possible for this current to become negative, as explained elsewhere in this issue. A little extra amplification can often be obtained when the control grid of a screen-grid valve is biased about $\frac{3}{4}$-volt negative. With regard to pentodes, the screen potential is not critical, and, in order to reduce considerably the plate current, without much loss of signal strength, it is possible to decrease the screen voltage to, say, 75 per cent. of the plate voltage, provided that the bias is reduced accordingly.

When using voltage-dropping resistances in decoupling schemes or with eliminators, the pentode screen current is of importance, and has been given for maximum H.T., optimum screen volts and bias as an additional figure in the average anode-current column. In designing a receiver scientifically, so that the successively growing signal voltage swings can be safely accommodated by each valve in turn, it should be remembered that the permissible grid swing of a valve is twice the figure given in the bias column.

When deriving H.T. current from lighting mains the average anode current column should prove of great assistance in fixing the values of the various voltage dropping or smoothing resistances.

It may be helpful, in order to show how we can make best use of the Valve Data Sheet, to take as an example a popular three-valve set, such as *The Wireless World* "Regional Receiver,"[1] and to choose for it suitable modern valves of high mutual conductance. The low-resistance high-frequency transformer, of the type used in the "Everyman Four," requires for maximum efficiency a valve having a high mutual conductance and an A.C. resistance of some 30,000 ohms (see article already referred to entitled "Choosing the Right Valve"). The Marconi or Osram H.L.610 fulfils these requirements, and it will be seen that with an anode voltage of 150 a negative bias of $1\frac{1}{2}$ volts is necessary.

Choosing New Valves.

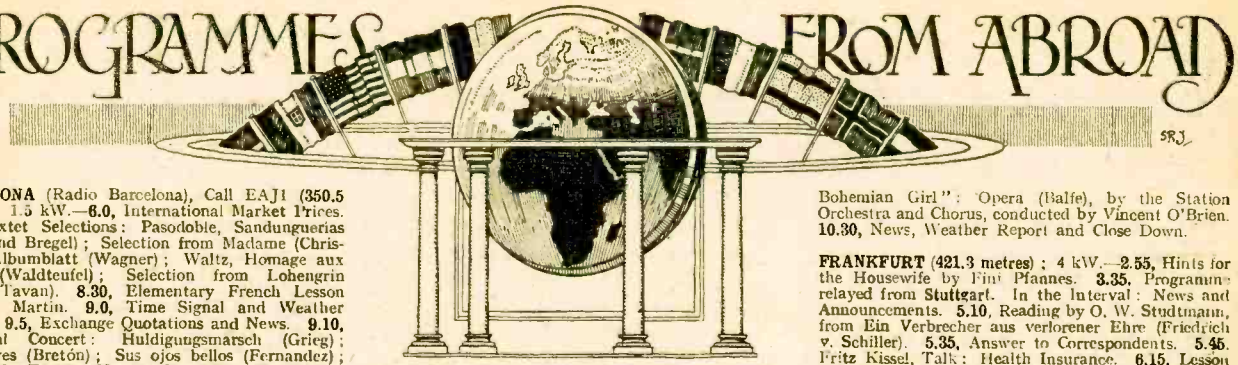
A happy choice for the anode-bend detector would be the six-volt member of the new sharp-bend steep-slope "D" valves—namely, the Mullard P.M.6D—with the high mutual conductance of 2. As this valve has an A.C. resistance of 9,000 ohms, it would be as well to reduce the anode coupling resistance in the receiver from 250,000 to 50,000 ohms so that the stage amplification is sufficiently small to permit the use of a pentode output valve. As the P.M.6D requires $4\frac{1}{2}$ volts bias at 150 volts H.T. for amplification (see tables) it would be necessary to use $4\frac{1}{2} \times 2 = 9$ volts bias for anode rectification with the same value of H.T. potential.

A new six-volt pentode—the P.M.26—is now available, and would more than double the acoustic output as compared with that from a triode. It will be observed that the bias for this valve is 12 volts for 150 volts H.T. An examination of the tables will show that the total anode current is 1.8 mA. for the H.F. valve, plus 24 mA. for the pentode, and a fraction of a milliamp. for the detector, totalling just over 26 mA. This load is within the discharge capabilities of H.T. accumulators, from which one common positive lead at 150 volts would be taken. If a mains H.T. eliminator be chosen to feed this receiver, and the voltage available at the input to the filter circuit under the load conditions were 200, the resistances required to drop 50 volts for the H.F. valve would be $\frac{50}{0.0018} = 30{,}000$ ohms (approx.), and for the pentode plate and screen respectively $\frac{50}{0.021} = 2{,}500$ ohms and $\frac{50}{0.003} = 15{,}000$ ohms. The anode-bend detector would be fed from a potential divider, as recently explained in this journal.[2]

[1] This receiver, although described in August, 1927, is based upon what is still considered to be fundamentally sound practice, and employs a neutralised triode coupled by a litz-wound H.F. transformer to an anode bend detector, which in turn is resistance-coupled to an output valve.

[2] *The Wireless World*, November 28th, 1928, p. 724.

PROGRAMMES FROM ABROAD



SATURDAY, FEBRUARY 16th.

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

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—**6.0,** International Market Prices. **6.10,** Sextet Selections: Pasodoble, Sandunguerias (Tápia and Bregel); Selection from Madame (Christiné); Albumblatt (Wagner); Waltz, Homage aux Dames (Waldteufel); Selection from Lohengrin (Wagner-Tavan). **8.30,** Elementary French Lesson by Prof. Martin. **9.0,** Time Signal and Weather Report. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Concert: Huldigungsmarsch (Grieg); La Dolores (Bretón); Sus ojos bellos (Fernandez); Ritmos de España No. 2 (Raurich); Ronde des Lutins (D'Ambrosio); Overture to Idomeneo (Mozart). **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (365.9 metres); 1.5 kW.—**5.30,** Programme for Children. **6.0,** Programme for Girls. **7.0,** Orchestral Selections. **7.30,** Concertina Recital. **7.50** Topical Talk. **8.0,** Talk on the Theatre. **8.30,** Ballad Recital. **9.0,** Weather Report, News, and Time Signal. **9.15.** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (1,648.3 metres); 40 kW.—**12.45,** Phototelegraphy Transmission. **1.30,** Programme for Children. **2.0,** Herr B. K. Graef, Talk: Elocution. **2.30,** Weather Report and Exchange Quotations. **2.40,** Talk for Women. **3.0.** Educational Talk by Fritz Westermann. **3.30,** Programme from Hamburg. **4.30,** Talk by Dr. Völter. **5.0,** Dr. Adolf Reichwein, Talk: Educational Travels abroad for Young Workers. **5.30,** Elementary Spanish Lesson. **5.55,** Hauptmann Rohde, Talk: Algiers and Tunis—The Land of its People. **6.20,** Prof. Kestenberg, Talk: The Rudiments of Music in the Life of our Time. **7.0,** "Rural Programme": "The Awakening of the Town," (a) Uhrschläge der Turmglocke, (b) Morgenfanfaren der Türmer from Lohengrin (Wagner) (c) Weckweisen der Statthalter und Stadtmusik; Serenades, (a) Schäfers Sonntagslied (Kreutzer), (b) Paraphrase in Kromes Grüsse an die Heimat (Nehl), (c) Der kreuzfidele Kupferschmied March (Peter); "Ein Gemeenderoate"—Monologue in Silesian Dialect; "Noonday Music on the Market Square," (a) Elfenmarsch (Rindel), (b) Aufzug der Stadtwache (Jessel), (c) Soldier's Chorus from Rübezahl (Flotow), (d) Katzbachmarsch (Becker). **8.0,** Orchestral Concert: La Poeme de l'Extase (Scriabine); Suite, Czar Saltana (Rimsky-Korsakoff); Eine Nachtauf kahlem Berge (Moussorgsky); Classical Symphony (Prokofieff). **9.0,** Programme from **Vox-haus.**

BERLIN (Voxhaus) (475.4 metres); 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m**, Weather Report, News and Time Signal. **10.0,** 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. Erwin Sadowski, Talk: The German Cultural Work in China. **3.0.** Talk on Medical Hygiene by Dr. Paul Frank. **3.30,** Talk and Reading from the Works of Hermann Stehr. **4.0,** Orchestral Concert: Overture to Mignon (Thomas); Leidenschaftliche Frage (Dransmann); Two Ballet Scenes from Hamlet (Thomas); Selection from Carmen (Bizet); Jacqueline (Krome); Waltz, Die Schönbrunner (Lanner); Two Lyrical Pieces (Grieg). (a Nocturne, (b) March of the Dwarfs; Serenata di baci (de Micheli); Selection from The Minnesingers (Amadei) followed by Programme Announcements. **5.30,** Paul Neubecker, Talk: Social Insurance. **6.0.** Dr. Hans Strobel, Talk: Music in the World of To-day. **6.30,** Talk: The Younger Generation. **7.0,** "With the Microphone through Berlin," by Fred Hildebrandt and Alfred Braun. **9.0,** Water Polo Match, Germany v. England, relayed from the Luna-park, followed by Weather Report, News, Time Signal, Sports Notes and Dance Music. **11.30** (approx.), Close Down.

BERN (407 metres); 1.5 kW.—**4.0,** Concert by the Kursaal Orchestra. **6.29,** Time Signal and Weather Report. **6.30,** Frau Alice Hubschmid-Nöel, Talk: The Master of the House and his Guests. **7.0,** "The Bird Fancier"—Operetta in Three Acts (Zeller). After the Second Act—News. **10.0** (approx.), Dance Music. **11.0** (approx.), Close Down.

BRESLAU (321.2. metres); 4 kW.—**2.0,** Review of Books by Dr. Werner Milch. **3.0,** Concert from the Works of Oscar Fétras: Overture, Liebe schafft Rat; Waltz, Märchen aus dem Quellental; Kinderlieder Marsch; Waltz, Veilchen am Wege; Polospiele; Xylophone Solo, Polka, Funkensprache; Frohsinn auf den Bergen; Waltz, Redaktionsgeheimnisse; The Tyrol in Song and Dance; Overture, Blumenfest; The Turkey Trot; Waltz, Moonlight on the Alster; March, Freikugeln. **4.30,** Review of the Films of the Week. **5.10,** Talk by Herr Paul Walter, relayed from **Gleiwitz** (326.4 metres). **5.35,** Hans Joachim Plein, Talk in Esperanto: The Silesian Plant-world. **5.45,** Herr Schmidt, Talk: Silesian Frontiers. **6.20,** Shorthand Lesson. **6.50,** Dr. Humann, Talk: The Legal Punishment of the Future. **7.15,** Reading from his own Works by Hans Grimm. **7.45,** "Is Mr. Brown to be Condemned"? Farce (Fuchs and Wolf). **9.0,** News and Announcements. **9.30,** Dance Music. **11.0** (approx.), Close Down.

BRÜNN (432 metres); 2.5 kW.—**6.5,** Orchestral Concert: Overture to Cavalleria Rusticana (Mascagni); Exotic Suite, Mamaloi (Leuschner); Selection from Faust (Gounod); Selection from Carmen (Bizet); Fantasia on Turandot (Puccini); Selection from I Pagliacci (Leoncavallo). **6.45,** Programme from Prague. **7.0,** Programme of French Popular Music. **8.0,** Selections for Balalaïkas. **8.30** Orchestral Concert. **9.0,** Programme from Prague. **9.20** Programme Announcements and Theatre Notes. **9.25,** Tzigane Music relayed from **Bratislava** (278 metres).

BRUSSELS (512 metres); 1.5 kW.—Experimental Transmission on a High Power. **5.0,** Dance Music from the St. Sauveur Palais de Danse. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Pianoforte Selections. **7.0,** Selection of Gramophone Dance Records. **7.30,** La Radio Chronique. **8.15,** Concert from the Works of Massenet: Overture to Phèdre; Song; Prelude from Hérodiade; Song; Marche Sainte et danse sacrée; Song; Ballet Music from Hérodiade; Ballet Music from Le Cid; Three Melodies; Ballet Music from Manon; Song; Prelude from Roma; Song; Selection from Les Erynnies. In the Interval: Topical Talk. **10.10,** News and Announcements in Esperanto. **10.15,** Concert from the Palace Hotel. **11.0** (approx.), Close Down.

BUDAPEST (555.5 metres); 20 kW.—**4.0,** Literary Programme. **4.30,** Hungarian Song Recital. **5.30,** Talk on Wagner. **6.0,** Selection of Gramophone Records. **6.20,** Introductory Talk to the following Transmission. **6.30,** "Rheingold": Opera (Wagner). **9.0,** Time Signal, Weather and Tide Reports and News, followed by Concert by the Tzigane Orchestra from the Grand Hotel Britannia.

CRACOW (314.1 metres); 1.5 kW.—**4.0,** Programme of English, Scotch and Irish Tales. **4.25,** Talk relayed from **Warsaw.** **4.55,** Programme from **Warsaw.** **5.50,** Miscellaneous Items and News. **6.10,** Talk on Wireless. **6.56,** Time Signal from the Astronomical Observatory. **7.0,** Chimes from the Church of Notre Dame. **7.5,** Talk on 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 (411 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,** Pianoforte Solos by Dina Copeman. **8.15,** "The Bohemian Girl": Opera (Balfe), by the Station Orchestra and Chorus, conducted by Vincent O'Brien. **10.30,** News, Weather Report and Close Down.

FRANKFURT (421.3 metres); 4 kW.—**2.55,** Hints for the Housewife by Fini Pfannes. **3.35,** Programme relayed from **Stuttgart.** In the Interval: News and Announcements. **5.10,** Reading by O. W. Studtmann, from Ein Verbrecher aus verlorener Ehre (Friedrich v. Schiller). **5.35,** Answer to Correspondents. **5.45.** Fritz Kissel, Talk: Health Insurance. **6.15,** Lesson in Esperanto by W. Wischhoff. **6.45,** Herbert Schäffner, Talk: Animals in Literature. **7.15,** "Reissinger v. Reissinger," followed by Dance Music from **Vox-haus.** **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (392 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. **11.40 a.m.,** Concert relayed from **Hanover** (566 metres). In the Interval at **11.55 a.m.,** Time Signal. **12.10,** News and Snow Report. **1.40,** Exchange Quotations. **2.30.** Review of Books. **3.30,** "Sunshine in Venice." **4 30.** Orchestral Concert. **5 30,** Dr. Carl Krämer, Talk: The Labour Market. **5.55,** Dr. Guido Möhring, Talk: The Prevention of Graft in Business. **6.20,** Relay from the Research department of the Eppendorf Hospital. **6.55,** Weather Report. **7.0,** Vocal and Instrumental Concert relayed from **Kiel.** (250 metres): Overture to Die Fledermaus (Strauss); Air from Der Wildschütz (Lortzing); Two Airs from Czar and Carpenter (Lortzing); Duet from The Czar and Carpenter (Lortzing); Duet from The Merry Wives of Windsor (Nicolai); Trio from The Marriage of Figaro (Mozart); Selections from Die Meistersinger (Wagner); Overture to A Midsummer Night's Dream (Mendelssohn); Duet from Stradella (Flotow); Air from La Clochette de l'Ermite (Maillart); Duet from The Merry Wives of Windsor (Nicolai); Duet from Czar and Carpenter (Lortzing); Air from Der Freischütz (Weber); Duet from The Marriage of Figaro (Mozart); Waltz, Thermen (Strauss). **9.0,** Programme Announcements, News, Sports Notes and Snow Report. **9.20,** Selections from the Works of Oscar Fétras. **10.50,** North Sea and Baltic Weather and Ice 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,** Programme organised by the Workers' Radio Association. **6.25,** German Lesson by Mr. Edgar Grün. **7.25,** Police Announcements. **7.45,** Programme arranged by the Workers' Radio Association: Concert and Talk. **11.10** (approx.), Close Down.

HUIZEN (336.3 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,** Evening Concert. **6.10,** Talk by M. Gerisch. **6.20,** Concert (continued). **6.30.** Cathloic Bulletin. **6.40,** English Lesson. **7.10,** Lesson in Dressmaking. **7.40,** Talk by Father Wynhoven. **8.0,** "Il Seraglio"—Opera (Mozart). **9.10,** News and Announcements.

KALUNDBORG (1,153.8 metres); 7 kW.—Programme also for **Copenhagen** (339.8 metres).—**6.30** a.m., Morning Gymnastics. **10.0 a.m.,** Weather Report. **12.15,** Educational Talk. **2.0,** Programme for Children. **2.30,** Instrumental Concert. In the Interval—Reading by Thomas P. Hejle. **5.20,** Sophie Petersen, Talk: In the Land of the Caucasus. **5.50,** Weather Report. **6.0,** News, Exchange Quotations and Time Signal. **6.20,** David Grünbaum, Talk: Modern Foreign Authors—Arnold Bennett. **7.0,** Chimes from the Town Hall. **7.2,** Readings by David Grünbaum from the Works of Arnold Bennett. **7.45,** Sonata for Violin and Pianoforte in E Minor Op. 24 (Sjögren). **8.15,** (approx.), News. **8.30,** Finnish Concert: Introduction by the Author, Morten Korch; Reading, Omkring Lampen (Korch); Recitations by the Actor, Christian Schröder, (a) Nu skal i bare höre (Schröder), (b) Kan Du tie med et (Clausen), (c) Hans Laursens Vise (Banke), (d) Folkesnak (Hansen); Readings from the Works of Morten Korch, (a) De Rasmus Greve skaffede Regn, (b) Gamle Birthes Bryllupsdag, (c) En Solskinsplet; Recitations by the Actor, Christian Schröder (a) Den villeste, (b) Je ae saa glad (Morten Korch), (c) Hugnagi (Christian Schröder); Finnish Folk Dances for Violin, Viola, Clarionet and Double Bass. **9.45,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

Programmes from Abroad.—

KATTOWITZ (416.1 metres) ; 10 kW.—4.25 Children's Letter Box. 4.55, Programme for Children. 5.50, Announcements. 6.10, Talk by Mr. K. Zienkiewicz. 6.56, Time Signal. 7.0, Talk by M. Rutkovsky. 7.30, Programme from Warsaw. 9.0, Weather Report and News. 9.30, Dance Music.

KAUNAS (2,000 metres) ; 7 kW.—4.0, Programme of Talks. 6.30, Evening Entertainment.

LAHTI (1,504 metres) ; 35 kW.—5.15, Talk. 5.35 Songs. 5.55, Orchestral Concert of Sacred Music. 6.30, "Lea"—Play (Aleksis Kivi). 7.30, Concert: Orchestral Selection, Vision (Gounod); Trumpet Solo, Andante from the Haydn Concerto (Vilkko). 7.45, News in Finnish and Swedish and Close Down.

LANGENBERG (463.2 metres) ; 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres), and **Münster** (265.5 metres).—12.5, Orchestral Concert from the Works of Oscar Fétras: Hindenburg March; Waltz, Scheiden und Meiden; Overture, Blumenfest; Potpourri, Von Bühne zu Bühne; Polospiele; Lustige Marionetten; Overture, Liebe schafft Rat; Waltz, Moonlight on the Alster; Potpourri, The Tyrol in Song and Dance; Waltz, Wenn die Fusschen sie heben; Rosen auf den Bergen; March, Freikugeln. 1.30, Hints for the Housewife. 2.0, Programme for Children by Els Vordemberge. 2.30, Economic Report. 2.40, Arthur Wurbs, Talk on Wireless Technique—Valve Transmitters. 3.0, Dr. Teleky, Talk for Women: The Influence of Working for a Living on Children, Young People and Women. 3.25, Dr. Franz Rodens, Talk: Henri Bergson, the Nobel Prize Winner. 3.45, Prof. Curt Glaser, Talk: From the Written to the Printed Book. 4.5, Prof. Honigsheim, Talk: Youth and Family Life. 4.25, English Lesson, by Prof. Haase. 4.45, Gramophone Selections. In the Interval at 5.15, Programme Announcements. 5.30, Dr. Stulz, Talk: How to learn to understand History. 5.50, Lesson in Morse. 6.15, Dr. Wieruszovsky, Talk: Marriage and Divorce. 6.40, Prof. Hessen, Talk: What do we know of the Soul? 7.0, Humorous Variety Programme followed News, Sports Notes, Business Announcements, Orchestral Concert and Dance Music.

LEIPZIG (361.9 metres) ; 4 kW.—3.30, Orchestral Concert. 4.45, Wireless News and Talk. 5.0, "The Letter Box." 5.20, Weather Report and Time Signal. 5.30, Programme relayed from **Königswusterhausen**. 6.0, Prof. Erich Marx, Talk: Lessing as a Religious Critic, followed by Wireless Talk. 6.30, Dr. Fritz Kaphahn, Talk: The Sentiment of Europeanism in Germany in the Nineteenth Century. 7.0, Programme relayed from **Frankfurt**. 9.0, Labour Market Report, Snow Report, Weather, News, Sunday Programme Announcements and Sports Notes. 9.30, Dance Music from **Voxhaus**. 11.30 (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (427 metres) ; 3 kW.—7.0, Chimes, Exchange Quotations and Programme of Dance Music. 8.0, Scientific Talk by Dr. Zito. 8.25, News and Announcements. 9.45, Agricultural Report and Market Prices. 10.0, Chimes and Time Signal, followed by Selection from "Los Gavilanes," Musical Play in Three Acts (Guerrero), followed by News. 12.30 a.m. (approx.) (Sunday), Close Down.

MILAN, Call 1MI (504.2 metres) ; 7 kW.—7.15, Talk: Industrial Review. 7.25, News and Announcements. 7.30, Time Signal and News, followed by Introductory Talk to the following Transmission: "Orpheus," Opera (Gluck); in the Intervals: Talk on Musical History and Aesthetics; Talk on Giovanni, Marradi; News and Economic Report. 10.0 (approx.), Close Down.

MOTALA (1,365 metres) ; 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Horby** (260.9 metres), **Ostergund** (720 metres), **Sundsvall** (545.5 metres).—4.0, Concert of Light Music. 5.0, Programme for Children. 5.30, Concert of Balalaika Music. 6.0, Ballads to the Lute and Recital of Poems. 6.45, Sonata for Violin and Pianoforte, No. 7, in F Major (Mozart). 7.0 Cabaret Concert. 8.0, Topical Talk. 8.15, News and Weather Report. 8.45, Dance Music. 11.0 (approx.), Close Down.

MUNICH (536.7 metres) ; 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres).—5.0, Recital of Songs. 5.35, Labour Market Report. 6.0, Answers to Correspondents. 6.30, Reading from a Short Story on Natural Science. 7.0, "Das vierte Gebot," Folk Play in Seven Scenes (Ludwig Anzengruber). 9.0, Gramophone Records; in the Interval, at 9.20, News. 10.30 to 11.30, No Transmission. 11.30, Concert by the Station Trio: Morning, Noon and Night Overture (Suppé); Selection from Tiefland (d'Albert); Violin Solo, En Bateau (Debussy); Nocturne from Liebesträume (Liszt); Habaneras (Arbos); Seguidillas (Arbos); Selection from The Merry Widow (Lehár). 12.30 a.m. (approx.) (Sunday), Close Down.

Saturday, February 16th.

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

NAPLES, Call 1NA (333 metres) ; 1.5 kW.—7.30, Wireless Talk, Announcements, News and Harbour Notes. 8.0, Time Signal. 8.2, Orchestral Selection: Overture to The Bartered Bride (Smetana); "La Nemica," Comedy in Three Acts (Niccodemi); in the First Interval: Violin Solo, Overture (Villani); in the Second Interval: Violin Solo, Hungarian Rhapsody (Hansel). 9.50, News. 9.55, Calendar and Programme Announcements. 10.0 (approx.), Close Down.

OSLO (397 metres) ; 1.5 kW.—Programme relayed by **Fredriksstad** (887 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—5.0, Programme for Children. 6.15, Weather Report and News. 6.30, Talk on Philology, relayed from **Fredriksstad**. 7.0, Time Signal. 7.2, Orchestral Concert: The Wedding of the Rose (Jessel); Selection from The Bird Fancier (Zeller) Barcarolle (Tchaikovsky); In a Sledge through St. Petersburg (Eilenberg); Old Porcelain (Humphries); Persian Dance (Svendsen); Madrigal (d'Ambrosio); Viennese Melodies (Morena). 8.0, Recitations. 8.30, Weather Report and News. 8.45, Topical Talk. 9.0, Popular Song Recital. 9.30, Dance Music. 11.0 (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres) ; 5 kW. 5.0, Pasdeloup Concert. 7.10, Weather Report. 7.20 to 8.50, "Le Journal Parlé."

PARIS (Petit Parisien) (336 metres) ; 0.5 kW.—8.45, Gramophone Selections, Talk and News. 9.0, Concert: Overture to The Barber of Seville (Rossini); Selection from Paul et Virginie (Masse). 9.25, News and Announcements. 9.30, Symphony Concert: A Summer's Night in Madrid (Glinka); Popular Russian Songs (Liadoff). 10.0, News and Concert: Ballet Music from Le Roi s'amuse (Delibes); Nocturne from the First Orchestral Suite (Massenet); Hungarian Dance, No. 2 (Brahms).

PARIS (Radio Paris), Call CFR (1,769 metres) ; 15 kW.—12.30, Programme of Dance Music. 1.0, Exchange Quotations and News. 1.15, Dance Music (continued). 2.0, Market Prices and Religious Information. 3.30, Exchange Quotations. 3.45, Dance Music by the Joss Ghislery Symphonians. 4.45, Market Prices and News. 6.30, Exchange Quotations and Agricultural Report. 6.45, Gramophone Concert: Vocal Tango, Copetin (Remondini), by M. Urquiri; Neapolitan Songs (Lama) by Di Mazzei; Selection from Le Roi d'Ys (Lalo) by Mlle. Madeline Sibille; Quartet Selections, (a) Moment Musical (Schubert), (b) Canzonetta (Mendelssohn); Song, Meunier tu dors (Raiter), by M. Alibert; Vocal One-Step, C'était une blonde (Gabaroche); Song, C'est moi le mari (Warren), by M. Alibert; Vocal Fox-Trot, A Siren's Dream. 7.30, Pianoforte Lesson, by M. Pierre Lucas. 8.0, Dr. Evrof, Talk: The Protection of Children Against Tuberculosis, followed by Market Prices and News. 8.15, Concert: Songs; Dance Music; in the Intervals, News.

POSEN (336.3 metres) ; 1.5 kW.—4.30, English Lesson. 4.55, Programme from Warsaw. 5.50, Talk on the Lottery and its Development. 6.15, Pianoforte Recital: Selections (Chopin), (a) Etude in C Minor, (b) Nocturne, (c) Waltz in G Flat Major, (d) Polonaise in A Major, Hungarian Rhapsody (Liszt). 6.45, Programme for Women. 7.0, Miscellaneous Items. 7.30, Programme from Warsaw. In the Intervals: Theatre and Cinema Notes and News. 9.0, Time Signal and News. 9.30, Cabaret Entertainment. 11.0, Concert arranged by the Maison Philips. 1.0 a.m. (approx.) (Sunday), Close Down.

PRAGUE (343 metres) ; 5 kW.—4.50, Agricultural Transmission. 5.0, German Transmission, News and Readings. 6.0, Time Signal and News. 6.5, Concert by Wind Instruments. 6.45, Talk: James Cook. 7.0, "Gollwell's" Popular Evening. 8.0, Programme in Commemoration of the Poet Vrchlicky. 8.30, Concert from Brünn. 9.0, Time Signal and News. 9.20, Theatre Review. 9.25, Tzigane Concert relayed from **Bratislava** (278 metres). 10.0, Time Signal and **Carillon**.

ROME, Call 1RO (443.8 metres) ; 3 kW.—6.50, Topical Talk, Sports Notes, News, Exchange Quotations and Weather Report. 7.29, Time Signal and Press Review. 7.45, Concert by the Royal Band of the Guardia di Finanza: Hymn to Rome (Puccini); Grand Fantasia on Nero (Boito); Entry of the Boyards (Halvorsen); "Paris-Lyon-Mediterranée": Comedy in One Act (Carré and Labrousse); Symphonic March, L'Avvento (Manente); Scherzo (Manente); Histoire d'un Pierrot (Costa); Talk: The World of Literature and Art; Waltz, Cloches dans la nuit (Alger); Avanguardia di monelli (Gastaldon); Selection from Joan of Arc (Verdi). 9.50, Topical Talks and News. 10.0 (approx.), Close Down.

SCHENECTADY Call 2XAF (31.48 metres) 30kw.—11.30 p.m.—White House Coffee Programme relayed from **New York**. 12.0 Midnight, Phil Spitalny's Music, relayed from **New York**. 12.30 a.m. (Sunday), Musical Programme relayed from **Rochester**. 1.30 to 4.0 a.m. **New York** Programme. 1.30 a.m. Mildred Hunt and Marimba Orchestra. 2.0 a.m. General Election Hour. 3.0 a.m., Lucky Strike Programme. 4.0 a.m. Dance Music from the Hotel Van Curler, **Schenectady**. 5.0 a.m. (approx.), Close Down.

STAMBOUL (1,200 metres) ; 5 kW.—5.0, Concert of Turkish Music, followed by Exchange Quotations, Market Prices, Weather Report and Time Signal. 7.0, Orchestral Concert: Sérénade mélancolique (Tchaikovsky); Troïka (Tchaikovsky); Cavatina (Borodine); Russian Echo (Leopold); Russian Rhapsody (Borodine). 8.30, News and Close Down.

STUTTGART (374.1 metres) ; 4 kW.—1.0, Programme for Children by Elsa Pfeiffer, Karl Köstlin, and the Station Orchestra. 2.0, Concert of Light Classical Music. 3.30, Thé Dansant relayed from the Pavillon Excelsior. 5.0, Time Signal and Weather Report. 5.15, Prof. Hans Halm, Talk: Irkutsk, on the Trans-Siberian Railway. 5.45, Prof. Adolf Lampe, Talk: Buy, and pay later, relayed from **Freiburg** (577 metres). 6.15, Dr. Wolff, Talk: Bookkeeping. 6.45, Time Signal and Sports Notes. 7.15, Programme relayed from **Frankfurt**, followed by News and Dance Music. 11.0 (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (383 metres) ; 8 kW.—12.45, Concert. 8.0, Exchange Quotations and News. 8.30, Concert: Marche Lorraine (Ganne); Overture to Sigurd (Reyer); March, Officer of the Law (Hall); King Cotton March (Sousa); Barnum and Bailey's March (King); March salutation (Seitz); Argentine Songs with Guitar accompaniment, (a) El Carretero, (b) Ramona, (c) Araca Corazon, (d) A la luz del candil; Orchestral Selections of Viennese Music, (a) Parade des petits lutins, (b) Selection from Cendrillon (Massenet), (c) Donauwellen (Strauss), (d) Sobre las Olas, (e) Selection from The Dollar Princess (Fall), (f) Rêve de Valse, (g) Selection from Die geschiedene Frau (Fall), (h) La fête des Gnomes. 9.45, Accordion Selections of Dance Music. 10.0, Four Selections for Hawaiian Guitar. 10.15, North African News. 10.30 (approx.), Close Down.

VIENNA (520 metres) ; 15 kW.—3.15, Orchestral Concert: March, Zigeunerlager (Carl); St. Hubertus Overture (Fucik); Waltz, Mediziner-Balltänze (Ganglberger); Selection from Le Tribut de Zamora (Gounod); Egerländer Marsch (Kopetzky); Die Post in Walde (Schäffer); Der Vater des Regiments (Ziehrer); Selection from Lilac Time (Schubert-Berté); Polka-Mazurka, Die Libelle (Jos. Strauss); March from Die gold'ne Meisterin (Eysler); Gavotte, Mister Brumm (Ganglberger); Gallop, Radio-Wien (Bader). 5.0, Fairy-Tales for Children by Elly Peiskar. 5.30, Albrecht Golerus, Talk: Ski-ing as a Popular Sport. 6.0, Rudolf Jeremias Kreutz in Selections from his own Works. 7.5, Time Signal and Weather Report. 7.10, "Der Bettelstudent": Comic Opera in Three Acts (Millöcker), followed by Phototelegraphy Transmission.

VILNA (426.7 metres) ; 1.5 kW.—4.25 Concert by the Military Band. 4.55, Programme relayed from **Warsaw**. 5.50, Readings from the Book "More Joy" (Bishop Keppler). 6.10, Programme relayed from **Warsaw**. 6.35, News and Time Signal. 7.0, Talk on National Education. 7.30, Programme relayed from **Warsaw**. 10.30 (approx.), Close Down.

WARSAW (1385.7 metres) ; 10 kW.—4.35. Programme for Children. 5.50, Miscellaneous Items. 6.10, Wireless Review. 6.35, News and Time Signal. 7.0, Concert of Light Music. In the Interval: Theatre Notes. 9.0, Aviation Notes, Weather Report and News. 9.20, Police Announcements and Sports Notes. 9.30, Dance Music from the Oaza Restaurant. 10.30 (approx.), Close Down.

ZURICH (489 metres) ; 1 kW.—6.15, Time Signal and Weather Report. 6.17, Concert: Orchestral Selections, Songs to the Lute, Humorous Items, and Zither Solos. 9.0, Weather Report and News. 9.10, Gramophone Selections of Dance Music

Programmes from Abroad.

ALGIERS, Call PTT (353 metres); 1 kW.—12.30, Concert by the Station Orchestra conducted by C. Cerlini: Overture to 'Athalie' (Mendelssohn).

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—11.0 a.m., Relay of Chimes from the Barcelona Cathedral. 11.5 a.m., Report of the Provincial Meteorological Service, Weather Conditions for Europe and Forecast for North-East Spain, followed by Aviation Route Report. 1.30, Concert of Light Music by the Iberia Trio, with Gramophone Records in the intervals. 2.45 to 6.0, No Transmission. 6.0, Opening Signal and Stock Exchange Quotations. 6.10, Concert by the Station Orchestra, with Tenor Songs by Miguel Artelli. 8.20, Orchestral Selections. 8.40, Sports Results. 9.0 (approx.), Close Down.

BASLE (1,034 metres); 0.25 kW.—7.30, Programme relayed from Zürich. Shrovetide Programme. 9.0 Late News Bulletin and Weather Report and Forecast. 9.30 (approx.), Close Down.

BERGEN (365.9 metres); 1.5 kW.—9.30 a.m., Relay of Church Service. 11.30 a.m., Weather Report and Forecast followed by General News Bulletin. 4.0, Relay of Evening Service. 7.50, Current Topics. 8.0, Duets by Mrs. Hilda Torsen and Mr. Olaf Johannessen. 8.30, Talk or Literary Selection. 9.0, Weather Report and Forecast, Late News Bulletin and Time Signal. 9.15, Dance Music. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1648.3 metres); 40 kW.—7.55 a.m., Relay of Chimes from the Garrison Church at Potsdam. 8.0 a.m., Morning Recital of Music relayed from Voxhaus, followed by the Cathedral Chimes. 10.30 a.m., Concert relayed from Voxhaus. 12.45 to 1.15, Experimental Transmission of Pictures. 1.30, Practical Hints for the Farmer. 1.45, Report on the Week's Markets. 1.55, Talk. 3.0, Talk. 3.30, Musical Programme. 7.0, Concert or Play, followed by News from the Press and Dance Music. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475.4 metres); 4 kW.—7.55 a.m., Chimes from Potsdam Garrison Church. 8.0 a.m., Vocal and Instrumental Recital, with Address in the interval and followed by Chimes from the Berlin Cathedral. 10.30 a.m., Concert. 1.30 to 2.25, Three Agricultural Talks. 2.30, Children's Corner. 3.0, Talk. 3.30, Musical Programme. 7.0 (approx.), Concert or Play, followed by Weather Report and Forecast and Late News Bulletin. Time Signal and Sports Results. 9.30, Dance Music. 11.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—9.30 a.m. to 10.30 a.m., Protestant Sermon. 12.0 Noon, Time Signal and Weather Report and Forecast. 12.5, Orchestral Programme. 6.23, Time Signal, Weather Report and Football Results. 6.30, An Hour in Old Bern. 7.30, Concert. 8.45, Sports Notes. Late News Bulletin and Weather Report and Forecast. 9.0, Concert of Light Music by the Kursaal Orchestra. 9.35 (approx.), Close Down.

BÉZIERS (211 metres) 0.6 kW.—8.30, General News Bulletin and Sports Notes. 8.45, Programme of the latest Pathé and Pathé-Art Gramophone Records arranged by La Maison Relin-Minoles. 10.30 (approx.), Close Down.

BRESLAU (321.2 metres); 4 kW.—Programme relayed by Gleiwitz (326.4 metres). 8.15 a.m., Relay of Chimes from Christ Church. 11.0 a.m., Concert. 7.15, Concert of National Music, with the collaboration of Ernst Arnold. 9.0, Late News Bulletin. 9.30 Dance Music. 11.0 (approx.), Close Down.

BRUSSELS (512 metres); 1.5 kW.—5.0, Light Music by the Orchestra at the Armenonville Tea Room. 6.0, Programme for Children, arranged by the Théâtre des Enfants. 6.30, Trio Concert, with Sololsts. The following transmissions experimentally on high power. 7.30, "Le Journal Parlé de Radio-Belgique." 8.15, Concert by the Station Orchestra, conducted by M. René Tellier, Baritone Songs by M. de Kock. 10.15, News from the Evening Press. 11.0 (approx.), Close Down.

BUDAPEST (555.5 metres); 20 kW.—8.0 a.m., News from the Press and Beauty Notes for Women. 9.0 a.m., Relay of Church Service. 2.30, Agricultural Talk. 9.30, Programme of Light Music by the Jeno Pertis Orchestra, relayed from the Hotel Britannia.

COLOGNE (283.2 metres); 4 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Langenberg (462.2 metres) and Münster (265.5 metres).—6.45 a.m., Boxing Instruction by Dr. Ludwig Bach. 7.5 a.m., Lesson in German Shorthand, by Hans Molitor. 7.25 a.m. to 7.55 a.m., Lesson in Esperanto, followed by a Weekly Programme Review in Esperanto, by Alfred Dormanns. 8.0 a.m., Church Chimes. 8.5 a.m.

SUNDAY, FEBRUARY 17th.

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

to 9.0 a.m., Catholic Morning Festival with Address and Instrumental Solos. 10.0 a.m. to 10.30 a.m., Fritz Worm, Talk: The Honour of the German Language. 10.35 a.m. to 10.55 a.m., Talk on Agriculture. 11.0 a.m., Organ Recital, by Prof. Hans Bachem, relayed from the Grosse Messehalle, Cologne. 12.0 Noon, Orchestral Concert, conducted by Herr Eysoldt. 7.10, Concert or Play, followed by Late News Bulletin, Sports News and Light Music. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—8.30, Organ Recital. 9.0, Vocal and Instrumental Concert. 11.0, National Anthem and Weather Report and Forecast. 11.15 (approx.), Close Down.

CRACOW (314.1 metres); 1.5 kW.—9.15 a.m. to 10.45 a.m., Relay of Cathedral Service from Vilna. 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., Philharmonic Concert, relayed from Warsaw. 1.0 and 1.20, Talks for Farmers. 1.40, "La Chronique Agricole," by Dr. St. Wasniewski. 2.0, Weather Report and Forecast. 2.15, Relay of Philharmonic Concert from Warsaw. 6.0, Twenty Minutes of Variety. 6.20, Talk. 6.56, Time Signal, relayed from the Observatory. 7.0, Fanfare, relayed from the Church of Notre Dame. 7.15, Sports Results. 7.45, Recital of Songs and Chamber Music: Violin Concerto in A Minor (J. S. Bach), played by Frederick Alex, and accompanied on the Piano by Mlle. Ladislasse Markiewicz. 9.0, Programme relayed from Warsaw. Late News Bulletin, Police News and Sports Results. 9.30, Relay of Concert by the Orchestra at the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—8.30 to 11.0, Programme relayed from Cork: Vocal and Instrumental Concert, with Violin Solos by Seamus O'Mahony. 11.0, National Anthem and Weather Report and Forecast. 11.15 (approx.), Close Down.

FRANKFURT (421.3 metres); 4 kW.—Programme relayed by Cassel (252.1 metres).—7.30 a.m. to 8.30 a.m., Sacred Recital of Music. 11.0 a.m., Concert. 7.30 (approx.), Concert or Play, followed by Dance Music. 11.30 (approx.), Close Down.

HAMBURG, Call HA (in Morse) (392 metres); 4 kW.—Programme relayed by Bremen (273 metres), Flensburg (219 metres), Hanover (566 metres) and Kiel (250 metres).—7.20 a.m., Time Signal. 7.25 a.m., Weather Forecast, followed by General News Bulletin. 7.40 a.m., Some Modern Industrial Problems. 8.0 a.m., Weekly Legal Talk. 8.15 a.m., Programme of Music. 9.55 a.m. (For Kiel and Flensburg), Morning Service and Sermon, relayed from the University Church at Kiel. 10.0 a.m., Talk. 11.55 a.m., The Nauen Time Signal. 12.5 (for Flensburg, Hamburg and Kiel), Instrumental Music. 12.5 (for Hanover), Popular Gramophone Records. 12.5 (for Bremen), Orchestral Concert. 1.0, Children's Corner, arranged by Hans Bodenstedt. 2.0, Musical Programme. 6.0, Talk. 6.30, Talk on Physical Culture. 6.40, Sports News. 6.55, Weather Report and Forecast. 7.0, Concert or Play, followed by Weather Report, Late News Bulletin, and Dance Music. 10.50 (for Bremen, Flensburg, Hamburg and Kiel), North Sea and Baltic Weather Report. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—11.40 a.m., Talk on Chess by Mr. J. Davidson. 12.10, Concert by the Station Trio. 1.40, Talk. 2.10, Concert. 7.40, Time Signal, Weather Report and Forecast and News Bulletin. 7.55, Concert by the Wireless Orchestra, conducted by Nico Treep. Tenor Solos by Louis van Tulder. Followed by Gramophone Records. 11.10, (approx.), Close Down.

HUIZEN (336.3 metres); 4 kW.—Transmits from 5.40 on 1,852 metres. 8.5 a.m., Morning Service and Address. 9.30 a.m. (approx.), Relay of Church Service. 12.10, Concert of Trio Music. 1.40, Talk. 5.25, Relay (on 1,852 metres) of Evening Service from Delft. Sermon by the Minister, the Rev. T. J. Hagen. 7.50, Concert. 10.25, Epilogue by the Choir, conducted by Mr. Jos. Pickkers. 10.40 (approx.), Close Down.

KALUNDBORG (1,153.8 metres); 7 kW.—Programme also for Copenhagen (339.8 metres).—9.0 a.m., Church Service, relayed from Copenhagen. 10.30 a.m. to 10.40 a.m. (Kalundborg only), Weather Report of the Meteorological Institute at Copenhagen. 5.20, Talk. 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, Relay of the Town Hall Chimes from Copenhagen. 7.2, Concert by the Station Orchestra. 9.0, Orchestral Concert. 10.0, Relay of Dance Music from the Palace Hotel, Copenhagen. The Orchestra conducted by Teddy Petersen. In the interval at 11.0, Town Hall Chimes, relayed from Copenhagen. 11.30 (approx.), Close Down.

KATTOWITZ (416.1 metres); 10 kW.—9.15 a.m., Relay of Church Service. 10.56 a.m., Time Signal, followed by Weather Report and Forecast. 2.15, Relay of Philharmonic Symphony Concert from Warsaw. The Orchestra, Rawel and Gawel (Wallek-Walewski). 5.0, Popular Concert. 6.0, General Notices. 6.20, Talk by Professor B. Richter. 6.56, Time Signal. 7.0, Talk. 7.30, Concert. 9.0, Weather Report. News from the Press and Sports Results. 9.30, Popular Dance Music. 10.30 (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—3.0, Programme for Young People. 3.30, Talk. 4.0, Talk by J. Ardickas. 4.55, Time Signal and Weather Report and Forecast. 6.0, O. Masiotiene, Talk for Women. 6.30, Concert or Play. 8.30 (approx.), Close Down.

KÖNIGSBERG (280.4 metres); 4 kW.—Programme relayed by Danzig (456 metres). 8.0 a.m., Recital of Choral and Organ Music with Address in the interval. 9.56, a.m. (Danzig only), Weather Report. 10.0 a.m. (Königsberg only), Weather Report and Forecast. 10.05 a.m., Concert. 11.55 a.m., Time Signal relayed from Nauen, followed by Weather Report and Forecast. 12.0 Noon, Relay of Concert by the Scheffler Orchestra, playing at the Central Hotel, Königsberg. 1.0, Chess Problems by P. S. Leonhardt. 3.15, Orchestral Concert. 7.5, "The Barber of Baghdad," Opéra-comique in Two Acts. Music and Libretto by Cornelius. Produced by Kurt Lesing and under the musical direction of Erich Seidler. 9.10, Late News Bulletin and Sports Results. 9.30, Dance Music. 11.0 (approx.), Close Down.

LAHTI (1,504 metres); 35 kW.—Programme also for Helsingfors (374 metres). 8.0 a.m., Relay of Morning Service (in Finnish). 9.50 a.m., Press News. 10.5 a.m., Instrumental Concert. 10.50 a.m., Weather Report and Forecast and Time Signal. 11.0 a.m., Relay of Service (in Swedish). 3.0, Concert by the Station Orchestra, directed by Erkki Linko. 4.57, Time Signal and Weather Report. 5.10, Evening Service relayed from St. John's Church. 7.0, Music Recital. 7.45, Late News Bulletin in Finnish followed by News in Swedish. 8.30 (approx.), Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Cologne (283.2 metres), and Münster (265.5 metres).—6.45 a.m., Lesson in Boxing. 7.5 a.m., German Shorthand Lesson by Hans Molitor. 7.25 a.m., Esperanto Lesson by Alfred Dormanns. 7.45 a.m. to 7.55 a.m., Summary in Esperanto of the Week's Programmes. 8.0 a.m., Chimes. 8.5 a.m. to 9.0 a.m., Catholic Recital of Music with Address in the Interval. 10.0 a.m. to 10.30 a.m., Talk on the German Language. 10.35 a.m. to 10.55 a.m., Talk for Farmers. 11.0 a.m., Recital of Music. 12.0 Noon, Orchestral Concert. 7.10, "Gasparone," Operetta by Millöcker. Musical Director: Herr Kühn. Followed by General News Bulletin, Sports Notes and Dance Music, conducted by Herr Eysoldt. 11.0 (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—Programme relayed by Dresden (276 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., Musical Selections. 12.0 Noon, and 12.30, Agricultural Talks. 3.0, Musical or Dramatic Programme. 4.0, Concert. 5.30, Talk. Doctor Lewin L. Schücking, England and the Puritans. 6.0, Talk. 6.30, Concert. 8.0 "A Visit at Midnight," by Ludwig Hirsch, under the direction of Hans Peter Schmiedel. 9.0, Late News Bulletin and Sports Results. 9.30, Dance Music, relayed from Berlin. 11.30 (approx.), Close Down.

LYONS (Radio Lyon) (291 metres); 1.5 kW.—8.0, Orchestral Concert, with Saxophone Solo, "Aubade d'amour" (Monti). 10.0 (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (427 metres); 3 kW.—Programme relayed by Salamanca (EAJ22) (455.9 metres).—2.0 Chimes and Time Signal. 2.5 Orchestral Selections with Literary Item in the interval. 3.30 to 7.0, No Transmission. 7.0, Relay of Chimes. 7.5, Dance Music. 8.30 to 10.0, No Transmission. 10.0, Chimes followed by Time Signal. 10.5, Popular Programme by the Wireless Orchestra with Guitar Selections by Asuncion Granados and provincial songs by Amelio Zori. 12.0 Midnight.

Programmes from Abroad.—

Dance Music by the Palermo Orchestra relayed from the Alkazar. **12.30 a.m.** (approx.) (Monday), Close Down.

MILAN, 1MI (504.2 metres); 7 kW.—**9.0 a.m.,** Opening Signal. **9.2 a.m.,** English Lesson. **9.30 a.m** to **10.15 a.m.,** Sacred Recital with Vocal and Instrumental Solos. **11.30 a.m.,** Time Signal. **11.32 a.m.,** Concert by the Station Quartet. **3.45** to **5.0,** Musical Selections. **7.30,** Time Signal followed by Station Announcements. **8.0,** Relay of an Opera from the Scala Theatre. At end of Act One: Talk by Ulderico Tegani on "Town and Country." At end of Act Two: Sports News and Communications from the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (1,365 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Hörby** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.5 metres).—**10.0 a.m.,** Relay of Church Service from **Stockholm.** **4.0,** Programme for Children. **4.55,** Relay of Stockholm Town Hall Chimes. **5.0,** Evening Service relayed from **Stockholm.** **7.15.** Concert by a String Orchestra, relayed from **Göteborg.** **8.15,** General News Bulletin and Weather Report and Forecast. **8.40,** Musical Selections. **10.0** (approx.), Close Down.

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres) and **Nuremberg** (240 metres).—**10.0 a.m.,** Chimes from the Munich Town Hall. **10.10 a.m.,** The Bavarian Wireless Weather Chart. Pianoforte Recital by Lucile de Mariette. **7.0,** Concert. **9.20** (approx.), Late News Bulletin. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333** metres); L5 kW.—**8.30 a.m.,** French Lesson by Professor Etienne Verdier. **9.0 a.m.,** Concert of Sacred Music. **3.45,** Programme for Children. **4.0,** Vocal and Instrumental Concert. **4.30,** Time Signal. **7.30,** Topical Talk. **7.50,** Report from the Naples Harbour Authorities. **8.0,** Time Signal. **8.02,** Concert of Selections from well-known operas: Tenor Solo, "Com'è gentil" from Don Pasquale (Donizetti), sung by R. Rotondo, with pianoforte accompaniment. **9.0,** Sports Results. **9.55,** Calendar and Comments on forthcoming programmes. **10.0** (approx.), Close Down.

OSLO (497 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (551 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**9.20 a.m.,** Chimes. **10.0 a.m.,** Service relayed from St. Saviour's Church. **6.15,** Weather Report and Press News. **7.0,** Time Signal. **8.30,** Weather Report and Forecast and News from the Press. **8.45,** Topical Talk. **9.0,** Dance Music. **10.30** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**1,488** metres); 5 kW.—**7.56 a.m.,** Time Signal on 32.5 metres. **5.0,** Relay of Pasdeloup Concert. **7.10,** Weather Report and Forecast. **7.20,** Le Journal Parlé with Sportiug News for the Day and Racing Results from "Paris Sport." **7.56,** Time Signal on 32.5 metres. **8.0** to **8.50,** Concert of Orchestral Music with Instrumental Solos. Violin Solos by Mlle. Paulette Melicourt-Dernarne.

PARIS (Petit Parisien) (**336** metres); 0.5 kW.—**8.45,** Gramophone Records. **8.50,** Talk. **8.55,** Press News. **9.0,** Concert by artistes from the Opéra and Opéra-comique. **9.25,** General News Bulletin. **9.30,** Concert of Symphony Music conducted by M. Estyle, of the Paris Conservatoire. **10.0,** Late News Bulletin. **10.10,** Orchestral Concert, Ballet Music from Parysatis (Saint-Saëns). **11.0** (approx.), Close Down.

PARIS (Radio LL) (**370** metres); 1 kW.—**2.30,** News from the "Radio Agricole Française." **3.0,** Programme of Dance Music. **9.0,** Vocal and Instrumental Concert. **10.0,** Carillon de Fontenay. **10.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (**1,769** metres); 15 kW.—**8.0 a.m.,** General News Bulletin and Press News. **8.30 a.m.,** Physical Culture, by Dr. Diffre. **12.0 Noon,** Address by Father Lhande, followed by Sacred Concert with Choral Renderings. **12.30,** News from the Press. **12.45,** Concert by the Albert Locatelli Orchestra, with interval item by Bilboquet. **3.30,** The Latest Gramophone Records; Press News in the Interval. **6.30,** Agricultural Report. **6.45,** The Pathé Half Hour. **7.30,** Press News. **7.45,** The Radio Paris Guignol; in the Intervals: Les Jacasseries de Polichinelle, by Bilboquet. **8.30,** Café Concert; in the Intervals: Late News Bulletin and Press News. **10.30** (approx.), Close Down.

PARIS (Radio Vitus) (**299** and **37** metres); 1.5 kW.—**10.0 a.m.,** Songs. **10.20 a.m.,** Pianoforte and Organ Music. **10.40 a.m.,** Selections by the Symphony Orchestra. **11.0 a.m.,** Chamber Music. **11.20 a.m.,** Violin and 'Cello Recital. **11.40 a.m.,** Dance and Light Music. **12.0 Noon,** Close Down.

PITTSBURGH, Call KDKA (**63** and **27** metres); 25 kW.—**4.0,** Sessions Clock Chimes. **4.2,** Church Service. **7.0,** The Roxy Symphony Concert, relayed from **New York.** **8.0,** Concert by the Mu-Sol-Dent Little Symphony Orchestra. **9.0,** Organ Recital, by Dr. Charles Heinroth. **9.45,** Relay of Service from the Shadyside Presbyterian Church, and Sermon by the Minister, the Rev. Hugh Thomson Kerr. **11.0,** Light Music by the Orchestra at the William Penn Hotel, Pittsburgh. **11.30,** Programme by the Whittall Anglo-Persians, relayed from **New York.** **12.0 Midnight,** Sessions Clock Chimes. **12.2 a.m.** (Monday), Service, relayed from the Calvary Protestant Episcopal Church and Sermon by the Pastor, the Rev. E. J. Van Etten. **1.0 a.m.,** Enna Jettick Melodies, relayed from **New York.** **1.15 a.m.,** Collier's Radio Hour, relayed from **New York.** **2.15 a.m.,** Entertainment by the Utica Jubilee Singers, relayed from **New York.** **2.45 a.m.,** El Tango Romantico, relayed from **New York.** **3.15 a.m.,** Longines Time from **New York.** **3.30 a.m.** (approx.), Close Down.

POSEN (**336.3** metres); 1.5 kW.—**9.15 a.m.** to **10.45 a.m.,** Relay of Service from Posen Cathedral. **11.10 a.m.,** Time Signal. **11.15 a.m.** and **11.35 a.m.,** Agricultural Talks. **11.55 a.m.,** Talk for Peasants. **2.0,** Relay of Service from Posen Cathedral. **3.0,** Symphony Concert, relayed from **Warsaw.** **4.30,** Talk by Mr. Winiewicz. **4.50,** Programme for Children, conducted by Mme. W. Trojanowska. **5.20,** Musical Selections. **6.0,** Report of the Catholic League of Polish Youth. **6.20,** Talk, relayed from **Warsaw.** **6.45,** Talk. **7.5,** Variety Concert. **7.30,** Concert, relayed from **Warsaw**; in the Intervals: Literary Selection and Theatre and Cinema News. **9.0,** Time Signal. **9.5,** Sports Results. **9.20,** Dancing Lesson, by Mr. Starski. **9.40,** Dance Music, relayed from the Carlton Restaurant. **11.0** (approx.), Close Down.

PRAGUE (**343** metres); 5 kW.—**8.0 a.m.,** Concert of Sacred Music. **9.0 a.m.** and **9.30 a.m.,** Agricultural Transmissions. **3.30,** Concert. **4.30,** Programme for Workers. **5.0,** Programme for German Listeners, with News and Music. **7.0** (approx.), Concert. **9.0,** Time Signal and Late News Bulletin, followed by Theatre Reports. **9.20,** Popular Concert. **10.30** (approx.), Close Down.

RABAT, Call PTT (**414** metres); 2 kW.—**12.30** to **2.0,** Selections by the Radio Maroc Orchestra. **4.0** to **5.0,** Military Band Concert. **8.15,** "Le Journal Parlé" and General News Bulletin. **8.30,** Concert by the Wireless Orchestra; in the Interval, at **9.30,** Talk and Sports Results, by M. Barrier. **10.30,** Dance Music, relayed from "La Chaumière de Rabat." **11.0** (approx.), Close Down.

RIGA (**528** metres); 4 kW.—**3.0,** Concert. **4.0** to **5.30,** Programme of Talks. **6.0,** The Station Orchestra, under the direction of Janis Medin. **8.0,** Weather Report. **9.30,** Concert, relayed from the Café de l'Opéra. **10.0** (approx.), Close Down.

ROME, Call 1RO (**443.8** metres); 3 kW.—**8.30 a.m.,** Opening Signal. **8.32 a.m.,** Lesson in German. **9.0 a.m.** to **9.45 a.m.,** Sacred Concert with Vocal and Instrumental Solos. **10.0 a.m.,** Relay from the Casa di Dante, with Introductory Talk. **12.0 Noon,** Opening Signal. **12.5** to **1.0,** Trio Concert. **1.0** to **4.0,** No Transmission. **4.0,** Opening Signal. **4.5** to **5.30,** Variety Concert. **6.50,** News and Agricultural Notes. **7.15,** Sports Results and General Announcements. **7.29,** Time Signal. **7.45,** Concert by the Grand Symphony Orchestra: "Sant' Elena al Calvario," Symphony, by Leonardo Leo, (a) Maestoso, (b) Larghetto, (c) Allegro, Andante maestoso. **9.50,** Late News Bulletin. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (**19.56** metres); 30 kW.—**6.30,** Programme by the Peerless Reproducers, relayed from **New York.** **8.30,** Organ Recital by Elmer A. Tidmarsh at the Union College Memorial Chapel, **Schenectady, N.Y.** **9.0,** Talk for Men by Doctor S. Parkes Cadman, relayed from **New York.** **10.30,** Musical Programme. **11.0,** Stetson Parade Programme, relayed from **Boston, Mass.** **11.30** The Acousticon Half Hour from **New York.** **12.0 Midnight,** The Old Company's Programme from **New York.** **12.30 a.m.** (Monday), Relay from the Capitol Theatre, **New York.** **2.0 a.m.,** Talk by David Lawrence, relayed from **Washington, D.C.** **2.15 a.m.** The Atwater Kent Hour from **New York.** **3.15 a.m.** Programme by the National Light Opera Company, relayed from **New York.** **4.15 a.m.,** Experimental Transmission of Television Signals. **4.45 a.m.** (approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (**369.9** metres); 2 kW.—**2.0,** Concert by the Wireless Orchestra, followed by Gramophone Records. **3.0** to **9.30,** No Transmission. **9.30,** Orchestral Concert with Vocalists. **11.0,** Flamenco Songs and Dance Music. **11.30** (approx.), Close Down.

STAMBOUL (**1,200** metres); 5 kW.—**5.0,** Selections of Turkish Music. **7.0,** Concert by the Station Orchestra. **8.30,** Late News Bulletin. **9.45** (approx.), Close Down.

STUTTGART (**374.1** metres); 4 kW.—Programme relayed by **Freiburg** (577 metres).—**10.15 a.m.,** Concert. **1.0,** Transmission for Children. **7.0** (approx.), Concert or Play, followed by Late News Bulletin and Sport Results. **9.30** (approx.), Light Music. **10.30** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (**383** metres); 8 kW.—**12.45,** Concert. **1.0,** Time Signal (Carillon). **1.5,** Continuation of Concert. **1.45** News from the Daily Press. **3.0,** Exchange Quotations from Paris and Market Prices with News from the Fournier Agency. **8.15,** News from "La Dépêche" and "Le Petit Parisien." **8.30,** Concert. **9.0,** Concert arranged by the Association des Commerçants Radio-électriciens du Midi. Selections from the "Barber of Seville" (Rossini). In the interval at **9.0,** Time Signal (Carillon). **10.15,** "Le Journal sans papier," and Late News Bulletin. **10.30** (approx.), Close Down.

VIENNA (**520** metres); 15 kW.—Programme relayed by **Graz** (354.2 metres), **Innsbruck** (455.9 metres), **Klagenfurt** (455.9 metres), and **Linz** (250 metres).—**9.20 a.m.,** Recital of Music. **10.0 a.m.,** Concert. **2.15,** Experimental Transmission of Pictures. **2.40,** Concert. **7.0,** Time Signal, Weather Report and Forecast. **7.05,** First Performance of "Ballade von der Stadt," Play for Wireless Transmission by Franz Csokor, produced under the direction of the author, followed by Concert and Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

VILNA (**426.7** metres); 1.5 kW.—**9.10 a.m.** to **10.45 a.m.,** Relay of Service from the Cathedral. **10.56 a.m.** to **4.30,** Programme from **Warsaw.** **10.56 a.m.** Time Signal and General News Bulletin. **11.10 a.m.,** Concert. **1.0** to **2.0,** Talks on Agriculture. **2.15.** Concert of Symphony Music. Variations on Mozart Themes (Chopin) by R. Kaczorouna (Piano). **5.20.** Musical Selections. **6.20,** Talk relayed from **Warsaw** **6.45,** Late News Bulletin. **7.30** Concert from **Warsaw.** **9.0,** Aviation Route Conditions, Weather Report and Late News Bulletin relayed from **Warsaw.** **9.30** Dance Music by the Orchestra at the "Oaza" Restaurant, **Warsaw.** **10.30** (approx.), Close Down.

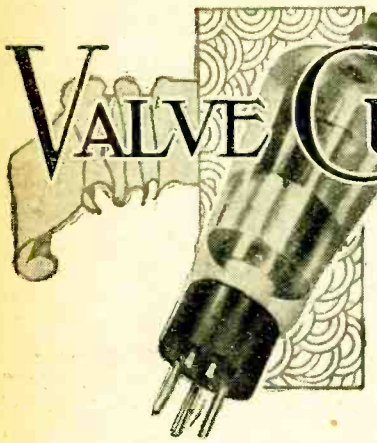
WARSAW (**1,385.7** metres); 10 kW.—**9.15 a.m.** to **10.30 a.m.,** Relay of Cathedral Service. **10.55 a.m.** Time Signal and Fanfare relayed from the Church of Notre Dame at **Cracow,** followed by Aviation Route Report and Weather Forecast. **11.10 a.m.,** Concert by the Philharmonic Orchestra. **1.0 to 2.0,** Agricultural Talks. **2.0,** Weather Report and Forecast. **2.15,** Concert of Symphony Music by the Philharmonic Orchestra with Vocalists. **6.0,** Variety Items. **6.20,** Talk. **6.45,** General News Bulletin. **6.56,** Time Signal. **7.0** to **7.25.** Talk. **7.30,** Concert, with Clarionet Solos by A. Kalinowski. Theatre News in the Interval. **9.0,** Aviation Route Report and Weather Forecast. **9.5.** Late News Bulletin. **9.20** Police Communications and Sports News. **9.30,** Relay of Dance Music from the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (**308.3** metres); 0.7 kW.—**10.30 a.m.,** Orchestral Concert. **4.0,** Dance Music relayed from the Pik-Kabaret. **5.30,** Travel Talk by Professor Josef Pavelić: Italy. **6.45,** Talk and News. **7.0,** Opera relayed from the Zagreb National Theatre. In the interval at **8.50** (approx.), Press News and Weather Report and Forecast. **10.0** (approx.), Close Down.

ZÜRICH (**489** metres); 1 kW.—**10.0 a.m.,** Concert by the Station Orchestra. **11.29 a.m.,** Time Signal, followed by Weather Report and Forecast. **11.30 a.m.,** Gramophone Selections. **3.0,** Selections by the Carletti Orchestra playing at the Carlton Elite Hotel. **6.30,** Time Signal. **6.33,** Catholic Address. **7.0,** Shrovetide Programme. Artistes: Herr Tänperli and Herr Tschümperli; Hans Vaterhaus; Otto Strauss at the piano; and the Station Orchestra. **9.0,** Late News Bulletin and News from the Neue Züricher Zeitung. **9.40** (approx.), Close Down.

Sunday, February 17th.

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



Valve Current from the Mains

Obtaining Optimum Performance with A.C. Valves. Remarkable Characteristics of the New Screen Grid Valve for A.C. Mains.

By E. YEOMAN ROBINSON
(Chief Valve Engineer, Metropolitan-Vickers Electrical Co., Ltd.).

PERHAPS one of the most outstanding features of this last year is the great step forward which has been made in the development of all-mains-receivers. This development in not surprising since the cost of replacing H.T. batteries and recharging accumulators is the most serious item of the running cost of a wireless set. In addition, by going over to mains operation larger valves can be used, since the cost of operating an H.T. battery eliminator and A.C. valves is extremely low, with the result that much better quality of reproduction can be obtained.

Generally improved operation is also due to the fact that the high-tension and low-tension voltages are always at the right value; consequently once the experimenter has tried complete mains operation with success —and with the new A.C. valves there is nothing tricky— he is not likely to revert to a battery-operated set.

High Mutual Conductance.

In converitng a set of all-mains operation on A.C. supply, the H.T. battery is replaced with the now well-known H.T. battery eliminator and the accumulator is dispensed with by employing A.C. valves whose cathodes are heated with current derived from the electric light mains by means of a step-down transformer. The easiest method of using alternating current is to employ indirectly heated cathode valves, for with these the heating current is not passed through the cathode, but through a separate heater which is insulated from it. In the Cosmos series of A.C. valves the heater consists of a non-inductive hairpin-shaped heater coated with porcelain and enclosed in a nickel tube, which is in turn coated with a mixture of barium and strontium oxides. The combination of the non-inductive heater and the equipotential cathode prevents hum being introduced. The constituents of the porcelain are such that at the operating temperature of the cathode it is slightly conducting, which is also a factor in preventing mains hum.

Since the cathode must have a separate connection the valve is fitted with a five-pin cap, an adaptor, however, permits of the use of an ordinary valve-holder which enables an existing set to be converted to mains operation without altering the wiring.

The use of an equipotential cathode enables improved operating characteristics to be obtained, so that the gain per stage is approximately doubled when these A.C. valves are employed. Originally only two Cosmos A.C. valves were marketed, but the range has now been greatly increased, and there are five three-electrode valves whose characteristics are given in the table below:—

	AC/G.	AC/R.	AC/P.1	AC/P.2	AC/X.
Mutual Conductance in Milliamps. per volt ..	2.0	3.5	2.5	2.5	0.6
Amplification Factor	35	10	5	5	10
Impedance in Ohms	17,500	3,000	2,000	2,000	17,000

The characteristics of the AC/G. valve make it suitable for use with either transformer coupling (H.F. or L.F.) or resistance coupling. With a good low-frequency transformer with a ratio of, say, 3½ to 1 the gain per stage is approximately 120. When using resistance coupling a low anode resistance will give good overall amplification and greatly reduce high-note loss. The AC/R., AC/P.1 and AC/P.2 valves are for power amplification. The AC/R. will handle enough power to operate the average loud speaker. The AC/P.1 and AC/P.2 are larger power valves rated at 220 and 400 volts H.T. max. respectively, though on the same anode voltage they will deliver the same amount of power, so that unless an anode voltage of 300 to 400 is available an AC/P.1 should be employed. With 220 volts H.T. on the AC/P.1 an anode current of nearly 30 is necessary, so that unless the eliminator is capable of supplying 30 milliamperes at this voltage, probably the same amount of power will be obtained with the AC/R., with the advantage of twice the amplification in the last stage.

A.C Valves and the Low-frequency Amplifier.

Two low-frequency transformer-coupled stages should never be used with AC/G. valves owing to their great sensitivity. The best combination for two stages of L.F. is one stage of resistance-capacity coupling followed by a transformer-coupled stage, which combination will give with a modern transformer a reasonably uniform amplification at both low and high frequencies, and in addition enable anode bend rectification to be used without loss of low audio frequencies. Anode bend rectification

Valve Current from the Mains.—

should always be employed wherever possible on mains sets owing to its freedom from interference. For a local station set or a set employing one stage of high-frequency amplification, one stage of transformer coupling only is satisfactory as employed on the " A.C. Two " and " A.C. Three " mains sets already described in the pages of this journal. The AC/X valve has a comparatively low mutual conductance, and is relatively speaking a poor valve, but it is intended for use where the superior characteristics of the AC/G. valve make it too lively. For example, in many existing sets the high-frequency stage will oscillate with an AC/G. valve and an AC/X valve should, therefore, be employed. Similarly, if a set is equipped with two stages of low - frequency transformer - coupling the AC/X should be used instead of the AC/G. The valve is, therefore, valuable when an existing set of old design is converted to all-mains operation.

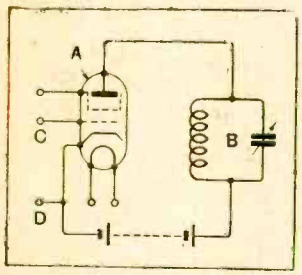


Fig. 1.—Using an indirectly heated screen grid valve with an A.C. resistance of 800,000 ohms and a mutual conductance of 1.5 mA./volt an overall amplification of 256 per stage can theoretically be obtained.

Calculating the Amplification per Stage.

The latest development is the A.C. screen grid valve. This valve employs an equipotential cathode which enables a high mutual conductance and a high amplification factor and very low residual interelectrode capacity to be obtained. Under working conditions, i.e., with grid bias, the mutual conductance is 1.5 milliamperes per volt, whilst the amplification factor is approximately 1,200, giving an approximate anode impedance of 800,000 ohms; consequently a very high gain per stage, for example, 300-400, can be obtained. A few explanatory remarks on the gain per stage will not be amiss. Referring to Fig. 1, suppose the screen grid valve A has a mutual conductance of 0.4 mA. per volt, and a sufficiently high amplification factor (and hence impedance) to avoid introducing damping into the tuned circuit B; assume also that this circuit has a resistive impedance of 200,000 ohms when in resonance, then the application of a signal of 0.01 volt between control grid C and cathode D will produce a voltage of

$$\frac{200{,}000 \times 0.4 \times 0.01}{1{,}000} = 0.8 \text{ volt}$$

across the tuned circuit, which means that the theoretical gain will be $\frac{0.8}{0.01} = 80$. However, if the valve has an impedance of 200,000 ohms the gain will be reduced to 40 per stage, which figure is more in accordance with the results usually obtained with screen grid valves.

If the mutual conductance of the valve A is 1.5 mA. per volt the gain will be 320 for a valve of infinite impedance or 256 for a valve with an impedance of 800,000 ohms. *The gain per stage is, therefore, dependent primarily on the mutual conductance and secondarily on the amplification factor of the valve.* The function of the screen grid is to act as an electrostatic shield between the control grid and anode to make the capacity feedback so small that the amplifier is stable. The residual inter-electrode capacity can never be reduced to zero, since the grid must be perforated and the maximum permissible capacity for stability is dependent upon the gain per stage which is obtained. If the gain per stage is increased four times by increasing the mutual conductance of the valve the inter-electrode capacity must be reduced to about 1/16 in order to give the same margin of stability. Consequently *two screen grids* operating in cascade are used in the AC/S valve. Figures 2 and 3 give the characteristic curves of the valve. Fig. 2 shows ordinary static curves from which the working anode current may be obtained. Fig. 3 shows the voltage factor and mutual conductance characteristics of an average valve obtained dynamically under working conditions by means of a Miller bridge. It will be seen that the actual amplification factor and mutual conductance is greatly dependent upon the particular anode and screen voltages which are employed, and can be varied within very wide limits.

Secondary Emission from Screen Grid.

Under the recommended conditions with 60 volts on the screen grid, 1.5 volts negative on the control grid, and 150 volts on the anode, the mutual conductance is 1.5 milliamperes per volt and the amplification factor is 1,200, whereas with 80 volts on the screen the amplification factor is reduced to 500, whilst the mutual conductance is increased to 2.0 milliamperes per volt. The increase in mutual conductance is obviously due to the higher screen voltage employed. The decrease in amplification factor is due to secondary emission from the screen grid. Electrons emitted from the filament strike the screen grid and knock off further electrons by impact. These secondary electrons are drawn away to the anode,

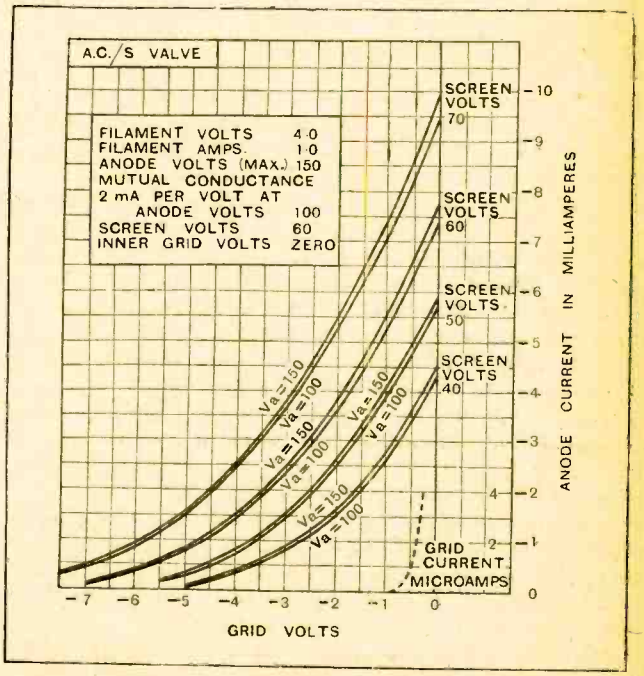


Fig. 2.—Static curves of the indirectly heated screen grid valve (AC/S).

Valve Current from the Mains.—

but with 80 volts on the screen less are drawn away than with 60 volts on the screen, so that the amplification factor of the valve is reduced. It will be seen that with even 60 volts on the screen the amplification factor is greatly dependent upon the secondary electrons, for the true amplification factor of the valve, which may be obtained by making the screen volts low, is about 5,000.

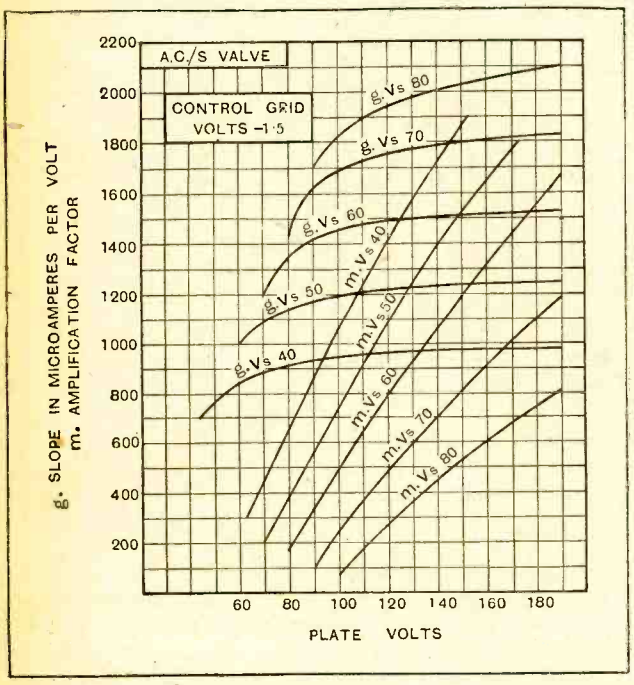


Fig. 3.—Dynamic curves of the AC/S valve taken under working conditions by means of a Miller bridge.

It will, therefore, be seen that the amplification factor is dependent upon both screen and anode voltages, whilst the mutual conductance is practically independent of the anode voltage, but increases with the screen voltage.

In use a screen grid voltage of about 60 is recommended; this should always be obtained from the eliminator by means of a potentiometer connected across the H.T. supply, as shown in Fig. 4, and as was explained in an article entitled "Dropping Volts."[1] A series resistance should never be used with any screen grid valve to obtain the required voltage, because the screen current varies widely from valve to valve, and may even be negative, so that a series resistance does not give any control of the screen voltage, but only ensures that it is less than that of the anode. Apart from the fact that the cathode is indirectly heated, the A.C. screen grid valve is used in the same way as any other, though in view of the high gain per stage and the fact that an eliminator will probably be used to supply the H.T for the whole set, care must be exercised to prevent capacity feed-back between the various parts of the system. One of the tuning coils should be astatic; this renders perfect screening of the H.F. stages unnecessary. Generally it will be found that any trouble due to feed-back will be caused by the L.F. amplifier. The guiding principle, therefore, should be to screen completely this amplifier and prevent H.F. getting into the loud speaker and eliminator, from whence it may feed back into the aerial. To prevent this occurring the following precautions should be observed: An 0.1 mfd. condenser should be connected between each screen grid and earth, the connection being made as close to the valve as possible. If more than one screen grid is supplied by the same potentiometer they must be separated by an H.F. choke; furthermore, H.F. signals must be kept out of the L.F. amplifier by means of a by-pass condenser and H.F. chokes; also a resistance of 100,000 ohms should be put in series with each L.F. amplifier grid.

[1] See *The Wireless World*, November 28th, 1928, p. 724.

The L.F. Amplifier Should be Screened.

The windings of the loud speaker should be earthed and supplied by an output transformer or choke capacity feed, and the L.F. amplifier should be as far as possible completely screened. The final eliminator smoothing condensers for the detector and L.F. amplifier stages should be placed inside the screened L.F. amplifier compartment; it is also sometimes advisable to insert H.F. chokes between these condensers and the eliminator. The mid-point of the heater wiring, the eliminator case and transformer cores should be earthed, whilst separate grid bias batteries should be used for each H.F. stage independent of that for the detector and L.F. stages, unless it is proved that a common battery or the eliminator grid bias supply causes no trouble.

For coupling the A.C. screen grid valve a tuned anode circuit or a 1 to 1 transformer as indicated in Fig. 5, or an H.F. choke condenser-coupled to a tuned circuit, as shown in Fig. 6, should be employed. The tuned anode circuit should not be used except for the tuned circuit preceding the detector, and then only if cumulative grid rectification is employed owing to the necessity for using a condenser and grid leak for transferring the signals to the grid of the succeeding grid. The transformer should have a 1 to 1 ratio and its primary may consist of a winding of fine wire wound on to the coil former in between each turn of the secondary winding.

When a set is equipped with A.C. valves and an H.T. battery eliminator trouble may possibly be experienced due to hum, back-coupling, or "motor boating" and instability. As far as "motor boating" is concerned this has already been dealt with in these columns, and we do not propose to discuss its prevention here except to point out that the incorporation of A C valves may increase the tendency to "motor boat" owing to the greater amplification obtained. This can be prevented by increasing the effectiveness of the separate filters employed for the detector and intermediate valves.

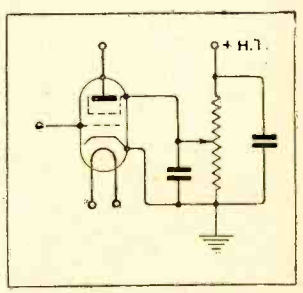


Fig. 4.—A potentiometer should always be used to provide screen voltage when an H.T. eliminator is used to feed a screen grid valve.

Hum is due to E.M.F.'s induced in the set from the electric light mains and apparatus connected to them such

Valve Current from the Mains.—

as transformers, eliminators, fires, motors, etc. It may be of the fundamental frequency of the supply mains (generally 50 cycles) or harmonics of this frequency, or it can be of considerably higher frequencies due to line disturbances; it may be introduced into the set either electrostatically or electromagnetically.

Electrostatic Pick Up.

The various grid connections of the set have a small capacity to the house wiring, the eliminator, the transformer supplying the heating current for the A.C. valves, electric fires, etc. Owing to this capacity an alternating charge is induced on the grid of the detector valve if there is a high impedance between the grid and the cathode. To prevent this hum the impedance between grid and cathode should be made low, and therefore anode bend detection should preferably be employed, since at the frequencies we are concerned with the impedance of the tuned circuit will be equal to its resistance, i.e., not more than a few ohms. With cumulative grid detection, hum from this cause may be minimised by using a low value grid leak and connecting it to a positive grid bias, which has the effect of greatly reducing the grid filament impedance. For example, with a two-megohm grid leak the grid filament impedance will be reduced to, say, 30,000 ohms by connecting the grid leak to 1½ volts positive, and 10,000 ohms by connecting it to 3 volts positive, owing to the grid current which flows as a result of this connection.

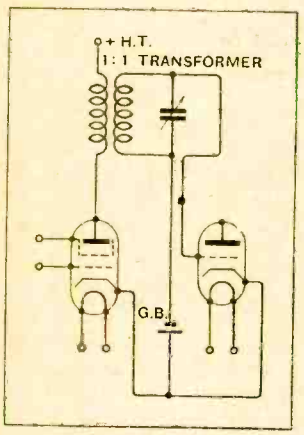


Fig. 5.—A satisfactory method of coupling the A.C. screen grid valve is by means of an H.F. transformer with a 1 : 1 ratio.

However, cumulative grid detection should be avoided whenever possible, because it is always uncertain how much hum may be picked up due to this cause. A set with a cumulative grid detector may be perfectly satisfactory when first tried out, but hum may be introduced by changing the position of the eliminator, by bringing further electrical apparatus into the room, by moving the set into a different room or a different locality where mains interference is worse, or the disturbances in the supply mains may be greatly increased when some nearby consumer connects a motor or other equipment to the mains. Hum due to electrostatic pick-up generally contains a proportion of 50-cycle hum, a proportion of harmonic hum, and may contain a general barrage of all frequencies very much like atmospherics.

Although the detector valve is the one most sensitive to electrostatic pick-up, pick-up may occur in other stages of the set if the leads connecting two valves are sufficiently long or wander about the set in any manner, particularly when resistance capacity coupling is employed. Pick up may occur in the detector stage even with anode bend detection if the grid pin of the valve is making indifferent contact with the socket, for in such a case the contact will have a high resistance sufficiently low to pass on the radio frequency which is being detected, but sufficiently high to cause a charge to be picked up electrostatically on the grid. If hum is obtained the grid pins of all the valves should be opened out and the connections to all the grid terminals and the sockets inspected to see that good connection is made. In the same way the electrostatic pick-up may occur with plug-in coils if the pins are not making good contact, or if the coil has a high resistance.

It is often thought that if the set is completely screened this trouble should not exist, but this is not the case, since the various H.T. leads connected to the eliminator serve as a means for introducing hum to the inside of the screening box. Nevertheless, screening does give a considerable improvement, but it is, of course, essential that any screens used should be earthed. It is also advantageous to earth the cases of the eliminators and transformers if these are of metal. The set should also be earthed. This is a point frequently overlooked when a gramophone pick-up is employed. It is most important to see that this earth is effective; sometimes hum will be found to be due to a bad earth connection, resulting in pick up in the earth lead. Finally, care should, of course, be taken to see that none of the high voltage flexible leads connected to the electric light mains wander round the set.

Electromagnetic Pick Up.

Electromagnetic pick up in the set is easier to diagnose than electrostatic, but generally it is more difficult to eliminate. It is entirely due to the use of magnetically leaky transformers, and is due to their stray magnetic field. Unfortunately, most small transformers seem particularly prone to this disease. A set employing resistance-capacity coupling throughout is not greatly troubled with this form of pick-up, but frequently the coil of the tuned circuit in front of the detector is sufficiently large to cause hum to be picked up. This is particularly the case with long-wave coils or with short-wave coils of large diameter of the efficient type, such as are employed in the "Everyman Four" set. Pick-up can be prevented by orienting the coil or the power transformers which are suspected until there is zero coupling between them. An astatic coil used in the detector grid circuit will greatly reduce any magnetic pick-up due to the absence of external field.

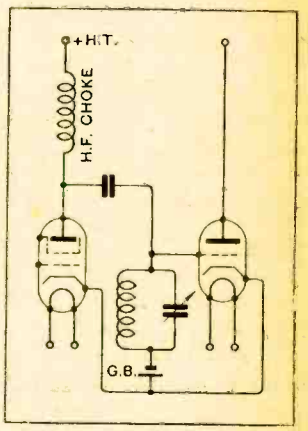


Fig. 6.—The parallel-fed (choke-condenser) method of coupling a screen grid valve.

If the set is transformer-coupled, pick-up may occur in the inter-valve transformers, and may be prevented in the same way by orienting these transformers or the power transformers in order to reduce the coupling to zero. To give minimum coupling the cores should be

Valve Current from the Mains.—

at right angles to each other. The easiest way to determine the cause of the trouble is to place the eliminator and the transformer supplying the valve filaments at a considerable distance from the set, say 6ft. to 8ft., until hum is practically eliminated, then bring the heater transformer near to the set. By rotating this transformer a point of minimum or zero hum will be found. When the transformer has been fixed in this position, the H.T. battery eliminator should be brought near to the set and a similar point of minimum pick-up determined. If the H.T. battery eliminator contains two transformers set at right angles to each other, this procedure becomes difficult if both transformers are magnetically leaky, and the only way to effect a real improvement is to place the cores of both transformers parallel to each other.

Another useful dodge, which may sometimes be employed when it is not convenient to orient the transformers owing to lack of space, is to reverse the primary winding of one power transformer so that the leakage fluxes neutralise each other. This is, of course, only possible in those cases in which the leakage flux is practically the same for both transformers. Magnetic screening of the power transformers is very difficult to carry out, and to be effective an iron screen at least $\frac{1}{16}$in. thick must be employed. We have dealt with the causes of hum. Diagnosis of trouble may be made easy when converting an existing set or building a new set by introducing the eliminators and the A.C. valves in stages and in a logical sequence which gives a chance to correct the performance at each stage.

Locating and Curing Hum.

The following method of procedure will be found to be comparatively simple: Connect up the set with A.C. valves and dry battery or accumulator H.T. Do not connect the H.T. battery eliminator to the set, and see that this is disconnected entirely from the electric light mains. If the set is provided with one or more H.F. stages, the H.F. valves should be removed and the aerial connected to the deetctor tuned circuit through a small condenser. Switch on the set. It should be free from hum, and the H.T. battery eliminator and the H.F. stage should not be incorporated until it is working satisfactorily under these conditions. If hum is present first see that the set is connected to give anode-bend detection, and then test if the valves are at fault. To do this change the valve in the detector stage for one of those used in subsequent stages. If the hum does not disappear the fault does not lie with the valve.

Remove the L.T. transformer 6ft. to 8ft. from the set, and observe if the hum decreases. If it does this locates the cause of the trouble. The transformer should then be brought back into the position it is finally to occupy and oriented with respect to the tuned circuit coil and the inter-valve transformers to find the position of minimum hum. Both the tuned circuit and the inter-valve transformer may be picking up hum, and both of these may have to be rotated until the best position is found. If there is still some hum present, open the valve pins to make sure that they are making good contact, and check up the grid connections to see that these are not at fault. See also that the flexible connection connecting the transformer to the electric light mains is not located near the set. The set must be working properly under these conditions before further tests are proceeded with.

If cumulative grid detection must be used, how reconnect the set with condenser and grid leak. If hum is introduced, try the effect of more positive bias on the detector grid, and earth the transformer core or case. Also try the effect of moving it away from the set. However, unless an H.F. stage is employed, it is best to wait until the battery eliminator has been tried out before going to cumulative grid detection, because when this is introduced it may give pick-up.

If an H.F. stage is used now plug in the H.F. valve and connect the aerial to its proper terminal. The set should be free from hum and stable. If hum is introduced, the set is oscillating, and must be stabilised. Now disconnect the H.T. battery and connect the H.T. battery eliminator to the set, put the two-pin plug into the wall socket, but do not switch the eliminator switch on, and observe if hum is introduced. No hum should be introduced, if it is, it is due to a faulty grid connection or to the use of cumulative grid detection. Switch on the eliminator. If hum is introduced, proceed in the manner indicated above by removing the eliminator 8/10ft. from the set, and observe the effect of doing this and also orienting coils, etc.

Hum may be caused by insufficient smoothing in the eliminator, or "motor boating" may be caused by reaction in the eliminator. These two troubles can only be properly cured by redesigning the eliminator, introducing further smoothing or separate feed circuits for the intermediate stages. When the eliminator is switched on the extra high tension available for the H.F. valve (if any) may cause this to oscillate, which oscillation, if it is not rendered obvious by heterodyning with an incoming signal, may be mistaken for hum. If the set oscillates, restabilise. A faulty grid bias battery may easily introduce hum by interposing a high resistance in the grid circuit of the detector valve. If the incorporation of A.C. valves and the H.T. battery eliminator is carried out in the gentle stages indicated above, no inexplicable hum will be found; but if the set is connected up with A.C. valves and battery eliminator at the same time, if hum is introduced the causes for its introduction are so numerous that it is well-nigh impossible to isolate them.

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BOOKS RECEIVED.

Encyclopédie de la Radio, by Michel Adam. A comprehensive descriptive dictionary, in French, of wireless apparatus, giving, at the end of each description, the equivalent English and German terms. Pp. 355, with 1,550 illustrations and diagrams. Published by Etienne Chiron, Paris. Price 50 francs.

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Wireless, The Modern Magic Carpet, by Ralph Stranger. A popular exposition of radiotelephony and modern broadcasting, with 250 diagrams and illustrations. Pp. 312. (London: S. W. Partridge and Co., price 3s. 6d. net.)

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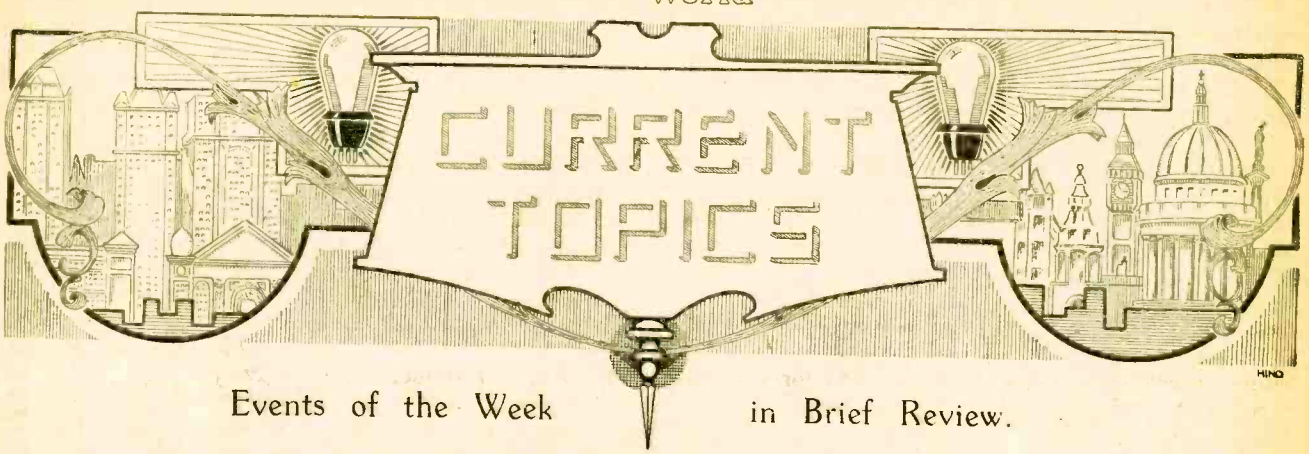
Everyman's Wireless, by Ernest H. Robinson (5YM). A simple technical description for "the great body of listeners whose interest is mainly in the programmes." Pp. 248. (London: Cassell and Company, Ltd Price 3s. 6d. net.)



Events of the Week in Brief Review.

A WIRELESS INDUCEMENT TO HOUSEHOLDERS.

A recent announcement in a daily paper advertising freehold houses on an estate at Hounslow mentions first in a list of special features "Five-valve Portable Wireless Receiving Set."

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AID TO ORATORY IN REICHSTAG.

Microphones, amplifiers, and loud speakers have been installed in the German Reichstag in order to strengthen the voices of speakers, especially, it is understood, on those occasions when speakers are subjected to interruption and the House is generally suffering from noise created by opposing parties. When necessary it will be possible to so increase the amplification that the voice of the President can be made to dominate the tumult. At present there is not much demand in Germany for the speeches in the Reichstag to be publicly broadcast.

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OBJECTION TO NEW EIFFEL TOWER WAVELENGTH.

It is stated that the French Ministry of Posts and Telegraphs has lodged a protest against the adoption of 1,485 metres as a new wavelength for Eiffel Tower, and has requested the Geneva Union to assist in authorising a return to 2,650 metres.

It has also been suggested that the increased power of Eiffel Tower transmitter warrants its adoption in Europe for the official broadcasts by the League of Nations.

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NEW STRASBOURG TRANSMITTER.

The French Ministry of Posts and Telegraphs has arranged for the installation of a high-power broadcasting station at Strasbourg. If the new station is approved by the Chamber of Deputies in the Senate the allowance made for the construction of the station is expected to be in the neighbourhood of three-and-a-half million francs. A regular service will be guaranteed to both French provinces of Alsace and Lorraine, and all announcements will be made both in French and in German.

The new station, if approved, will probably be in operation some time about January 1st, 1930, or soon after that date.

"THE WEEK'S GOOD CAUSE."

According to a statement issued by the B.B.C. over £63,000 was realised as the result of "The Week's Good Cause" appeals from 2LO during 1928. This amount does not include the Miners' Fund appeal, nor the amount realised in connection with two other appeals for which the figures are not yet available.

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THE LEAGUE OF NATIONS STATION.

Test transmission through the high-power short-wave Kootwijk (Holland) transmitter on behalf of the League of Nations commences on March 12th and will be continued on March 19th and 26th for the U.S.A.; on March 13th, 20th, and 27th for Japan; and on March 14th, 21st, and 28th for Australia. The broadcasts for U.S.A. will be between 10 and 11 p.m. G.M.T., those for Japan and Australia towards 2.0 p.m. G.M.T., or as soon after as the existing public telephony service between Holland and the Dutch East Indies permits.

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GOOD LUCK, SINGAPORE!

We hear that a Singapore firm—Radio-arts, Ltd.—proposes to establish a Malay broadcasting station for the special purpose of relaying short-wave programmes throughout the Straits Settlements and Malay States. Schedules are being arranged with the technical staffs of the Chelmsford, Melbourne, and Sydney stations to enable continuous programmes to be given each evening from 7.30.

Lest they be accused of excessive optimism, the organisers state that 2LO has already been received satisfactorily through 5SW, and that Malayan listeners have already enjoyed performances given in the London Palladium.

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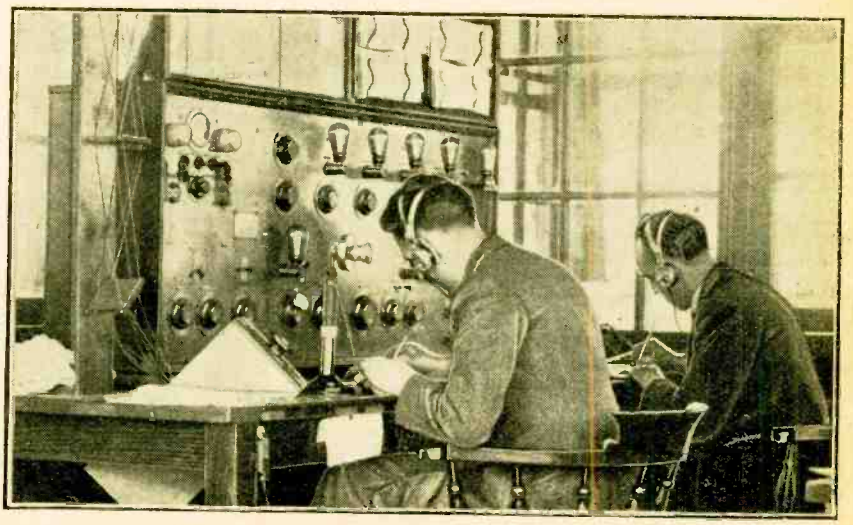
BROADCASTING LIBELS.

An interesting point of law has been raised in the French Courts as a result of a request made by a man who was mentioned in an Eiffel Tower news broadcast, claiming to have the right of broadcasting a reply to the statement on the following day.

Under a French law relating to the Press, anyone injured by a reference to himself in the Press has a right to insert a reply in the same position and type and up to double the length in the next issue of the newspaper, but the Court decided that this law did not necessarily hold in the case of broadcasting.



RADIO AIRCRAFT CONTROL AT CROYDON. The position-finding equipment for giving the location of cross-Channel aircraft.

WIRELESS WORLD LABORATORY TESTS

A Review of Manufacturers' Recent Products.

R.I.-VARLEY BI-DUPLEX TRANSFORMER.

The majority of high-quality intervalve transformers are designed for use with valves of medium impedance, and it is unnecessary to legislate for direct currents in the primary of more than, say, 4 mA. Occasionally, as in special public address

R.I.-Varley Bi-Duplex transformer for heavy anode currents.

amplifiers, a transformer is required which can be made to follow a "super-power" valve of the receiving class for transferring power to an output valve of transmitting dimensions.

The R.I.-Varley Bi-Duplex transformer has been designed specifically for this purpose, and will maintain an excellent frequency characteristic for all D.C. currents up to 20 mA. The makers state that with 15 mA. flowing through the primary, the response curve is practically a straight line from 50 up to 3,000 cycles, after which it rises slightly to 6,000 cycles. A practical test showed that the reproduction of high notes was particularly good. Two different valves were tried, one taking a current of 2.5 mA. and the other 10 mA. No difference in the performance of the transformer under these two sets of conditions could be detected by ear.

Without D.C. flowing through the primary the inductance is about 30 henrys; the D.C. resistance of the primary is 1,500 ohms. The price is 27s. 6d.

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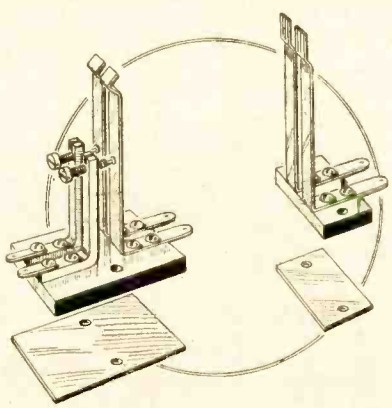
PICTURE RECEIVER CONTACTS.

Components are now coming to hand making it possible to build the Picture Receiver with a minimum of difficulty. Small parts are often troublesome to construct, and particularly is this true in the case of spring contacts. Messrs. Wilkins & Wright, Ltd., Utility Works, Holyhead Road, Birmingham, who are devoting their attention to supplying the amateur with all necessary parts for building the complete instrument have produced a complete set of contacts conforming to the details given in the design. These contacts are mounted on suitable paxolin bases, and are supplied with under-insulating pieces of mica. The accompanying illustration shows the details of construction. One pair of contacts is used in conjunction with the cams to switch in and out of circuit the relay and stylus as well as to close the clutch circuit. The other pair of springs is used as brushes for energising the magnetic clutch.



The Utility set of contacts for use in the construction of the Picture Receiver.

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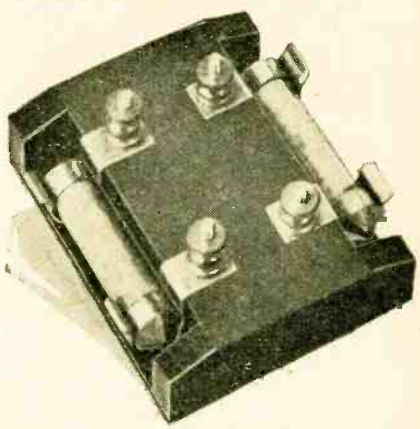
DETEX R.C.C. UNIT.

This is an inexpensive resistance-capacity unit made by the Detex Distributors, Ltd., Detex House, 125-9, Rosebery Avenue, London, E.C.1, the price being only 4s. The measured values of the anode resistance and grid leak, which



Detex R.C.C. unit.

are both of the familiar removable grid leak type, were found to be 215,000 ohms and 940,000 ohms respectively, these figures comparing favourably with the makers' values of 0.25 megohm and 1 megohm respectively. The capacity of the coupling condenser is 0.01 mfd.

The above resistances are fitted in all models as standard, but other values can be supplied if specified.

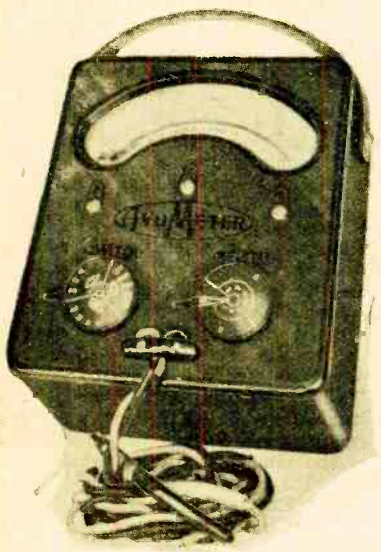
AVOMETER.

The 1928 model Avometer is a combination instrument designed and manufactured by the Automatic Coil Winder and Electrical Equipment Co., Ltd., Winder House, Rochester Row, London, S.W.1, for measuring D.C. currents, voltages, and also resistances, and covers the following ranges :—

Current.	*Voltages.*
0-12 amperes.	0-1,200 volts.
0-1.2 ,,	0-120 ,,
0-120 milliamperes.	0-12 ,,
0-12 ,,	0-1.2 ,,
	0-120 millivolts.

Resistance.
0-1 megohm.
0-100,000 ohms.
0-10,000 ,,
0-1,000 ,,

The nucleus of the instrument consists of a spring-controlled moving coil pivoted on two polished steel points which are mounted in sapphire jewel bearings and swung in a powerful magnetic field generated by a cobalt steel magnet. A knife-edged pointer is fitted to the moving coil, and this travels across a dial on which is engraved two scales approximately 5in. long. The upper scale is engraved 1,000 to 0, this being used for all resistance measurements, while the lower scale, which reads 0-120, is used for measuring current and voltage. The dial is provided with a mirror to facilitate accurate reading of the pointer position. The various ranges are brought into use by connecting suitable resistances either in series or shunt with the moving coil, these being controlled by a multi-point switch mounted on the front panel with the mechanical parts



The Avometer, a multi-range measuring instrument.

totally enclosed. The control for this switch is the left-hand knob on the front panel. To the right of this is another knob which operates a rheostat, this being intended as an auxiliary control for regulating the amount of current, if necessary, but does not affect the calibration of the instrument on the current ranges.

When used as an ohmmeter for measuring resistance values a 1½-volt cell, housed in a small compartment in the back of the instrument, is brought into use. This, however, is connected in circuit only when measurements coming within the scope of the two lower resistance ranges are being made. For the two higher ranges, *i.e.*, 0-100,000 ohms and 0-1 megohm, an external battery of 7.5 volts or 75 volts should be connected in series with the resistance under test, the lower voltage being used for 100,000 ohm. range.

Before commencing to take measurements of resistance on the two lower scales. it is advisable to check the meter to correct for any drop in voltage of the small 1½-volt cell. Each instrument is provided with full instructions regarding the *modus operandi*, these being contained on a metal plate fixed to the back of the case.

A few measurements were made on each range and checked against standard laboratory instruments, the degree of accuracy being found very satisfactory. For example, on the 120 mA. range a current which the Avometer indicated as being 50 mA. was measured on the standard instrument as 49.8, an error of plus 0.4 per cent., or of about the order of the thickness of the needle and as near as it is possible to read with the instrument under normal conditions.

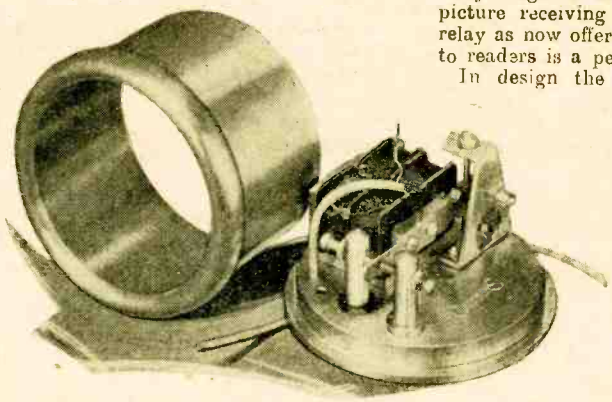
Measurements on the 1.2- and 12-volt ranges were for all practical purposes identical with the readings obtained on our standard instruments, and on the 120-volt range a small error of less than plus 1 per cent. was recorded.

Very careful measurements were made with an accurately adjusted resistance using the Avometer as an ohmmeter. By following the makers' instructions as regards initial check before taking readings, the resistance as indicated by the Avometer agreed satisfactorily with the value found by bridge method.

When used as a voltmeter the resistance of the instrument is 167 ohms per volt, and a current of 6 milliamps is required for a full scale deflection. It is, therefore, possible to utilise the 0.12 voltage range as a milliammeter if desired to measure very small current values, in which case the instrument will be twice as sensitive as if used on the 12 mA. scale.

The external dimensions of the meter are 6½in. × 4in. × 7½in., and the weight 5 lb.

The price is £8 8s., and for 15s. extra a strong leather carrying case with handle and shoulder strap can be obtained.



The Goodmans' relay.

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GOODMANS' PICTURE RELAY.

Messrs. Goodmans, of 27, Farringdon Street, London, E.C.4, were specified as supplying the relay used in the construction of *The Wireless World* Picture Receiver. Careful attention was therefore given to the details of design at quite an early stage in the development of the picture receiving equipment so that the relay as now offered and ready for supply to readers is a perfected article.

In design the present model is still very similar to the relay described in the constructional article, though experience has shown that attention to detail is important in producing a highly sensitive relay, and in particular care has been given to the selection and treatment of the iron used in the making of the electromagnet. Although the magnet core is of liberal section it definitely does not retain its magnetism to an extent that demands appreciable spring tensioning of the armature in order to prevent sticking at the contacts. Half a milliampere through the 4,000 ohm winding causes the armature to pull up, and for controlling a local circuit with absolute reliability less than 1 mA. will suffice. Excessive current through the relay does not render readjustment necessary as is commonly the case with small relays and due to the retention of magnetism by either magnet or armature. This relay is a first-class instrument, and sells at 39s. 6d.

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MISCELLANEOUS PARTS FOR THE PICTURE RECEIVER.

There are a few minor parts specified in the design of the wireless picture receiver, which owing to their simplicity have been overlooked by certain of the manufacturers supplying components for this instrument. As the amateur may not have to hand suitable material for the making of these parts Messrs. Williams & Moffat, Ltd., Ladypool Road, Sparkbrook, Birmingham, are now listing many of the smaller pieces needed when assembling in addition to the complete Simplicon carrier recently referred to in this section. Among the small parts is the bracket used to hold the brake which engages on the edge of the clutch made exactly in accordance with the specified design. This part is included among the components made by Williams & Moffat, and is provided with fixing holes suitably spaced to permit of assembly on the standard drilled panel.

CORRESPONDENCE.

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

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

EMPIRE BROADCASTING.

Sir,—I have read with interest various letters from your correspondents, some giving their views and some their experiences on short waves.

I should like, as an Englishman living in an outpost station, to express my thanks to those who have advocated Empire broadcasting.

I follow with interest all you publish regarding short waves, and, not like this one correspondent who bought American parts and criticised 5SW's programme, I buy British parts and hope for a British programme.

Through your review of the "Igranic" short-wave kit, I purchased the same direct, explaining how I was situated, and am very pleased with results, the set being stable and non-radiating. I am left with the feeling that they (the manufacturers) still have an interest in the set.

My previous set, an experimental one, employed capacity resistance, without L.F., so that when I tuned in a continuous wave station or a carrier wave (letting the set go into oscillation) it was transmitting.

Now, I find that although I am the only listener on this island, over 200 miles from anywhere where there is likely to be another listener, I can detect listeners tuning in to broadcast programmes, proving that receivers are capable of transmitting over a long distance.

As some listeners use the "Blind Spot," satisfied only in being able to receive over a very long distance, there is the possibility that heterodyning occurs, thus the reception of a distorted programme may not be the fault of the transmitting station.

The above may affect reports sent in from populated areas.

Christmas Island, Straits Settlements. WILLIAM GEORGE EMSLIE.

NEW YEAR RESOLUTIONS.

Sir,—I was interested in the letter of Mr. Guy S. M. Ashby in your issue of January 23rd. I had a similar experience at the show last year. The Marconi Co. were exhibiting a valve under the title of L.S.6. I obtained the particulars of this valve from one of the assistants. As it happened it was just the type of valve which would suit some experiments I am making, but when I wished to place an order for some I was told it was not on the market. I am still wanting some valves of this particular type

Sutton Coldfield. DEREK SHANNON.

WIRELESS IN THE POLICE FORCE.

Sir,—The police forces of the provinces are now taking up the use of wireless seriously, according to recent reports, and some of the more energetic branches of the force have already installed wireless.

There is no doubt that with proper organisation wireless should be a great boon to this service in assisting in intercommunication, but it seems to me that such a result can only be accomplished if the men employed are first-class wireless operators. I am informed that the qualification for operators in this service is only such as is necessary for an amateur operator, whereas I maintain that if wireless is to be put to its proper test in the police force the very best qualified men should be employed and operators only partially qualified should not be engaged.

It seems also ridiculous that in forming an efficient police wireless section hard and fast rules regarding height and other standards should be enforced, as these would appear to have no bearing whatever on technical efficiency.

The efficiency of the service seems bound to suffer if such qualifications are insisted upon and held to be of more account than technical ability and training.

Barnsley, Yorks. EX-WIRELESS OFFICER, R.N.R.

B.B.C. TALKS.

Sir,—In the issue of January 16th a paragraph appeared in the "Broadcast Brevities" under the heading of "So Talks *are* Popular." In this paragraph you point out that nearly all the competitors were anxious to give a talk, but you omit to say that the individuals in question have not the same resources of entertainment at their disposal as have the Savoy Hill officials.

Further, a single individual cannot do very much else, unless he be especially skilful on some musical instrument, and unfortunately these skilful performers are inclined to be reticent; hence the desire to talk.

Again, the subjects chosen were interesting, and no one but an habitual grumbler is opposed to an interesting talk.

I fear, then, that the "chuckle over the ironical results" is not founded on a correct view of the results.

Hale, Cheshire. K. CLAYTON.

TELEVISION.

Sir,—I should not have troubled you with this letter had it not been for the discourtesy of your correspondent, Mr. A. Moir, to the President and Council of the Television Society published in your issue of January 30th. Mr. Moir observes that "it is significant that the Council and supporters of the Television Society have not sprung from among the leaders of radio interests." as if the study of the science and art of applied physics was wholly embraced by writers on "radio interests."

Whilst Mr. Moir's letter contributes nothing whatever to our knowledge of the subject under discussion, it is noteworthy for his ignorance of the many wireless Television demonstrations given before competent physicists, including the President, Dr. Fleming, Professor Cheshire and over eighty members of the Television Society, with visitors at the December meeting, who greeted a wireless demonstration on the commercial Televisor with expressions of satisfaction and astonishment at the marked advance evidenced by the active and full-toned images received. Also a deputation of Post Office Engineers officially attended a demonstration of the Baird apparatus, and unanimously reported the demonstration by wireless to be satisfactory and suitable for a test through a Broadcasting Station, whilst Dr. Fleming, who, I suppose, Mr. Moir will recognise as a leader in radio interests, has written with reference to sceptics of Baird's wireless demonstrations: "That recognisable images of moving and living objects such as human faces have been transmitted even to large distances by wire and by wireless, by Mr. Baird's methods, admits of no manner of doubt. Those who deny it have simply not seen it. There are sufficient credible witnesses of it to place it quite beyond the region of dispute. CLARENCE TIERNEY,

Chairman of Council, The Television Society.

London, S.W.1.

READERS' PROBLEMS ANSWERED

"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.

Litz Wire.

In order to increase the maximum wavelength attainable, I propose to add ten turns to the litz-wound secondary of my H.F. transformer. Will it be necessary to avoid a joint by rewinding the coil with new wire, or do you consider it permissible to solder on a short length? I would prefer this, if possible, as I already have a sufficient length of wire to make the addition, but not enough for a new winding. R. P. F.

Provided you make the joint carefully, picking up connection with each strand of the two ends, there is no practical objection to a soldered joint, and we would not advise you to go to the expense of obtaining new wire.

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Automatic Control.

Can you give me a diagram for an automatic device to switch off my receiver when the carrier wave ceases; or, alternatively, refer me to a published description of such an arrangement in a back number? I should make it clear that the device is required only to switch off the set. F. H. B.

Assuming that you are using anode bend rectification, it should not be a difficult matter to fit an automatic device. A relay, which will be connected in the anode circuit of the detector as shown in Fig. 1, will be required; this must be sufficiently sensitive to close the contact on the increased anode current flowing when a signal is applied to the grid, and at the same time the contact should remain open on the small "standing" current passed when no signal is coming in.

Due to an increased interest in picture reception, a number of firms are turning their attention to the production of comparatively simple relays which should have suitable characteristics for your purpose; at the same time, it should be pointed out that an inexpensive piece of apparatus can hardly be expected to operate on the small maximum current passed by a high-impedance detector valve with a very high resistance in its anode circuit. Accordingly, it may be necessary for you to make some modifications, possibly by reducing the value of your present resistance, and even by substituting a detector valve of lower impedance.

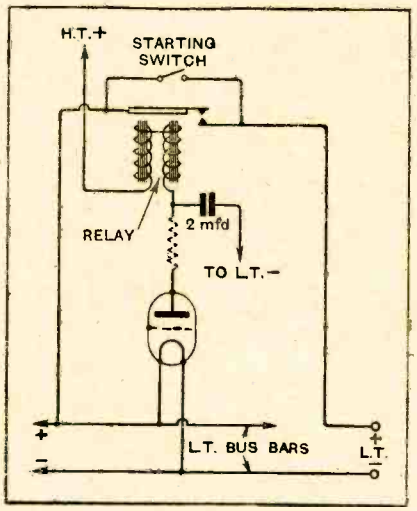

Fig. 1.—A relay arranged to switch off the filament circuit automatically at the end of a transmission. Coupling resistance shown in dotted lines.

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.

You will probably find it convenient to connect a starting switch across the relay contacts in the manner shown in the diagram; this should be of the "push" type, and, provided a strong signal is being received and adjustments are correct, the relay contacts will remain closed when the switch is released.

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Neutralised H.F. Amplifier.

I am in trouble with a two-stage neutralised H.F. amplifier, in which litz-wound "Wireless World" transformers are used. It seems to be impossible to neutralise the receiver over more than a few degrees of the tuning condensers; subject to this limitation, amplification is enormous, but you will realise that operation of the set is altogether too difficult, and I should welcome any suggestions you have to make. T. F. P.

It is an extremely difficult matter to get two high-amplification H.F. stages with neutralised couplings into a state of satisfactory operation, but it can be done; we would refer you to the description of "*The Wireless World* Five" in our issues of January 5th and 12th, 1927, as we think that you will gain some useful information from the articles. You must realise that complete screening will be essential, and that the various joints of the shielding boxes must be properly closed from an electrical point of view. You are also advised to adopt some of the "decoupling" schemes described in the issue of April 25th, 1928, if you have not already done so.

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The Pentode.

Economy in anode current is essential, and I should like to know if you can give me a suggestion as to how to use a pentode valve in such a way as to satisfy this requirement. Very great volume is not required, but I do not wish to introduce any alteration or modification that would seriously impair quality. E. C. S.

One of the best ways of reducing the consumption of current from the high-tension battery when a pentode valve is used is to apply a voltage to the screen (through the terminal on the valve cap) some 30 per cent. or so less than that applied to the anode. This scheme is widely adopted, and although it reduces the undistorted output attainable, it can be recommended in cases where this can be tolerated.

Trouble with D.C. Mains.

Pending the change-over to an alternating current supply, I am operating my "A.C. Three" receiver from an L.T. accumulator and a D.C. eliminator fed from 240-volt mains with a negative earth. My trouble is that I get quite severe shocks from the projecting grub-screws which secure the condenser dials; what is the cause of this? G. S. S.

We feel almost certain that you are in error in supposing that your negative main is earthed, and we think a test will show that we are correct in this assumption. As is well known, additional precautions have to be taken when the negative supply lead is "live," and to get over your particular trouble of shocks from the fixing screws, we suggest that they should be reduced in length, and after insertion you might run a little molten insulating compound over their heads.

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Adding H.F. to the "Pentode Two."

I have made up the "Pentode Two" (to the modified circuit given in the "Readers' Problems" section of your issue of January 9th), and have obtained such good results that I feel inclined to attempt the addition of an H.F. stage, using a screened-grid valve. This amplifier would be built in a metal screening case which I already have. Do you think that the idea is practicable? J. W. P.

Generally speaking, we do not recommend the addition of H.F. amplification to existing detector-L.F. receivers, but in this particular case, the circuit arrangement is such that it should be possible to make the addition in a satisfactory manner without any very great difficulty.

The circuit diagram of a suitable amplifier and its connections to the receiver are given in Fig. 2. In the first place, certain alterations must be made to the receiver; a large condenser of 0.25 mfd. or so (Cx) must be inserted in the lead which at present joins the centre point of the coils to L.T., and an H.T. feed wire must be run to the battery through a decoupling resistance, R, of some few hundred ohms. In addition, it will be necessary to short-circuit the aerial coupling condenser (C_1 in the original diagram). To connect up the amplifying unit, it is necessary to make arrangements to extend the battery leads to it, preferably by taking connections from the existing terminals, and to join the plate of the H.F. valve to the present aerial terminal.

To revert to the original Det.-L.F. arrangement, all you have to do is to remove the short-circuit from the aerial feed condenser, take off the added H.T. supply lead, and to short-circuit the condenser Cx.

There is, of course, no reason why you should not fit a wave-changing switch to the H.F. unit, in order that reception of the two broadcasting wavebands may be carried out without interchanging coils.

○○○○

Free Grid Bias.

I am told that it is possible to obtain a certain amount of negative grid bias without using an extra battery. How can this be arranged? B. H. B.

It is fairly easy to get a certain amount of "free" grid bias, but this is limited in extent to the difference between the voltage required to operate the filament of the valve and that supplied by the L.T. battery. The procedure is to insert the necessary fixed resistor or rheostat between the negative L.T. busbar and the valve filament terminal, and to take the grid circuit return lead to a common negative point and not to the filament itself. If this is done, any voltage drop across the resistor will be applied to the grid.

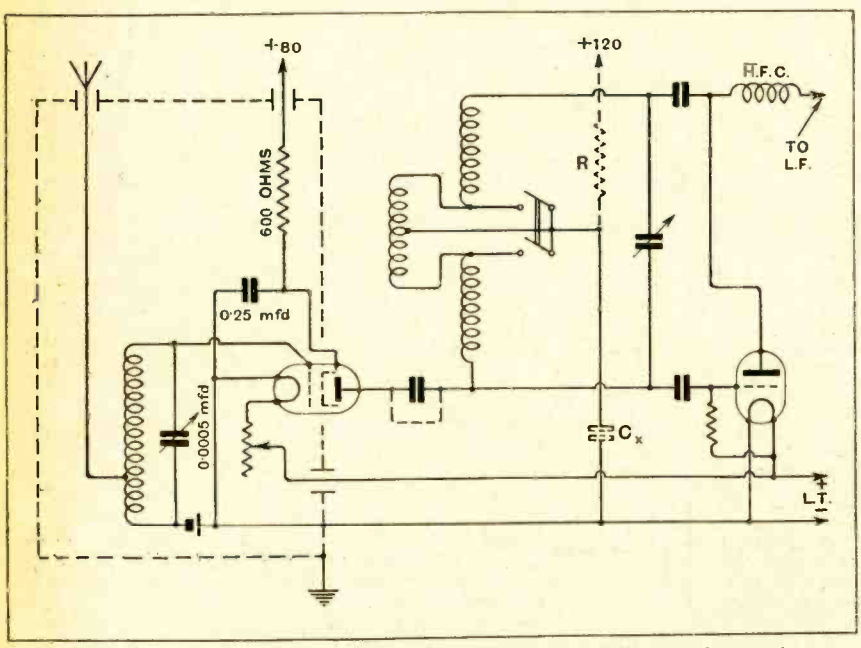

Fig. 2.—An H.F. amplifying unit for the "Pentode Two." Additions and alterations to the receiver itself are shown in dotted lines.

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The Picture Receiver.

My picture receiver, built in accordance with your recent description, occasionally fails during reception in that the trigger does not arrest rotation. As a result, synchronisation is lost and the remainder of the picture obliterated. C. T. F.

This is a common fault, yet one that is easily remedied. The causes, however, are many. They are:—

(1) Insufficient grid bias.

(2) Excessive signal strength.

(3) Sticking of relay contacts, due to insufficient spring tension on the armature.

(4) An interfering signal or excessive "mush"

(5) A poorly fitting catch. It is advisable to shape the catch so that its lower edge protrudes into the catch-plate to a greater extent than the top edge. By this means it is impossible for the slot to jump the catch unless the magnet is energised.

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Periodic Interference.

I am troubled by the fact that a loud click is produced by my loud speaker about once every minute. As far as is known, there is no electrical machinery in the block of buildings in which I live. Can you suggest a remedy? T. S. E.

We think it probable that this interference is caused by a system of electric clocks. This form of interference does not differ greatly from that due to other electrical apparatus, and it is extremely difficult to eliminate. We believe, however, that some of the manufacturers of this apparatus have found a simple way of preventing—or, at any rate, very considerably reducing—this interference, and we think your best course is to approach the owner of the clocks.

○○○○

Selectivity.

Will the addition of a second L.F. stage to my Det.-L.F. receiver help me in any way towards reducing interference from my local station, which monopolises the majority of the tuning scale on both medium and long wavelengths? L. H. F.

Yes, and no. At first sight one would be inclined to say no; and, indeed, this would be true were you to make no other alterations to the set. Although L.F. amplification does not in itself have any effect on selectivity, it will enable you to work with a looser aerial coupling, as it compensates to a certain extent for signal strength lost in this way. This gain is not important, and we strongly recommend you, if possible, to rebuild your set, and to add an H.F. amplifying valve.

The Wireless World AND RADIO REVIEW

(16th Year of Publication)

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CONTENTS OF THIS ISSUE.

"NATION SHALL SPEAK PEACE UNTO NATION."

WHEN the British Broadcasting Corporation, then newly constituted, chose as its motto the quotation "Nation shall speak peace unto Nation," it must be assumed that the choice was not made without very careful consideration of its significance and the obligation which its adoption implied. As time goes on, however, far from showing any enthusiasm for communicating afield the attitude of the B.B.C. seems to be becoming more and more insular in character.

With an Empire such as ours we should lead the world in the development of long-distance broadcasting and strain every effort to make the utmost use of the opportunities which broadcasting provides for linking together our scattered Dominions, but even then, we should not be living up to the motto of the Broadcasting Corporation, for to do that fully also requires that we should establish broadcasting as a means of *international* communication. Instead of aspiring to these aims we see, in any direction in which we may look for evidence, a disinclination on the part of the B.B.C. to pursue anything but an insular policy. The short-wave broadcasting station 5SW is making little or no progress; complaints from abroad are constantly received that the times of transmission are unfavourable for reception in different parts of the world, and that the type of material broadcast is not of a character to appeal to the listener.

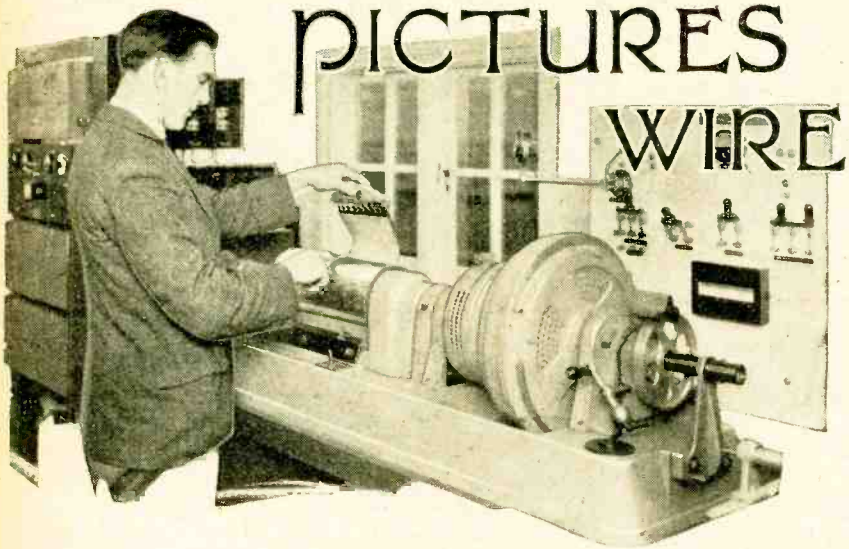
The absence of transmissions on Saturdays and Sundays and the unsuitable times of transmission generally is due, we understand, to the fact that the B.B.C. still regard the station as nothing more than experimental, and the times of working are, we are told, decided by what times can be arranged at the Marconi Works at Chelmsford, where the station is housed, without upsetting that company's routine work.

Limiting Range of Transmission.

A paper sponsored by the B.B.C. and read by the Chief Engineer before the Institution of Electrical Engineers was reported on recently in our pages. This paper provided proof of the tendency of the broadcasting organisation to confine its activities to our own islands, for the paper discussed the design of transmitting aerials where the object in view was to limit the range of broadcasting stations and concentrate the energy in a local area. The proposals were put forward as providing a possible solution for the present congestion on the broadcasting wavelengths in use in Europe. If this were the sole means left for overcoming the interference one would, of course, accept it as an unfortunate but inevitable step which had to be taken, but it does not seem to us that, supposing such an arrangement of aerial design did provide the results contemplated, that no alternative solution to the problem could be found.

The limitation of the number of stations and permission to increase power would, as we have pointed out, give much the same result and, interesting as the modification in aerial design may seem to be, it is questionable whether it is so intriguing as to justify its adoption. We know, of course, that the B.B.C. are subjected to constant, and often petty, criticism on matters where a difference of opinion may exist, but we feel that in pursuing a policy of inactivity in the sphere of international and Empire broadcasting, and particularly in neglecting the possibilities of the short-wave station, the B.B.C. are ignoring an opportunity which we venture to suggest is much more than an opportunity, being, in fact, an obligation which their motto bears witness they have taken upon themselves with their eyes open and yet have failed to meet.

PICTURES BY BEAM WIRELESS



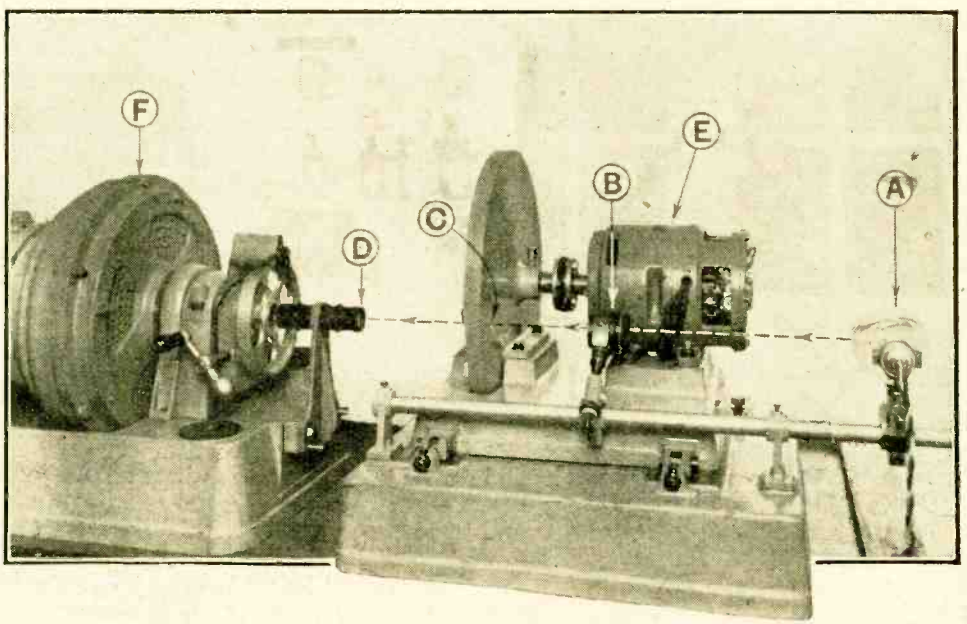
The New Marconi Picture Transmitting Equipment.

PICTURE transmission has two aims, one—the obvious—that of communicating illustrated matter by telegraph and the other, which is often overlooked, the transmission of written and printed matter so that the resultant speed of transmission is greater than by Morse signalling. An interesting fact is that in the early nineteenth century the facsimile telegraph preceded the general use of the Morse code. Bain, in 1842, used what was called a "chemical telegraph," consisting of a contact moving over a chemically treated paper reproducing the actual lettering which was set up at the transmitter in the form of metal-faced type. How similar was Bain's apparatus to the picture telegraph of to-day, even to the use of starch iodide solution for the production of the image at the receiver.

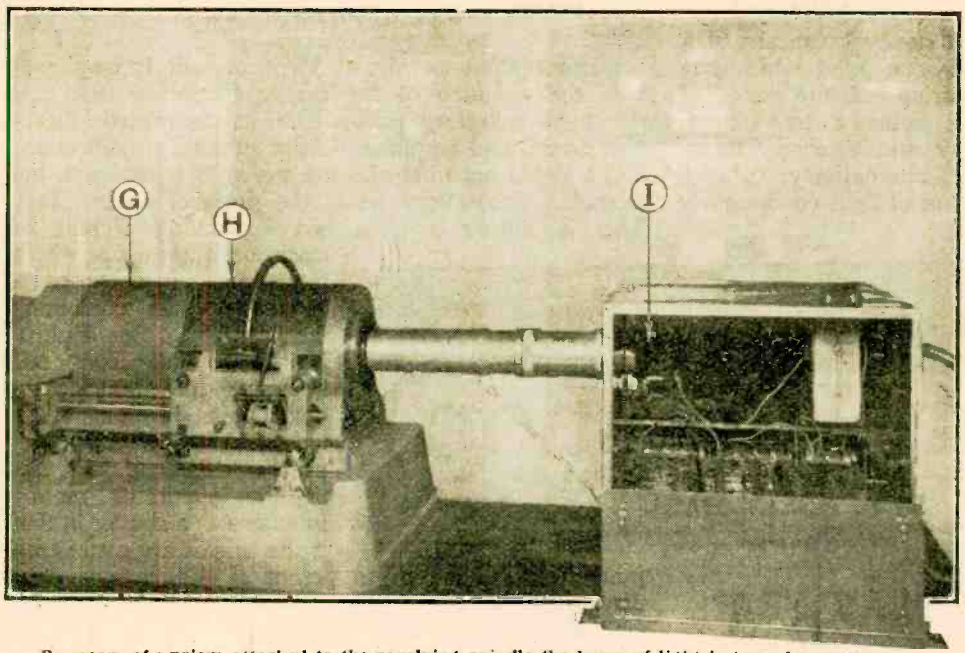
A growing demand for a successful system of picture transmission over our long-distance radio telegraph circuits has caused the Marconi Company to devote its energies to providing such a service. An accompanying illustration reveals the degree of success that has been attained, and a description of the apparatus used will, no doubt, be of special interest to those readers who are now turning their attention to the new field of picture reception.

For the purpose of establishing the service the picture transmitting equipment has been installed at the Canadian end of the beam circuit and works to the beam receiver located at Somerton, in Somerset. It is the transmitting apparatus that is shown in the several illustrations, the receiver consisting of identical gear with the omission of certain parts. To those thoroughly acquainted with picture transmitting systems the Marconi apparatus may be briefly described. Picture analysis is effected by a rotating and traversing spot of light. Modulated signals are created with an interrupting carrier frequency and photoelectric cell. Synchronising is achieved by tuning fork and alternator. Reception is by Kerr cell and photographic paper.

By reference to the illustrations the various components can be readily identified when considering in detail the action of the apparatus. A generous source



Light from the source A is focussed by the condensing lens B and passes on through the aperture C, behind which is a serrated disc which introduces the carrier frequency. The interrupted beam is focussed at D so as to produce a pencil of light passing down the hollow spindle of the alternating current motor F.



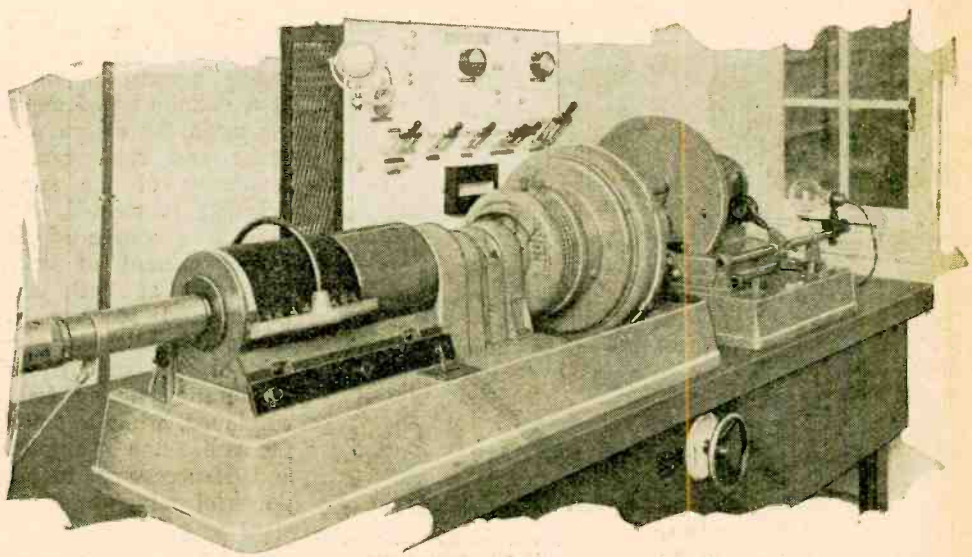
By means of a prism attached to the revolving spindle the beam of light is turned so as to sweep the image which traverses the smooth face of the cylinder G when held in the carrier H. Another revolving prism carried by the shaft collects the dispersed light and conveys it to the light tight box containing the photoelectric cell.

of light, such as a metal filament lamp of high candle power, is brought to a focus on the surface of a steel chopper disc, the purpose of which will be appreciated in a moment. Interrupted light emerging on the other side of this disc is focussed to an extended beam passing right through the centre of a motor spindle. A prism is rotated by the spindle so that the beam of light is turned at right angles and brought to a focus as a point of light sweeping the face of the picture to be transmitted. Light falling on dark parts of the image is absorbed, and on light parts dispersed. Such dispersed light is picked up by a second prism which is also attached to the rotating spindle and is conveyed on as a pencil of light, which is eventually focussed and admitted into a photo-electric cell. As is well known, the resistance of the cell varies according to the amount of light reaching its interior. This change in resistance produces a change in current which, in turn, sets up a corresponding change in potential across the ends of a resistance.

Thus, black and white portions of the picture are represented as high and low potentials at the input terminals of a valve amplifier. It is obvious that a maintained rise in potential such as would correspond with the white part of the picture would not create a signal through the amplifier as is intended. It is for this reason that the chopper disc has been introduced so that instead of constant potentials being set up a high-pitched note is produced when light falls on to the cell. Some such system of interruption is present in all forms of picture transmitter and is referred to as the carrier frequency. It will be appreciated that if very fine lines in the image are to be conveyed through the amplifier as trains of low-frequency oscillations that the carrier frequency must be as high as mechanical and amplifying conditions will permit. The chopper disc has a diameter of 14in. and has 144 equally spaced holes near its periphery producing a maximum carrier frequency of 12,000 cycles. For normal working the carrier frequency is adjusted to 6,000 cycles. The disc, which is quite light, is totally enclosed in a protective housing except for the hole through which the light emerges.

Picture Analysis.

It should be noted that while the point of light sweeps across the face of the picture under transmission, it is not made to move axially as might be expected. Instead, the rotating prism is located within a hollow cylinder, the point of light traversing a slot. On the outer face of this cylinder, which is highly polished, is a semi-circular clamp which holds the image face downwards



The complete transmitting equipment. The receiver is of similar construction except that the carrier-frequency disc is omitted and a Kerr cell with polariscope added.

Pictures by Beam Wireless.—

on to the cylinder, propelling it slowly by means of a screw across the slot. An obvious point which one might raise here is that only during half the period of rotation is the picture being actually transmitted. Such a condition is avoided by simultaneously transmitting from two machines, or, alternatively, using a compound prism so that the beam of light continuously sweeps in semicircles.

Reception by Kerr Cell.

For reception an almost identical unit is employed with the omission of the carrier frequency disc and the light collecting prism with its associated photo-electric cell and amplifier. After suitable amplification, and a signal potential of some 500 volts is required, the incoming fluctuations reach the poles of a Kerr cell. This is simply a glass box containing a pair of electrodes the ends of which represent the plates of a condenser and containing the transparent liquid nitrobenzine. The Kerr cell intercepts the tube of a polariscope in that it is located between the Nicol prisms. In brief, this part of the apparatus merely functions as a shutter in that if the prisms are set in conjunction with the cell to permit of the passage of a pencil of light through them, then a change in potential across the cell will cause a complete cutting off of the light. It is obvious, therefore, that a beam of light passing down the centre spindle is controlled by the Kerr cell and distributed around the cylinder by the rotating prism. It is only necessary to place a piece of bromide paper under the carrier clip in the same manner as the original is held at the transmitter and the beam of light will slowly build up the image, which is revealed by subsequent development. It is interesting to see the flickering light sweeping across the transparent bromide paper. Only ruby light is, of course, permissible in the receiving room.

Marconi Facsimile Tests WAJ. Subject 39

By A. NEELY HALL

Author of "Making Things with Tools," "The Boy Craftsman," "Homemade Toys for Girls and Boys"

A PLAY PERI

WHEN I told you in last month's article on the Back Yard Cave that I would next show you how to make a periscope, I knew that the play periscope held great possibilities for fun.

As you probably know, the periscope is a long tube with mirrors inside. When you are in your cave below the surface of the ground, by means of your periscope you will be able to tell what is going on above without exposing yourself to view. The periscope is the submarine's eye when this craft is under water. It is the trench fighter's means of watching for the enemy, in trench warfare.

Here are some of the ways in which you can have fun with the homemade periscope. Your cave was built without a window, because caves do not have windows. But the ventilator in its roof is an excellent lookout, and with the periscope raised, as shown in Figure 1, you will be able to see as plainly as though you had climbed up into the ventilator box. Now just imagine that your cave is a submarine submerged in mid-ocean, and if your

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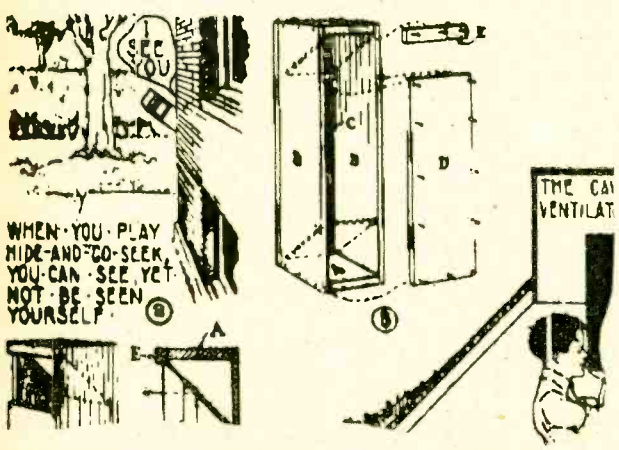
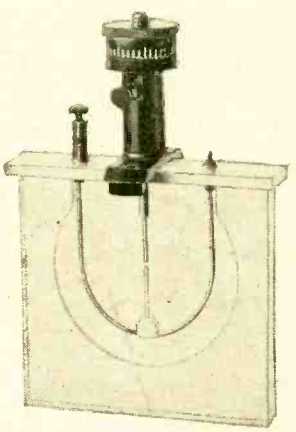
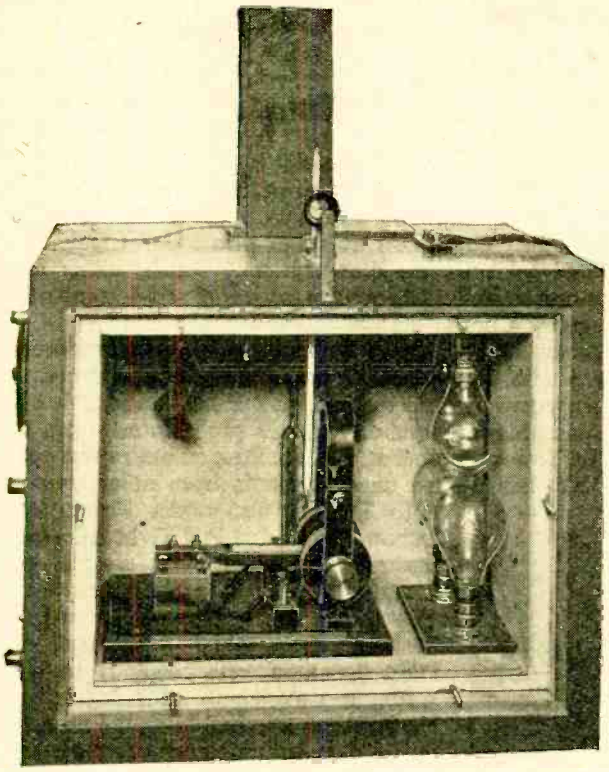


This specimen transmitted picture, which was telegraphed across the Atlantic, suggests the possibility of the simultaneous production of newspapers at centres thousands of miles apart. As an alternative to the use of the Morse code for the transmission of messages this illustration reveals how an increase in speed of signalling can be obtained.

The most important part of any picture transmitting system is the method adopted for running the two machines as closely in step as if they were linked together on a common shaft. It is generally appreciated that many types of alternating current motor run at a definite speed depending upon the design of the stator and rotor and the frequency of the supply. All that is needed, therefore, is a source of alternating current at definite frequency at both transmitter and receiver. To create this alternating current of constant frequency a vibrating tuning fork is employed, while to suitably increase the amplitude and, if necessary, to produce harmonic frequencies, a powerful valve amplifier is used. To maintain as constant as possible the frequency emitted by the fork it must be kept at a constant temperature. Within the chamber housing the fork, therefore, is a thermostat



The Kerr cell. It acts as a light shutter so that the apparent opacity of the nitrobenzine which it contains varies with the potential applied to its electrodes.



The tuning fork used to generate an A.C. current of constant frequency. Temperature is kept steady by means of a thermostat which makes use of a toluol filled expansion bulb to be seen near the thermometer in the centre of this illustration. On the right are the heater lamps and to the left a fan which is fitted to maintain the air in circulation.

control making use of a toluol filled thermometer. Carbon filament lamps raise the temperature of the air within the container, causing an expansion of the toluol. At a critical temperature the circuit of the carbon lamps is broken and restored again as the temperature falls. Incidentally, even the contacts of this toluol thermometer actuate the lamp circuit through a valve amplifier so that the thermometer contacts are not called upon to pass current. In operation the heater lamps are switched in and out of circuit continuously.

Alternating current of constant frequency is thus available at transmitter and receiver and is fed to the respective alternators. Actually the main driving power is provided by a D.C. motor which adjoins the alternator, the latter merely checking an increase in speed by absorbing power and increasing the load, while slow running is remedied by the alternator supplementing the available power.

The sweep of the prism, which corresponds with the length of the image, is 9in., while the traverse may be adjusted to between 80 and 140 lines to the inch. With a normal running speed of 90 revolutions to the minute and some 90 lines to the inch, an image 7in. × 9in. will take seven minutes to transmit. On a page of printed matter of these dimensions it is possible to accommodate no fewer than 1,500 words. Apart, therefore, from any other advantages that may be gained by facsimile transmission a signalling speed of some 200 words a minute is attained.

Although the scope of this article is limited to the actual picture sending and receiving equipments, the images that are received reveal in a conclusive manner the somewhat surprising reliability of beam communication.

RADIO AT THE BRITISH INDUSTRIES FAIR.

FIFTY-THREE radio manufacturers have taken space at the British Industries Fair which was opened at the White City on Monday, February 18th. Although this number represents a slight decrease as compared with last year the stand space occupied has been increased by about 30 per cent. Held in February, the radio section of the Fair is becoming year by year to be regarded as an intermediate exhibition between the Olympia shows, and in consequence there are likely to be a number of new products among the exhibits which will be of interest to the amateur.

To facilitate the demonstration of loud speakers a receiver-amplifier has been installed by Ferranti, Ltd., and the output conveyed to the various stands in the manner adopted at the Manchester exhibition.

Admission is free to trade visitors; the Fair being open each day from 10 a.m. to 9 p.m., closing on Friday, March 1st. The public is admitted after 4 p.m., excepting Saturday, February 26th, when the hour is changed to 1 p.m. The Radio Section is to be found in Hall MM.

Below is a list of the exhibitors with stand numbers.

WIRELESS SECTION.

Atalanta, Ltd. ..... MM 74
Atkinson, C. Creswick ..... MM 61
Axuel Time Switches ..... MM 72
Bakelite, Ltd. ..... MM 37
Belling and Lee ..... MM 36
Brown, S. G., Ltd., and Telegraph Condenser Co., Ltd. ... MM 46
Brownie Wireless Co. ..... MM 57
Burgoyne Wireless, Ltd. ..... N 9
Clarke, H., & Co. (M/c.), Ltd. MM 25A
Cole, E. K., Ltd. ..... MM 73
Cook's Wireless Co. ..... MM 69
Cossor, A. C., Ltd. ..... MM 31, 32, 33
De La Rue, Thos., and Co., Ltd. MM 41
Dubilier Condenser Co. (1925), Ltd. ..... MM 50
Dyson, J., and Co., Ltd. ..... MM 68
Eastick, J. J., & Sons ..... MM 70
Edison Bell, Ltd. ..... MM 47
Ever Ready Co., Ltd. ... . MM 51
Fellows Manufacturing Co., Ltd. NN 1
Ferranti, Ltd. ..... MM 48
Formo Co. ..... MM 67
Fuller Accumulator Co., Ltd. ... MM 65
Garnett, Whiteley and Co., Ltd. MM 38
Graham Farish, Ltd. ..... MM 64
Halcyon Wireless Co., Ltd. ... ... MM 66
Igranic Electric Co., Ltd. ... . MM 40
"Indurite" ..... MM 44
Laker, John and James, Co. ..... MM 56
Lever, Eric J. (Trix), Ltd. ..... MM 58
Lissen, Ltd. ..... MM 28 & 28A
Loewe Radio Co., Ltd. ..... MM 53
London Metal Warehouses, Ltd. MM 43
M-L Magneto Syndicate, Ltd. ... MM 75
M.P.A. Wireless, Ltd. ..... MM 49
Mullard Wireless Service Co., Ltd. ..... MM 25
Neophone Engineering Co. ..... MM 59
Ormond Engineering Co., Ltd ... MM 52
Phantestra MM 26A-27A, N 37-38, A 14 & 22
Radio-in-phone ..... NN 3
Read Radio, Ltd. ..... MM 63
Rees Mace Manufacturing Co., Ltd. ..... MM 42
Ricarda Electric Co. ..... N 9A
Savoy Radio Co. ..... N 6
Selectors, Ltd. ..... MM 35
Spauldings, Ltd. ..... MM 71
Trader Publishing Co., Ltd. ... MM 45
Truphonic, Ltd. ..... MM 34
Wandle Radio Co. ..... N 10
Watmel Wireless Co., Ltd ..... MM 54
Westinghouse Brake & Saxby Signal Co., Ltd. ..... MM 39
Whittingham Smith and Co. ..... MM 60
Wright and Weaire, Ltd. ..... MM 62
Zone Wireless Co. ..... NN 2

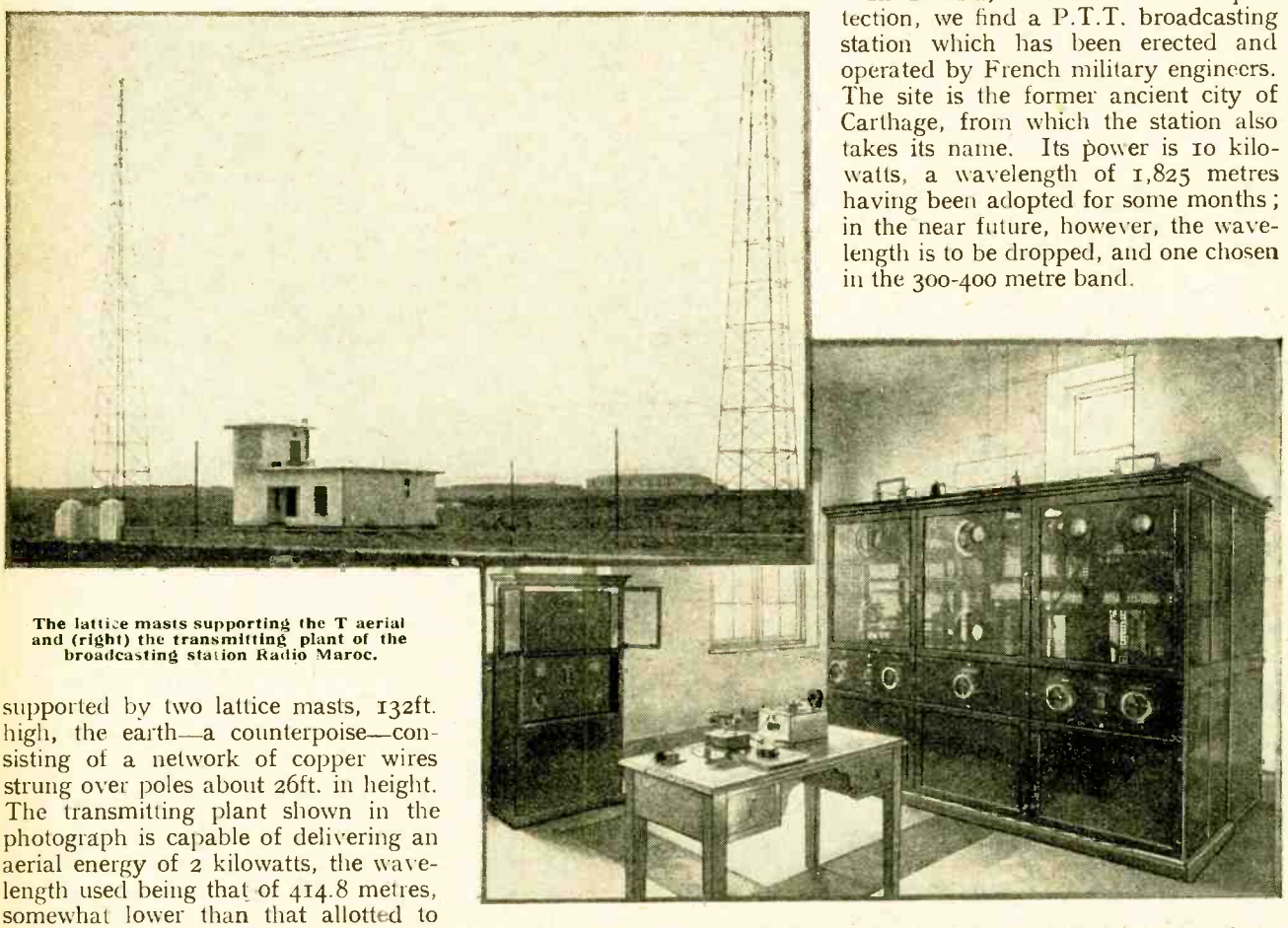
RADIO IN NORTH AFRICA.

The Broadcasting Stations of Morocco and Tunisia.

OF the broadcasting stations operating in the Black Continent the transmissions best heard in Great Britain are those emanating from Radio Maroc (Rabat), North Africa. In view of the interest aroused during the past two months by the capture of musical and other programmes from this source, a few notes on the working of the station may prove welcome to casual listeners.

Radio Maroc, although officially a French P.T.T. station, is actually owned by the Posts and Telegraphs Department of the Shereefian Government French Protectorate of Morocco.

As will be seen from the photograph, the T aerial is



The lattice masts supporting the T aerial and (right) the transmitting plant of the broadcasting station Radio Maroc.

supported by two lattice masts, 132ft. high, the earth—a counterpoise—consisting of a network of copper wires strung over poles about 26ft. in height. The transmitting plant shown in the photograph is capable of delivering an aerial energy of 2 kilowatts, the wavelength used being that of 414.8 metres, somewhat lower than that allotted to the station by the Bureau of the Union Radiophonique at Geneva. A continuous service is given from 12.30 p.m. to 11 or 11.30 p.m. G.M.T. nightly, with the exception of Mondays, on which day the station takes a well-earned rest.

Some few months back, on the closing down of the small privately owned Omega broadcasting station at Casablanca, Radio Maroc opened a permanent studio in that city, and have connected it by landline to their own transmitter. From Casablanca three programmes are taken weekly. On Wednesdays, as a regular feature, at 8.15 p.m., and again at 10.30 p.m., the listeners are treated to Arab music, which may consist either of a diminutive orchestra or of a series of self-accompanied songs by a native singer.

As an interval signal during gaps in the entertainment the studio has adopted the ticking of a metronome, seventy-two beats to the minute. When favourable conditions obtain, the station relays programmes from the Eiffel Tower, or other P.T.T. studios; on one or two occasions it has tapped entertainments from other sources.

In Tunisia, also under French protection, we find a P.T.T. broadcasting station which has been erected and operated by French military engineers. The site is the former ancient city of Carthage, from which the station also takes its name. Its power is 10 kilowatts, a wavelength of 1,825 metres having been adopted for some months; in the near future, however, the wavelength is to be dropped, and one chosen in the 300-400 metre band.

At Kasbah a new short wave transmitter has been installed for a wireless telephony service between Tunis and St. Assise.

Broadcast telephony in Tunisia has made a strong appeal to the European population. Regulations are few, the main one being that on the purchase of a receiver the owner shall pay an initial tax to the Post Office of 10 francs, and a further 5 francs yearly. J. G. A.

CURRENT TOPICS

Events of the Week in Brief Review.

WIRELESS PICTURES AND TELEVISION.

The interesting possibility of a merger between Wireless Pictures, Ltd., and the Baird Television Company has formed the subject of conversations between representatives of the two companies. At the time of going to press we learn authoritatively that no definite arrangement has yet been arrived at.

The existing agreement between Wireless Pictures, Ltd., and the B.B.C. for the transmission of Fultograph pictures from Daventry extends until October next.

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A FIVE MINUTE JOB.

The German police are making considerable use of the broadcasting stations. A few evenings ago Hamburg broadcast a police description of a stolen lorry. Five minutes later the lorry was recovered and the thieves were in custody.

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IGNORING THE BRUSSELS PLAN.

One of the European stations which are ignoring the *Plan de Bruxelles* is Radio Luxembourg, which resumed transmissions on January 15th. The allotted wavelength is 220.6 metres, but the station is working on 1,200 metres. Programmes are transmitted on Sundays between midday and 4 p.m. (G.M.T.) and on Tuesdays and Thursdays from 9 p.m.

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COMPETITION FOR WIRELESS CABINET DESIGN.

A prize of £5 is offered for the design of a wireless cabinet in plywood, in connection with the 1929 Competition of Industrial Designs organised by the Royal Society of Arts. Full particulars are obtainable from the Secretary, John Street, Adelphi, London, W.C.2.

The competitions were inaugurated in 1846 for "useful objects calculated to improve general taste."

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THE 15 HOURS' LIMIT.

The Philippine Legislature has decided that small vessels from 200 to 300 tons sailing in Philippine waters must carry wireless if their trips exceed 15 hours' duration.

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THE UNLICENSED LISTENER.

Virtuous listeners who pay their licence fees are helping to finance the Post Office hunt for "pirates." In a written reply to Sir Nicholas Grattan-Doyle, the Postmaster-General states that in 1928 1,135 prosecutions were instituted and convictions were obtained in all but seven cases. The difference between the cost of the prosecutions and the amounts recovered is borne out of the proportion of the licence revenue which is retained for management.

WIRELESS FOR TIRED TELEPHONISTS.

According to Hull telephone operators, the best antidote to "'phone headache" is the sound of a loud speaker. After a heated debate the Hull Corporation Telephones Committee has consented to the installation of wireless in operators' recreation rooms. But the operators must bear the expense.

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WIRELESS AND THE MOTOR SPEED RECORD.

ZSZ is the special call sign allotted to the short-wave station which has been erected at Verneukpan, Cape of Good Hope, to enable the outside world to follow the progress of Captain Campbell in his attempt to break the motor speed record.

The operators are housed in two tents on the slopes of the Kopje overlooking the vast stretch of sun-baked mud on which a track is being prepared for Captain Campbell's effort, says a *Daily Telegraph* correspondent. Hitherto all Press messages have had to be motored fifty miles over shocking roads to the nearest telegraph station. Now, however, it is hoped that direct touch will be maintained with many European countries and America. The wavelength of ZSZ is approximately 40 metres.

POST OFFICE WIRELESS SERVICE EXPANDS.

Owing to the expansion of the Post Office Transatlantic Wireless Telephone and other services, new accommodation is to be provided in London to house additional staff and plant. The first step will be the demolition, soon after Easter, of the present building in Queen Victoria Street, E.C.4, which will be replaced by a building nine storeys high, capable of accommodating these services for some time to come. The new building will contain plant for transmitting pictures by telegraph for Press publication.

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ECHOES FROM THE DEPTHS OF SPACE.

The peculiar wireless "echoes" investigated last year by Professor Stormer, of Oslo, and described in *The Wireless World* of November 28th last, are to be the subject of further tests by a number of European stations during the next few weeks. It will be remembered that, while listening to a 30-metre signal at Eindhoven, Professor Stormer and other engineers heard echoes after an interval of from 3 to 15 seconds. On the basis of these results, Professor Stormer formulated the theory that the waves were reflected from an electronic layer beyond the Heaviside Layer, thereby suggesting that the latter is not an insuperable barrier to wireless signals as has been generally supposed. The hypothetical layer of electrons seems to produce the most noticeable echo effect when the sun is in the earth's magnetic equatorial plane, a condition which occurs in February and March, and in October.

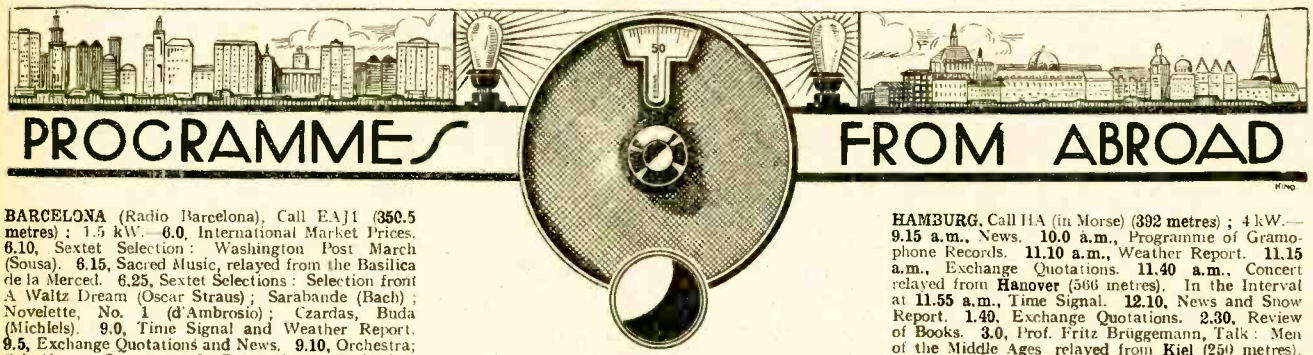
WHO'S WHO IN THE ETHER.

(Answers to Correspondents.)

L. S. (Dundee): Since February 1st Scheveningen-Haven (Holland) has reduced its wavelength from 1,950 to 1,852 metres; it operates at odd times throughout the day. C. H. B. (Hendon): No, many of the French stations have either retained their old wavelengths or arbitrarily chosen others to suit their own convenience. C. M. (Yeovil): Without doubt Lille, working on a lower wavelength than advertised, about 245 metres; it opens its transmissions with a short local march (gramophone record). T. A. C. (Birmingham): Esperanto broadcast from Leningrad, giving details of forthcoming programmes. Yes, the transmission can be picked up at loud-speaker strength. F. R. (Holloway): Your estimate of wavelength is vague; possibly an extended transmission from PTT Paris, but cannot confirm. H. H. (Aberdeen): The French transmission was from Warsaw. Verbal answers to correspondents by the station director. A. P. (S.E.1): A relay by Königswusterhausen of the Cologne Carnival Procession at noon, Monday, February 11th; also taken by all the Rhineland transmitters. H. K. (Leeds): Stuttgart relayed a WGY (Schenectady) transmission of a boxing match in which one of the opponents was a German champion. Querist (Dublin): Copenhagen frequently relays foreign stations; these transmissions were heard through Kalundborg on 1,153.8m. I. H. (Finsbury Park): (1) Huizen broadcasts daily on the lower wavelength until 5.40 p.m. G.M.T., when it takes over the wavelength of Scheveningen-Haven (1,852m. 162kc.), the latter commercial station having closed down. The Huizen Sunday morning sacred service is transmitted on 1,852m. (2) Radio Toulouse appears to have abandoned the 388-metre wavelength, and since February 1st has been experimentally broadcasting on 500m. (just under Milan). V. B. (Putney): See reply to H. K. (Leeds). H. O. (Kensington): You give no date; could you send fuller details? O. L. P. (Chester): This was Stuttgart; the announcer does not always give the name of the station, but calls *Hier Suedfunk*. H. B. (Margate): When Eiffel Tower is transmitting it will be difficult for you to hear Moscow, but try for the latter station at about 9.30 p.m., when FL. closes down; at 9.55 p.m. you should hear a carillon from the Kremlin bells. W. V. (Nottingham): No, Huizen; see answer to I. H. (Finsbury Park). S. W. P. H. (Newark): We cannot understand your reference to 225kc. *above* motala; we can only assume this is a test, as the long-wave stations are experiencing considerable difficulty in fitting themselves in the band. Warsaw has reduced its wavelength from 1,401m. to 1,385.7m. in order to get away from Moscow. C. A. H. (Manchester): Nice-Juan-les-Pins. R. B. (Lincoln): Not a broadcasting station; apparently amateurs, but we have received no other reports. E. N. F. (Wallington): You give neither date nor time when transmission was heard. Turin is on 275m. If this call was heard (frequently in Italian and French) you picked up a relay by some foreign station, probably Flensburg taking it from Hamburg. E. A. K. (Chiswick): From the details you give we take it that the transmission was received on about 220/225m. 3LO (Melbourne) broadcasts regularly on 371m., but special concerts are transmitted every Sunday from 7 to 8 p.m., G.M.T., through the short-wave station on 31.6m. Apparently you have picked up a European relay of Melbourne. Such relays cannot be advertised in advance, as their carrying out depends on atmospheric conditions. Major (Clapham): Both Flensburg and Nurnberg come in at great strength and are often easier to capture than Hamburg or Munich; from the former you hear the Hamburg call frequently abbreviated to *Hier Norag*.

"JAY COOTE."

(Alterations and additions to the list of European stations which appeared in our issue of February 6th will be found on page 214.)



PROGRAMMES FROM ABROAD

SATURDAY, FEBRUARY 23rd.

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

BARCELONA (Radio Barcelona), Call EAJ1 (**350.5 metres**); 1.5 kW.—**6.0**, International Market Prices. **6.10**, Sextet Selection: Washington Post March (Sousa). **6.15**, Sacred Music, relayed from the Basilica de la Merced. **6.25**, Sextet Selections: Selection from A Waltz Dream (Oscar Straus); Sarabande (Bach); Novelette, No. 1 (d'Ambrosio); Czardas, Buda (Michiels). **9.0**, Time Signal and Weather Report. **9.5**, Exchange Quotations and News. **9.10**, Orchestra; Selections: Overture to La Dame Blanche (Boieldieu) Sardana, L'Aplec de Sant Farriol (Carbonell); Habanera, La Aparición (Cotó); Selection from Phryné (Saint-Saëns); Waltz, Wienerblut (J. Strauss); Turkish March (Moussorgsky). **10.0**, Programme relayed from **Madrid**, EAJ7.

BERGEN (**365.9 metres**); 1.5 kW.—**6.0**, Programme for Girls. **7.0**, Orchestral Concert. **7.50**, Topical Talk. **8.0**, Song Recital by Ingeborg Berner Grude. **8.30**, Recitation by Sverre Erichsen. **9.0**, Weather Report, News and Time Signal. **9.15**, Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1,648.3 metres**); 40 kW.—**12.45**, Phototelegraphy Transmission. **1.20**, Programme for Children by Ursula Scherz. **2.0**, Herr B. K. Graef, Talk: Elocution. **2.30**, Weather Report and Exchange Quotations. **2.40**, Talk for Women. **3.30**, Programme relayed from **Hamburg**. **4.30**, Wilhelm Flügel, Talk: The Organisation of Officials. **5.0**, Dr. Adolf Reichwein, Talk: Educational Travels Abroad for Young Workers. **5.30**, Elementary Spanish Lesson. **5.55**, Herr Rohde, Talk: North Africa—the Land and Its People—Tripoli. **6.20**, Prof. Leo Kestenberg, Talk: The Rudiments of Music in the Life of our Time. **7.0**, Agricultural Programme. **8.0**, Programme from **Voxhaus**.

BERLIN (Voxhaus) (**475.4 metres**); 4 kW.—**9.10 a.m.**, Market Prices. **9.15 a.m.**, Weather Report, News and Time Signal. **10.0**, 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 D. Scharlau. **3.0**, Dr. Otto Brendel, Talk: New Ways of Archæology. **3.30**, Anecdotes by Dr. Rudolf Blümner. **4.0**, Orchestral Concert: Overture to The Magic Flute (Mozart); Rautendeleins Leid (Zöllner); Selection from Der Golem (d'Albert); Selection from Eva (Lehár); Boston, In the Middle of the Night (Rose and Donaldson); Two Rhythmical Paraphrases, (a) Indian Love Song (Lieurance), (b) Poet and Peasant (Katzmann); followed by Programme Announcements. **5.30**, Dr. Siegfried Kadner, Talk: The Present Day and the Primitive World—Psycho-Analysis In the Primitive World. **6.0**, Max Cohen-Reuss, Talk: New Taxation Laws. **6.30**, Herr H. Reyss, Talk: The German Electro-Technical Industry in the World Market. **7.0**, Orchestral Concert from the Hotel Kaiserhof. **8.0**, Dialogues from World Literature—Goethe; Ballads and Poems in Dialogue; Conversations with Eckermann; Napoleon's Conversation with Goethe; Epigrammatic Dialogue; As a Setting, the Sonata for Violin and Pianoforte in A Major, Op. 30, No. 1 (Beethoven), followed by Weather Report, News, Time Signal, Sports Notes and Dance Music. **11.30** (approx.), Close Down.

BERN (**407 metres**); 1.5 kW.—**6.30**, Talk: August Strindberg's Views on Life and Art. **7.0**, Fugue Recital from the Works of Bach, relayed from **Basle** (1,034 metres). **9.0**, News and Weather Report. **9.15**, The Kursaal Orchestra. **9.40**, Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**321.2 metres**); 4 kW.—**6.20**, Shorthand Lessons. **6.50**, Topical Discussion. **7.15**, Orchestral Concert: Overture to Titus (Mozart); Romance from La Juive (Halévy); Torch Dance (Blotow); Intermezzo from L'Amico Fritz (Mascagni); Romance from Cavalleria Rusticana (Mascagni); March from Prince Igor (Borodin); Selection from Carmen (Bizet); Tarantella (Nicode); Kaiser Waltz (J. Strauss); Jubel-Festmarsch (J. Strauss). **9.0**, News. **9.30**, Dance Music. **11.0** (approx.), Close Down.

BRÜNN (**432 metres**); 2.5 kW.—**6.0**, Programme from **Prague**. **6.5**, Orchestral Concert. **6.45**, Talk: Trade Unions. **7.0**, Concert of Chamber Music: Summer Evening (Ambros); Spring Song (Janacek); Two Songs (Nesvera); Song of the Ocean (Hrazdira); Songs (Steinemann); Elegy Op. 23 (Suk); Songs (Nesvera). **8.0**, Programme from **Prague**. **8.25**, Selections of Popular Foresters' Songs. **8.40**, Programme from **Prague**. **9.20**, Programme Announcements. **9.25**, Orchestral Concert.

BRUSSELS (**512 metres**); 1.5 kW.—Experimental Transmission on a high power. **5.0**, Concert from the Armenonville Tea Rooms. **6.0**, Elementary English Lesson. **6.25**, Intermediate English Lesson. **6.45**, Pianoforte Selections. **7.0**, Gramophone Selections of Dance Music. **7.30**, "La Radio-Chronique." **8.0**, Concert relayed from the Royal Conservatoire, Liége, under the direction of M. François Rasse, with M. Joseph Jongen (Organ) and M. Charles Herman (Violin): Fourth Symphony (Glazounoff); Concerto for Violin and Orchestra (Mendelssohn); Concerted Symphony for Organ and Orchestra (Jongen); Selection from Don Juan (R. Strauss); in the Interval—Topical Talk. After the Concert—News and Close Down.

BUDAPEST (**555.5 metres**); 20 kW.—**4.5**, Orchestral Concert of Light Music: Vesuviana (Marchetti); Potpourri, Walzerflut (Fétras); Ballet Suite (Tchaikovsky); Ballet Music from Faust (Gounod); March, The Stars and Stripes (Sousa). **5.15**, Introductory Talk to the following Transmission. **5.30**, "Siegfried"—Opera (Wagner), relayed from the Royal Opera House. **9.30**, Time Signal, News and Weather Report, followed by Concert by the Tzigane Orchestra from the Grand Hotel Britannia.

CRACOW (**314.1 metres**); 1.5 kW.—**6.10**, Mr. J. Regula, Talk: The Foreign Politics of the Past Week. **6.56**, Time Signal from the Astronomical Observatory. **7.0**, Relay of Chimes from the Church of Notre Dame. **7.30**, Programme relayed from **Warsaw**. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**411 metres**); 1.5 kW.—**1.30**, Weather Report and Gramophone Selections. **7.20**, News. **7.30**, Poetry Recital by May Pitchford. **7.45**, Irish Lesson by Seamus O'Duirinne. **8.0**, Selections by the Station Orchestra. **8.30**, Bass Solos by Thomas Keane. **8.45**, Violin Solos by Alice Feeley. **9.0**, "Master Wayfarer"—Play by Mary Sheridan and Company. **9.30**, Overture by the Station Orchestra. **9.40**, The Five Trumps. **10.20**, Selections by the Station Orchestra. **10.30**, News, Weather Report and Close Down.

FRANKFURT (**421.3 metres**); 4 kW.—**2.55**, Hints for the Housewife by Fini Pfannes. **3.35**, Orchestral Concert of Modern Dance Music. In the Interval—News and Announcements. **5.30**, Answers to Correspondents. **5.45**, Esperanto Lesson by W. Wischhoff. **6.0**, Dr. Scheibe, Talk: The Prevention of Accidents. **6.30**, Dr. Oehler, Talk: The Social Ranks of the French People. **7.0**, Orchestral Concert: Overture to The Nuremberg Doll (Adam); 's kommt a Vogerl geflogen—German Folk Song—arranged by Ochs, in the Style of (a) Bach, (b) Haydn, (c) Mozart, (d) Joh. Strauss, (e) Verdi, (f) Gounod, (g) Richard Wagner, (h) Beethoven, (i) Mendelssohn, (j) R. Schumann, (k) Brahms, (l) Meyerbeer; Military March. **7.30**, Programme from **Stuttgart**, followed by Dance Music from **Voxhaus**. **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**392 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. **11.40 a.m.**, Concert relayed from **Hanover** (566 metres). In the Interval at **11.55 a.m.**, Time Signal. **12.10**, News and Snow Report. **1.40**, Exchange Quotations. **2.30**, Review of Books. **3.0**, Prof. Fritz Brüggemann, Talk: Men of the Middle Ages, relayed from **Kiel** (250 metres). **3.30**, Concert of Chamber Music relayed from **Kiel**: Grand Concerto for Oboe, Violin, 'Cello, String Orchestra and Piano Op. 51 (Emborg); Divertimento for Flute and String Orchestra, Op. 53 (Gernsheim). **4.30**, Concert of Request Items. **5.30**, Dr. Hannes Kaufmann, Talk: Economics. **6.0**, Dr. Hähnsen, Talk: Handicrafts, relayed from **Kiel**. **6.25**, Otto Reiner, Talk: Friedrich Spielhagen on the 100th Anniversary of his Birthday. **6.55**, Weather Report. **7.0**, "Halloh"—Revue. **9.30**, Weather Report, News, Sports Notes and Programme Announcements. **9.50**, Dance Music. **10.50**, North Sea and Baltic Weather and Ice Reports.

HILVERSUM (**1,071 metres**); 5 kW.—**9.40 a.m.**, Time Signal and Daily Service. **10.10 a.m.**, Gramophone Records. **10.25 a.m.**, Concert of Trio Music. **11.25 a.m.**, Gramophone Records. **11.40 a.m.**, Police Announcements. **11.55 a.m.**, Lunchtime Concert. **1.40**, Concert relayed from the Tuschinski Theatre, **Amsterdam**, under the direction of Mr. Max Tak, with Pierre Palla (Organ). **3.40**, Italian Lesson by Mr. Giovanni Rizzini. **4.40**, French Lesson by Mr. Raymond Lafont. **5.40**, Orchestral Concert: Selection from the Works of Waldteufel (Kling); Fantasia on the Works of Jos. Strauss (Fétras); Fantasia on the Works of Lincke. **6.25**, German Lesson by Mr. Edgar Grüm. **7.25**, Police Announcements. **7.45**, Programme arranged by the Workers' Radio Society—Concert and Talk. **11.10** (approx.), Close Down.

HUIZEN (**336.3 metres**); 4 kW.—Transmits on 1,852 metres from 5.40 p.m. **5.10**, Gramophone Records. **6.10**, Talk by M. van Luin. **6.30**, Catholic Bulletin. **6.40**, Elementary English Lesson. **7.10**, Dress-making Lesson. **7.41**, Talk by Prof. van Rooy. **8.0**, Concert: Overture to Egmont (Beethoven); Choral Selections, (a) Domine non sum dignus (Haller), (b) Domine regit me (Vollaerts), (c) Uchtend (de Nobel); Selection for Soprano, Violin and Piano, Panis angelicus (Franck); Sonatina for Pianoforte (Appeldoorn); Air (Bach); Chanson Louis XIII for Violin and Piano (Couperin); Choral Selections, (a) Dorschen, (b) De Theeketel, (c) De lente luwt (Appeldoorn), (d) Cupidootje (Röntgen); Soprano and Pianoforte Selection from the First Act of La Bohème (Puccini); Item to be announced. Choral Selections, (a) Ecce Quomodo Moritur (Handel), (b) Een stem aan 't strand (Brandts Buys); O Salutaris for Soprano, Violin and Piano (Flégier); Pianoforte Solo, Boerendans (Appeldoorn); Der Spielmann (Hildach); Andante from the Symphony in D Major (Haydn); Coronation March from The Prophet (Meyerbeer). **9.10** (approx.), News.

KALUNDBORG (**1153.8 metres**); 7 kW.—Programme also for **Copenhagen** (339.8 metres).—**6.30 a.m.**, Morning Gymnastics. **10.0 a.m.**, Weather Report. **12.15**, Educational Talk. **2.0**, Programme for Children. **2.30**, Orchestral Concert: Overture to Raymond (Thomas); Waltz, Mon rêve (Waldteufel); Humoresque (Dvorak); Selection from Tiefland (D'Albert); African Dance (Ganne), Mars and Venus (Ganne); Mazurka from A Life for a Czar (Glinka); Recitations; Cracovienne fantastique (Paderewsky); Vision d'amour (Friml); Waltz, Til Saeters (Svendsen); Selection from The Circus Princess (Kálmán); Spanish Serenade (Bizet); Military March (Elgar). **4.50**, Talk by Edv. Nielsen-Stevns. **5.20**, Talk by J. N. Risum. **5.50**, Weather Report. **6.0**, News and Exchange Quotations. **6.15**, Time Signal. **6.30**, Kai Friis Moller, Talk: Rudyard Kipling. **7.0**, Chimes from the Town Hall. **7.2**, Reading from the Works of Rudyard Kipling. **7.30**, Programme of Hawaiian Music by Assmann's Hawaiian Quartet, followed by News. **8.30**, Concert of Light Music: Tipperary; March (Amers); Chant sans paroles (Tchaikovsky) Selection (Kollo); Overture to Fatinitza (Suppé) Variations on 's kommt ein Vogel geflogen (Ochs) in the Style of the Old Masters; In the Interval: Recitations from Lolliker (Rosenkrantz). **9.45**, Dance Music from the Industri Restaurant. **11.0**, Chimes from the Town Hall. **11.15** (approx.) Close Down.

Programmes from Abroad.—

KATTOWITZ (416.1 metres); 10 kW.—**3.0,** Gramophone Selections. **4.0** Music Lesson by Prof. F. Sachse. **4.25,** Letter Box for Children. **4.55,** Programme for Children. **5.50,** Announcements. **6.10,** Talk by Mr. K. Rutkovsky. **6.56,** Time Signal. **7.0,** Talk by Herr W. Czechowicz. **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. **5.30,** Agricultural Report. **6.0,** Aviation Notes. **6.30,** Orchestral Concert. **7.0,** Literary Review. **7.30,** Evening Entertainment.

LAHTI (1,504 metres); 35 kW.—**4.0,** Talk. **4.20,** Songs. **4.35,** Talk. **4.57,** Time Signal, Weather Report and Press Review. **5.15,** "The Barber of Seville": Opera (Rossini) with Introductory Talk. In the Interval: News. **7.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (283.2 metres), and **Münster** (265.5 metres).—**12.5,** Orchestral Concert: March, Unter der Friedenssonne (Blon); Waltz, An die Fernen (Waldteufel); Overture to Lucio Silla (Mozart); Selections from Die Königskinder (Humperdinck); Original Fantasia for Cor Anglais (Lalliet); Fantasia on the Works of Godard (Urbach); Tango, Via Dolorosa (Lesso-Walerio); Weekend im Schlaraffenland (Armandola); Selection from Boccaccio (Suppé). **1.30,** Hints for the Housewife. **2.0** Programme for Children by Els Vordemberge. **2.30,** Economic Report. **2.40,** Herr P. Brüls, Talk: Wireless Technique. **3.0,** Talk for Women by Dr. Herta Kraus. **3.30,** Dr. Lenneberg, Talk: Why is Glass transparent? **4.0,** Dr. Friedrich Luther, Talk: The Spiritual Life of Young People. **4.25,** Dr. Stulz, Talk: How to learn to understand History. **4.45,** Gramophone Selections. In the Interval at **5.15,** Programme Announcements. **5.30,** Dr. Lips, Talk: The Development of Culture. **5.50,** Economic Report and Sports Notes. **6.0,** Relay from the Wilhelm Marx-Haus, Düsseldorf: Programme of Talks and Hymns arranged by the Association for Adult and Industrial Education. **7.0,** Humorous Variety Programme, followed by News, Sports Notes, Business Announcements, Orchestral Selections and Dance Music. **12.0 Midnight** (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—**3.30,** Orchestral Concert. **4.45,** Advertising Notes. **5.0,** The Letter Box. **5.20,** Weather Report and Time Signal. **5.30,** Programme relayed from **Königswusterhausen.** **6.0,** Astronomy Talk. **6.30,** Talk on Films. **7.0,** "Die Ballnacht": Operetta Selections (Oscar Straus). **8.15,** Concert of Dances: Two German Dances (Mozart), (a) Der Leiermann, (b) Der Kanarienvogel; Slavonic Dances (Dvorak); Valse caprice (Rubinstein); Norwegian Dances (Grieg); Piedmontese Dance (Sinigaglia); Valse de Concert (Glazounoff); Hungarian Dances (Brahms). **9.0,** Labour Market Report, Snow Report, Weather, News, Sunday Programme Announcements and Sports Notes. **9.30,** Dance Music relayed from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 (427 metres); 3 kW.—**7.0,** Chimes, Exchange Quotations and Programme of Dance Music. **8.0,** Dr. Zito, Talk: Inventions and Inventors. **8.25,** News and Announcements. **9.45,** Weekly Agricultural Report. **10.0,** Chimes, followed by "Seraphin, the Self-satisfied," Farce in Two Acts (Foglietti-Roig); in the Interval at **12.0 Midnight** (approx.), News. **12.30 a.m.** (approx.) (Sunday), Close Down.

MILAN, Call 1MI (504.2 metres); 7 kW.—**7.15,** Talk on Verdi, with Pianoforte Illustrations, followed by News. **7.30,** Time Signal, News and Introductory Talk on the following Transmission. **7.45** (approx.), "Isabeau," Opera (Mascagni); in the Intervals: Readings from Nave (d'Annunzio), Industrial Review, News and Economic Notes. **10.0** (approx.), Close Down.

MOTALA (1,365 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Böden** (1,200 metres), **Göteborg** (346.8 metres), **Horby** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.5 metres).—**5.30,** Cabaret Programme, relayed from **Göteborg.** **6.15,** Talk on the following Transmission. **6.30,** "Don Juan," Opera (Mozart), from the Royal Opera House, in the Interval at **8.15,** News and Weather Report. **10.0,** Dance Music. **11.0** (approx.), Close Down.

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres).—**4.30,** Talk: The Town as a Guardian. **5.0,** Zither Recital. **5.35,** Labour Market Report. **6.30,** Talk: Family History, relayed from **Nuremberg.** **7.0,** Recital of Songs. **7.30,** Orchestral Concert: Overture to Nebuchadnezzar (Verdi); Spanish Rhapsody for Pianoforte and Orchestra (Liszt); Waltz from Eugen Onegin (Tchaikovsky); Trepack (Tchaikovsky); Overture to The Thieving Magpie (Rossini); Concerto for Trumpet and Orchestra (Graf); Selection from Turandot (Puccini); Hindou Dance from The Pearl Fishers (Bizet); The First Hungarian Rhapsody (Liszt); Xylophone Solos, (a) Alsatian Peasant Dance, No. 1 (Merkling), (b) Jongleur Galopp (Dittrich); Helena Quadrille (Offenbach). **9.20,** News, followed by Concert from the Park Hotel. **11.30** (approx.), Close Down.

Saturday, February 23rd.

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

NAPLES, Call 1NA (333 metres); 1.5 kW.—**7.30,** Wireless Notes, Announcements, News and Harbour Notes. **8.0,** Time Signal. **8.2,** Concert: Orchestral Selection, Overture to Banditenstreiche (Suppé); "Mario and Maria," Comedy in Three Acts (Lopez); in the First Interval: Violin Solos, (a) Meditation from Thais (Massenet), (b) Serenade (Cilea); in the Second Interval: Violin Solos (Chopin), (a) Mazurka Op. 7, No. 3, (b) Waltz, Op. 64, No. 2. **9.50,** News. **9.55,** Calendar and Programme Announcements. **10.0** (approx.), Close Down.

OSLO (497 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**5.0,** Programme for Children. **6.15,** Weather Report and News. **6.30,** Talk: The History of Language, relayed from **Fredriksstad.** **7.0,** Time Signal. **7.2,** Carnival Programme: Prologue, Songs, Dance Music and Interludes. **9.0,** Weather Report and News. **9.15,** Topical Talk. **10.50,** Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres); 5 kW.—**5.0,** Pasdeloup Concert. **7.10,** Weather Report. **7.20** to **8.50,** "Le Journal Parlé."

PARIS (Petit Parisien) (336 metres); 0.5 kW.—**8.45,** Gramophone Selections, Talk and News. **9.0,** Concert. Overture to Phèdre (Massenet); Selection from Jocelyn (Godard); Ballet Music from Raymonda (Glazounoff); Japanese Suite (Holst); Scènes alsaciennes (Massenet); Mazurka (Debussy); Russian Dance from Boris Godounoff (Moussorgsky); in the Intervals, News and Announcements.

PARIS (Radio Paris), Call CFR (1,769 metres); 15 kW.—**12.30,** Dance Music. **1.0,** News and Exchange Quotations. **1.15** Concert (continued). **2.0,** Market Prices and Religious Information. **3.30,** Exchange Quotations. **3.45,** Concert. **4.45,** Market Prices and News. **6.30,** Exchange Quotations and Agricultural Report. **6.45,** Programme of Gramophone Selections: One-Step, Parisette (Wolter); Spanish Song, Cordoba (Albéniz) by José Padilla's Orchestra; Tenor Song from Romeo and Juliet (Gounod) by M. Edmond Rambaud; Soprano Song from Manon (Massenet) by Mme. Ninon Vallin; Vocal Fox-Trot, Aime-moi (Mario Cazes) by Jovatti; Caucasian Song, Kazbek, played by a Balalaika Orchestra; One-Step, Dans les magasins (Borel-Clerc); Soprano Solo, Paysage (Hahn) by Mme. Ninon Vallin; Among my Souvenirs (Nicholls-Leslie). **7.30,** Pianoforte Lesson by M. P. Lucas. **7.45,** Market Prices and News. **8.0,** M. Maurice Fould, Talk: The Fourth International Congress of the Scientific Organisation of Labour. **8.15,** Concert: Duet for Horn and Flute, with Orchestra (Filt); Orchestral Selections, (a) Zambra (Laparra-Grecourt), (b) Jota (Laparra-Grecourt), (c) Suite from The Little Dutch Girl (Kálmán); Sur la route (Pouger); in the Intervals, News.

POSEN (336.3 metres); 1.5 kW.—**4.15,** Talk on Scouts. **4.30,** English Lesson by Dr. Arend. **4.55,** Programme relayed from **Warsaw.** **5.50,** Recent News from the Exhibition of Home Industries. **6.15** Concert by the Mandoline Society: March, Per aspera ad astra (Urbach); Waltz-Intermezzo, Bells of Vineta (Lindsay-Theimer); Selection from Faust (Gounod). **6.45,** Talk for Women by Mme. S. Swidzinska. **7.0,** "Paganini"—Operetta in Three Acts (Lehár), relayed from the Municipal Theatre at **Bydgoszcz.** In the Intervals—Theatre and Cinema Notes and News. **10.0,** Time Signal and Miscellaneous Items. **10.15,** Cabaret Entertainment. **11.0,** Orchestral Concert arranged by the Maison Philips. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (343 metres); 5 kW.—**6.0,** Time Signal and News. **6.5,** Gramophone Selections of Czech Music. **6.45,** Talk: Old Czech Dances. **7.0,** Popular Musical Programme: Peter Simple Polonaise (Nedbal); Polka (Nedbal); Songs; Popular Review (Ranzato); Champagne (Lumbye); Popular Songs; Flowers of the Tatra (Piskacek). **8.0,** Foresters' Programme. Quartet for Horns. Popular Talk. **8.25,** Programme from **Brünn.** **8.40,** Popular Programme, "The Poacher"—Play (Kaves). **9.0,** Time Signal, News, Sports Notes and Theatre Review. **9.25,** Programme from **Brünn.**

ROME, Call 1RO (443.8 metres); 3 kW.—**6.50,** "Giornale parlato," Sports Notes, News, Exchange Quotations and Weather Report. **7.29,** Time Signal and Report of the International Labour Office at Geneva. **7.45,** Concert by the Band of the RR. Carabinieri. March (Cherubini): Selection from William Tell (Rossini); "Lo Specchio"—One Act Comedy (Pusinich); Two Movements from the Fifth Symphony for Organ (Widor); Hungarian Dance in G Minor (Brahms); Talk on Literature and Art; Seven Songs without Words (Mendelssohn); Selection from The Force of Destiny (Verdi). **9.50,** "Giornale parlato" and News. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAF (31.48 metres); 30 kW.—**11.27,** Telechron Time Signal and Weather Report. **11.30,** White House Coffee Programme relayed from **New York.** **12.0 Midnight,** Phil Spitalny's Music, relayed from **New York.** **12.30 a.m.** (Sunday), Musical Programme relayed from **Rochester.** **1.30 to 4.0 a.m., New York** Programme. **1.30 a.m.** Programme by Mildred Hunt and the Marimba Orchestra. **2.0 a.m.,** General Election Hour. **3.0 a.m.,** Lucky Strike Programme. **4.0 a.m.,** Dance Music from the Hotel Ten Eyck. **5.0 a.m.** (approx.), Close Down.

STUTTGART (374.1 metres); 4 kW.—**5.0,** Time Signal and Weather Report. **5.15** Talk: The Treatment of Alcoholism, relayed from **Freiburg** (577 metres). **5.45,** Financial Talk: Gold and Currency, relayed from **Freiburg.** **6.15,** Lesson in Book-keeping. **6.45** Talk: Carl Candidus, the Alsatian Poet, with Recitations from his Works. **7.30,** "Indra"—Opera in Three Acts (Flotow), followed by Variety Programme of Light Music, One Act Farce, News, Sports Notes and Dance Music from **Voxhaus.** **11.30** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (383 metres); 8 kW.—**12.45,** Concert. **8.0** Exchange Quotations and News. **8.30,** Concert: Orchestral Selections, (a) Overture to Les Saltimbanques (Ganne), (b) Selection from The Gipsy Baron (Strauss), (c) Selection from Madame Butterfly (Puccini), (d) March (Von Blon), (e) Polonaise (Chopin), (f) Danse macabre (Saint-Saëns), (g) Hungarian Dance No. 2 (Brahms) (h) España (Chabrier), Vocal Selections from (a) Les Saltimbanques (Ganne), (b) La Bohème (Puccini), (c) Philémon et Baucis (Gounod), (d) Mireille (Gounod), (e) Le Jongleur de Notre Dame (Massenet), (f) L'Attaque du Moulin (Bruneau), (g) I Pagliacci (Leoncavallo), (h) Rigoletto (Verdi), 'Cello Solos, (a) Prize Song from Die Meistersinger (Wagner), (b) Ava Maria (Schubert), (c) Nocturne (Chopin), (d) Sonata (Chopin). **9.42,** Programme of Waltzes. **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (520 metres); 15 kW.—**3.0,** Vocal and Orchestral Concert. **4.40,** Programme for Children. **5.10,** Dr. Bernhard Paumgartner, Talk: Mozart as Man and Artist. **5.40,** Reading from the Works of Georg Büchners. **6.25,** Time Signal and Weather Report. **6.30,** Symphony Concert from the Grosse Konzerthaus: Overture to Jessonda (Spohr); Symphony in A Major (Mozart); Overture to Tannhäuser (Wagner); Symphonic Poem, Ein Heldenleben (R. Strauss). **8.10,** "Salon Pitzelberger," Operetta in One Act (Offenbach), followed by Phototelegraphy Transmission.

VILNA (426.7 metres); 1.5 kW.—**4.0,** Talk by Leon Wollejko. **4.25,** Song Recital by Mme. Hedvige Krug. **5.0,** Programme relayed from **Cracow** **5.50,** Topical Talk. **6.10 to 7.5,** Programme relayed from **Warsaw.** **7.5,** Talk: National Education. **7.30,** Programme relayed from **Warsaw.** **9.0,** News and Announcements. **9.30,** Dance Music.

WARSAW (1,385.7 metres); 10 kW.—**4.25,** Talk by Dr. M. Henzel. **4.55,** Programme for Children, relayed from **Cracow.** **5.50,** Miscellaneous Items. **6.10,** Wireless Review by Dr. M. Stepowski. **6.56,** Time Signal **7.0,** Prof. S. Niewiadomski, Talk: The History of Polish Music. **7.30,** "Most Beautiful of Women," Operetta in Three Acts (Bromme). **9.0,** Aviation Notes, Weather Report, News, Police Announcements and Sports Notes. **9.30,** Dance Music from the Oaza Restaurant. **10.30** (approx.), Close Down.

ZURICH (489 metres); 1 kW.—**6.17,** New Gramophone Records. **7.0,** Orchestral Concert, relayed from **Basle** (1,034 metres) followed by News and Concert by the Orfeo Mandoline and Guitar Orchestras, with Jodel Duets by Fr. Spühler and Willy Rubin.

Programmes from Abroad.—

ALGIERS, Call PTT (353 metres); 1 kW.—12.30, Programme by the Wireless Orchestra and C. Cerlini (Flute): Wedding March from Lohengrin (Wagner).

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—11.0 a.m., Relay of Cathedral Chimes. 11.5 a.m., Meteorological Report for Europe and North-East Spain and Aerial Route Conditions. 1.30, Concert by the Iberia Trio, with Gramophone Records at intervals. 2.45 to 5.0, No Transmission. 5.0, Opening Signal, followed by Symphony Concert, relayed from the Gran Teatro del Liceo; Agricultural Reports and Market Prices in the intervals. 8.20, Concert by the Wireless Orchestra. 8.40, Sports News. 9.0 (approx.), Close Down.

BASLE (1,034 metres); 0.25 kW.—7.30, Concert. 9.0, Late News Bulletin and Weather Report and Forecast. 9.30 (approx.), Close Down.

BERGEN (365.9 metres); 1.5 kW.—9.30 a.m., Sacred Service and Sermon. 11.30 a.m., Weather Report and Forecast and General News Bulletin. 7.20, Recital of Songs by Ingeborg Berner Grude: Aria from Don Pasquale (Donizetti). 7.50 Topical Talk. 8.30, Talk or Literary Selection. 9.0, Weather Report and Forecast, followed by Late News Bulletin and Time Signal. 9.15, Dance Music. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,648.3 metres); 40 kW.—7.55 a.m., Relay of Potsdam Church Chimes. 8.0 a.m., Choral and Instrumental Concert, relayed from Voxhaus, followed by Chimes from Berlin Cathedral. 11.0 a.m., Relay from the Reichstag. 12.45 to 1.15, Experimental Picture Transmission. 1.30 to 2.25, Three Agricultural Talks. 3.0, Talk. 3.30, Concert. 7.0, Concert, followed by Late News Bulletin and Music. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475.4 metres); 4 kW.—7.55 a.m., Relay of Chimes from Potsdam. 8.0 a.m., Morning Concert and Address, followed by Cathedral Chimes. 11.0 a.m., Memorial Service of the National War Graves Commission, relayed from the Reichstag. 1.30 to 2.25, Market Report and Farming Talks. 2.30, Stories for Children. 3.0, Talk. 3.30, Concert. 7.0 (approx.), Concert or Play, followed by Weather Report and Forecast and Late News Bulletin, Time Signal and Sports News. 9.30, Musical Selections. 11.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—9.30 a.m to 10.30 a.m., Catholic Sermon. 12.0 Noon, Time Signal and Weather Report and Forecast. 12.5, Orchestral Concert. 6.29, Time Signal, Weather Report and Football Results. 6.30, Concert. 7.30, Concert or Play. 8.45, Sports Notes, Late News Bulletin and Weather Report. 9.0, The Station Orchestra in Selections of Light Music. 9.35 (approx.), Close Down.

BEZIERS (211 metres): 0.6 kW.—6.0, Transmission arranged by "La Radio Agricole Française." 8.30, General News Bulletin and Sports Results. 8.45, Concert of Pathé and Pathé-Art Gramophone Selections, under the auspices of La Maison Relin-Minoles. 10.30 (approx.), Close Down.

BRESLAU (321.2 metres); 4 kW.—Programme relayed by Gleidwitz (326.4 metres). 8.15 a.m., Relay of the Christ Church Chimes. 10.0 a.m., Recital of Music. 7.0, Programme relayed from Berlin. 9.0, Late News Bulletin. 9.30, Musical Programme. 11.0 (approx.), Close Down.

BRÜNN (432 metres); 2.5 kW.—8.0 a.m., Morning Concert of Sacred Music. 9.0 a.m., Agricultural Talk. 9.30 a.m., Agricultural Programme. 3.30, Orchestral Concert 5.0, German Programme. 6.5 (approx.), Concert. 9.20, Musical Programme. 10.30 (approx.), Close Down.

BRUSSELS (512 metres); 1.5 kW.—5.0, Orchestral Concert relayed from the Armenonville Tea Room 6.0, Children's Corner, under the direction of M. Léon Leroy. 6.30, Concert by the Wireless Trio, with Instrumental Solos. The following transmissions will be made experimentally on high power. 7.30, La Radio-Chronique. 8.15, Concert or Play. 10.15, (approx.), Late News Bulletin. 11.0 (approx.), Close Down.

BUDAPEST (555.5 metres); 20 kW.—8.0 a.m., Press Communications and Beauty Hints. 9.0 a.m., Relay of Sacred Service. 2.30, Talk arranged by the Ministry of Agriculture. 9.15 (approx.), Programme of Music or Play.

COLOGNE (263.2 metres); 4 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Langenberg (462.2 metres) and Münster (265.5 metres).—6.45 a.m., Lesson in the Art of Self Defence. 7.5 a.m., German Shorthand Lesson. 7.25 a.m. to 7.55 a.m., Esperanto Lesson by Alfred Dormanns and Notes on the Week's Programmes. 8.0 a.m., Relay of Chimes. 8.5 a.m. to 9.0 a.m., Protestant Recital with Address and Choral Renderings. 10.0 a.m. to 10.30 a.m., Talk on the German Language: Its Worth and Honour. 10.35 a.m. to 10.55 a.m., Talk. 11.0 a.m., Relay from the Reichstag. Memorial Service arranged by the National War Graves' Commission. 12.0 Noon, Orchestral Concert. 7.0, Concert or Play, followed by Late News Bulletin, Sports Results and Musical Selections. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—8.30, Vocal and Instrumental Concert: Moore Anniversary Programme by the Corkonians' Vocal Quartet. 11.0, National Anthem, followed by Weather Report and Forecast. 11.15 (approx.), Close Down.

CRACOW (314.1 metres); 1.5 kW.—9.15 a.m. to 10.45 a.m., Relay of Cathedral Service. 10.56 a.m., Fanfare relayed from the Church of Notre Dame, followed by Time Signal. 11.5 a.m., Weather Report and Forecast. 11.10 a.m., Relay of Concert by the Warsaw Philharmonic Society. 1.0 and 1.20, Two Talks on Agricultural Topics. 1.40, "La Chronique Agricole," by Dr. St. Wasniewski. 2.0, Weather Report and Forecast. 2.15, Relay of Philharmonic Concert from Warsaw. 5.20, Concert relayed from Warsaw. 6.0, Variety Programme. 6.20, Talk 6.56, Time Signal relayed from the Astronomical Observatory. 7.0, Relay of the Fanfare from the Church of Notre Dame. 7.15, Sports Notes and Results. 7.30, Concert relayed from Warsaw. 9.0 to 9.30, Programme relayed from Warsaw. 9.0, Aviation Route Report and Weather Report and Forecast. 9.5, News from the Polish Telegraph Agency 9.20, Police News and Sports Results. 9.30, Orchestral Selections from the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—8.30 to 11.0, Programme relayed from Cork. Concert of Vocal and Instrumental Music: Violin Solo by Signor F. Grossi. 11.0, National Anthem and Weather Report and Forecast. 11.15 (approx.), Close Down.

GENEVA (760 metres); 1.5 kW.—9.0 a.m., Morning Service and Address relayed from the Victoria Hall. 2.0, Concert arranged by La Maison Maxa S.A., of Geneva; Selections of Popular Dance Music Gramophone Records. 7.15, Talk on the Day's Events in Sport, by M. Vieux, Sports Editor of the "Tribune de Géneve." 8.0., Recital of Music. 9.30 (approx.), Close down.

HAMBURG, Call HA (in Morse), (392 metres); 4 kW.—Programme relayed by Bremen (273 metres), Flensburg (219 metres), Hanover (566 metres), and Kiel (250 metres).—7.20 a.m., Time Signal. 7.25 a.m., Weather Report and Forecast and General News Bulletin. 7.40 a.m., Industrial Questions of To-day. 8.0 a.m., Legal Notes. 8.15 a.m., Recital of Music. 9.55 a.m., (for Kiel and Flensburg), Relay of Divine Service from the University Church. 10.0 a.m., Talk. 11.55 a.m., Time Signal from Nauen. 12.05 (for Hanover), Gramophone Selections. 12.05 (for Bremen), Musical Programme. 1.0, Funkheinzelmann's Programme for Children. 2.0, Recital of Music. 5.0, Concert. 6.0, Talk. 6.30, Talk arranged by the School of Physical Training. 6.40, Sports Notes. 6.55, Weather Report. 7.0, Concert or Play. 9.30, Inland Weather Report and Late News Bulletin. 9.45, Concert. 10.50 (for Bremen, Flensburg, Hamburg and Kiel), Weather Report for the North Sea and Baltic. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—11.40 a.m., How to play Chess, by Mr. J. Davidson. 12.10, Concert of Orchestral Music. 2.10, Orchestral Concert. 7.40, Studio Performance of "Lohengrin," Opera by Wagner. 11.10 (approx.), Close Down.

HUIZEN (336.3 metres); 4 kW.—Transmits from 5.40 on 1,852 metres. 8.5 a.m., Morning Service and Sermon. 9.30 a.m., Relay of Divine Service from Leiden. Sermon by the Minister, the Rev. H. C. van den Brink. 12.10, Concert by the Wireless Trio. 1.40, Talk. 5.30, Relay (on 1,852 metres) of Church Service. 7.50, Concert. 10.25, Choral Epilogue conducted by Mr. Jos. Pickkers. 10.40 (approx.), Close Down.

KALUNDBORG (1153.8 metres); 7 kW.—Programme also for Copenhagen (339.8 metres). 9.0 a.m., Relay of Divine Service from Copenhagen. 10.30 to 10.40 a.m. (Kalundborg only): Weather Report and Forecast from the Meteorological Institute at Copenhagen. 5.20, Talk. 5.50 (Kalundborg only): Weather Conditions from the Copenhagen Meteorological Institute. 6.0, Press Communications. 6.15, Time Signal. 6.30, Talk. 7.0, Town Hall Chimes relayed from Copenhagen. 7.2, Concert. 8.45, Concert by the Wireless Orchestra, conducted by Launy Grondahl and Violin Solo by Carl Rydahl. 9.45, Dance Music by the Orchestra playing at the Palace Hotel, Copenhagen, under the direction of Teddy Petersen. In the interval at 11.0, Town Hall Chimes relayed from Copenhagen. 11.30 (approx.), Close Down.

KATTOWITZ (416.1 metres); 10 kW.—9.15 a.m., Relay of Morning Service. 10.56 a.m., Time Signal followed by Weather Report and Forecast. 2.15, Relay of Symphony Concert by the Warsaw Philharmonic Society. The Orchestra, "L'apprenti sorcier" (Dukas). 6.0, Miscellaneous Announcements 6.56, Time Signal. 7.30, Concert. 9.0, Weather Report, News from the Press and Sports Notes. 9.30, Programme of Dance Music. 10.30 (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—3.30, Talk. 4.0, Talk by J. Ardickas. 4.55, Time Signal followed by Weather Report and Forecast. 6.0, O. Masiotiene, Talk: "Woman and the Home." 6.30, Concert or Play. 8.30 (approx.), Close Down.

KÖNIGSBERG (280.4 metres); 4 kW.—Programme relayed by Danzig (456 metres). 8.0 a.m., Organ Recital with Choral and Instrumental Items and Address. 9.56 a.m. (Danzig only): Weather Report. 10.0 a.m. (Königsberg only): Weather Report and Forecast. 10.40 a.m., National Memorial Service with Address by Dr. Gessler, President of the War Graves' Commission. 11.55 a.m., International Time Signal from Nauen, followed by Weather Report. 1.0, Hints for the Chess Player by F. S. Leonhardt. 2.0, Spanish Lesson for Beginners by Kurt Metze, Lecturer in Spanish at the Technical Institute. 3.15, Concert by the Station Orchestra. 7.5, Wireless Sketch followed by Musical Programme. 9.10 (approx.), Late News Bulletin and Sports Results.

LAHTI (1,504 metres); 35 kW.—Programme also for Helsingfors (374 metres). 7.0 a.m., Relay of Sacred Service. 9.50 a.m., Press News. 10.5 a.m., Musical Recital. 10.50 a.m., Weather Report and Forecast followed by Time Signal. 11.0 a.m., Relay of Church Service (in Swedish). 3.0, The Wireless Orchestra conducted by Erkki Linko. 4.57, Time Signal and Weather Report. 7.20, Music by the Wireless Orchestra, Selection from "Boris Godounov" (Moussorgsky). 7.45. Late News Bulletin in Finnish. 8.0, News Bulletin in Swedish. 8.30 (approx.), Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Cologne (263.2 metres) and Münster (265.5 metres).—6.45 a.m., Boxing Lesson by Dr. Ludwig Bach. 7.5 a.m., Lesson in German Shorthand. 7.25 a.m., Esperanto Lesson. 7.45 a.m., A Review of the Programmes (in Esperanto) by Alfred Dormanns. 8.0 a.m., Church Chimes. 8.5 a.m. to 9.0 a.m., Protestant Morning Recital with Address and Instrumental Solos. 10.0 a.m. to 10.30 a.m., Talk by Fritz Worm. 10.35 a.m. to 10.55 a.m., Talk. 11.0 a.m., See Cologne. 12.0 Noon, Musical Programme. 7.3, "Rheingold" (Wagner). Produced by Herr Anheisser. Musical Director: Herr Buschkötter. Followed by Late News Bulletin, Sports News and Light Music. 11.0 (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—Programme relayed by Dresden (276 metres).—7.30 a.m., Relay of Organ Recital. 8.0 a.m., Vocal and Instrumental Recital. 11.0 a.m., Relay from the Reichstag of Memorial Service arranged by the National War Graves Commission. 12.0 Noon and 12.30, Two Talks on Agriculture. 3.0, Musical or Dramatic Hour. 4.0, Concert with Vocalists. 5.30, Talk. 6.0, Talk. 6.30, Concert. 8.0, Play. 9.15, News from the Press and Sports News. 9.45, Concert. 11.30 (approx.), Close Down.

LYONS (Radio Lyon) (291 metres); 1.5 kW.—7.30, "Le Journal Parlé" with News from the Press, Announcements and Theatre Report. 8.0, Concert with Vocal Items. Overture to "The Barber of Seville" (Rossini). 10.0 (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (427 metres); 3 kW.—2.0, Chimes and Time Signal. 2.5, Concert by the Union Radio Wireless Orchestra, with Literary Selection in the Interval. 3.30 to 7.0, No Transmission. 7.0, Relay of Chimes, followed by Popular Dance Music. 8.0, Talk on "Some Famous Travels." 8.30 to 10.0, No Transmission. 10.0, Chimes, followed by Time Signal. 10.5, Concert by the Wireless Orchestra. 10.30, Programme relayed from the Hotel Nacional; Concert by the Orchestra. 12.30 a.m. (approx.), Close Down.

MILAN, Call 1MI (504.2 metres); 7 kW.—9.0 a.m., Opening Signal. 9.2 a.m., Elementary Lesson in

SUNDAY, FEBRUARY 24th.

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Programmes from Abroad.—

English. **9.30 a.m.** to **10.15 a.m.**, Vocal and Instrumental Concert of Sacred Music. **11.30 a.m.**, Time Signal. **11.32 a.m.**, Programme by the Wireless Quartet. **12.30** to **3.0**, No Transmission. **3.0**, Opening Signal. **3.2**, Concert. **4.0**, Variety Concert by the Wireless Quintet, with Vocalists: Soprano Solo by Tina Scandurra, Pure anch'io vissi un di, from Marion De Lorme (Ponchielli). **7.30**, Time Signal, followed by Wireless Notices. **8.0**, Relay of an Opera; at end of Act I: Talk by Ulderico Tegani on "Town and Country"; at end of Act II: Sports Results and News from the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (1,365 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres), **Göteborg** (346.8 metres), **Hörby** (260.9 metres), **Ostersund** (720 metres) and **Sundsvall** (545.5 metres).—**10.0 a.m.**, Sacred Service, relayed from **Stockholm**. **4.0**, Children's Corner. **4.55**, Town Hall Chimes, relayed from **Stockholm**. **5.0**, Divine Service, relayed from **Stockholm**. **6.15**, A Play by Jules Romains. **8.15**, Late News Bulletin and Weather Report and Forecast. **10.0** (approx.), Close Down.

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres) and **Nuremberg** (240 metres).—**10.0 a.m.**, Relay of Chimes from the Munich Town Hall. **10.10 a.m.**, Transmission of the Bavarian Wireless Weather Chart. **3.0**, Concert of Orchestral Music. **6.30**, Relay from the National Theatre in Munich of "Aida," Opera, by Verdi. **9.20** (approx.), Late News Bulletin, followed by Relay of Musical Programme. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (333 metres); 1.5 kW.—**8.30 a.m.**, Lesson in French, conducted by Prof. Etienne Verdier. **9.0 a.m.**, Morning Recital of Sacred Music. **3.45**, Programme for Children. **4.0**, Orchestral Concert, with Vocal and Instrumental Solos. **4.30**, Time Signal. **7.30**, Current Topics. **7.50**, Transmission of the Naples Harbour Authorities. **8.0**, Time Signal. **8.2**, Programme of Selections from Popular Operas: Baritone Solo by Raffaele Aulicino with Orchestral Accompaniment, Lo vedremo veglio audace, from Ernani (Verdi). **9.0**, Sports Notes. **9.55**, Calendar and Summary of To-morrow's Programmes. **10.0** (approx.), Close Down.

OSLO (497 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**9.50 a.m.**, Carillon. **10.0 a.m.**, Morning Service, relayed from the Garrison Church. **6.15**, Weather Report and Forecast, followed by News from the Daily Press. **7.0**, Time Signal. **8.30**, Weather Report and Press Communications. **8.45**, A Journalist talks on Current Events. **9.15** (approx.), Dance Music. **10.30** (approx.), Close Down.

PARIS (Eiffel Tower) Call FL (1,488 metres); 5 kW.—**7.56 a.m.**, Time Signal on 32.5 metres. **5.0**, Relay of Pasdeloup Concert. **7.10**, Weather Report and Forecast. **7.20**, "Le Journal Parlé," including Police Memoirs by Detective Ashelbé, and Racing Results received from "Paris Sport." **7.56**, Time Signal on 32.5 metres. **8.0** to **8.50**, Orchestral Concert, with Instrumental Solos. The Orchestra: Retour à l'endroit familier (Florent Schmitt).

PARIS (Petit Parisien) (336 metres); 0.5 kW.—**8.45**, Popular Gramophone Selections. **8.50**, Talk. **8.55**, Press Communications. **9.0**, Concert by Well-known Artistes of the Opéra and Opéra-Comique. **9.25**, General News Bulletin. **9.30**, Symphony Concert under the direction of M. Estyle, of the Paris Conservatoire: Caprice Italien (Tchaikovsky). **10.0**, Late News Bulletin. **10.10**, Orchestral Concert. **11.0** (approx.), Close Down.

PARIS (Radio LL) (370 metres); 1 kW.—**12.30**, Programme under the auspices of "Radio Liberté"; General News Bulletin and Announcements. **12.40**, Music by the Charles Séringes Trio, with Edouard Flament at the Piano. **1.0**, Carillon de Fontenay. **2.30**, Transmission, arranged by the "Radio Agricole Francaise." **3.0**, Dance Music Programme by "Les Etablissements Radio LL." **9.0**, Vocal and Instrumental Concert. **10.0**, Carillon de Fontenay. **10.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (1,760 metres); 15 kW.—**8.0 a.m.**, General News Bulletin and Press Communications. **8.30 a.m.** Physical Exercises conducted by Doctor Diffre. **12.0 Noon**, Sermon by Father Lhande, followed by Recital of Sacred Music. **12.30**, News from the Press. **12.45**, Programme by the Albert Locatelli Orchestra with Selection by Bilboquet in the interval. **3.30**, Concert of Gramophone Records arranged by "L'Industrie Musicale." Press News in the interval. **6.30**, Agricultural News. **6.45**, The Pathé Programme. **7.30**, Press News. **7.45**, The Radio Paris Circus. **8.15**, Concert of Symphony Music conducted by M. Eugène Bigot: The Orchestra, Jota-Serenade (Marcel Laisne). In the intervals:

Sunday, February 24th.

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

Late News Bulletin and News from the Evening Papers. **10.30** (approx.), Close Down.

PARIS (Radio-Vitus) (299 and 37 metres); 1.5 kW.—**10.0 a.m.**, Song Recital. **10.20 a.m.**, Pianoforte and Organ Selections. **10.40 a.m.**, Symphony Music. **11.0 a.m.**, Chamber Music. **11.20 a.m.**, Violin and 'Cello Solos. **11.40 a.m.**, Popular Dance Tunes and Selections of Light Music. **12.0 Noon**, Close Down.

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—**4.0**, Sessions Clock Chimes. **4.2**, Divine Service. **7.0**, The Roxy Symphony Hour relayed from **New York**. **8.0**, Orchestral Concert. **9.0**, Organ Recital by Dr. Charles Heinroth, Director of Music at the Carnegie Institute. **9.45**, Service relayed from the Shadyside Presbyterian Church. **11.0**, Selections by the Orchestra, playing at the William Penn Hotel. **11.30**, Entertainment by the Whittall Anglo-Persians, relayed from **New York**. **12.0 Midnight**, Sessions Clock Chimes. **12.2 a.m.**, (Monday), Relay of Service from the Calvary Protestant Episcopal Church, with Sermon by the Pastor, the Rev. E. J. Van Etten. **1.0 a.m.**, Enna Jettick Melodies relayed from **New York**. **1.15 a.m.**, Collier's Radio Hour relayed from **New York**. **2.15 a.m.**, Concert by the Utica Jubilee Singers relayed from **New York**. **2.45 a.m.**, El Tango Romantico relayed from **New York**. **3.15 a.m.**, Longines Time from **New York**. **3.30 a.m.** (approx.), Close Down.

POSEN (336.6 metres); 1.5 kW.—**9.15 a.m.** to **10.45 a.m.**, Relay of Cathedral Service. **11.10 a.m.**, Time Signal. **11.15 a.m.** and **11.35 a.m.**, Talks on Agriculture. **11.55 a.m.**, Transmission for Peasants. **3.0**, Relay of Symphony Concert from **Warsaw**. **4.15**, Programme relayed from the University Hall at Posen. **6.0**, Talk arranged by the Catholic League of Polish Youth. **6.20**, Talk relayed from **Warsaw**. **6.45**, Talk. **7.5**, Variety Items. **7.30**, Concert. **9.0**, Time Signal, followed by General News Bulletin. **9.20**, Lesson in Dancing, conducted by Mr. Starski. **9.40**, Relay of Light Music. **11.0** (approx.), Close Down.

PRAGUE (343 metres); 5 kW.—**8.0 a.m.**, Sacred Recital of Music. **9.0 a.m.**, Agricultural Talk. **9.30 a.m.**, Agricultural News. **10.0 a.m.**, Concert. **3.30**, Programme of Music. **4.30**, Programme for Workers. **5.0**, News Bulletin and Musical Selections for German Listeners. **9.0**, Time Signal, General News Bulletin and Sports Results. **9.15**, Theatre News. **9.20**, Popular Concert. **10.30** (approx.), Close Down.

RABAT, Call PTT (414 metres); 2 kW.—**12.30** to **2.0**, The Station Orchestra. **4.0** to **5.0**, Concert of Military Music. **8.0**, Le Journal Parlé and General News Bulletin. **8.15**, Concert by the Radio Maroc Orchestra. In the interval at **9.15**, Sports Results and Talk on Sporting Events by M. Barrier. **10.15**, Dance Music by the Orchestra at the "La Chaumière de Rabat," or Relay of European Stations. **11.0** (approx.), Close Down.

RIGA (528 metres); 4 kW.—**9.15 a.m.**, Relay of Morning Service. **12.0 Noon**, Children's Programme of Songs and Stories. **2.0** and **2.30**, Talks. **3.0**, Concert. **4.0** to **5.30**, Talks. **6.0**, Orchestral Concert, conducted by Janis Medin. **8.0**, Weather Report and Forecast. **8.30**, Music by the Orchestra at the Café de l'Opéra. **10.0** (approx.), Close Down.

ROME, Call 1RO (443.8 metres); 3 kW.—**8.30 a.m.**, Opening Signal. **8.32 a.m.**, Elementary Lesson in German. **9.0 a.m.** to **9.45 a.m.**, Morning Recital of Sacred Music. **10.0 a.m.**, Relay from the Casa di Dante, with Introductory Talk. **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**, Concert of Variety Items. **6.50**, News and Agricultural Bulletin. **7.15**, Sports Talk and General Notices. **7.29**, Time Signal. **7.45**, Operatic Concert: "Le Maschere," Lyrical Comedy in Three Acts by Mascagni, with the collaboration of the Station Orchestra and Choir. **9.50**, Late News Bulletin. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (19.56 metres); 30 kW.—**6.30**, Concert by the Peerless Reproducers, relayed from **New York**. **8.30**, Organ Recital by Elmer A. Tidmarsh, relayed from the Union College Memorial Chapel, **Schenectady, N.Y.** **9.0**, Doctor S. Parkes Cadman: Address to Men relayed from **New York**. **10.30**, Twilight Voices Programme from **New York**. **11.0**, Concert by the American Legion Band relayed from **Boston, Mass.** **11.30**, The Acousticon Programme relayed from **New York**. **12.0 Midnight**, The Old Company's Programme, with Vocalists, from **New York**. **12.30 a.m.** (Monday), Relay from the Capitol Theatre, **New York**. **2.0 a.m.**, Talk on "Our Government" by the Editor of the "United States Daily," relayed from **Washington D.C.** **2.15 a.m.**, The Atwater Kent Hour from **New York**. **3.15 a.m.**, Programme relayed from **New York**. **4.15 a.m.**, Experimental Transmission of Television Signals. **4.45 a.m.** (approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (369.9 metres); 2 kW.—**2.0**, Concert by the Station Orchestra followed by Popular Gramophone Selections and Spanish Music. **3.0** to **9.30**, No Transmission. **9.30**, Concert of Orchestral Music and Flamenco Songs with Vocal Items. **11.30** (approx.), Close Down.

TALLINN (408 metres); 2.2 kW.—**7.30** (approx), Relay of Morning Service. **1.30**, Agricultural Talk and Market Report. **6.0**, Concert with Soloists. **9.0** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (383 metres); 8 kW.—**12.45**, Concert with Instrumental Solos. **1.0**, Time Signal. **1.5**, Continuation of Concert. **1.45**, News from "Le Télégramme," "L'Express" and "Le Midi Socialiste." **8.0**, Local Market Prices and General News Bulletin. **8.15**, News from the Press. **8.30**, Concert. **9.0**, Orchestral Concert with Vocal and Instrumental Solos: The Orchestra, Le Rouet d'Omphale (Saint-Saëns). **10.15**, North African Notes followed by Late News Bulletin. **10.30** (approx.), Close Down.

VIENNA (520 metres); 15 kW.—Programme relayed by **Graz** (354.2 metres), **Innsbruck** (455.9 metres), **Klagenfurt** (455.9 metres), and **Linz** (250 metres).—**9.20 a.m.**, Recital of Music. **10.0 a.m.**, Orchestral Concert. **2.30**, Experimental Phototelegraphy Transmission. **7.0**, Time Signal followed by Weather Report and Forecast. **7.05**, "The Pannicke Case" by Auditor: Repeat Performance of the Play given on December 1st with the addition of the prize-winning conclusion, under the direction of Dr. Hans Nüchtern, followed by Musical Programme and Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

VILNA (426.7 metres); 1.5 kW.—**9.10 a.m.** to **10.45 a.m.**, Morning Service relayed from the Cathedral. **10.56 a.m.** to **4.15**, Programme relayed from **Warsaw**. **10.56 a.m.**, Time Signal followed by General News Bulletin. **11.10 a.m.**, Philharmonic Symphony Concert **1.0** to **2.0**, Talks for Farmers. **2.15**, Concert by the Warsaw Philharmonic Society with Violin Solo by Mr. J. Dahman. **4.15** (approx.), Children's Corner. **6.20**, Talk relayed from **Warsaw**. **6.45**, Time Signal and Late News Bulletin. **9.0**, Aviation Route Conditions and Weather Report and Forecast relayed from **Warsaw**. **9.20**, Police Report and Sports Results relayed from **Warsaw**. **9.30**, Dance Music relayed from the "Oaza" Restaurant, **Warsaw**. **10.30** (approx.), Close Down.

WARSAW (1,385.7 metres); 10 kW.—**9.15 a.m.**, Relay of Cathedral Service. **10.56 a.m.**, Time Signal and Fanfare relayed from the Church of Notre Dame at **Cracow**, followed by Aviation Route Report and Weather Forecast. **11.10 a.m.**, Relay of Symphony Concert. **1.0** to **2.0**, Agricultural Talks. **2.0**, Weather Report and Forecast. **2.15**, Symphony Concert by the Warsaw Philharmonic Orchestra. **6.0**, Variety Programme. **6.20**, Talk. **6.45**, General News Bulletin. **6.56**, Time Signal. **7.0** to **7.25**, Talk. **7.30**, Concert: The Orchestra: Overture to Iphigenia in Aulis (Gluck). **9.0**, Aviation Route Report and Weather Report. **9.5**, Late News Bulletin. **9.20**, Police Report, and Sports Results. **9.30**, Dance Music by the Orchestra at the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (308.3 metres); 0.7 kW.—**10.30 a.m.**, Concert of Instrumental Music. **4.0**, Relay of Programme from the Pik-Variété. Dance Music by the "Jolly Fellows' Orchestra." **5.30**, Travel Talk on Italy by Professor Josef Pavelić. **6.45**, Talk and Announcements. **7.0**, Relay of an Opera from the Zagreb National Theatre. In the interval at **8.50** (approx.), News from the Press and Weather Report and Forecast. **10.0** (approx.), Close Down.

ZÜRICH (489 metres); 1 kW.—**10.0 a.m.**, Orchestral Concert. **11.29 a.m.**, Time Signal followed by Weather Report and Forecast. **11.30 a.m.**, Popular Gramophone Records. **3.0**, Programme by the Carletti Orchestra relayed from the Carlton Elite Hotel. **6.30**, Time Signal. **6.33**, Protestant Address. **7.5**, Programme relayed from **Vienna**: "The Pannicke Case" by Auditor, the Play broadcast on December 1st. Repeat Performance with addition of the conclusion as sent in by the prize-winner in the competition. **9.0**. Late News Bulletin and Communications from the Neue Züricher Zeitung. **9.40** (approx.), Close Down.

High-frequency Amplification and Single-dial Tuning.

UP to the present, producers of "kit" sets have mainly concentrated their efforts on single circuits, and have rigorously avoided any complications beyond those strictly necessary for getting results. The G.E.C. "Music Magnet," the subject of this article, is anything but complicated, but it has at least one outstanding feature in the form of "ganged" tuning of its two main controls.

From the theoretical diagram given in Fig. 1 it will be seen that the circuit is, in broad outline, a combination of screen grid H.F. amplifier, detector, and a single L.F. stage; this is certainly the most popular arrangement of to-day, if detector-L.F. sets, with their almost insuperable shortcomings in the matter of selectivity, are omitted.

The aerial is coupled to the grid circuit through an "untuned" transformer, an optional connection giving a series condenser for greater selectivity. H.F. coupling is by means of a tuned anode circuit, one side of the variable condenser C_2 being at earth potential. This arrangement—which is of advantage in connection with the gang tuning scheme—is at first sight rather puzzling, but is easy enough to follow if the side of the condenser in connection with the common negative lead is regarded as being joined to the inductance coil through the screen and the large by-pass capacity of 1 mfd., which offers a low-reactance path to H.F. currents.

Reaction is controlled by a variable condenser, by means of which the amount of plate circuit energy fed back to the grid may be regulated. No choke is fitted, as the impedance of the primary of the L.F. transformer used as a coupling between detector and L.F. amplifier is judged to be sufficient.

Points in Design.

As regards details, tuning coils are the most interesting items. Aerial-grid and anode assemblies are of similar appearance, each being wound on a set of three concentric tubular formers. In the case of the aerial transformer, the aerial coil is wound externally, while the long and medium-wave windings are carried on the inner tubes. The same applies to the tuned anode coils, except that the place of the aerial coupling inductance is occupied by a reaction winding.

A simple form of switch, operated by rotation of a milled ebonite roller, places the two coils in parallel for medium-wave reception; in the open position the long-wave winding only is in circuit. As both aerial and reaction coils are fixed it will be obvious that their inductance and position with respect to the tuned windings must be carefully chosen in order that they may be effective on both wavelengths.

The tuning condensers C_1 and C_2 are mounted together, and are fitted with a simple yet effective attachment to the metal panel. The rotors are mechanically and electrically connected, and are driven by means of a knob through a friction gear consisting of a bevelled crown wheel the edge of which is gripped between

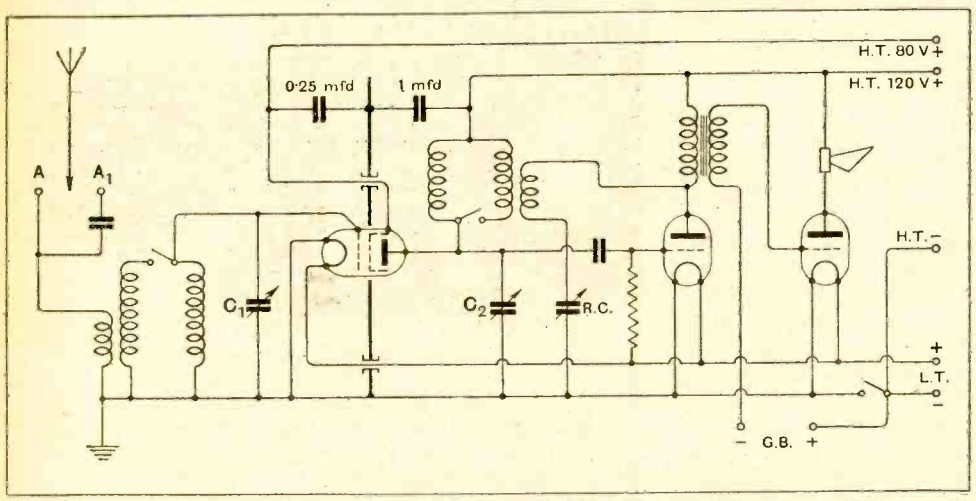
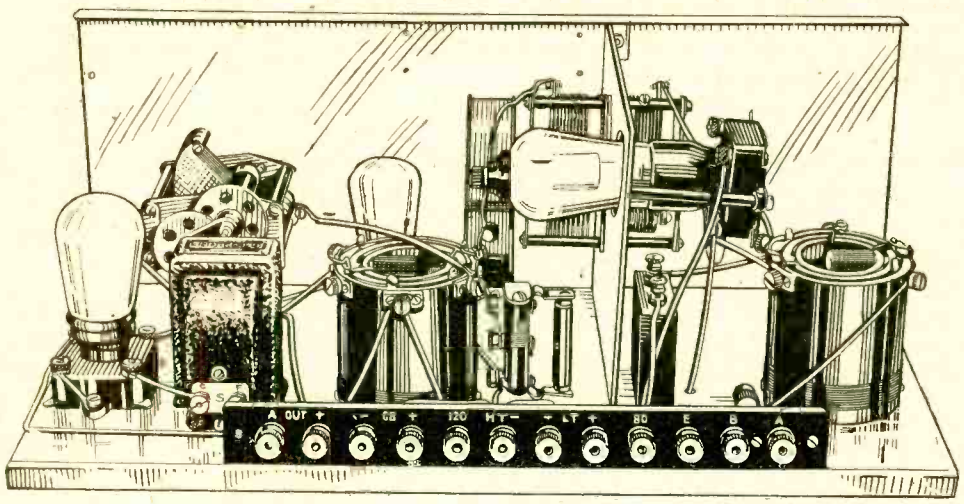


Fig. 1.—Theoretical circuit diagram. Tuning condensers C_1 and C_2 are linked together, and are controlled by a single knob.

Kit Constructors' Notes.—

spring washers. This arrangement gives a lower reduction ratio than usual, but it seems to be well chosen with regard to the decrement of the tuned circuits; this is a point not always taken into consideration. There is no provision for individual adjustment of the rotors, but, in justice to the designers and makers, one should hasten to add that this extra complication does not seem to be in any way necessary, nor, indeed, does it appear that it would serve any useful purpose.



Rear view, showing mounting of components. Note wave-changing switches on top of coils.

In order to simplify assembly, the grid condenser and leak (which have normal values) are mounted as a unit for attachment to the baseboard, which, like the front panel, is of sheet aluminium.

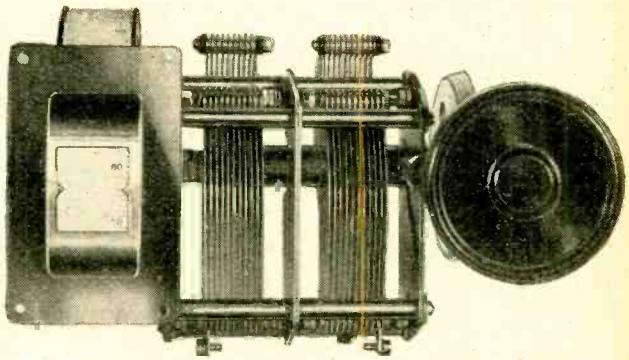
Other features of the design may be summed up in a few words. Apart from the aluminium panel and baseboard already mentioned, there is also a transverse vertical screen of the same metal. To this is attached, by means of brass distance pieces and screws, a Benjamin valve-holder carrying the screen grid valve, which projects through a hole in such a way that the external screen acts more or less as an extension of the internal shield. Filament current is controlled by an on-off switch, the circuit being completed through the frame of the switch and the panel.

A Successful Tuning System.

Before testing the set on signals, the natural tendency was to satisfy one's curiosity as to the effectiveness of the "ganged" tuning. The writer admits to a pessimistic attitude regarding this method of control, and was consequently all the more surprised to find that it functioned in an altogether unexceptionable manner. A rough test, carried out by mounting a small balancing condenser on top of the panel, with one side joined to the screen and the other alternatively to either stator, showed that there was no appreciable need for readjustment of either tuning capacity over the main part of the tuning scale. This applied to both wavebands, and results were not sensibly affected by inclusion in circuit or otherwise of the series aerial condenser. There was no tendency towards "double humped" tuning, which is too often evident when simultaneous control of two circuits is attempted.

Obviously, apart from the question of design, such results could only be obtained by special methods of manufacture and testing of both coils and variable condensers; there seems no reason to suppose that difficulties should arise with regard to tuning, but constructors in doubt on this point can easily apply the simple test described. This should be done while listening to a weak transmission, and if the addition of extra capacity to either half of the double condenser gives louder signals, it may fairly be assumed that there is a fault. During the process of assembly and wiring special care should be taken to avoid rough treatment of the condensers.

In the matter of performance the average user might be willing to sacrifice some sensitivity—and even some selectivity—for the undoubted advantage of single-knob tuning. In this case no such sacrifice need be made; the capabilities of the receiver in both respects are well above the average of its class. In particular, selectivity on the long waves is of a high order, and there was no difficulty in separating Eiffel Tower (on its new wavelength) and Daventry 5XX. The set was tested at a distance of $1\frac{3}{4}$ miles from 2LO, under the worst "town" conditions; it was found that there was but little short-wave interference on the long waveband, and that such interference was hardly evident above wavelengths of 1,050 metres. As for the medium band, there was, of course, serious "spreading" of the local station, but the band of interference was distinctly narrower than with the average set of this type. In fact, under more reasonable conditions, selectivity would be adequate.



Complete dual condenser assembly.

The untuned aerial-grid coupling seems to operate particularly successfully on both wavebands, and, up

Kit Constructors' Notes.—

to a point, the same may be said of the reaction coupling, which undoubtedly presented a similar problem to the designers. It goes without saying that adjustment of regeneration has a negligible effect on tuning, otherwise the single-knob tuning device would be a failure. On the long waves control is reasonably constant, and there is hardly any overlap; the latter remark applies, with slightly less force, to operation on the medium band, but there is considerable difference in the feed-back capacity settings for different points on the tuning scale. This is not a serious matter, particularly in view of the fact that the set is distinctly *not* of the type which depends essentially on reaction for its sensitivity.

As far as quality of reproduction is concerned the detector-L.F. amplifier combination has evidently been well chosen and, up to the power-handling capacity of either of the recommended output valves, satisfactory results can be depended upon, together with ample volume for average requirements.

In assembling and wiring there are few, if any, possible sources of trouble for the inexperienced. In the set of parts made up for test it was noticed that the aerial-grid and H.F. coupling coil assemblies did not bear a definite identifying mark; they seem to be identical, and would therefore be interchangeable for either function, but care should be taken to mount them with their terminals as shown in the pictorial diagram.

A short-circuit between fixed and moving vanes of either condenser C_2 or the reaction condenser R.C. would introduce a short-circuit across the source of H.T. supply; although this is hardly likely to happen if reasonable care is taken, its ill-effects are prevented by inclusion of a flashlamp fuse intended for insertion in the H.T. feed lead.

Finally, why is the receiver rated as being capable of receiving exactly 27 stations? Almost any set will do that—at night-time and under the right conditions. A much greater tribute to its capabilities is the statement that, under the really bad conditions already described, five stations were well received in daylight. Frankly, the set is too good to be classified in this way.

KIT CONSTRUCTORS' PROBLEMS.

In spite of the Information Department Rule 6, which provides that queries dealing with tracing of faults or modifications must be confined to sets described in this journal or to standard manufactured products, a large number of letters dealing with "kit" sets have lately been received. In view of the apparent demand by readers for advice on these subjects, it has been decided to extend the service—at any rate, as a temporary measure—to embrace questions dealing with such sets of this kind as have been discussed in these pages under the heading of "Kit Constructors' Notes."

A few typical questions and answers (which have already been sent by post) are printed below: they deal with the set reviewed in our issue of January 23rd and the instrument discussed above.

The extended service is subject to the general rules of the Information Department, given in the "Readers' Problems" section.

Tuned Aerial Circuit.

Is there any obstacle in the way of adding a tuned auto-coupled aerial circuit to my Cossor "Melody Maker" on the general lines of the arrangement included in the "Two-Circuit Two" (The Wireless World, *February 6th*)*? I should, of course, mount the extra tuning condenser and coil externally.* L. S. S.

The receiver in question lends itself very readily to modification in this way; it will be necessary to provide a variable tapping connection on the grid coil. The tuned aerial circuit may be completed through the external earth lead.

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Increasing Volume.

For my "Osram Music Magnet" set I have been using an ordinary power valve, but, wishing to increase volume as much as possible (without, of course, spoiling quality), I intend to obtain another output valve. Bearing in mind that my maximum H.T. voltage is 120, *do you recommend a pentode or triode?* W. M.

A pentode will give a greater output, but with an ordinary loud speaker we think you will obtain sufficient undistorted output from a good three-electrode valve of low impedance. If, on the other hand, your main interest is in the reception of distant stations at loud speaker strength, it cannot be denied that the pentode will afford a much greater amplification.

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A Correction.

In the circuit diagram of the "Cossor Melody Maker" given on page 92 *of your issue for January 23rd, I notice that G.B.+ is shown as being connected to the L.T. positive lead. Is this an error? It does not conform with the arrangement of my own receiver.* C. C. N.

Yes, we are afraid that in this matter the diagram is incorrect; as usual, the positive side of the grid bias battery should be shown as in connection with L.T. negative.

Faulty Switch Wiring.

I have successfully completed the G.E.C. "Music Magnet" except for one detail; the on-off switch does not operate, and to switch off the set it is necessary to disconnect one wire on the L.T. accumulator. I suppose I have made a mistake in wiring, but cannot trace it; can you help me with a suggestion? S. G. R.

This should not be a difficult fault to trace out, and we expect you will find that the trouble is due to the fact that you have made your connection to the side of the switch which is in metallic contact with the panel; this is wrong, and has the effect of short-circuiting the switch. As stated in the makers' instructions, the lead should be taken to the insulated terminal.

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Pentode Output.

Would it be possible to substitute my present output valve with a pentode—my aim being to increase volume and L.F. magnification? My set is a "Melody Maker." P. R. W.

Generally speaking, the pentode works at its best in sets with a single L.F. stage with transformer coupling, preceded by a grid circuit detector. This arrangement is included in your present set, and therefore there is no reason why a pentode valve should not be used. Of course, you must make provision for feeding a positive voltage to the screen grid.

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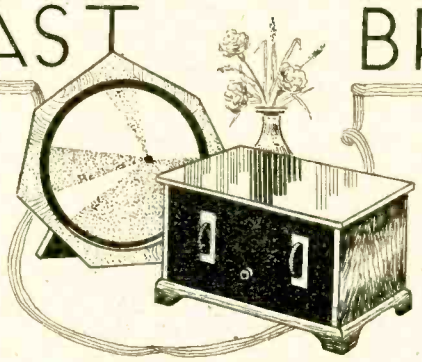
Earthing the Screening Case.

In The Wireless World *of January 23rd you say, with reference to the "Cossor Melody Maker," that the case may be earthed by "attaching a wire connected between a screw securing one of the angle-pieces of the box and the common negative lead." Does this mean the accumulator or the H.T. negative lead?* E. S.-P.

As H.T.– and L.T.– are connected together, it is immaterial to which lead the junction is made; in fact, it is, as stated, a common connection for the negative sides of each battery.

BROADCAST BREVITIES



By Our Special Correspondent.

Prague.

The B.B.C. will hold a watching brief at the highly important wireless conference of European Governments which meets at Prague from April 4th to 13th next. Officially Britain will be represented by the Post Office, but members of the B.B.C. will accompany the Post Office party to advise on matters affecting broadcasting.

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A Sequel to Washington.

The conference will be virtually a sequel to the Washington Convention, and the agenda will cover all wireless questions, from telegraph wavelengths to broadcast copyright. Austria is asking for a thorough revision of European call-signs, and Holland is championing the cause of amateur transmitters, particularly in regard to the allocation of wavelengths. Germany is asking for special wavelength bands for police work and weather reports. There will, of course, be a strong representation of the Bureau Internationale de Radiophonie from Geneva.

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Interference Problem Grows.

These are not happy days for the Bureau. Mr. A. R. Burrows, the genial secretary-general, can bear testimony to the flood of complaints pouring in anent the *Plan de Bruxelles*. Speaking generally, there is more interference on the Continent than in this country, but conditions are far from ideal over here, as any reader will agree who listens to the B.B.C. stations in turn. The engineers at Savoy Hill are now agreed that there is more heterodyning than before the change.

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Aberdonians Claim a Rebate.

The greatest sufferers are Newcastle listeners, many of whom endure agonies from the wipe-out effects produced by Nuremberg. Aberdeen has troubles—of a different kind. Since 2BD dropped to 311.2 metres many Aberdonians have been put to the expense of buying a new coil. Several have written to the B.B.C. claiming a rebate on their licence fees.

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Defying the Weather.

In the old days any sudden change in the weather conditions produced a crop of troubles for the B.B.C. technical department. Snowstorms brought down aerials and a night's frost sometimes froze the water used for valve-cooling. Nowadays the B.B.C. is prepared for anything from a blizzard to a sandstorm. During the present Arctic spell Savoy Hill has not received a single report of breakdown due to the weather.

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A Composer's Tribute.

Because Sir Thomas Beecham continues to display an attitude of good-humoured condescension to the microphone it is singularly gratifying to all who accept broadcasting seriously that a few days ago the composer Delius was moved to send Sir Thomas this telegram: "Heard perfectly your beautiful interpretation of my work. Am writing." Delius was listening at far-away Fontainbleau!

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English from Hilversum.

The Dutch announcer at Hilversum speaks English better than any other announcer on the Continent. He delivers a delightfully crisp speech at the conclusion of the Brandes concerts on alternate Sunday evenings. The next of the series will be given on February 24th at 5.40 p.m. Wavelength: 1,071 metres.

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Short Waves from Toulouse.

The fight between Radio Toulouse and the French postal authorities over the operatic performances from the Capitole Theatre shows no signs of slackening since the matter received mention in these columns three weeks ago. Radio Toulouse is using a "wireless link," the performances being relayed from the theatre to a receiver on the Plateau de Balma on a 93-metre wavelength.

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Truth About the Savoy Bands.

The microphone is a hard master, and I understand that it is this fact which is responsible for the "mutual agreement" between the B.B.C. and the Savoy Hotel to discontinue the broadcasting of the Savoy Bands after February 28th.

For a considerable time past experiments have been conducted to improve the acoustic conditions of the famous Savoy ballroom for broadcasting purposes, without, however, the success which had been hoped for. Since the ballroom exists primarily for the delectation of the dancers present, and further tests might encroach upon their interests, the respective authorities have taken the course which seems to them best.

By the way, it is interesting to note that at least twenty dance bands are waiting for the privilege of entertaining listeners.

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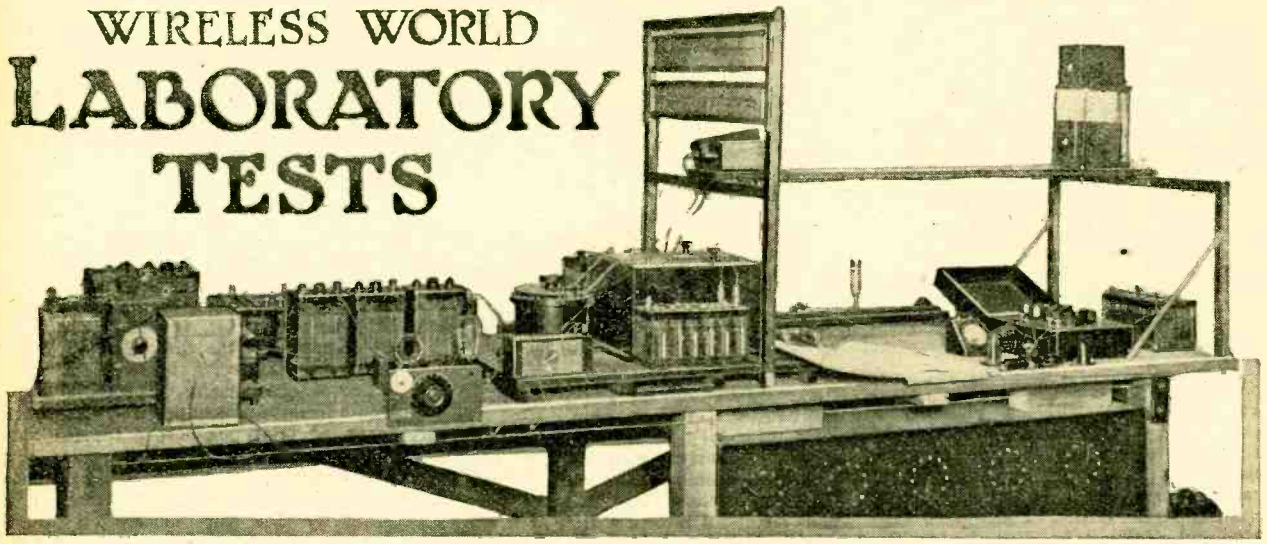
Five Types of Listener.

Racking its brains for new ideas for radio entertainment, the National Broadcasting Company of America has incidentally discovered that listeners fall into five main groups. There are those who think that there is (*a*) too much jazz, (*b*) too much classical music, (*c*) too many educational talks, (*d*) not enough of anything, and (*e*) too much of everything.

It is said there was once a listener who was pleased with everything.

THE LONDON REGIONAL STATION. A photograph taken last week at Brookman's Park, near Potters Bar, showing the main buildings of the new regional station nearing completion. Apparatus of the kind to be installed here is being experimented with by Daventry, 5GB.

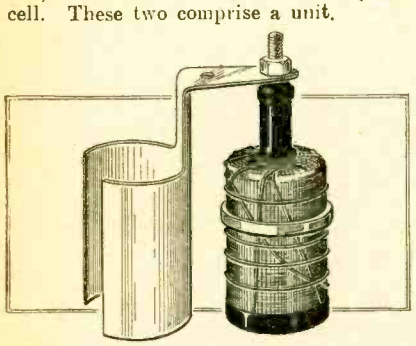
WIRELESS WORLD LABORATORY TESTS



A Review of Manufacturers' Recent Products.

CLEARY WET H.T. BATTERIES.

These are made by M. Cleary, 226, Albert Road, North Woolwich, London, E.16, and are supplied either as complete batteries or as single units. A unit comprises a sac element and a zinc, the latter being stamped from sheet metal with connecting lug in one piece. Special attention has been given to the contact between the zinc and carbon rod, this being treated with a non-corrosive fluid. To prevent creeping of the electrolyte, all parts above the level of the liquid have been dipped in paraffin wax. A general idea of the assembly can be seen from the illustration, which shows a sac element which is the positive of one cell, and a zinc element of an adjacent cell. These two comprise a unit.



Sac and zinc elements in the Cleary wet H.T. batteries. Note the compound sealing on the bottom of the sac.

The glass containers used in this case measure 1⅝in. square by 2½in. high, the tops being waxed. Batteries assembled from these units can be supplied in specially designed crates. A 45-volt battery (30 cells) is priced at 15s. 3d., and a 60-volt assembly (40 cells) 21s. 8d.

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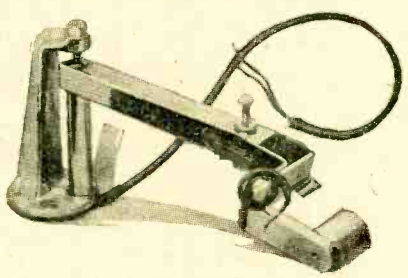
"BEAMU" PICK-UP CARRIER.

The design and construction of a gramophone pick-up carrier plays no mean part in prolonging the life of the records, and careful attention to certain points in design will be well repaid. The "Beamu" gramophone pick-up arm has been designed to reduce the wear on the records to a minimum, this being achieved mainly by providing a means of counterbalancing the weight of the electrical pick-up device, and, secondly, by pivoting the moving portion of the arm so that it swings easily, thereby removing any tendency on the part of the needle to drag.



"Beamu" pick-up carrier with enclosed leads.

In this particular model the weight of the pick-up is taken by a leaf spring which can be adjusted to vary the needle pressure between wide limits.

The device exhibits excellent workmanship, being constructed from a clean aluminium casting for the main support and stout brass, heavily nickel-plated, for the remaining parts. The traversing arm is built up from three parts, a cylindrical portion mounted vertically to form the main bearing and a horizontal square section piece to which is pivoted the pick-up attachment with its spring counterbalance. The vertical and horizontal parts of the arm are hollow, and the wires from the pick-up are taken through the centre of these, thereby eliminating the possibility of drooping leads becoming entangled with any of the moving parts. A short length of twin cable is supplied, and it is obviously the intention of the designers that this should be attached to either terminals or a suitable two-pin socket on the cabinet housing the driving mechanism.

This useful accessory is made by Messrs. Beagley and Musto, 47, Cranbourne Street, London, W.C.2, and the price is 10s. 6d.

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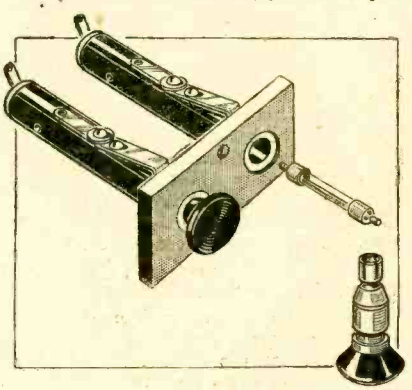
GAMBRELL TWIN FUSE UNIT.

This has been designed for incorporating in mains-driven sets and battery eliminators, and the fusing current has been adjusted to give a greater measure of protection to the apparatus than that afforded by the house fuses. The object of providing two fuses is to enable one to be connected in each supply lead, a precaution which is often overlooked. The fuse wire is protected by a glass tube fitted with brass end contacts. When fitting a fuse one end should be inserted in the fuse carrier, which is then pushed into the barrel of the unit until the spring engages with the groove in the carrier.



Gambrell twin fuse unit and fuse holder.

The fusing current is stated to be one ampere, but on test we found that in one case the fuse "blew" at 1.5 amps., while

in another the fusing current was 2 amperes. This, however, will provide adequate safeguard for the apparatus and house fuses, as the latter rarely "blow" below 5 amperes.

The makers are the Gambrell Radio, Ltd., Buckingham House, Buckingham Street, Strand, London, W.C.2, and the price of the unit is 6s. 6d., a spare fuse costing 6d.

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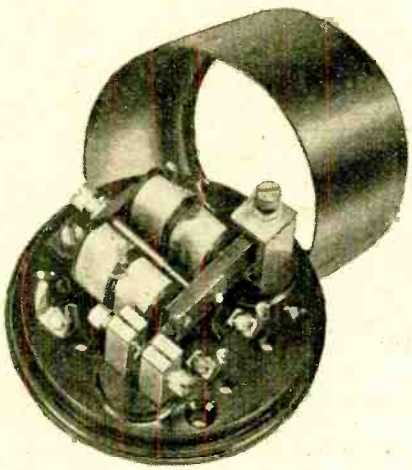
UTILITY RELAY.

Of primary importance in the construction of a picture receiver is that the relay, as well as being sensitive, shall give unfailing performance. As much detailed instrument work is involved in the making of a first-class relay, readers will prefer to purchase a manufactured article in preference to undertaking such a difficult task.

A relay has been constructed by Wilkins and Wright, Ltd., Utility Works, Holyhead Road, Birmingham, around the design recently given in these pages. The base dimensions have been followed in order that the relay can be attached to a standard drilled panel. To avoid the need of providing an insulating piece beneath the base, the relay parts have been assembled on an attractive bakelite moulding. The small magnet carries four 1,000-ohm spools, while a light spring adjustment between the poles provides a restoring tension to the armature. Both contact pillars and armature bearing support are substantially set up, producing a robust movement that will retain its critical setting in spite of long and severe usage. A current of 0.75 mA. through the 4,000-ohm winding closes the relay contacts with sufficient pressure for energising the trigger circuit.



A new relay for the picture receiver. It is a Utility product and is assembled on a bakelite insulating base.

On this current the relay will operate with a clean, quick action. Tested with a heavy current of 6 mA., there was no tendency for the armature to retain on the pole faces. The movement is protected under a nickelled cover with glass top.

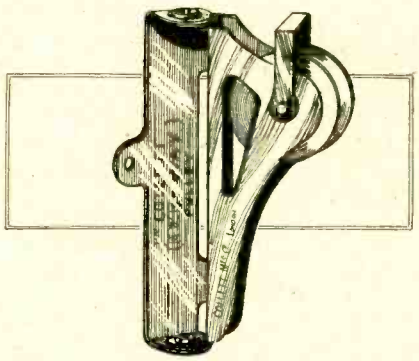
COLLETT'S "EZE-WAY" PULLEY.

The Collett "Eze-way" pulley should go a long way towards solving a difficult problem which besets the wireless listener, as owing to its unique design it imparts a greater factor of safety to the aerial system than any other device of its kind.

The main feature of the pulley is that a special wheel with two grooves is fitted, thereby enabling two halyards of different diameter cord to be passed through the pulley.

Those most commonly used are not provided with special fixing attachments, and it is usual to attach these to the mast by either wire or cord, but the "Eze-way" system ensures a more certain fixing than this. The main framework of the pulley is stamped from stout brass, heavily tinned to render it weatherproof, and the wheel is pivoted in such a manner that the weight of the aerial is distributed over a reasonably large area, and as the device is screwed to the mast at three points there is little danger of this coming adrift.

The No. 2 model is provided also with a pivoted back plate, thereby imparting a self-aligning quality which enables the pulley to adjust itself automatically to the direction of the aerial and greatly



The feature of this pulley is the double-grooved wheel for accommodating two separate halyards. A Collett product.

diminishing the danger of the hoist overriding the pulley wheel and becoming jammed. Furthermore, this feature reduces the wear on the cord and gives it a much longer life.

The No. 1 model is not provided with a swivelling back plate, and is therefore cheaper; but it will be found quite as satisfactory as the No. 2 model, provided it is mounted so that the wheel is in direct alignment with the pull of the aerial. The makers are Messrs. S. H. Collett Manfg. Co., 60, Pentonville Road, London, N.1, and the prices are as follows:—No. 1 model, 2s. 3d.; No. 2 model, 2s. 6d.

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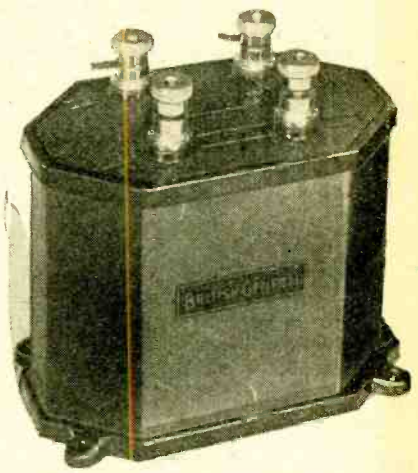
"BRITISH GENERAL" TRANSFORMERS.

The massive design of these transformers in itself shows promise of good performance, and this initial impression is, in fact, borne out by test. They are made in two ratios, a 5 : 1 for second stage coupling and a 3 : 1 for use following a high impedance detector valve.

The 3 : 1 transformer has a primary impedance at 920 cycles of 744,000 ohms, and under the same conditions the 5 : 1 transformer shows an impedance of 40,400 ohms.

In testing the transformers under broadcasting conditions a general purpose valve of 30,000 ohms A.C. resistance was used. The 3 : 1 ratio transformer gave results identical with the standard transformer used for comparison, and can



British General "Super Shrouded" transformer.

be definitely ranked as a first-rate instrument. The 5 : 1 transformer under these conditions showed a slight loss of bass, but this would be rectified by the use of a valve of impedance lower than 30,000 ohms in the first L.F. stage.

Both transformers are priced at 18s. 6d., and the makers are the British General Manufacturing Co., Ltd., Brockley Works, Brockley, London, S.E.4. An attractive finish is provided by the polished and plated metal container, which acts as an effective shield. The terminals are carried on the brown moulded top.

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TRADE NOTES.

A Correction.

We wish to take this opportunity to correct an unfortunate mistake in the price of the Oldham H.T. accumulator units, type L.H.T.L., which, in our review published on page 134 in our issue of January 30th last, was erroneously given as 7s. 3d. Since the Olympia Show there have been two reductions in the price of this particular 10-volt unit, and it is now offered at 6s. 9d.

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"Polymet" Midget Fixed Condensers.

It will be recalled that in our issue of January 23rd last we reviewed a selection of "Polymet" products, but were unable to give the price of the midget mica fixed condensers.

This information has now come to hand, the prices being as follows:—

0.001 mfd. to 0.0005 mfd., 10d. each.
0.001 mfd., 1s.; and 0.002 mfd., 1s. 2d.

THE CONE LOUD SPEAKER.

Lektophone Corporation *v.* S. G. Brown, Ltd. Important Patent Decision.

AN infringement action of considerable importance to those interested in the manufacture and sale of cone loud speakers has recently been brought before the High Court.

Plaintiffs in the case were the Lektophone Corporation of Jersey City, U.S.A., who sued Messrs. S. G. Brown, the well-known radio manufacturers, for infringement of Letters Patent No. 16602 of 1914. This patent was originally granted to Marcus Clarence Hopkins, but is now owned by plaintiffs, who complained specifically of the sale by the defendants of a " Mascot " loud speaker during the Radio Exhibition held at Olympia last September.

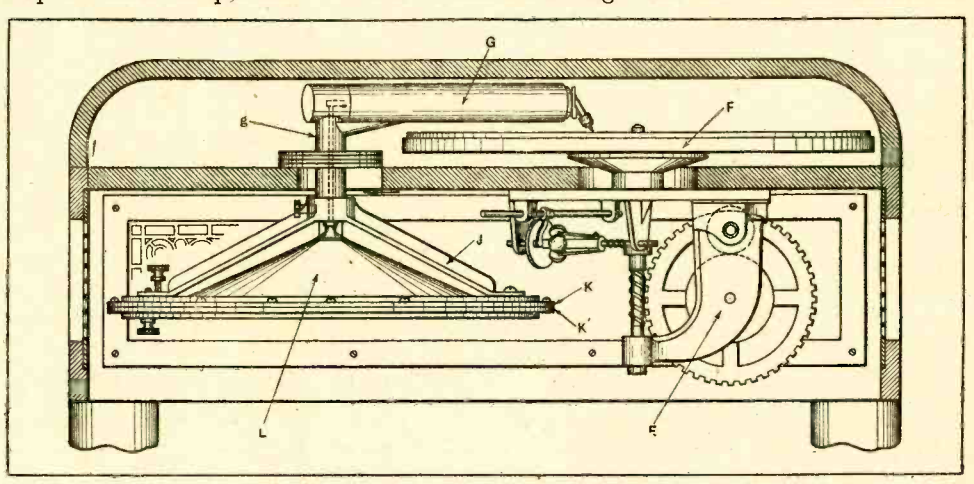
The " Cone " Patent.

The accompanying illustration shows one of the figures taken from the patent specification in question. It represents a gramophone with a record table F and driving motor E. The vibration of the stylus is transmitted through a horizontal tube G and a vertical tube *g* to the " sound regenerator " or cone L, which forms the basis of the present action.

The conical diaphragm L is supported by a three-armed spider J which carries two metal rings K, K^1, between which the edges of the diaphragm are rigidly clamped.

The firm claim appended to the specification reads as follows:—

" A sound regenerating machine of the kind set forth in which a tympanum of at least nine inches in diameter is provided, freely exposed to the air in which the sounds are to be propagated, the tympanum having a central conical portion surrounded by an annular portion, which is supported in a rigid manner at its periphery."



An illustration from the Hopkins patent, the subject of the action.

Case for Plaintiffs.

In opening the case for the plaintiffs, counsel said that when one considered what had to be done in order to convey to a distant audience the effect of an orchestra playing a symphony, and when one further reflected that this result could be attained by the vibration of a simple piece of material in the form of a disc or cone, then he was bound to say that it struck him as an extraordinary tribute to the ingenuity of the human mind.

A disc of several inches diameter with a rod attached to its central point at right angles was probably the ideal way of generating sound waves. The wave emitted by the disc must have a length of about eight times the diameter of the disc if the note was going to be radiated in perceptible volume.

If, for instance, one used a disc of five inches and another of nine inches diameter for reproducing orchestral music, then the five-inch disc would give no perceptible response for frequencies lower than 330, whereas the larger one would reproduce frequencies as low as 184 cycles per second. This illustrated one advantage of using a larger disc.

If the edges of the disc were left free there was a distinct liability to " blast." Further, there was a real manufacturing difficulty in the making of large discs, because it was difficult to get a material which would maintain its surface plane, i.e., always without breaking up into local deformations.

Dr. Eccles gives Evidence.

Dr. W. H. Eccles, F.R.S., past President of the Institute of Electrical Engineers, was the first witness for the plaintiffs. He said that any substance capable of carrying longitudinal waves would transmit sound. Small discs had already been used in combination with horns for radiating sounds, but they could not deal effectively with low notes.

When a small disc vibrated to and fro the air could move easily from back to front of the vibrating surface, provided there was no horn. This led to the creation of useless air currents, and the consequent dissipation of a portion of the available sound energy. When a horn was used all the available energy was concentrated, the wave-front spreading inside the horn until it reached the open air. If the pressure was not too high it would enter the open air without much reflection.

The main object of the Hopkins patent was to make a sound reproducer that would operate without a horn and yet give a large volume or output throughout the whole musical range.

Asked in cross-examination how long it had been common knowledge that if a horn was not used the diaphragm must be made larger, Dr. Eccles replied, " I

The Cone Loud Speaker.—

don't know that it has been common knowledge at any stage."

"Is it common knowledge now?"

"Yes, since the development of the loud speaker."

"When do you place the coming in of the cone loud speaker?"

"With the coming in of Hopkins' invention."

"The device of getting stiffness by 'coning' has been suggested by a great many other people?"

"It has been used by many people."

"Was it not known long before this patent that to get purity of tone you had to make the diaphragm vibrate as a whole?"

"I don't remember it being put in that way."

In re-examination Dr. Eccles said that the general nature of Hopkins' discovery was that if one wished to reproduce loudly by cone diaphragms, one must constrain the edge so that it did not vibrate locally. In other words, so that there were no standing waves in or near the edge. By doing that the diaphragm was made to move plunger-fashion, or more as a whole.

Dr. Eccles was in the box for the greater part of five days, answering upwards of 2,500 questions.

Other Licensees.

The Assistant Secretary of Standard Telephones and Cables, Ltd. (formerly the Western Electric Co.), stated in evidence that his company had an arrangement with the Lektophone Corporation for mutual dealing with patents, including the one now in dispute. He gave particulars of sales by various licensees, including the Graham Amplion Co., the General Electric Co., and the Celestion Co.

The Defence.

The case for the defence was a denial of any infringement, and a counterclaim for the revocation of the Hopkins patent on the grounds of lack of novelty and subject-matter, as well as insufficiency of description.

Defendants' counsel said the case had been presented as if the Hopkins patent had enjoyed a great commercial vogue. The fact was that the Hopkins patent was dug up in this country about 1927, and had never been heard of before here.

A large diaphragm was of no use at all prior to the introduction of the thermionic amplifier, which first enabled comparatively large power to be handled. The demand for a large disc or cone loud speaker only came in with broadcasting and the concurrent use of multi-stage receiving sets capable of producing much greater power than could be obtained from a stylus-driven machine such as the gramophone.

He submitted that the Hopkins patent extended only to sound-producing machines of the gramophone type. There were very material differences between this and the modern loud-speaker as used for broadcast reception.

Mr. J. Swinburne, F.R.S., giving evidence for the defence, said that the term "loud speaker" only came into use after the introduction of the valve amplifier, which provided for the use of considerable power derived from a local battery.

In his view there was no novelty in what Hopkins claimed, *i.e.*, using a large diaphragm and dispensing with the horn. Nine inches was not a critical size in diaphragms. For low notes it was quite a suitable selection, though good results could be obtained using a diameter of four or five inches.

Judgment.

Mr. Justice Tomlin, in pronouncing deferred judgment, said that at the time of the Hopkins patent the use of sound reproducers was practically limited to gramophones. Thermionic valve amplifiers as applied to modern broadcast reception were unknown. He found that the Mascot loud speaker did not infringe the Hopkins patent and judgment would accordingly be given for the defendants (Messrs. Brown) on this issue.

The counterclaim for revocation of the patent must, however, fail. He found the patent valid for a diaphragm as claimed and applied to a gramophone or other stylus-driven machine. Judgment on this issue was accordingly given in favour of the Lektophone Corporation.

USEFUL DATA CHARTS. (No. 22.)

Transmission of Sidebands by a Tuned Circuit.

WHEN a tuned grid circuit is loosely coupled to an aerial as in Fig. 1 the result is as if a small alternating voltage were injected in series in the tuned circuit: the impedance of this circuit at any frequency is shown in Fig. 2, where the resistance of the coil is drawn horizontally and the reactances of the coil and condenser are drawn vertically and in opposite directions.

When the frequency is such that these two reactances are equal they cancel out and the circuit behaves as a pure resistance, the circuit is said to be tuned to the

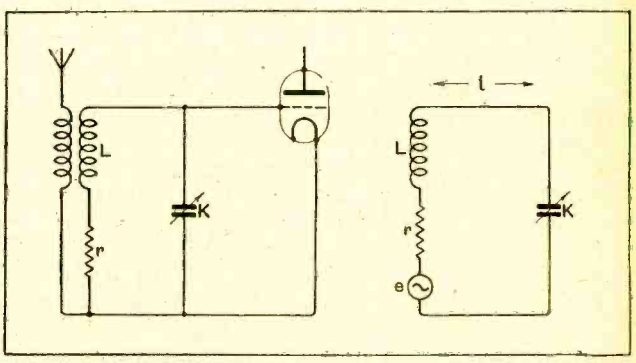
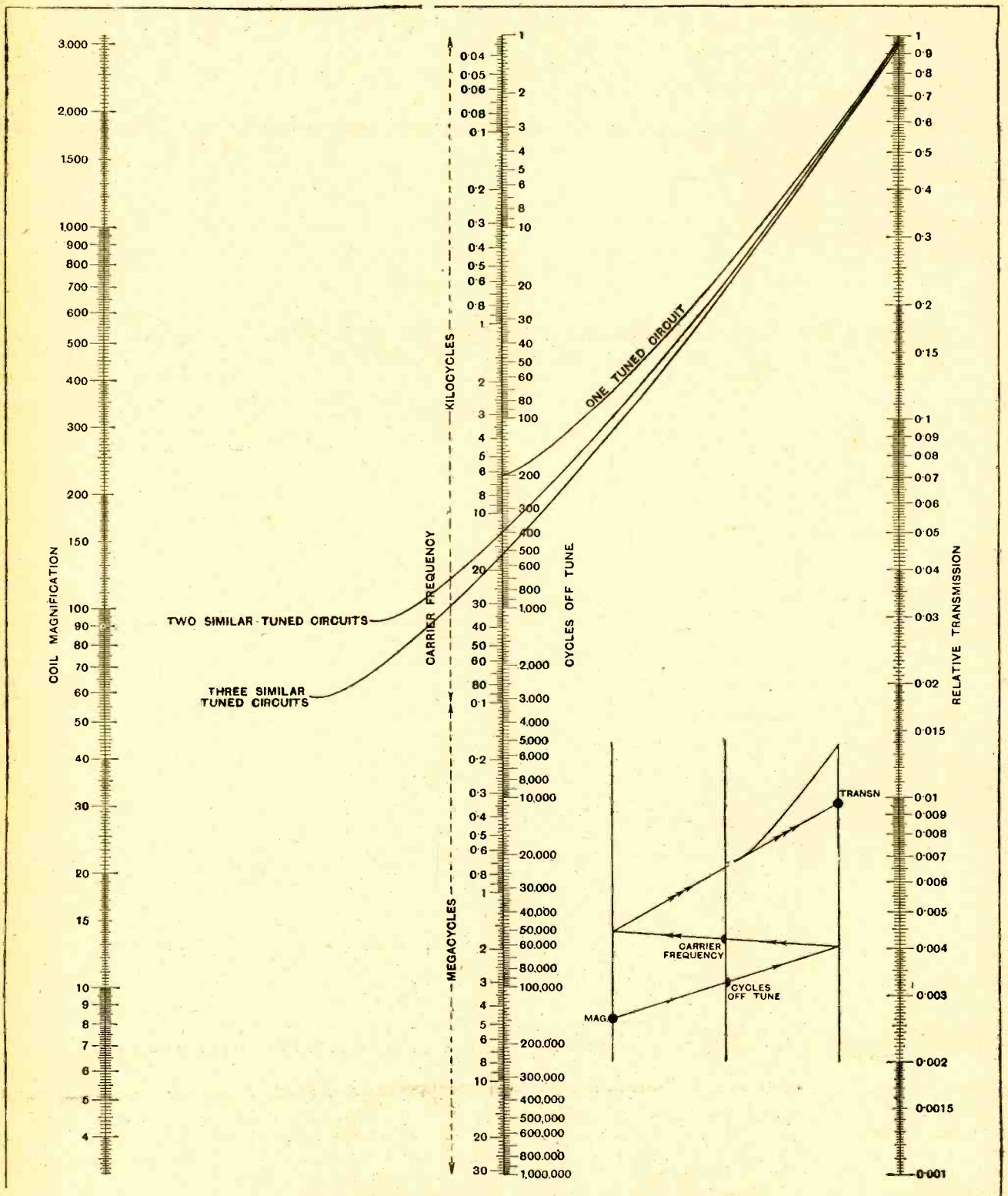


Fig. 1.—A tuned grid circuit loosely coupled to an aerial. On the right is the equivalent electrical network.



W W. ABAC

TRANSMISSION OF SIDEBANDS BY TUNED CIRCUIT

Nº 22.

Useful Data Charts (No. 22).—

incoming signal, and the current equals the injected e.m.f. divided by the coil resistance, $i=e/r$. The voltage across the condenser is this current multiplied by the condenser reactance (which equals the coil reactance at the tuning point), so that voltage across condenser-injected e.m.f. = coil reactance-coil resistance, or $V/e=\frac{L.2\pi f}{r}$. This ratio is called the voltage magnification of the coil or simply the coil magnification, but it is, of course, not due to the coil alone, but is the magnification obtained when the coil is tuned to the incoming frequency by a suitable condenser. Coil magnifications of from 100 to 200 can be obtained with solid wire coils of suitable design when the aerial is coupled very loosely, and still larger values are possible when stranded wire is used. When closer coupling is resorted to some of the energy in the grid circuit is diverted to the aerial, and the result is as if the coil resistance were increased so that the coil magnification is decreased: with an average aerial connected to the coil a quarter of the way up from the L.T. end the magnification may drop 50 to 75 per cent.

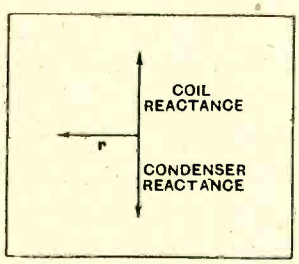


Fig. 2.—The impedance of the tuned circuit of Fig. 1 is here shown. The resistance of the coil is drawn horizontally and the reactances of coil and condenser are shown vertically and in opposite directions.

Selectivity of Tuned Grid Circuit.

A change in the incoming frequency will alter both the reactances shown in Fig. 2. If an original frequency of a million c.p.s. is increased by 10,000 c.p.s. (an increase of 1 per cent.) the coil reactance becomes 1 per cent. greater and the capacity reactance 1 per cent. smaller. Accordingly, the circuit has a residual reactance as in Fig. 3, and its impedance is represented by the slant line. This impedance will increase as the frequency rises, and the increase will be more noticeable when r is small; in other words, a low resistance circuit gives a sharp tuning curve, while with high resistance the curve is flat.

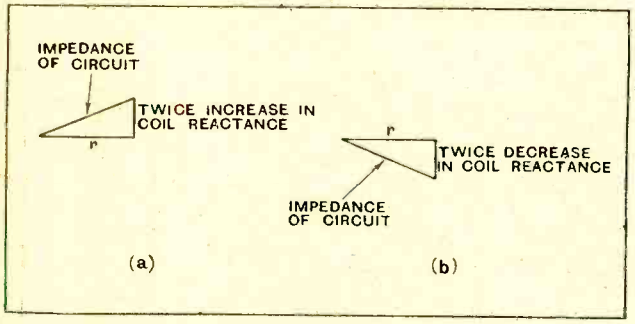


Fig. 3.—When the incoming frequency is greater than the tuning frequency the impedance rises as in (a); when the frequency is less the impedance rises as in (b).

Tuning Curve when Coil Magnification is Known.

Chart No. 22 allows the tuning curve to be plotted when the coil magnification is known. Thus when this figure is 50 and the circuit is tuned to a frequency of a million c.p.s. the relative transmission will fall to a value of 0.447 when the frequency changes by 10 kilocycles.

The complete curve is plotted in Fig. 4. It can be obtained from the chart by a few minutes' work. A 5,000-cycle note is seen to be transmitted with an efficiency of 0.707, while a station of equal strength at the aerial and spaced 30 kilocycles away would come in with a strength represented by 0.166, and would be likely to cause interference.

Two or Three Tuned Circuits in Cascade.

The tuning curve of Fig. 4, corresponding to a grid circuit is unaltered if the same circuit is used as a plate load, except that the differential valve resistance will appear as a shunt resistance to the coil. With a screen-grid valve this shunting effect is usually small. Accordingly, if the first grid tuned circuit transmits

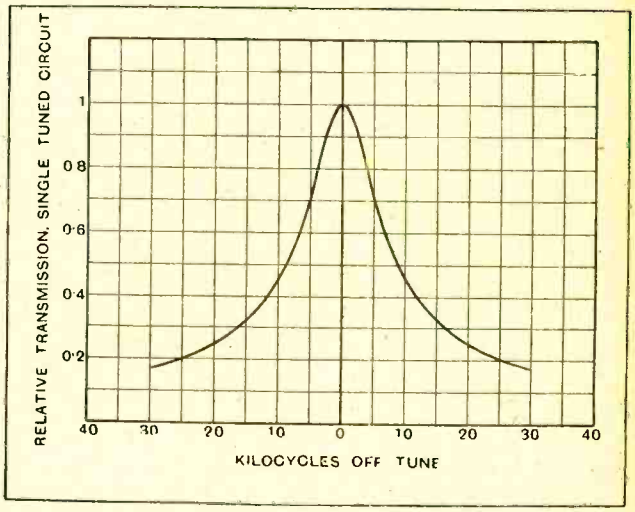


Fig. 4.—Complete tuning curve plotted from Abac No. 22. The coil magnification is 50 and the frequency one megacycle (300 metres).

0.9 of any sideband, a similar tuned plate circuit will transmit 0.9 also, and the total transmission will be $0.9^2=0.81$. Similarly, 3 circuits transmit $0.9^3=0.729$. Three curves are drawn on the chart to enable us to deal with such circuits in cascade.

CANADA'S QUARTER MILLION LICENCES.

MORE than 250,000 Canadians holding radio receiving sets had paid the Government tax of $1 up to the end of November, 1928, an increase of 17,000 as compared with the end of November, 1927.

The returns indicate that there are 226,240 private radio receiving licences, although it is believed that more than 100,000 sets exist for which no licences have been issued. The revenue from the issue of licences is devoted by the Department of Marine and Fisheries to the improvement of radio services, about a score of radio anti-interference cars being in use.

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.

B.B.C. CALL SIGNS.

Sir,—The purpose of this letter is to enquire how it is that the British broadcasting stations (with two exceptions) are operating under call signs to which they have no right.

Under the terms of the Wireless Telegraphic Convention held at Washington in 1927 (and agreed to by the British Government) all commercial and broadcasting stations shall have a call sign consisting of three letters, the index letter denoting the nationality of the station, the calls consisting of a number followed by one or more letters being allocated exclusively to experimental and amateur stations, the number in this case being prefixed by a letter or letters denoting nationality. Other countries have conformed to the Convention, viz., PCJJ is now PCJ, and 2XAF is now W2XAF, so it is rather mysterious why the B.B.C. stations have not done the same.

It would be extremely interesting to have views upon this matter. Though it is a matter of small importance what calls are used, yet it seems a question of principle, and the B.B.C. should not be allowed to disregard laws which other people are bound by. The terms of the Washington Agreement came into force on January 1st, 1929. C. S. BRADLEY, 92AX.

London, N.8.

EMPIRE BROADCASTING.

Sir,—Attention has repeatedly been drawn to the unsatisfactory status of the so-called Experimental Short-wave Broadcasting Station 5SW. As clearly pointed out in both Editorial and Correspondence columns, this station has carried out its initial series of transmissions over a sufficiently long period to justify the hope that some conclusion has been arrived at as a result of the expenditure involved. But still no official indication is given one way or the other with regard to Empire broadcasting. If the scheme is impracticable, why continue to raise false hopes, and if practicable, why not extend the service on a permanent and not an "experimental" basis?

The advantages of Empire broadcasting are manifold. There is abundant evidence of a demand for it from the Dominions, where the people naturally ask why enterprise in short-wave broadcasting should be left to foreigners when they are keen to hear their own Mother Country, who is silent over the week-end, and who withholds news and other items of interest to the Empire listener. The objection that perfect reception cannot be guaranteed is not likely to weigh heavily with the overseas Briton, who is only too glad to have a chance to hear what London is saying, even though he may have to listen hard and put up with a little fading at times. The gain in general good feeling and the linking up of our vast Empire would appear to be worth the upkeep cost, which at the most must be trifling in relation to, say, the upkeep of a single battleship.

Even in a technical report this aspect of the matter is emphasised by Dr. van der Pol in the current number of *Experimental Wireless* (page 12, last paragraph but one), who says: ". . . Especially many letters reached us from grateful listeners living in the Dutch East Indies, relatively far away from the civilised towns. Though the number of these listeners may not be high, the great appreciation they show for enabling them to listen to their Mother Country (even though the quality of reception is not yet ideal) can hardly be over-estimated." If this is the case with Holland, how much more applicable is the argument in favour of a British Empire broadcasting service?

Considerable loss of export trade in receiving apparatus is resulting from the present indeterminate policy. The Dominions and Colonies are ready to buy; the British manufacturer is ready to sell; but trade is hanging fire until some definite broadcasting service is inaugurated.

Then, further, the gain in prestige among foreign countries would surely be appreciable if a first-class world-wide broadcasting transmission were maintained.

On the technical side the choice of wavelength is undisturbed by Geneva or Brussels systems, and local interference with any imaginable power is almost non-existent.

What are the objections? Only one has so far been given any prominence. It is that British listeners would object to financing with a portion of their licence fees a service of which others get the benefit. Even granting that this does justice to British unselfishness, it is not necessary to go very far to see a way out of the difficulty. Even if the cost be estimated as high as 10% on the whole B.B.C. income, it only amounts to 9d. per licence. The Post Office at present retains half-a-crown out of each licence fee, and as presumably only a small portion of this is necessary to cover administrative expenses, there appears to be no valid objection to diverting a mere 9d. to Empire broadcasting. The Post Office could still easily cover the most liberal costs of issuing licences, would retain quite a useful amount in hand, and would have the satisfaction of helping to maintain a service of value to the Empire. BURNDEPT WIRELESS (1928), Ltd.,

M. J. Scroggie, B.Sc., A.M.I.E.E., Chief Engineer.

London, S.E.3.

STANDARD FREQUENCY BROADCASTS.

Sir,—Referring to the excellent suggestion contained in the letter from Mr. C. R. Mason, which appears in your issue of January 23rd, may I suggest that a suitable opportunity occurs for making a brief test on the lines he suggests after the General News Bulletin when a piano interlude usually takes place? If a test of this nature were made in place of the usual piano interlude and proved to be of value to listeners, the question of a more extended transmission could then be considered.

G. FREDERICK FORWOOD.

Limpsfield, Surrey.

A NAME FOR "BROADCAST HOUSE."

Sir,—I saw the letter of Mr. Pink in your issue of January 30th suggesting "Fleming House" as an alternative name for "Broadcast House," as Professor Fleming invented the thermionic valve. But what about Sir Oliver Lodge, who invented the tuning inductance, which is just as important? I suggest, therefore, "Fleming Lodge" instead as a name for "Broadcast House." R. A. BETTRIDGE.

Sudbury, Suffolk.

MARCONI PATENTS.

Sir,—Referring to your editorial on Marconi patents in the issue of *The Wireless World* for February 6th, I am instructed by my committee to point out that your article appears to be based on wrong premises and without due regard to certain important factors.

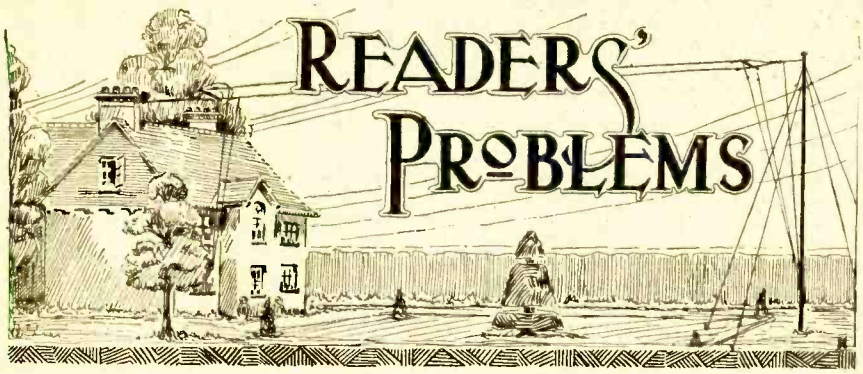
As the whole matter is *sub judice*, my committee do not feel justified in offering any further comment except to say that it sees no reason to question the reliability of the advice given to the trade as to its procedure in regard to Marconi royalties.

D. GRANT STRACHAN,

Secretary, The Radio Manufacturers' Association.

[The purpose of the editorial on Marconi patents referred to was to explain to our readers that the question of the amount of royalties payable by those who make use of Marconi patents is not yet settled, and indeed cannot be until after the result of the Marconi High Court appeal is known.

There is no suggestion of criticism of the attitude of the committee of the Radio Manufacturers' Association in recommending a common policy to the trade until the position is settled. It should be remembered that the article was written primarily for the information of those readers of *The Wireless World* who may pay royalties in connection with sets, but have no licence agreement with the Marconi Company.—Ed.]



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

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

Increasing Eliminator Voltage.

I have measured the voltage of my A.C. eliminator "on load" in the manner suggested in a recent article, and find that, as far as the supply to the output valve is concerned, it amounts to 150 volts. Now I should like to increase this to 150, and, if there is no objection, propose to connect in series a 20-volt H.T. accumulator battery. Is this possible? D. S. W.

There is no real reason why you should not increase eliminator voltage in this way, but, before doing so, we recommend you to try to modify the instrument so that the desired additional voltage may be obtained. If the instrument is a commercial product, you might get in touch with the manufacturers, who would possibly undertake the alteration themselves. Another small point: when you add a 20-volt battery, the current passed by the valve will be greater than before, and so the voltage drop in the eliminator will be increased; the result will be that the actual available additional voltage is something less than that of the battery.

Effect of the Cabinet.

My four-valve set worked quite well when first tested, but since fitting it in a cabinet I have been troubled with a low-frequency howl. I am quite sure that it is due to the cabinet (which is of wood), because, on withdrawing the set, it again works well. This seems very mystifying; have you ever encountered the same trouble, and can you suggest its cause? J. M.

This effect is uncommon, but is not unknown. We expect that the trouble will be traced to microphonic action in one of the valves—probably the detector—due to an acoustic resonance developed in the confined space of the cabinet, and in some cases to actual resonance of parts of the woodwork. As usual, the remedy is to mount the offending valve on a really good shock-absorbing mounting, and perhaps to enclose it in a box packed with cotton wool.

o o o o

Dropping Volts.

I have a two-range milliammeter and a large collection of wire-wound resistances—fixed, variable, and tapped. Would the following method of procedure be satisfactory, in order to arrive at the correct value of series resistance required to "drop" the voltage from an H.T. eliminator to each valve in the receiver? I propose to insert the milliammeter and a value of resistance known to be greater than that required in series with each anode in turn, the grids to be biased as recommended by the makers. Then resistance will be progressively reduced until the current indicated is that shown on the makers' curves as being that passed at the desired voltage and the bias known to be applied. Finally, a single resister equal to the sum of the separate elements will be inserted when they are removed. R. P. A.

There seems to be no objection to this scheme, unless you are unfortunate enough to have a more or less defective valve, or, at any rate, one with characteristics differing widely from the standard. An exception to this exists when the voltage applied to the screen of an S.G. valve is being regulated, and in this matter you should, if using these valves, be guided by articles published in the issues of this journal dated November 28th, 1928, and January 16th, 1929.

o o o o

Two Loud Speakers.

Is it possible to arrange a single-pole double-throw switch (which I already have) in such a way that two loud speakers may be operated simultaneously, or either one separately? If my present switch can be used, will you give me a circuit diagram showing the connections? It should perhaps be added that the set includes a choke-filter output arrangement. M. T. G.

The circuit you require is given in Fig. 1. As you will see, the switch is arranged so that either loud speaker may be short-circuited; in the open position,

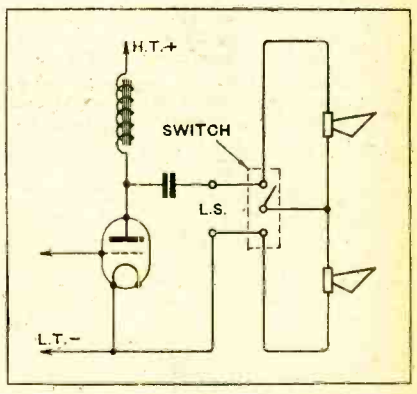


Fig. 1.—Simple switching arrangement allowing either one of two loud speakers to be used separately or both simultaneously.

both instruments are in series. This is the best arrangement when a choke-condenser feed is used.

o o o o

Rebuilding the "Everyman Four."

Will you give me a hint as to how to proceed in adapting my "Everyman Four" set for use with a screen grid H.F. valve? In particular, I should like to know if it would be necessary to use more screening than is at present provided S. F. B.

It will be advisable to use transformer coupling for the H.F. amplifier, and, if you wish to attain the maximum possible amplification, we think it essential that screening should be more complete than at present. It will hardly be necessary to screen the input end of the amplifier (the apparatus associated with the grid circuit of the valve), but we recommend that the H.F. coupling (transformer and condenser, etc.) should be completely enclosed in a metal box with well-closed joints.

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 Diary.

I cannot understand the instructions for working out values of voltage-dropping resistances given with regard to Circuit No. 12 in The Wireless World Diary. *Will you amplify the information given?* N. C. N.

We fear that your difficulty is due to an unfortunate error in the second paragraph, which should read "assume the mains voltage to be 240"—not 120 as printed. If the desired voltage of 120 is now subtracted from this figure, the next step in the example given will be obvious to you.

o o o o

L.F. Amplifier following Two H.F. Stages.

From statements that have appeared in your journal recently, I take it that the best type of two-stage amplifier to follow an anode bend detector preceded by two H.F. valves is a combination of resistance and transformer coupling (in that order), with provision for reducing the amplification of the first stage. I already have two good transformers; is there any way of using them, or must I obtain the components necessary for resistance coupling in the first stage? R. W.

It is by no means essential that the detector should be followed by resistance coupling, and it is possible to obtain good results with two transformers. The important point is that the L.F. amplification obtainable from this arrangement will be so large that any signal of sufficient amplitude to work the rectifier really well will normally result in overloading, and accordingly it will be necessary for you to make provision for reducing the magnification of the first stage to a very considerable extent. We suggest the arrangement shown in Fig. 2: a variable resistance, R, is connected across the primary of the first transformer. In order to improve stability, the condenser normally connected across this winding may be joined directly between plate and filament of the detector valve, as shown.

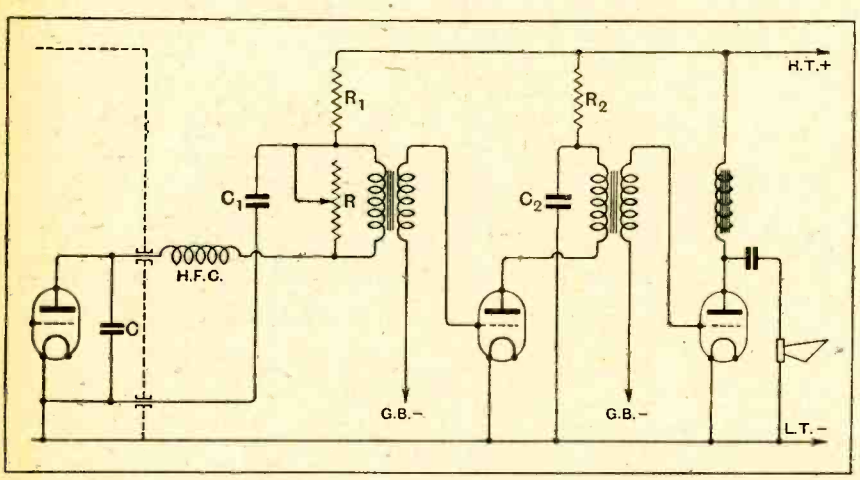


Fig. 2.—Two transformer-coupled L.F. stages with input volume control following anode bend detection. C, detector anode by-pass condenser; C_1, C_2, R_1, R_2, decoupling condensers and resistances.

One Operation at a Time.

My set is a "Standard Four," built into an American type of cabinet; there are a few other unimportant modifications to the original design. Results so far have been poor; the main trouble seems to be that the neutralising arrangement does not work properly. For instance, the balancing condenser is set so that the H.F. valve is stable on a certain wavelength, and the potentiometer is then adjusted to give best signals, but is not turned far enough to produce oscillation. On attempting to receive on a slightly different wavelength, it is found necessary to reset the potentiometer, as signals are then either too weak, or, if the receiver is in a sensitive condition, it is distinctly unstable. Does this suggest to you what is wrong? J. C. McE.

It seems that your trouble is due to incorrect operating procedure, and that you have complicated matters by regarding as interdependent two controls which are in fact quite distinct. In all probability you are so adjusting your potentiometer that a positive—instead of a negative—bias is being applied to the detector; the set is being stabilised by damping brought about in this way, and the valve is operating more or less as an inefficient "top bend" rectifier.

We suggest that your first operation should be the adjustment of the detector bias. Obtain a weak signal with the two tuned circuits so far out of resonance that there is no sign of instability; now rotate the potentiometer knob till strength is at a maximum; there will be no need to touch this again for reception on either waveband until battery voltages or valve characteristics undergo a considerable change.

Having finally disposed of this adjustment, you can concentrate on balancing the receiver, following the instructions given in the descriptive article.

The foregoing remarks apply to any receiver with a high-efficiency neutralised H.F. stage followed by anode bend detection with potentiometer bias control.

o o o o

Interaction Between Input and Output.

My four-valve receiver, with two screen grid H.F. amplifiers, is not completely stable when the filament rheostat controlling the high-frequency valves is turned full on. I notice, however, that on removing the aerial, oscillation no longer occurs: this seems quite opposed to my usual experience, as the addition of aerial loading generally seems to add stability. Can you suggest what is wrong? S. B. M.

The symptoms you describe would suggest that there is interaction between the aerial lead-in and the loud speaker (or phone) leads; the latter, in spite of quite elaborate precautions to keep H.F. energy out of the L.F. amplifier, may be carrying some high-frequency current. Accordingly, the two sets of leads should be separated as widely as possible.

WHO'S WHO IN THE ETHER

Alterations in Wavelengths.

Station.	Metres.	Kc.
AUSTRIA.		
Innsbrueck	455.9	658
Klagenfurt		
BELGIUM.		
Schaerbeek	250	1200
FINLAND.		
Lahti	1523	197
FRANCE.		
Paris (Radio)	1761	170.3
Petit Parisien	336.3	892
Radio LL (Paris)	370	809
Radio Vitus (Paris) ..	389	770
P.T.T. relays:		
Bordeaux-Lafayette ..	310	960
Lyons	460	636
Marseilles	313	956
Provincial Stations.		
Mont-de-Marsan	400	750
Strasbourg	403	991
Toulouse (Radio) ..	500	600
GERMANY.		
Aachen, (Aix-la-Chapelle) (relays Cologne) ..	452	664
HOLLAND.		
Huizen	1841	163
POLAND.		
Posen	336	893
SPAIN.		
Madrid (EAJ7)	423	708
Relays:		
Salamanca (EAJ22) ..	456	658
San Sebastian (EAJ8) ..	392	766
Barcelona (EAJ13) ..	263.2	1140
SWEDEN.		
Kristinehamn (relays Stockholm)	262.7	1140
Addition.		
Luxemburg (Grand Duchy)	1200	250

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CONTENTS OF THIS ISSUE.

DISTANT RECEPTION.

IN America listeners do not confine their attention to broadcast transmitters in their own particular State, and a wireless set, to achieve any reputation at all, must be capable of reception of programmes from very far afield. On the Continent of Europe the same state of affairs exists, for listeners are as much, if not more, attracted to the programmes of neighbouring countries as to reception of their own. It seems that it is only in our own country that, thanks no doubt to the policy of the B.B.C., the general listener does not search beyond these Islands for his programmes. There is, however, no denying that interest in foreign reception in this country is steadily increasing, and the only serious obstacle to extension of its popularity is the fact that there is so much mutual interference between stations in Europe that quite a number of programmes cannot be listened to consistently. Judging from the past attitude of the B.B.C. in discouraging distant listening, we might fear that they would do nothing by way of contributing to an improvement of this state of affairs, but fortunately they are compelled to do so in the interests of providing satisfactory reception from their own transmitters, for the reason that the quality of reception from British stations is apt to be seriously impaired if we have a foreign transmitter "sitting" on almost the same wavelength.

A reader, Mr. K. Younghusband, in the correspondence columns of our issue of February 6th made an interesting suggestion that each country should be allotted an exclusive *width* of waveband, to be determined by the number of stations which each country now has working. The object of this arrangement would be to ensure that interference with a station would then not be of foreign origin, since there would be no stations other than those belonging to a single country on that particular waveband. This seems to be a suggestion on the right lines, but the argument against it will, of course, be that all wavelengths are not equally efficient and suitable for broadcasting purposes, and, moreover, any substantial change in the waveband from that at present allotted to any country might be very unfortunate for listeners whose sets in that country might not be suitably designed for reception on the new band. That something drastic has got to be done in the near future there can be no doubt. The Brussels plan seems to have generally upset receiving conditions, and there is, in our opinion, considerably more mutual interference between stations now than formerly.

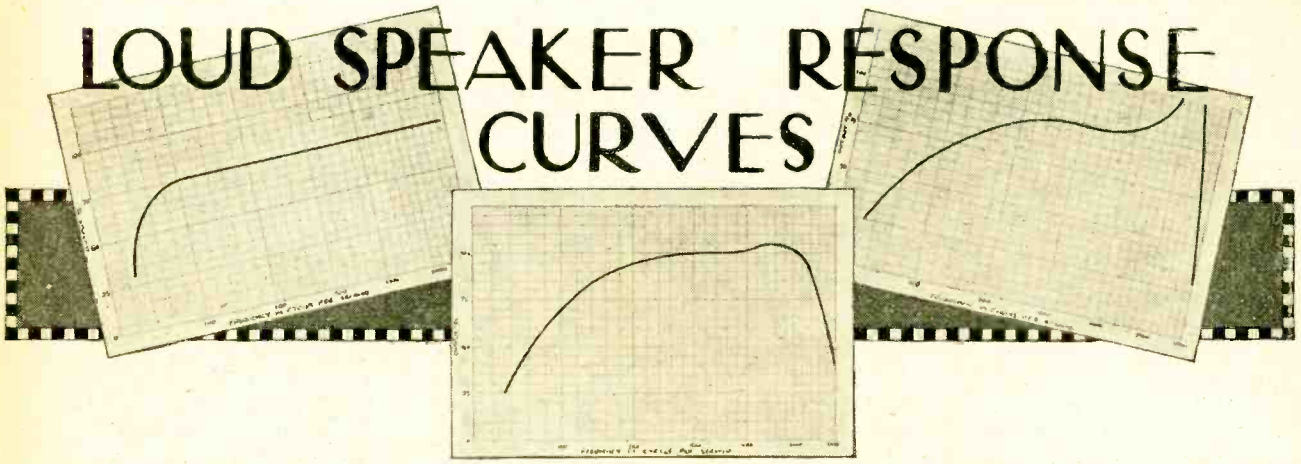
Station Identification.

In the past we have frequently recommended that the stations of Europe should each adopt some identification signal, and that the identification signals should be on some definite plan and frequently repeated during the programme, so that listeners could ascertain with very little trouble what station they were receiving.

But another point of view has been put to us recently. A friend who makes a hobby of listening to foreign transmissions expressed the view that he, for one, would be very much disappointed if some standard means of identification were introduced, because much of his interest in distant listening comes from the endeavour to identify the station he is hearing, quite apart from the enjoyment which he gets from the foreign programmes themselves, and he would be sorry to lose this interest in identification.

The response which has been received from those anxious to make use of our new service of station identification indicates how wide is the interest amongst our readers, and we hope that we shall continue to be able to assist any reader who cares to apply to us in difficulties relating to who's who in the ether.

LOUD SPEAKER RESPONSE CURVES



An Apparatus for the Projection of Frequency=output Characteristics.

By C. G. GARTON and G. S. LUCAS.
(Engineering Laboratory, B.T.-H. Co., Ltd., Rugby.)

READERS of *The Wireless World* will be quite familiar with curves showing the relation between the amplification ratio of an intervalve transformer at different frequencies. Such curves are referred to as " frequency-output " characteristics, since they represent the relation between frequency and secondary voltage for a constant value of primary voltage.

Similar curves can be obtained showing, for instance,

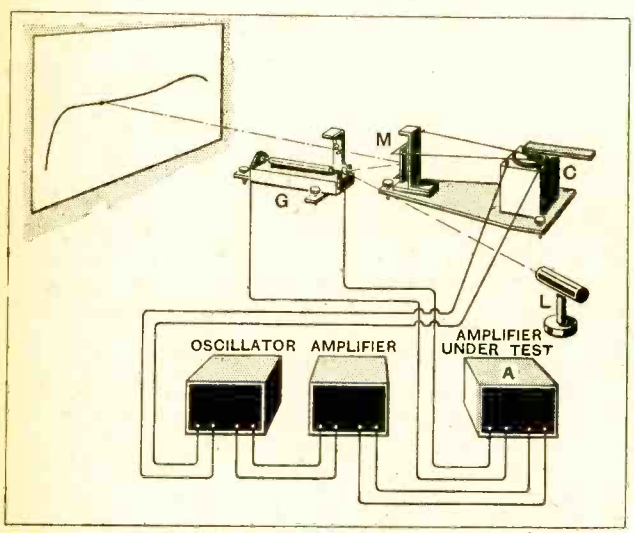


Fig. 1.—Schematic diagram of apparatus arranged to project the characteristics of an amplifier A.

the relation between the frequency and the current in the output circuit of an amplifier having a constant voltage in its first grid circuit; or between frequency and the sound output of a loud speaker having a constant current through its windings.

All these are " frequency-output " characteristics, and it is by this characteristic that every designer of wireless apparatus judges its performance.

If the reproduced signal is to be an accurate copy of the speech or music entering the microphone, obviously it is necessary that the amplification of the component parts of a receiver (valves, transformers, loud speaker, etc.) should be uniform for all frequencies, a necessity which intervalve transformer advertisements have made clear to all readers of the wireless journals. In other words, the ideal " frequency-output " characteristic would be a horizontal straight line, as shown by curve A in Fig. 7.

We do not at present often see published characteristics of amplifiers or loud speakers (mercifully so, perhaps!), but there is no doubt that, as the importance of these curves becomes more universally recognised, they will become as common as those of intervalve transformers.

Loud Speaker Frequency Characteristics.

One difficulty which has retarded the use of such curves has been the labour involved in obtaining measurements of the amplification at a large number of frequencies, from which the curves could be plotted. Especially is this so in the case of loud speakers, as will be seen from Fig. 9, where an enormous number of readings would be required in order to follow all the peaks of the curve.

The authors, being engaged in the design of amplifiers and loud speakers, were constantly in need of some rapid means of ascertaining the effect of changes in design on the frequency-output characteristics, and were led to devise an apparatus (described in this article) which automatically traces out on a screen the characteristic of the apparatus under test.

It must be acknowledged that the basic idea of such a method is not novel, a somewhat similar scheme having been described by B. S. Cohen and colleagues,[1] but their apparatus as published is suitable only for taking photographic records, whereas the authors, by modifying the arrangement in various ways, are able to trace the

[1] *J.I.E.E.*, October, 1926, Vol. 64, p. 1065.

Loud Speaker Response Curves.—

characteristic by the motion of a spot of light moving upon a screen, a method more suitable for this class of work, where rapid and non-permanent indications are desired. Also by the use of a different type of galvanometer the necessary circuits have been greatly simplified.

As explained in the first two paragraphs, frequency characteristics represent the variation of output with frequency for a constant value of input signal; therefore the first essential in any method of tracing frequency characteristics is a source of power of which the frequency can be continuously varied over the audio range of 50 to 10,000 cycles without variation of the voltage or current delivered. Such a device is termed a "constant output generator."

Controlling the Beam of Light.

Further, to project a curve such as would be plotted on squared paper (i.e., to rectangular co-ordinates), the beam of light which is used (as explained later) to trace out the curve must be given two deflections at right angles to one another, one in a vertical direction corresponding to changes in the output of the apparatus being tested, the other in a horizontal direction corresponding to changes in frequency.

To obtain these deflections, the beam of light is made to fall upon two mirrors in its passage from the light source (an arc lamp) to the screen. The first mirror tilts about a horizontal axis (giving a vertical deflection to the beam), and forms part of a galvanometer operated by the current output from the apparatus under test. A

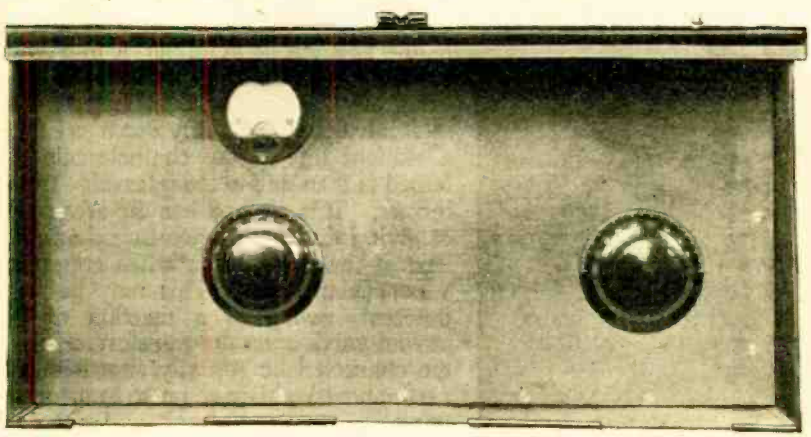


Fig. 3.—The control panel of the oscillator unit.

description of this galvanometer will be given later. The second mirror tilts about a vertical axis (giving a horizontal deflection to the beam), and is coupled mechanically to a variable condenser which (as described later) controls the frequency of the constant output generator. Thus the position where the beam of light strikes the screen, giving a visible spot, is controlled by two factors. First, the height of the spot upon the screen depends on the tilt of the first mirror, and, therefore, on the current supplied to the galvanometer from the apparatus under test. Secondly, the travel of the spot in a horizontal direction depends on the tilt of the second mirror, which varies with the frequency. It will, therefore, be seen that the combined motions of the spot, when the frequency is varied by rotating the controlling condenser, must trace out the "frequency-output characteristic" of the apparatus supplying the galvanometer.

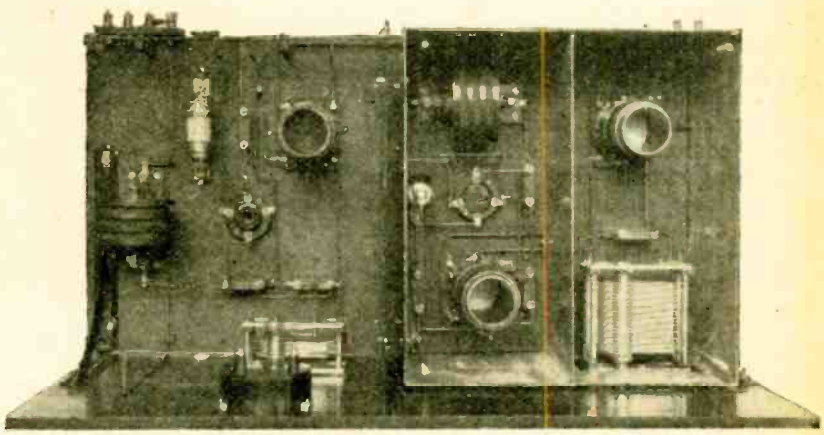


Fig. 2.—Plan view of the two oscillator circuits. The third compartment contains part of the mixing circuit.

Fig. 1 gives a schematic view of the apparatus as arranged for obtaining the characteristic of an amplifier, A. A small constant alternating voltage is supplied to the input terminals of the amplifier from the constant output generator, and the galvanometer G is connected in the output circuit of the amplifier. Then all that is necessary to obtain the characteristic is slowly to rotate the frequency condenser C, and with a pencil, record the path of the spot upon the screen.

Other arrangements of the circuits are required for obtaining the frequency characteristics of intervalve transformers or loud speakers, but these will be dealt with after a description of the constant output generator and the galvanometer.

The Output Generator.

The former piece of apparatus is substantially that described by H. L. Kirke [1] in *Experimental Wireless*, but with a few small modifications found necessary in the course of experiment. For the benefit of those not having read H. L. Kirke's paper, it may be briefly explained that the generator consists of two radio frequency oscillator circuits, tuned to about one hundred thousand cycles, of which one is variable over a frequency range of 90,000 to 100,000 cycles, while the frequency of the other is maintained constant. The two frequencies are picked up in a common "mixing" circuit, where they heterodyne one another, giving a difference frequency variable from 0 to 10,000 cycles,

[1] *Experimental Wireless*, February, 1927, p. 67.

Loud Speaker Response Curves.—

according to the frequency of the variable oscillator. The output from the " mixing " circuit is rectified in a detector stage, the unwanted radio frequency filtered away, and the resulting audio frequency amplified up through three stages of low-frequency amplification, ending in a power stage capable of delivering 2 watts of undistorted power.

Photographs of this part of the apparatus are shown in Figs. 2, 3, 4, and 5. The first shows a plan view of the two oscillator circuits (removed from their screening case), and on the right a third compartment containing part of the mixing circuit. Fig. 3 is a view of the oscillator circuits replaced in their case, with only the controls visible. Figs. 4 and 5 show similar open and enclosed views of the detector and amplifier stages of the generator. The small coils and fixed condensers on the extreme left of Fig. 4 form the filter circuit which separates the unwanted radio frequency from the output of the detector valve. The two small stud switches seen in Fig. 5 are potentiometer resistances in the grid circuits of the first and second L.F. stages, giving a means of readily varying the output from the generator.

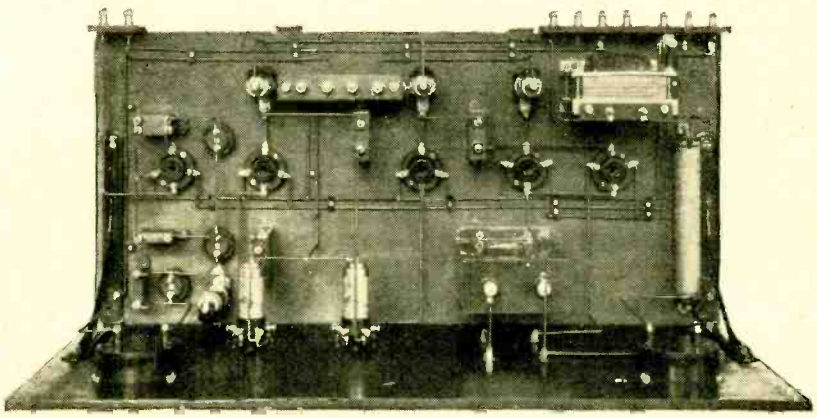


Fig. 4.—Plan view of the detector and amplifier stages of the generator.

The Galvanometer and Deflecting Mirrors.

Fig. 6 shows the base board carrying the variable condenser for frequency control, with its rotating mirror as described above, and on the right the galvanometer operating the other deflecting mirror. The condenser needs no detailed description; it is of square law type, and is connected in the tuned circuit of the variable frequency oscillator. The connection to the mirror M is by a cord passing over a pulley on the condenser spindle and secured to two projecting arms on the mirror spindle.

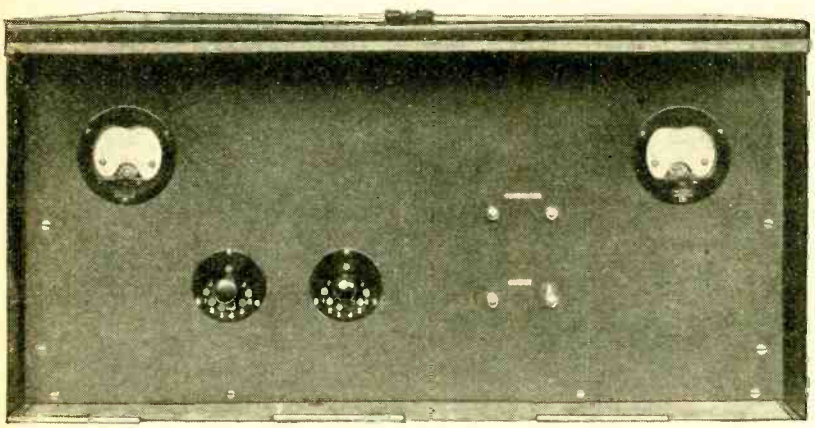


Fig. 5.—The controls on the panel of the unit shown in Fig. 4. The stud switches are potentiometers in the grid circuits of the first and second L.F. stages for varying the output from the generator.

The galvanometer must be of some type which will operate on audio frequency current, so that the usual moving coil or moving magnet types are unsuitable. A hot wire instrument was chosen as being the most suitable type, but a special construction had to be adopted in order to obtain sufficient sensitivity to operate on the small outputs obtainable from receiving valves.

The principle of operation of hot-wire instruments, as most readers will be aware, is that the current to be measured is passed through a fine wire, which consequently heats and expands. The increase in length is arranged to cause rotation of a fine spindle to which a small mirror is attached. In Fig. 6 the galvanometer is seen on the right. The fine wire, in this case of tungsten 0.0006in. in diameter, is stretched down the long brass tube visible in the photograph, while the mirror and spindle are seen at *m*.

In order to obtain characteristics of intervalve transformers, a two-stage " test " amplifier is required. This is so designed as to have a straight frequency-output characteristic when its two stages are coupled by a perfect intervalve transformer. This amplifier is connected in the position of amplifier A in Fig. 1, and its frequency characteristic obtained using the transformer to be tested as the intervalve coupling. Any departure from a straight line in the characteristic obtained is then due to the intervalve transformer. This method has the advantage of giving the actual operating characteristic of the transformer when supplying a particular valve. This may be very different, owing to a reaction of the second valve upon the transformer, from the characteristic (usually shown in advertisements) obtained on a transformer operating on open circuit and not connected to the grid of a valve. Some curves obtained in this way are shown in Fig. 7. Curve A is taken with resistance capacity coupling between the two valves; curve B, taken with an intervalve transformer, shows the effect of reaction from the second valve in producing resonance peaks at the higher frequencies. Curve C is taken on the same transformer with the secondary connections, and, therefore, the valve reaction reversed. This shows well the dependence of the transformer characteristic on other components in

Loud Speaker Response Curves.—the set. We come now to the most useful application of the apparatus—the obtaining of frequency-output characteristic on loud speakers. Until comparatively recently, few actual measurements were taken on loud speaker characteristics, owing to the difficulties involved, and performances were judged by ear, which is a very unreliable method, since individual taste and judgment varies very widely. Also the ear has great powers of accommodation, and rapidly accustoms itself to poor frequency characteristics, failing to notice defects which should be obvious. For this reason it is as essential to obtain measurements on loud speakers as on amplifiers, and the authors' projection apparatus enables this to be done with great facility.

The general principle of the method is to excite the loud speaker with constant current or voltage from the constant output generator, and to pick up the sound emitted, by means of a microphone placed in front of the loud speaker. The microphone current is then amplified and used to operate the galvanometer of the projection apparatus.

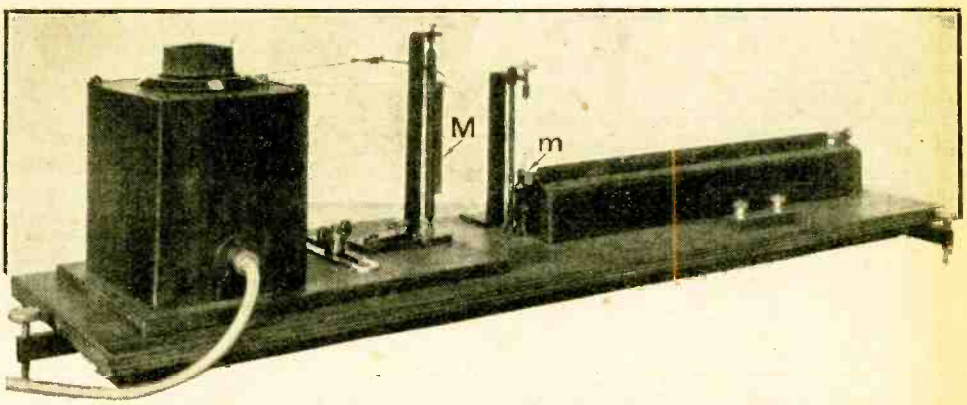


Fig. 6.—The frequency control equipment in which the mirror M is connected to the condenser spindle by means of a cord. The hot-wire galvanometer on the right is sufficiently sensitive to respond to weak audio-frequency currents.

Placing the Microphone and Loud Speaker.

It is essential to place the microphone and loud speaker in a special enclosure to avoid the effect of echoes, since the sound arriving at the microphone is not only that proceeding directly from the loud speaker, but also that reflected from surrounding walls and objects. The ideal would be a room so heavily draped with sound-absorbent material that no echoes could occur, but this cannot be realised in practice as all available substances reflect more or less of the sound incident upon them. The echoes in any ordinary room are sufficiently great to mask the true nature of any characteristic obtained in it. The room used by the author is built of wood, 12ft. by 9ft. in plan, and 9ft. high. The walls, ceiling and floor are loosely draped with two layers of soft felt, and one layer of cotton wool. Although echoes are not entirely eliminated, they are sufficiently reduced that the general shape of the curve obtained is correct, though significance cannot be attached to every peak and valley. Only the microphone and loud speaker are enclosed within this room; the experimenter and amplifying gear being outside, connection from the microphone to the latter being made through shielded cable.

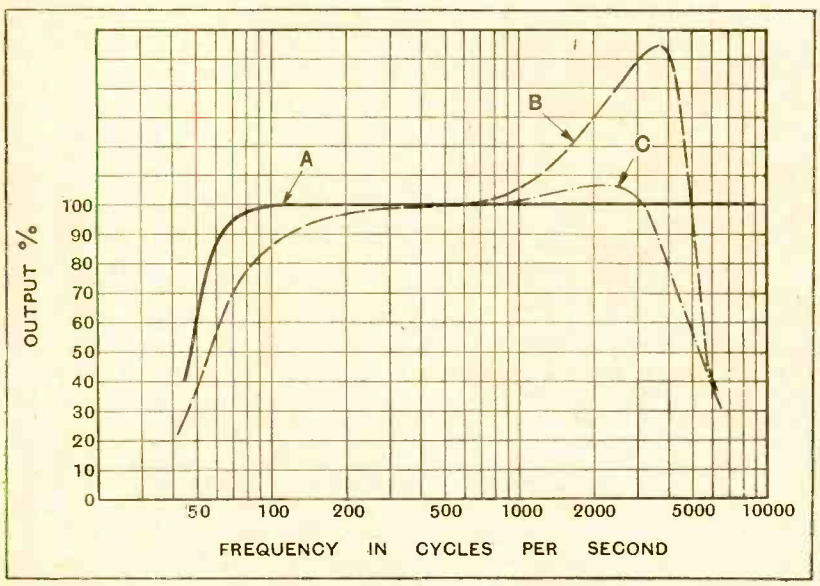


Fig. 7.—The frequency characteristics of three L.F. intervalve couplings. A is taken with resistance coupling between two valves; B is taken with an intervalve transformer and shows the high-frequency resonance peaks due to reaction from the second valve. Curve C shows the effect of reversing the valve reaction.

The Microphone.

The microphone used is of the condenser type, in which the pressure of the sound wave deflects a very light metallic diaphragm placed parallel and very near to a fixed metal plate. The variations in capacity of this arrangement are used to obtain a variable current corresponding to the sound energy. These condenser microphones are extremely insensitive, but have the great advantage that their sensitivity is constant over long periods of time, and is more nearly independent of the frequency than in any other type. For accurate work the curves obtained must be corrected for any variation of sensitivity of the microphone with frequency. The calibration of the microphone is obtained by methods outside the scope of this article, but it is generally sufficient to assume

Loud Speaker Response Curves.—

that the calibration is independent of frequency.

For lecture and demonstration work, where accuracy is unimportant, the ordinary carbon microphone might be used, and has the advantage of being about 100 times more sensitive.

The amplifier used in conjunction with the condenser microphone is a four-stage resistance capacity coupled set, of ordinary design, except in the first stage, where a four-electrode screen-grid valve is used. Although the use of such a valve for low-frequency amplification is not yet common, very satisfactory results can be obtained providing a plate voltage of about 350 volts is available. The voltage step-up obtained on the first stage is about 50 to 1, and on the entire amplifier 20,000 to 1. Fig. 8 gives a view of the interior of this piece of apparatus, and Fig. 9 shows some of the results obtained.

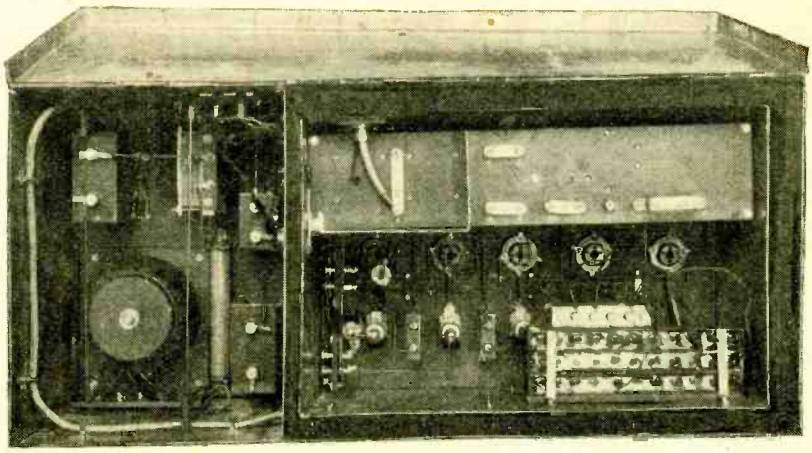


Fig. 8.—The four-stage resistance-coupled amplifier for the condenser microphone. A screen-grid valve is used in the first position.

Curve A in Fig. 9 shows the characteristic of a good horn type loud speaker, but, like all loud speakers of this type, its output consists largely of one resonance peak, in this case at about 800 cycles. Curve B is taken on a good moving coil speaker, and it will be seen that the output is much more widely distributed over the frequency range in curve A, although there is still a pronounced resonance, at about 2,500 cycles. Curve C shows a badly designed moving coil loud speaker showing the result of using too hard a paper for the cone. Most of the output is concentrated in a sharp peak in the very high frequencies, about 3,500 cycles.

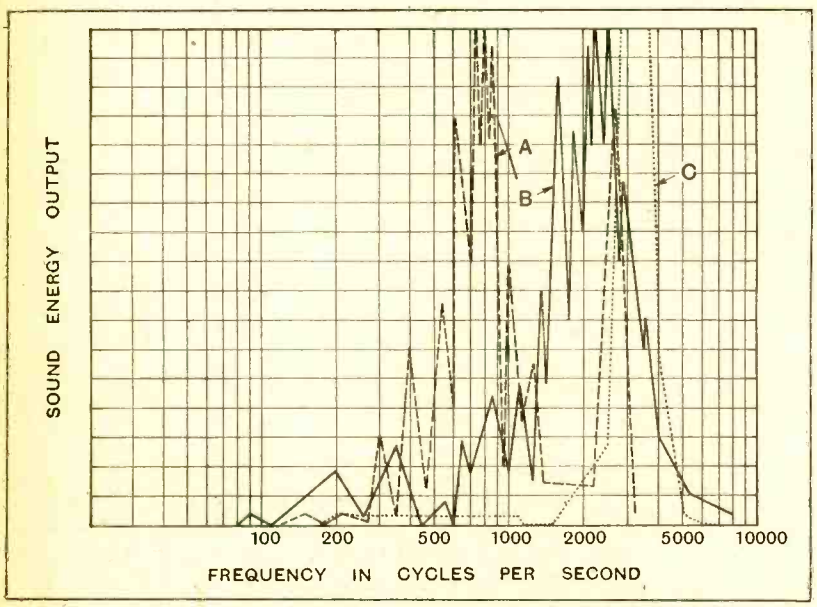


Fig. 9.—Response curves of various loud speakers. Curve A is the characteristic of a good horn-type loud speaker. Curve B is taken with a good moving coil loud speaker, while curve C shows a badly designed moving coil loud speaker using too hard a paper for the cone.

It will easily be realised that the experimenter finds it a great convenience to be able to obtain the characteristic of a loud speaker after each experimental alteration, with only a few moments' work and without the uncertainty and difficulty of listening. The use of this apparatus has already led to considerable improvements in moving coil speakers, and work along these lines is being actively pursued. The apparatus required may be beyond the average experimenter to install, but it is none the less of interest to know something of the methods adopted for comparative tests so helpful in improving designs.

CENTENARY OF "KING'S."

KING'S COLLEGE, London, than which few educational institutions have contributed more to the science of electrical communication, is urgently in need of funds for college buildings, the completion of the hostel, endowment of Chairs, and for scholarships and bursaries. The centenary of the College, which falls this year, has been made the occasion for launching a Centenary Appeal Fund, to which more than £64,000 has already been subscribed. Many more contributions, however, are required if the College is to maintain its progress and efficiency.

Among the discoveries and inventions emanating from the College laboratories during the last hundred years have been the Electric Telegraph, by Sir Charles Wheatstone, F.R.S., who was Professor of Experimental Philosophy from 1834-1875, and the prediction of the discovery of electro-magnetic waves by James Clerk Maxwell, F.R.S., Professor of Natural Philosophy from 1860-1865. Subjects now being investigated in the Wheatstone Laboratory under the supervision of Prof. O. W. Richardson, F.R.S., and Prof. E. V. Appleton, F.R.S., include wireless wave propagation, the modern quantum theory, soft X-rays, thermionics, and the generation of electrical oscillations by gas discharge.

Donations to the Appeal Fund may be sent to one of the Treasurers: The Rt. Hon. Reginald McKenna, or Sir Edward Troup, K.C.B., K.C.V.O., at King's College, Strand, W.C.2.

KIT CONSTRUCTORS' NOTES

The Cossor Melody Maker on Ultra-short Wavelengths.

IT is now generally admitted that for short-wave work a specially designed set is desirable, and there can be no doubt that it is necessary for making the best of poor receiving conditions. It is less widely realised that when signals are " coming over " really well, they can be satisfactorily received on an improvised arrangement, always provided that the wavelength range covered is suitable, and that the set can be brought up to the oscillation point by means of reaction. Thanks largely to increased power and improved technique at the transmitting end, even the most distant stations can be relied upon at least sometimes to provide a strong signal, and it is considered that users of the Cossor Melody Maker—and, indeed, other similar sets—will

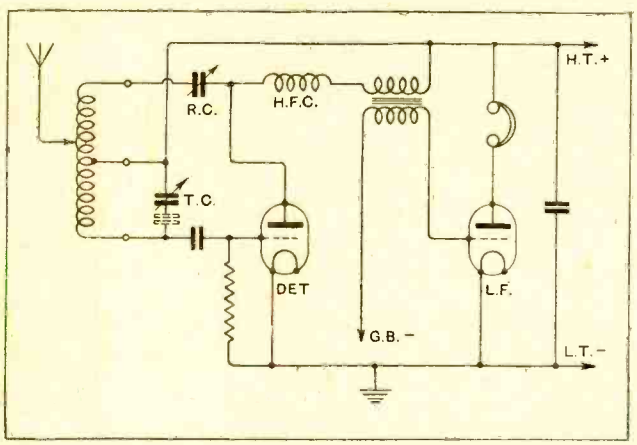


Fig. 1.—Simplified circuit diagram of short-wave conversion. Added series condenser shown in dotted lines.

welcome a description of a simple method of converting their receivers for this most interesting branch of wireless reception at a cost of but a few shillings and with a minimum of trouble. As proof of the effectiveness of the conversion, it is only necessary to say that Melbourne (3LO) and Schenectady (2XAF) were both well received on phones at the first attempt.

Pure H.F. amplification on the short waves is still a more than difficult matter, and, even if it is more or less successfully achieved, introduces operating complications. It was therefore decided to eliminate the H.F. valve entirely and to arrange for an aerial-grid coil to take the place of the existing tuned anode inductance. The final circuit is shown in simplified form in Fig. 1, from which it will be seen that the aerial is at the potential of the H.T. battery; this means that extreme care must be taken not to allow it to make contact with any earthed point, but otherwise does not introduce any undesirable features, and in any case this drawback could only be overcome at the expense of greatly increased complexity.

The first step is the construction of a special coil, of which the winding is shown diagrammatically in Fig. 2. It consists of eight turns of No. 24 D.C.C. wire, wound without spacing on a former 2½in. in diameter; one of the bakelite mouldings used in making the ordinary anode coils will serve the purpose admirably, but an ebonite tube, of the same diameter, attached to the base of a burnt-out valve, can be substituted. The lower end of the winding should be about 1½in. above the tops of the pins.

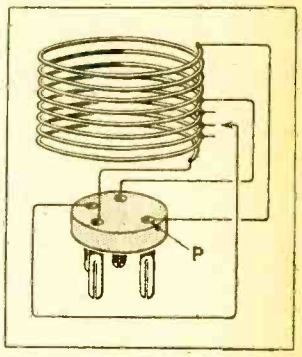
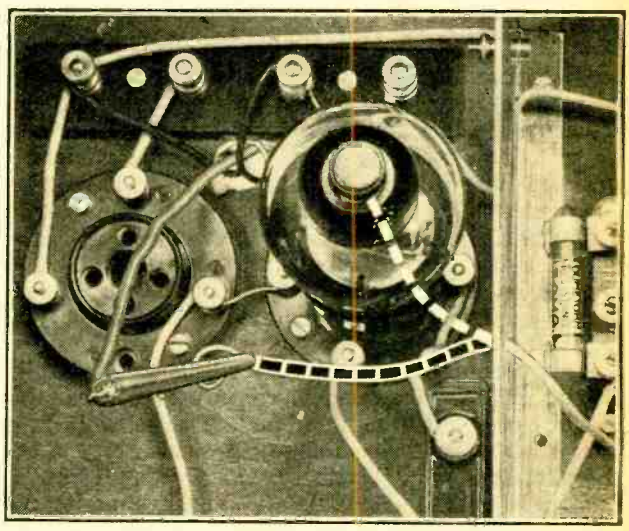


Fig. 2.—Diagrammatic sketch (not to scale) of coil covering the 22-40 metre waveband.

Starting from the top, join the end of the wire to the " plate " pin of the base, and wind on four turns; bend back the wire on itself and pass the loop thus formed through a hole drilled in the tube and join it to the pin as shown in Fig. 2. Still winding in the same direction, put on four more turns, making taps at each turn by baring about 1in. of the wire, twisting it to



Method of connecting the aerial. The normal aerial-grid coil is not required.

Kit Constructors' Notes.—

form a loop, and then soldering it. These tappings should be slightly staggered, so that the projecting loops are spaced by about half an inch. The end of the wire is passed through another hole in the former and secured to a pin as shown. Finally, a short length of rubber-covered flexible wire, fitted with a "crocodile" clip, is soldered to the remaining pin, thus enabling connection to be made at will to any one of the tappings.

Reducing the Condenser Value.

A variable condenser of 0.0005 mfd. is inconveniently large for short-wave work, so the capacity of the existing anode condenser (controlled by the right-hand slow motion dial) must be artificially reduced by connection in series of a fixed capacity. An Ormond air-dielectric condenser of 0.0002 mfd. capacity is suitable for this purpose; it is secured by a nut or terminal head to the cross-bolt of the variable condenser as shown in the accompanying photograph. A 1in. length of thin brass strip, with two holes ¾in. between centres, serves both as support and electrical connection.

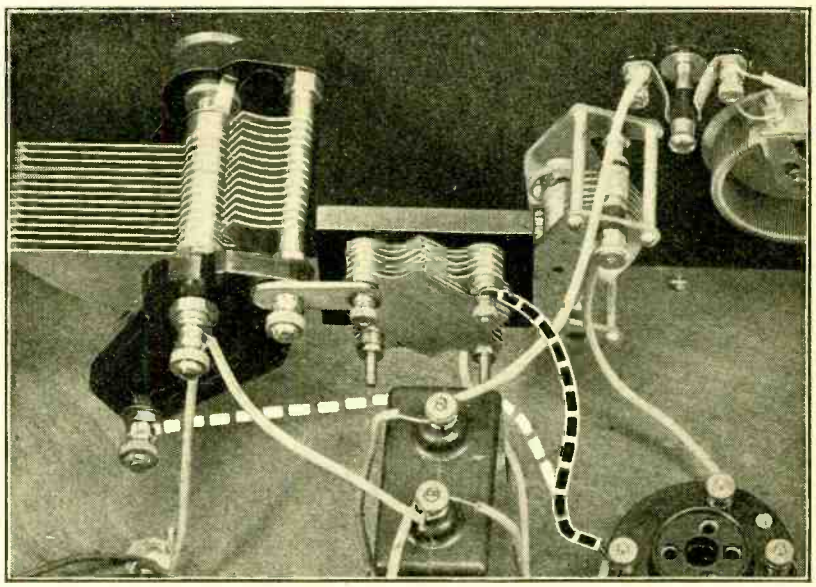
To change over to short-wave reception, turn off the H.F. filament rheostat, and fit the end of the aerial lead-in (which should be of well-insulated wire) with a "crocodile" clip. This is attached to the wire at present joined to the anode terminal of the screen grid valve. As already stated, care must be taken to avoid a short circuit.

Turning to the right-hand side of the vertical screen, it will be observed that one of the wires from the "plate" terminal of the anode coil socket is joined to the lower terminal of its tuning condenser; this latter connection must be changed over to the free terminal of the fixed capacity.

Some Operating Hints.

Before inserting the short-wave coil in its holder, connect the wander lead (which provides an aerial connection) to the first tapping point below the centre tap. The set is now ready for short-wave reception; tuning is carried out with the right-hand dial, and reaction is controlled in the normal manner. Oscillation should be obtainable at any setting of the tuning condenser, and the aim while searching for signals should be to keep the set in its most sensitive condition by simultaneous operation of the two knobs. Due in part to the fact that neither side of the reaction condenser is at earth potential, hand-capacity effects are naturally evident; although the operator can make allowance for the effect of withdrawing his hand, it is better to fit a larger knob or extension rod to the condenser.

Finally, it is advisable to try the effect of variation in the aerial tapping connection, ultimately choosing the one giving best all-round results; a single coupling turn is generally enough.



Connections of series condenser. In this and the preceding photograph normal position of the lead is shown by white dotted line, and short-wave position by black-white broken line.

KIT CONSTRUCTORS' PROBLEMS.

The service of the Information Department has been extended to deal with problems encountered by builders of "kit" sets discussed in these pages. Receivers already dealt with are the Cossor "Melody Maker" and G.E.C. "Music Magnet." The service is subject to the rules printed in the "Readers' Problems" section.

An Erring Neighbour.

I use a "New Cossor Melody Maker," and am troubled with distorted reception from the local station. The distortion is not always present, and usually commences with sounds of oscillation in the loud speaker. After a few minutes of this, speech and music sound as though the instrument were out of adjustment. When this form of distortion once sets in, nothing I can do seems to improve matters, but reproduction from other stations remains good. Can you suggest what is wrong? S. C. S.

Yes; this seems a clear case of "silent point oscillation" on the part of one of your neighbours, and there is nothing we can do to help you beyond expressing our sympathy and making the obvious suggestion of diplomatic advances to suspected offenders. Failing success, the next step that we should feel inclined to suggest is, unfortunately, not to be recommended, as we believe there are certain penalties attaching to "inciting to commit a breach of the peace"! So a report should be sent to the B.B.C., who will pass your complaint to the Post Office authorities.

○○○○

Easy to Answer.

For use with a "Music Magnet" receiver, would you prefer an H.T. eliminator or a battery of high-tension accumulators with a charger? My supply is alternating current at 230 volts. R. S. R.

The use of H.T. accumulators and a charger is certainly to be preferred, provided you do not object to the slightly greater cost, and to the fact that a certain amount of time must be devoted to maintenance. An eliminator cannot possibly give a *better* performance than a battery of adequate capacity, and unless it is suitably designed to work in conjunction with the receiver, there is always a chance of meeting with difficulties.

RADIO AT THE BRITISH INDUSTRIES FAIR

Apparatus of Interest to be Seen at the Stands.

BEING open to the public, the radio section of the British Industries Fair bids at taking a place as a radio show intermediate between the autumn exhibitions. Judged from this viewpoint, a radio enthusiast would hope to find a representative gathering of our manufacturers exhibiting an attractive display of radio productions. Should he expect to find a show likened to Olympia or Manchester, however, he will be disappointed. In support of this observation is the fact that the section comprises some fifty exhibitors only, as compared with Olympia with its two hundred or more stands, while new devices which, after all, make the strongest appeal, are almost absent. Manufacturers do not prepare for this exhibition—they just go there. These comments are, however, not adverse to the objects of the Exhibition in that it affords the foreign buyer the opportunity of studying a good portion of the British radio market.

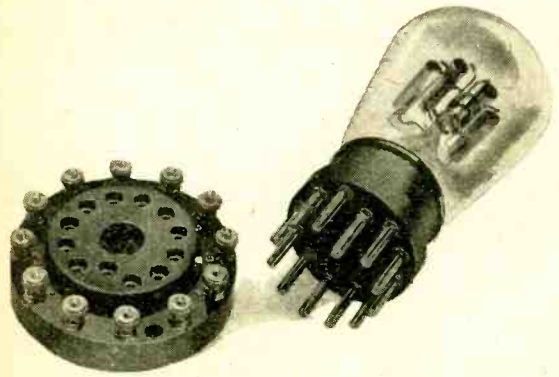
As we pass through various stages in the advance of radio the outlook changes. This is always so in a new industry. A signpost clearly stands out pointing the way to the extensive production of the radio gramophone. In view of recent developments this turn is not unexpected. Setting aside comparison with other radio exhibitions, our enthusiast will note this significant development. Whether by accident or intention, the radio section adjoins and intermingles with the gramophone display, and the most conspicuous exhibit of these two industries is the radio-gramophone. To assist the reader in gathering an idea of the apparatus to be seen, reference is here made to the stands in the order in which they appear in the official catalogue.

Stand to Stand Gleanings.

Precision tools designed to facilitate home radio construction are shown by Atalanta (Stand MM.74) whose special screwdrivers are now in common use. Axuel Time Switches, Ltd. (Stand MM.72) devote their stand principally to their clock-operated programme selectors, which, by simply inserting pins, switch the radio receiver into pre-arranged parts of the broadcast programme. At this stand, also, is a new valve, the "Four-in-One," a product of the Quadruple Valve Co., Ltd., of Northampton. Within a single valve are assembled four triode units intended for use as high-frequency amplifier, detector, and two low-frequency stages. This valve consumes 0.5 amperes at 1.8 volts on its filament terminals, and sells at 22s. 6d. In looking over the standard pro-

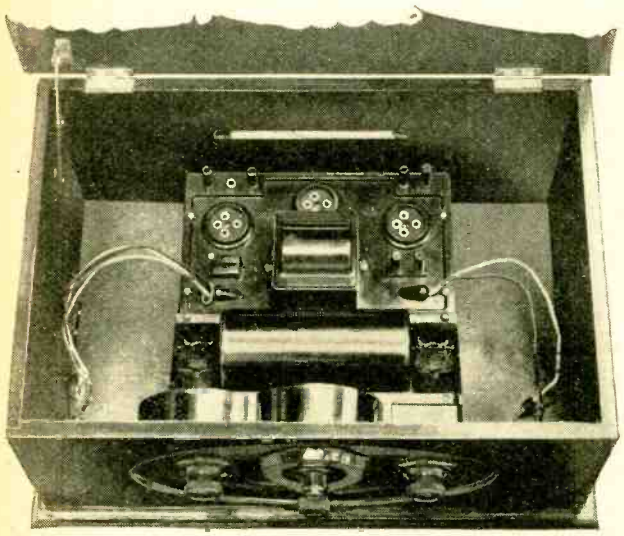
Radio at the British Industries Fair.—

ducts of S. G. Brown, Ltd. (Stand MM.46), one notes the introduction of a conical metal ring on the end of the moving coil of their loud speaker. This new feature removes a difficulty long experienced in that it prevents the moving coil from going out of shape, thus permitting of the use of a small gap and correspondingly small energising current.



Four separate elements are brought out to twelve terminals in the "Four-in-One" valve.

Brownie Wireless (Stand MM.57) are showing a new receiver—the Dominion III. It is a three-valve set for gramophone or radio reproduction. Its finish is unique in that a well-finished bakelite moulding houses the entire receiver unit. It sells at £5 17s. 6d. H. Clarke and Co., of Manchester (Stand MM.25a) exhibit their complete range of battery eliminators. A new feature is the provision of a potential for screen grid valves or anode bend detectors in that constancy of voltage is produced by a potential divider. Such an arrangement has become essential.



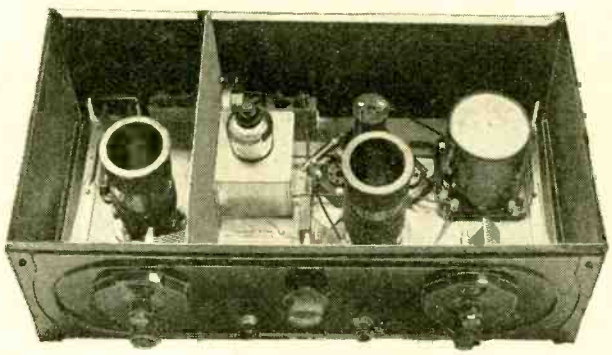
A new form of receiver construction. The Brownie Dominion III in which the receiver unit is carried on a bakelite moulding.

Home constructors who appreciate the convenience of receiver building from a kit of parts might apply for the new free constructional folder describing the Formo Screen Grid Three of Arthur Preen and Co., Ltd. It is claimed to be an amazingly simple set to construct and handle, and covers the two wave ranges without coil changing. Dry electrolytic condensers are a recent addition to the range of Dubilier products (Stand MM.50). The Westminster portable on the Dubilier stand is an ambitious set, for as well as embodying two screen grid valves and a pentode it carries a gramophone motor and turntable.

Sets, rather than Components.

The Ormond Condenser Co. (Stand MM.52) have turned their attention to the production of a radio gramophone, a high-class instrument in console cabinet. Among their small parts is a new multi-contact switch. This is one of the few stands showing numerous components, not the least interesting being the new bakelite mounted edgewise dial, which fitted to a condenser provides a slow-motion unit selling at about 11s.

The Watmel Wireless Co. (Stand MM.54), in addition to showing an electrically producing radio gramophone, have introduced a new instrument combining radio and gramophone, in which, although the music is emitted from a common grille, the gramophone is not an



The Formo Screen Grid Three—a kit-built receiver.

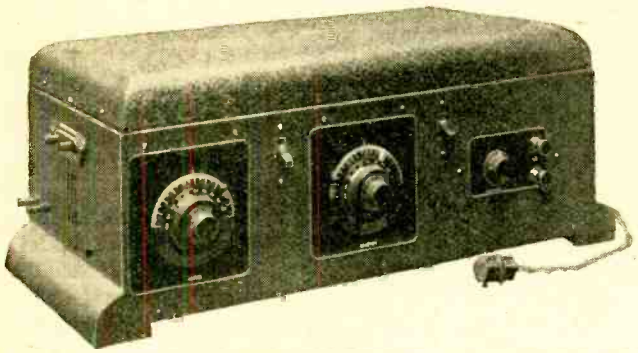
electrical reproducer. By so doing a hardy and serviceable instrument is produced at a popular price, while gramophone reproduction is not accompanied by a heavy drain upon the batteries. Trend in design is revealed at the stand of E. K. Cole, Ltd. (MM.73) in the production of an all-metal enclosed mains operated receiver. Power is entirely derived from the lamp socket. It is a three-valve set with modern valves of high performance. A volume control is fitted, together with provision for gramophone pick-up. This is probably the forerunner of a trouble-free class of receiver requiring no attention and running at a negligible cost.

Lissen, Ltd. (Stand MM.28), who are always prolific in the production of new designs, have considerably increased their range of components since the Olympia Exhibition. There is a new output choke for D.C. loads up to 45 mA., and a complete H.T. eliminator for D.C. mains. A miniature reaction condenser has been added to the condenser range, and amongst other new components are a 100-volt large-capacity H.T. battery, a ball-bearing turntable for portables, and an anti-microphonic valve-holder of robust design.

Wright and Weaire (Stand MM.62) are showing a

Radio at the British Industries Fair.—

neutralising condenser of original design, with a capacity range of 5 to 65 micro-mfd. This component is designed for back-of-panel mounting, and the operating spindle is insulated from both electrodes. There are also on view



The "Ekco-Lectric Straight Three"—an all-mains operated receiver.

some new smoothing chokes for L.T. as well as H.T. circuits. The cores are provided with an air gap to keep the inductance independent of the D.C. load, and the values range from 0.1 henry to 120 henrys.

The new short-wave transmitting valve (type S.W.3B) is one of the principal centres of attraction on the Mullard stand. There are also two new power rectifiers—the U.L.3 and U.L.4. Two additions to the range of

Igranic transverse current microphone and control unit.

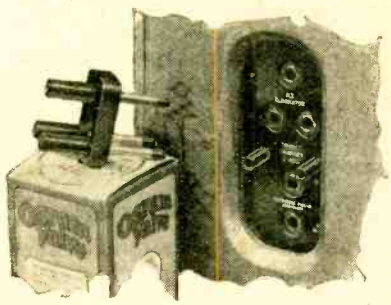
receiving valves should also prove of interest. The characteristics of these new valves, which are for power amplification, are as follow:—

Type.	Filament Current.	Volts.	Ampl. Factor.	A.C. Resistance.	Max. H.T.
DFA9	... 0.6	6.0	5	2,000	250
DO/20	... 1.3	7.5	5	2,000	425

On the Igranic stand considerable interest was displayed in the new "transverse current" microphone (Stand MM.40). This instrument has an excellent response curve and has been designed for broadcasting studios and public address systems. The carbon granules are of graduated size and are segregated into a number of cells, each cell being designed to deal with a particular band of frequencies. In this way it has been found possible to produce a better response characteristic than would be otherwise obtainable. The energising current is passed transversely through the cells in series and not from back to front as in the conventional carbon microphone A neat control unit is associated with the microphone in which the switching has been reduced to the simplest possible form.

Short-wave Sets.

Another Igranic product which is certain to attract the overseas buyer is the Phonovox Cinema Equipment on show in the demonstration hall. With this apparatus it is possible to dispense with an orchestra and to produce the incidental music to films through the medium of



Trix portable receivers are now fitted with a plug connector for joining to an external battery or battery eliminator. Engaging the connector disconnects the batteries in the set.

gramophone records. Two turntables are provided, together with volume controls for fading in and out so that the character of the music can be modified at any moment to conform with the changing themes of the film.

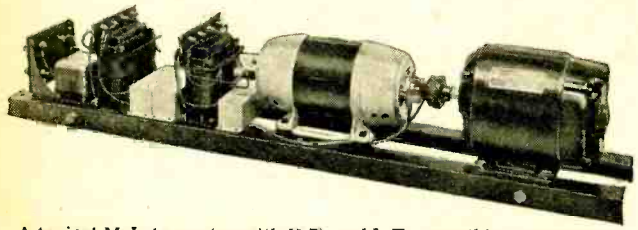
The M.P.A. "Ethatrope," on view on Stand MM.49, is another fine example of the application of the electrically reproducing gramophone to the needs of the kinema. It is built in the form of a handsome console, complete with music rests, and includes two electrically driven turntables with volume controls. Devices have also been included for the reproduction of "effects," such as wind and rain.

Short-wave receivers are naturally given prominence in view of the numbers of colonial buyers visiting the Fair. Selectors, Ltd. (Stand MM.35), are showing a well-made three-valve short-wave set, priced at £16, in which the whole of the H.F. circuit is screened from hand-capacity effects. Another short-wave set of more than usual interest is the new Rees Mace "All Wave" portable (Stand MM.42). The circuit comprises eight valves, including a screen grid valve, and is operated on the superheterodyne principle. The wave range of the receiver covers the medium- and long-wave broadcasting stations, as well as the ultra-short colonial and American transmissions.

The "Trix" Portable Five receiver, made by Eric J. Lever, Ltd., has now been modified for alternative mains or battery operation. A three-point plug is provided for attachment to any standard H.T. eliminator.

Radio at the British Industries Fair.—

and the contacts are so arranged that the H.T. batteries inside the set are automatically disconnected when the plug is inserted. Thus the receiver can be run off the mains at home and the batteries conserved for outdoor use. Connections have also been added for charging the L.T. battery *in situ* from a trickle charger. Both



A typical M-L generator with H.T. and L.T. smoothing equipment, suitable for use with a mains operated receiving set or electrically reproducing gramophones.

these improvements have been made without any increase in the original price of 17 guineas. Another interesting Trix product is the new two-valve portable at 10 guineas. This is a neat and compact instrument intended for local station reception, and includes a pentode output valve. Provision is made for the use of an outdoor aerial if distant stations are required.

Automatic Signalling.

The development of radio communication in sparsely populated districts in the Colonies has created a demand for a reliable and economical source of power for transmitters in isolated places. This demand is met by the automatic signalling hand generator, shown by the M.L. Magneto Syndicate, Ltd., on Stand MM.75. The output from this generator is 30 mA. at 800 volts and 2.6 amps. at 6 volts, a total of 40 watts. Incorporated in the generator casing is the Frost automatic signalling device which has been in use for some time by the R.A.F. An insulated disc carrying contact studs is driven off the main shaft through a worm wheel. The studs on this disc can be arranged to send out any prearranged signal, such as a call for a doctor, and the signal is repeated as long as the handle is turned. No skill or knowledge of Morse is required, and only one hand is required to work the generator.

In view of the increasing use which is being made of high-powered loud speaker equipments for public address systems, talking films, etc., the "double-current" motor generator sets on the M.L. stand should also be inspected. These machines, which are made for powers up to 170 watts, consist of a universal motor and a permanent magnet type generator supplying both H.T. and L.T. Particular attention has been paid to the elimination of commutator ripple, and units incorporating complete smoothing equipment are also available.

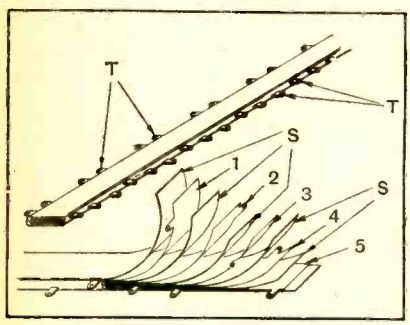
It will be gathered, then, that the British radio industry is fully alive to the potentialities and requirements of overseas markets. That there is an increasing demand for complete receivers there can be no doubt; many firms hitherto specialising exclusively on components are now turning their attention to complete sets, and the range of models exhibited by other firms have been in most cases augmented.

PATENT NOVELTIES.

Omnibus Wiring.

A noteworthy innovation in the wiring of wireless receivers is due to Mr. E. T. Flewelling, the inventor of a well-known circuit much favoured by amateurs some time ago.

A number of individual connectors 1-5 are laid together in a compound strip or bus-bar, and are interleaved with layers



Illustrating Flewelling's method of wiring.

S of insulating material. Metal tabs project at regular intervals along the length of the strip, to which the various components are connected either directly or by short lateral wires. Apart from the neatness and convenience of the new method of wiring, the compound strip forms a condenser which serves to replace the ordinary fixed by-pass condensers inserted across batteries, transformers, etc. Also by suitably choosing the tabs T the outer conductors can be used to screen the inner strips from the effect of stray magnetic fields.

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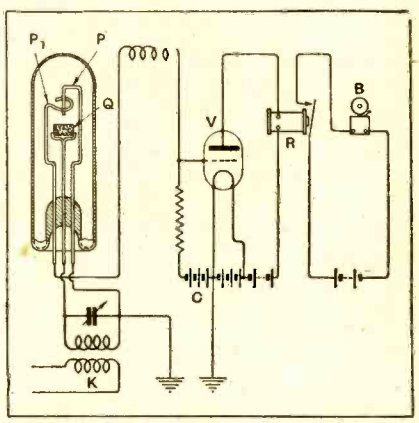
A Piezo-Electric Alarm.

It has been known for some time that a quartz or other piezo crystal immersed in neon or argon gas at low pressure will glow in a peculiar manner when it is energised at a frequency corresponding to the fundamental crystal frequency. The glow is due to ionisation of the surrounding gas.

This effect has been utilised by the Metropolitan Vickers Co. as the foundation of an ingenious relay designed to respond to small frequency changes. The device may be used, for instance, for bringing into operation different pieces of apparatus in a distant control system.

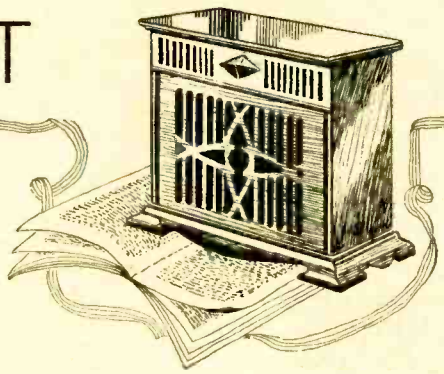
The arrangement is illustrated in the figure. A quartz crystal is mounted in a glass bulb with one electrode P nearly touching the crystal, and a second electrode P_1 surrounding the first. The electrode P_1 is connected to the grid of an amplifier V, which is given a heavy bias from a battery C such that no plate current normally flows. When, however, current of the fundamental crystal frequency appears in the input circuit K, the crystal glow sets in and the gas in the bulb is ionised, so that in effect the insulation gap between the electrodes P and P_1 is broken down, allowing the excess grid-bias to leak away through the path to earth so formed. Current



The circuit of the Met-Vick piezo-electric alarm.

will then flow in the plate circuit of the amplifier V to energise a relay R and so ring an alarm bell B or perform any other desired operation. (Patent No. 283,113.)

CURRENT TOPICS



News of the Week

CIVILISED ALMSHOUSES.

Twelve almshouses just erected at Barnet Vale, Herts, are equipped with electric light, baths and wireless.

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SINGLE WAVELENGTH WORKING.

"Single Wavelength Working" is the title of a paper by Captain P. P. Eckersley and Mr. A. B. Howe to be read before the Wireless Section of the Institution of Electrical Engineers on Wednesday next, March 6th, at 6 p.m.

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RADIO TOULOUSE BACKS OUT.

Since February 1st Radio Toulouse has fallen from grace by abandoning the 388-metre wavelength allotted to it under the Plan de Bruxelles and working on 500 metres. It is stated that the local P.T.T. station interfered on the lower wavelength.

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RECORD WIRELESS SHARE ISSUE.

What may be regarded as the biggest share issue in British wireless is, we understand, about to be launched as the result of negotiations concluded by the Kolster Radio Corporation of America for the formation of an English company to be called Kolster's Brandes, Ltd., which will take over the foreign rights of the Kolster patents.

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SET CONSTRUCTION *v.* KIT ASSEMBLY.

Comparing the French wireless amateur with the American, a Paris paper declares that the Frenchman is a genuine set constructor, whereas the American is a mere assembler of kits. Without wishing to be drawn into a discussion on the ethics of the question, we would point out that, in popular enthusiasm for wireless, America is far ahead of France.

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WIRELESS POSTER COMPETITION.

A rough sketch in colour will win a prize of £50 offered by the Radio Manufacturers' Association for the best design, submitted before May 31st next, for a poster to advertise the 1929 National Radio Exhibition at Olympia. In addition to the premier award there will be five other prizes, viz., 2nd prize, £25; 3rd prize, £10; 4th, 5th and 6th prizes, £5 each.

The designs (finished rough, in colour) must be full size upright, double crown 30in. x 20in., and must be treated with a view to reproduction by lithography in not more than nine colours and reduction for use as poster stamps (2½in. x 1½in.). They should, of course, be applicable to radio, and should incorporate the following wording: "The National Radio Exhibition, Olympia (New Hall), September 23rd to October 3rd, 11 a.m. to 10 p.m. Admission 1s. 6d. daily. (Tuesday, September 24th, up to 5 p.m., 2s. 6d.)." Sketches must be sent by May 31st next to the Secretary, The Radio Manufacturers' Association, Astor House, Aldwych, London, W.C.2., from whom further particulars can be obtained.

Entries will be judged by a Committee appointed by the R.M.A. Prize-winning and other selected sketches will be exhibited at the National Radio Exhibition.

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WORLD TESTS BY LEAGUE OF NATIONS.

The League of Nations will use the short-wave station PCLL, at Kootwijk, Holland, for a series of broadcasting tests next month, with the object of establishing communication with delegates in the United States, South America, Japan and Australia. The speeches will be in English, French, Spanish and Japanese. PCLL employs a wavelength of 18.4 metres with a power of 25 kW.

FORTHCOMING EVENTS.

WEDNESDAY, FEBRUARY 27th.

North Middlesex Radio Society.—At 8 p.m. At St. Paul's Institute, Winchmore Hill. Demonstration: "Signal Strength Measurement," by Mr. M. P. Young.

THURSDAY, FEBRUARY 28th.

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. Lecture on "New Apparatus," by a representative of Philips Lamps, Ltd.

Slade Radio (Birmingham).—At 8 p.m. At the Parochial Hall, Broomfield Road, Erdington. Members' Night. Talk on "Electricity."

Golders Green and Hendon Radio Society.—Monthly club dance.

MONDAY, MARCH 4th.

Newcastle-upon-Tyne Radio Society.—At 7.30 p.m. At 11, Saville Row. Lecture: "Radio and Common Sense," by Mr. S. Burns, M.I.E.E., M.I.Min.E.

Holloway Radio Society.—At Holloway School, Hilldrop Road, N.7. Demonstration by representative of Baker's "Selhurst" Radio.

TUESDAY, MARCH 5th.

Bec Radio Society.—At 7.30 p.m. At Bec School, Beechcroft Road, S.W.17. Demonstration by members.

Alma Wireless Society (Bermondsey).—At 7.30 p.m. At the Bermondsey Men's Evening Institute. Demonstration of the Cossor "Melody Maker."

WEDNESDAY, MARCH 6th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshment at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "Single Wavelength Working," by Capt. P. P. Eckersley and Mr. A. B. Howe.

Queen's Park Radio Society.—At 8 p.m. At St. Jude's Hall, Lancefield Street, W.10. Lecture by Mr. Percy W. Harris.

in Brief Review.

SIR OLIVER LODGE'S BEREAVEMENT.

We regret to record the death at Lake, Salisbury, on Wednesday last, of Lady Lodge, wife of Sir Oliver Lodge. They celebrated their golden wedding a year ago.

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"THE COMPLEAT FLAT."

Each of the 180 flats in the building now being erected over Baker Street Station, London, will be fitted with wireless. "Points" are to be installed in the reception rooms and kitchens, a "communal" wireless receiver being worked by the owning company.

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LOUD SPEAKER PROGRESS.

Mr. R. P. G. Denman, M.A., A.M.I.E.E., of the Science Museum, South Kensington, will read a paper on "Loud Speakers and Their Development" before the Royal Society of Arts, John Street, Adelphi, London, W.C.2, at 8 p.m. on Wednesday, March 13th. The paper will be illustrated by demonstrations. Dr. W. H. Eccles, F.R.S., will preside.

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THE POPULAR ARGENTINE.

Buenos Aires is becoming a wireless Mecca. Since the Berlin-Buenos Aires short-wave service *via* Nauen was opened, Paris and Brussels have both taken advantage of the new facilities. The latest country to announce a wireless service to the Argentine is Sweden. The Nauen station may soon be the centre of a cable network covering all the capitals of Europe.

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MELBOURNE HEARD IN A 'PLANE.

At a height of 3,000ft. over Croydon on Wednesday last, Messrs. Bert Hinkler and C. G. Allen succeeded in tuning in a 31.55 metre transmission from Melbourne on a McMichael six-valve superheterodyne. Magneto interference upset reception to a certain extent, but orchestral music and the announcer's voice were heard plainly at intervals. The attempt was organised by the Australian Press Association.

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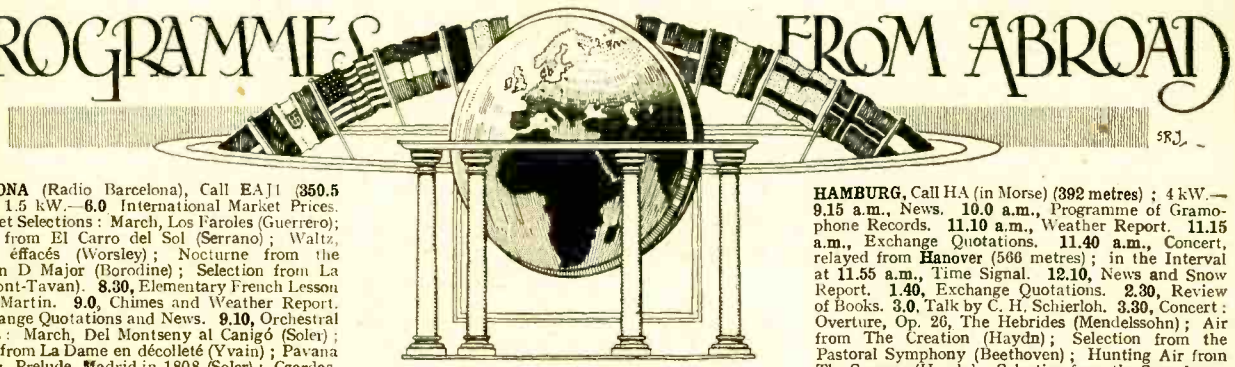
COMPANY PROSPECTUS BY WIRELESS.

Financial history was made last week through the agency of photo transmission by wireless. Hearing of the public issue of shares on the British market for a gramophone record company, New York financiers were able to market the shares to the American public by publishing the prospectus of the company at the same time as it appeared in the English newspapers. This was achieved by transmitting a photograph of the prospectus by beam wireless.

PROGRAMMES FROM ABROAD



SATURDAY, MARCH 2nd.

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

BARCELONA (Radio Barcelona), Call EAJ1 (**350.5 metres**) ; 1.5 kW.—**6.0** International Market Prices. **6.10,** Sextet Selections : March, Los Faroles (Guerrero); Selection from El Carro del Sol (Serrano) ; Waltz, Serments effacés (Worsley) ; Nocturne from the Quartet in D Major (Borodine) ; Selection from La Glu (Dupont-Tavan). **8.30,** Elementary French Lesson by Prof. Martin. **9.0,** Chimes and Weather Report. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Selections : March, Del Montseny al Canigó (Soler) ; Selection from La Dame en décolleté (Yvain) ; Pavana (Albéniz) ; Prelude, Madrid in 1808 (Soler) ; Czardas, Ilonka (Michiels) ; Radio March (Pecking-Lotter). **10.0,** Programme relayed from **Madrid,** EAJ7.

BERGEN (**365.9 metres**) ; 1.5 kW.—**5.30,** Programme for Children. **6.0,** Programme for Girls. **7.0** Orchestral Concert. **7.50,** Topical Talk. **8.0,** Talk by Ivan Kanonikoff. **8.30** Ballad Recital by Victor Ivarson. **9.0,** Weather Report, News and Time Signal. **9.15** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1648.3 metres**) ; 40 kW.—**12.45,** Phototelegraphy Transmission. **1.20,** Programme for Children by Ursula Scherz. **2.0,** Herr B. K. Graef, Talk : Elocution. **2.30,** Weather Report and Exchange Quotations. **2.40,** Talk for Women. **3.0,** Talks arranged by the Central Institute for Education. **3.30,** Programme relayed from **Hamburg. 4.30,** Dr. Hoche, Talk : Officialdom in the United States of America. **5.0,** Dr. Schlüter, Talk : Private and Public Welfare. **5.30** Elementary Spanish Lesson. **5.55,** Philological Talk by Dr. Hans Hajek. **6.20,** Prof. Leo Kestenberg, Talk : The Foundations of Modern Music. **7.0,** "Country" Programme : Fantasia for Pianoforte (Benoit) ; Two Old Flemish Songs, (a) Die Nachtigall, die sang ein Lied, (b) Es fiel ein Himmelstau ; Recitation : A Peasant Wedding ; Nocturne for Pianoforte (Verhulst) ; Two New Flemish Songs, (a) Ik ken een Lied (de Mol), (b) Het groetend kindje (de Boeck) ; Flemish Dance for Pianoforte (Blockx). **8.0,** Orchestral Concert : In der Natur (Dvorak) ; Fantasia for Violin and Orchestra (Suk) ; Aux Böhmens Hain und Flur (Smetana) ; followed by News and Dance Music from **Voxhaus. 11.30** (approx.), Close Down.

BERLIN (Voxhaus) (**475.4 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. **2.10,** Agricultural Report and Time Signal. **2.30,** Dr. Paul Frank, Talk : Medical Hygiene. **3.0,** Geological Talk by Leopold Lehmann. **3.30,** Reading by Friederike Lehner-Bressart from the Works of Raoul Auernheimer. **4.0,** Orchestral Concert : Overture to The Water Carrier (Cherubini) ; Peer Gynt Suite (Grieg) ; Elegy (Massenet) ; Minuet (Paderewsky) ; Poème (Fibich) ; Selection from Where the Lark Sings (Lehár), followed by Advertising Notes. **5.30,** Felix Stiemer, Talk : Friendship as Destiny : Nietzsche and Wagner. **6.0,** Dr. Max Wiener, Talk : The Career of the Jewish Rabbi. **6.30,** Talk by Albert Rohrberg. **7.0,** Jean Gilbert Programme on the occasion of his 50th Birthday. **8.0,** Cabaret Programme, followed by Weather Report, News, Time Signal, Sports Notes and Dance Music from the Hotel Adlon. **11.30** (approx.), Close Down.

BERN (**407 metres**) ; 1.5 kW.—**3.30,** Programme for Children. **4.0,** The Kursaal Orchestra. **6.0,** Fräulein Rosa Neuenschwander, Talk : The Choice of Professions for Girls. **6.29,** Time Signal and Weather Report. **6.30,** Herr Hans Morgenthaler, Talk : The Building Development in Old Bern. **7.0,** Popular Variety Programme. **8.15,** Concert relayed from Vevey. **8.45,** News and Weather Report. **9.0,** The Kursaal Orchestra. **9.35** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**321.2 metres**) ; 4 kW.—**3.15,** Friedrich Smetana Commemoration Programme. **4.30,** Weekly Film Review by Dr. Heinz Hamburger and M. Lippmann. **5.25** Hans Joachim Plehn, Talk in Esperanto : The Silesian Plant-world. **5.35,** Paul Schmidt, Talk : Silesian Frontiers. **5.55,** Weather Report. **6.0,** Concert from the Works of Brahms in Commemoration of his Election to the Honorary Degree of Doctor of Philosophy : Nänie for Choir and Orchestra, Op. 82 ; Speech ; Akademische Festoverture Op. 80. **7.15,** Debate : Art and Morals. **8.0,** 'Sechstage-Tempo". A Sports Sketch (Zelwen). **9.0,** Weather Report **9.10,** Relay of Swimming Competition from the Swimming Baths. In the Interval : News and Dance Music. **11.0** Relay of the Six Days' Race from the Sports Arena. **11.10,** Dance Music. **12.0 Midnight,** Close Down.

BRÜNN (**432.3 metres**) ; 2.5 kW.—**4.45,** German Transmission : News, Music and Talks. **5.15,** Journalists' Weekly Report. **6.0,** Programme from **Prague. 7.30,** Orchestral Concert. **9.0,** Programme from **Prague. 9.20,** Programme Announcements. **9.25,** Programme from **Prague.**

BRUSSELS (**512 metres**) ; 1.5 kW.—**5.0,** Concert from the Armenonville Tea-rooms. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Pianoforte Recital. **7.0,** Gramophone Selections. **7.30,** "La Radio-Chronique." **8.15,** Concert : Marche héroique (Saint-Saëns) ; Andante con moto from the Unfinished Symphony (Schubert) ; Solo for Oboe (Paladilhe) ; The Moonlight Sonata (Beethoven) ; Scherzo (Chopin) ; Cantilène for English Horn (Eeckhautte) ; Second Movement of the Symphony in D Minor (Franck) ; Selections from La Phalène (de Boeck) ; in the Interval at **9.0,** Topical Talk. **10.10,** News and Announcements. **10.15,** Orchestral Concert from the Palace Hotel.

BUDAPEST (**555.5 metres**) ; 20 kW.—**4.40,** Orchestral Concert. **5.40,** Talk : East Africa. **6.15,** Operetta. **9.0,** Time Signal, Weather Report and News, followed by Concert by Tzigane Orchestra from the Hotel Britannia.

CRACOW (**314.1 metres**) ; 1.5 kW.—**5.0,** Programme relayed from **Warsaw. 6.0,** Miscellaneous Items. **6.10,** Mr. J. Regula, Talk : Foreign Politics of the Past Week. **6.56,** Time Signal from the Astronomical Observatory. **7.0,** Chimes from the Church of Notre Dame, and News. **7.30,** Programme relayed from **Warsaw. 9.30,** Concert from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**411 metres**) ; 1.5 kW.—**1.30,** Weather Report and Concert of Gramophone Selections. **7.20,** News. **7.30,** Mr. F. H. Boland, B.A., LL.B., Talk : Irish Travel Openings in America. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Symphony Concert. **10.30,** News, Weather Report and Close Down.

FRANKFURT (**421.3 metres**) ; 4 kW.—**2.5,** Programme for Children. **2.55,** Hints for the Housewife by Fini Pfannes. **3.35,** Orchestral Concert from the Works of Smetana : Overture to Der Küss ; String Quartet in E Minor, from My Life ; Entr'acte and Entry of the King from Dalibor ; Overture to Libussa ; Selection from The Bartered Bride ; Ballet Music from Two Widows ; in the Intervals, News and Announcements. **5.10,** Reading by O. W. Studtmann from Ein Verbrecher aus verlorener Ehre (Schiller). **5.30,** Answers to Correspondents. **6.0,** Lesson in Esperanto by W. Wischhoff. **6.15,** Otto Ernst Sutter, Talk : Karl Schurz. **6.45,** Astronomical Talk by Prof. E. Sittig. **7.15,** "Toni Impekoven's Gay Excursion," Wireless Play, followed by Dance Music from the Künstlerklause, Gross-Frankfurt. **11.30** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**392 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. **11.40 a.m.,** Concert, relayed from **Hanover** (566 metres) ; in the Interval at **11.55 a.m.,** Time Signal. **12.10,** News and Snow Report. **1.40,** Exchange Quotations. **2.30,** Review of Books. **3.0,** Talk by C. H. Schierloh. **3.30,** Concert : Overture, Op. 26, The Hebrides (Mendelssohn) ; Air from The Creation (Haydn) ; Selection from the Pastoral Symphony (Beethoven) ; Hunting Air from The Seasons (Haydn) ; Selection from the Symphony, Im Walde (Raff). **4.30,** Orchestral Concert of Request Items. **5.30,** Dr. Stenzel, Talk : Arbitration. **6.0,** Georg Müller, Talk : From the Commercial Traveller to the Industrial Magnate. **6.25,** Dr. Wolfgang Panzer, Talk : Spain. **6.55,** Weather Report. **7.0,** Karl Schurz Memorial Programme, relayed from **Bremen** (273 metres). **8.30,** "Stage and Cabaret" Concert Programme ; in the Interval at **9.30,** Weather Report, Programme Announcements, News, Sports Notes and Snow Report. **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 Tuschinski Theatre, **Amsterdam. 3.40,** Italian Lesson by Mr. Giovanni Rizzini. **4.40,** French Lesson by Mr. Raymond Lafont. **5.40,** Time Signal. **5.41,** Concert of Orchestral Music. **6.25,** German Lesson by Edgar Grün. **7.25,** Police Announcements. **7.45,** Programme arranged by the Workers' Radio Society : Concert and Talk. **11.15** (approx.), Close Down.

HUIZEN (**336.3 metres**) ; 4 kW.—Transmits on 1,852 metres from 5.40 p.m.—**11.10 a.m.,** Programme for Hospitals. **12.10,** Concert of Trio Music. **2.40,** Programme for Children. **5.10,** Gramophone Selections. **6.10,** Talk by M. Gerisch. **6.20,** Gramophone Selections. **6.30,** Catholic Bulletin. **6.40,** Elementary English Lesson. **7.10,** Lesson in Dressmaking. **7.40,** Talk by Father Knops. **8.0,** Orchestral and Vocal Concert : Overture to Meeresstille und glückliche Fahrt (Mendelssohn) ; Second Part of the First Symphony (Beethoven) ; Recitative and Air from Serse (Handel) ; Song, Caro mio ben (Giordani) ; Scènes pittoresques (Massenet) ; Selections from Les Millions d'Arlequin (Drigo) ; Song with Orchestral Accompaniment, Mentre ti lascio (Mozart) ; Täubchen in Sonnenschein (Fétras) ; Prelude (Järnefeldt), Berceuse (Järnefeldt) ; Songs, (a) Vittoria mio Core (Carissini), (b) Wo die schöne Trompeten blasen (Mahler), (c) Ballad, Es war ein alter König (Diepenbrock) ; Reminiscences of Brahms (Morena) ; Selection from A Waltz Dream (Oscar Straus) ; Triumphal March (Hartmann). **9.10** (approx.), News and Close Down.

KALUNDBORG (**1153.8 metres**) ; 7 kW.—Programme also for **Copenhagen** (339.8 metres).—**6.30 a.m.,** Morning Gymnastics. **10.0 a.m.,** Weather Report. **2.0,** Programme for Children. **2.30,** Instrumental Concert : Turkish March (Mozart) ; Selection from Orpheus and Eurydice (Gluck) ; Waltz (Lanner) ; Polonaise Op. 61 (Schubert) ; Violin Solo, Träumerei (Schumann) ; Three Scandinavian Dances (Grieg) ; Recitations by Axel Strom ; Selection (Kollo) ; Cancion d'amor (Albéniz) ; Gavotte Marie Antoinette (Y'ener) ; Selections (Tchaikovsky), (a) Chanson triste, (b) The Months ; Waltz (Fall) ; March of the Gladiators (Fucik). **4.50,** Talk by W. Riedel. **5.20,** Talk by H. Dragehjelm. **5.50,** Weather Report. **6.0,** News and Exchange Quotations. **6.15,** Time Signal. **6.30,** Dr. Rimestad, Talk : Charles Baudelaire. **7.0,** Chimes from the Town Hall. **7.2,** Reading. **7.30,** Programme of Old Dance Music, followed by News. **8.45,** Chamber Music. Septet in E Flat Maior for Violin, Viola, Horn, Clarionet, Bassoon, 'Cello and Double Bass (Beethoven). **9.30,** Concert of Light Music by the Station Orchestra ; March, Per aspera ad astra (Urbach) ; Serenade (Gade) ; The Negro's Dream (Myddleton) ; Alaine (Schröder) ; Den lille Djaevels Födselsdag (Krome) ; Siamese Wedding (Langey). **10.0,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

KATTOWITZ (**416.1 metres**) ; 10 kW.—**2.45,** Economic Report. **3.0,** Music Lesson by Prof. F. Sachse. **3.25,** Children's Letter Box. **4.0,** Programme relayed from **Vilna. 5.0.** Programme for Young People. **6.0,** Miscellaneous Items. **6.20,** Mr. K. Zienkiewicz, Talk:

Programmes from Abroad.—

Contemporary England. **6.45,** News and Time Signal. **7.0,** Talk. **7.30,** Programme relayed from **Warsaw.** **9.0,** Weather Report and News. **9.30,** Dance Music.

KAUNAS (2,000 metres); 7 kW.—**6.0,** Weather Report and News. **6.30,** Concert of Mandoline and Guitar Selections. **7.0,** Miscellaneous Items. **7.30,** Orchestral Concert from the Works of Dvorak.

KÖNIGSBERG (280.4 metres); 4 kW.—**6.0,** Programme Announcements in Esperanto, followed by Topical Talk. **6.30,** Elementary English Lesson. **7.0,** "The Bartered Bride": Comic Opera in Three Acts (Smetana), followed by Weather Report, News, Sports Notes and Concert of Light Musical Selections and Dance Music. **11.0** (approx.), Close Down.

LAHTI (1,504 metres); 35 kW.—**5.15,** Talk. **5.35,** Orchestral Selections. **6.0,** Songs. **6.20,** Violin Recital by Erik Cronvall. **6.40,** Recitations. **7.0,** Choral Selections. **7.20,** Orchestral Concert: Dance Scene (Nielsen); Folie d'Espagne (Nielsen); Dance of the Elf-Maiden (Gade); Andante religioso (Henriques); Indian War-Dance (Lumbye). **7.45,** News in Finnish and Swedish and Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres) and **Münster** (265.5 metres).—**11.10 a.m.,** Gramophone Records. **12.5,** Orchestral Concert from the Café Corso, Dortmund: Overture to The Bohemian Girl (Balfe); Waltz, Seid umschlungen, Millionen (Strauss); Three Oriental Miniatures (Fischer); Selection from Werther (Massenet); Hungarian Dances Nos. 5 and 6 (Brahms); Selection from Das Dorf ohne Glocke (Künneke); Song, Wonnetraum (Meyer-Hellmund); Corso Marsch (Iseglio). **1.30,** Household Hints. **2.0,** Programme for Children by Els Vordemberge. **2.30,** Economic Report. **2.40,** Talk on High Frequency by Herr P. Brüls. **3.5,** Talk for Women by Marie Theres van den Wyenbergh. **3.35,** Hans Kafka: Reading. **4.0,** Dr. Wex, Talk: Hygiene for Young People. **4.20,** English Lesson by Prof. Hase. **4.45,** Programme of Gramophone Records. **5.30,** Dr. Stulz, Talk: How I reached an Understanding of Historical Events. **5.50,** Morse Lesson. **6.15,** Talk for Workers by Dr. Rauch. **6.40,** Dr. Lips, Talk: The Development of Human Culture. **7.0,** Paul Lohmar, Talk: First Aid. **7.20,** Variety Programme, followed by News, Sports Notes, Commercial Announcements, Concert and Dance Music. **12.30 a.m.** (approx.) (Sunday), Close Down.

LEIPZIG (361.9 metres); 4 kW.—**5.20,** Weather Report and Time Signal. **5.30,** Programme relayed from **Königswusterhausen.** **5.55,** Labour Market Report. **6.0,** Herr Braune, Talk: Guardianship and Education of To-day. **6.30,** Fritz Rothe, Talk: Safety First. **7.0,** "Don Juan": Opera (Mozart). In the Interval: Snow and Weather Reports, News, Sunday Programme Announcements and Sports Notes. **9.30,** Dance Music relayed from **Voxhaus.**

MADRID (Union Radio), Call EAJ7 (427 metres); 3 kW.—**7.0,** Chimes, Exchange Quotations and Programme of Dance Music. **8.0,** Scientific Talk by Dr. Zito. **8.25,** News and Announcements. **9.45,** Agricultural Report. **10.0,** Chimes, followed by "Die geschiedene Frau": Operetta (Fall). In the Interval at **12.0 Midnight** (approx.), News. **12.30 a.m.** (Sunday) (approx.), Close Down.

MILAN, Call 1MI (504.2 metres); 7 kW.—**6.55,** "Il Radio Giornale," News and Announcements. **7.15,** Talk: Industrial Review, followed by News. **7.30,** Time Signal, News and Introductory Talk to the following Transmission. **7.45** (approx.), "Crispino e la Comare," Opera (The Brothers Ricci); after the First Act: Readings from the Poems of De Bosis; after the Second Act: News and Economic Report. **10.0** (approx.), Close Down.

MOTALA (1,365 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Böden** (1,200 metres), **Göteborg** (346.8 metres), **Hörby** (260.9 metres), **Ostersund** (720 metres), **Sundsvall** (545.5 metres).—**4.0,** Orchestral Concert: Selection from Il Seraglio (Mozart); Ave Maria (Schubert); Du bist die Ruh (Schubert); Schlummerlied (Schumann); Sérénade-renaissance (Lange-Müller); Selection from La Tosca (Puccini); Meditation from Thais (Massenet); Panis angelicus (Franck); Intermezzo from Cavalleria Rusticana (Mascagni). **5.0,** Programme for Children. **5.30,** Relay of the Meeting of the High School Gymnasts. **6.30, Talk** on Professions and Professional Men. **6.45,** Sonata for Violin and Pianoforte, No. 11, in G Major (Mozart). **7.0,** Military Band Concert, relayed from **Karlstad** (219 metres): Symphonic March (Bonelli); Overture to Quo Vadis (Scassola); Selection from The Wizard of the Nile (Herbert); Waltz, Goldregen (Waldteufel); Suite (Lecocq); Cavalry March (Alfven). **8.0,** Topical Talk. **8.15,** News and Weather Report. **8.40,** Dance Music. **11.0** (approx.), Close Down.

Saturday, March 2nd.

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

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres).—**3.0,** Concert of Trio Music. **4.30,** Eugen Katzenberger, Talk: A Ramble through German Museums. **5.0,** Soprano Song Recital by Else Schuberth, relayed from **Nuremberg:** Two Songs (Rhode): (a) Versöhnung, (b) Der Abend hebt; Three Songs (Brahms): (a) An eine Aolsharfe, (b) Sommerabend, (c) Mein Lieb istein Jäger; Three Songs (Wolf): (a) Nun lass uns Fried en schliessen, (b) Der heilige Josef singt, (c) Herr, was trägt der der Boden hier. **5.35,** Labour Market Report. **6.0,** Answers to Correspondents. **6.30,** Pianoforte Recital by Alexander Gunselmann: Sonata, Op. 110, in A Flat Major (Beethoven); Two German Dances (Beethoven). **7.5,** Variety Programme. **9.20,** News and Announcements. **9.45,** Concert of Gramophone Selections. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (333 metres); 1.5 kW.—**7.30,** Wireless Talk, Announcements, News and Harbour Notes. **8.0,** Time Signal. **8.2,** Relay of an Opera from the San Carlo Royal Theatre. **9.50,** Calendar and Programme Announcements. **10.0** (approx.), Close Down.

OSLO (497 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**5.0,** Programme for Children. **6.15,** Weather Report and News. **6.30,** Talk. **7.0,** Time Signal and Orchestral Concert with Flute Solos: Suite for Flute and Piano, Op. 34a (Hernvied); Selection from Woodland Sketches (MacDowell); Love Scene from the Ballet, Scaramouche (Messager); Sonata for Flute and Piano, Flute de Pan (Mouquet); Selection from Czar and Carpenter (Lortzing); Selection from Orpheus in the Underworld (Offenbach); Le forgeron au forêt (Michaelis); Waltz from La Bayadère (Kálmán). **8.30,** Weather Report and News. **8.45,** Topical Talk. **9.0,** Recital of Swedish Songs. **9.30,** Dance Music from the Hotel Bristol. **11.0** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres); 5 kW.—**5.0,** Pasdeloup Concert. **7.10,** Weather Report. **7.20,** "Le Journal Parlé"—Programme of Talks, (a) M. Marc Frayssinet: The Postilion, (b) Dr. Pierre Vachet: Health, (c) Mlle. Jacqueline Bertillon: Social Works, (d) M. René Casalis: Sunday Sports; and Talks by other Contributors.

PARIS (Petit Parisien) (336 metres); 0.5 kW.—**8.45,** Gramophone Records, Talk and News. **9.0,** Concert: Overture to Les Noces de Jeannette (Massé); International Suite (Tchaikovsky); Danse macabre (Saint-Saëns); Rhapsody, España (Chabrier); Calliroé (Chaminade); Second Arabesque (Debussy); Fifth Slavonic Dance (Dvorak); in the Intervals at **9.25** and **10.0,** News.

PARIS (Radio Paris), Call CFR (1,769 metres); 15 kW.—**12.30,** Dance Music. **1.0,** Exchange Quotations and News. **1.15,** Dance Music (continued). **2.0,** Market Prices Report and Religious Information. **3.30,** Exchange Quotations. **3.45,** Dance Music by the Joss Ghislery Symphonians. **4.45,** Exchange Quotations and News. **6.30,** New York Exchange Closing Prices and Agricultural Report, followed by Gramophone Records. **7.30,** Pianoforte Lesson by M. Lucas. **7.45,** Exchange Quotations and News. **8.0,** M. Lefebvre-Dibon, Talk: More Children, Please! **8.15,** Vocal Concert. **9.0,** Dance Music; in the Intervals, News.

POSEN (336.3 metres); 1.5 kW.—**4.15,** Talk on Scouts. **4.30,** English Lesson by Dr. Arend. **4.55,** Programme relayed from **Warsaw.** **5.50,** Recent News from the Exhibition of Home Industries. **6.15,** Sonata in F Major for Violin and Piano (Grieg). **6.45,** Talk for Women by Mme. Swidzinska. **7.0,** Miscellaneous Items. **7.30,** Programme relayed from **Warsaw.** **9.0,** Time Signal and News. **9.30,** Cabaret Entertainment. **11.0,** Orchestral Concert, arranged by Maison Philips. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (343.2 metres); 5 kW.—**6.0,** Time Signal and News. **6.5,** Smetana Commemoration Programme: Talk, Recitations and Quartet Selection, From My Life. **7.0,** Selection of Popular Songs. **7.30,** Programme relayed from **Brünn.** **9.0,** Time Signal and News. **9.15,** Theatre Report. **9.25** Selection of Popular Music.

ROME, Call 1RO (443.8 metres); 3 kW.—**6.50,** Giornale parlato, News, Sports Notes, Exchange Quotations and Weather Report. **7.29,** Time Signal Giornale parlato and Press Review. **7.45,** Concert by the Band of the Royal Guardia di Finanza: Symphonic March (Manente); Fantasia, Homage to Bellini (Mercadante); Grand Finale from Don Carlo (Verdi); "Vendere l'anima al diavolo": One-Act Comedy (Maggini); Popular March, Anima nuova (Melchiorre); English Dances (Cowen); Selection from Amor (Marenco); Talk: Literary and Artistic Review; Tramonto d'autunno (Manente); Waltz Suite, Les Patineurs (Waldeteufel). **9.50,** Giornale parlato and News. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAF (31.48 metres); 30 kW.—**11.27,** Telechron Time Signal and Weather Report. **11.30,** White House Coffee Programme relayed from **New York. 12.0 Midnight** Phil Spitalny's Music, relayed from **New York. 12.30 a.m.** (Sunday), Musical Programme relayed from **Rochester. 1.30 to 4.0 a.m., New York** Programme. **1.30 a.m.,** Programme by Mildred Hunt and the Marimba Orchestra. **2.0 a.m.,** General Electric Hour. **3.0 a.m.,** Lucky Strike Programme. **4.0 a.m.,** Dance Music relayed from **Buffalo. 5.0 a.m.** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**5.0,** Concert of Turkish Music. **6.45,** Exchange Quotations, Weather Report and Time Signal. **7.0,** Concert: Overture to William Tell (Rossini); Marche pittoresque (Fucik); Selection from Rigoletto (Verdi); Lustige Bruder (Volster); Selection from Sybill (Jacobi). **8.30,** News and Close Down.

STUTTGART (374.1 metres); 4 kW.—**2.0,** Concert from the Works of Wagner. **3.30,** Thé Dansant from the Pavillon Excelsior. **5.0,** Time Signal and Weather Report. **5.15,** Prof. Nagel, Talk: From Bach to Beethoven. **5.45,** Gustav Moshack, Talk: The Centenary of the Birth of Karl Schurz. **6.15,** Book-keeping Lesson by Dr. Wolff. **6.45,** Dr. Venzmer, Talk: In the Native Quarters of Shanghai. **7.15,** Programme relayed from **Frankfurt,** followed by News **9.15,** Concert relayed from **Freiburg** (577 metres): March, The Star Spangled Banner (Sousa); Waltz, Ricordi de Carnevale (Sartori); Fantasia, Melodienkranz (Köhler); Dornröschens Brautfahrt (Rhode); German Folk Melodies (Kollmaneck); Rococo Serenade (Meyer-Helmund); Selection from Il Trovatore (Verdi); Klein Negerlein tanzt (Köhler). **10.30,** Programme relayed from **Frankfurt. 11.30,** "The Underworld": Midnight Revue. **12.30 a.m.** (approx.) (Sunday), Close Down.

TOULOUSE (Radiophonie du Midi) (383 metres); 8 kW.—**12.45,** Concert. **8.0,** Exchange Quotations and News. **8.30,** Instrumental Concert: Sonata in A Major for Violin and Piano (Fauré); Prelude in C Sharp Minor (Rachmaninoff). **9.0,** Concert arranged by "la Dépêche" and the Chorale des Minimes; In the Interval: Selections by Viennese Orchestra: I kiss your hand, Madame (Ralph-Ervi); Marche du Forgeron; Waltz, Delta (Browers); Waltz, Powone (Waldteufel). **11.0,** North African News. **11.15** (approx.), Close Down.

VIENNA (520 metres); 15 kW.—**4.35,** Concert of Chamber Music. **5.35,** Martin Brussot in Selections from his own Works. **6.20,** Song Recital: Waldseligkel (Marx); Selige Nacht (Marx); Liebesbriefchen (Korngold); Marietta's Song from Tote Stadt (Korngold); Ständchen (Rich. Strauss); Zueignung (Rich. Strauss). **6.45,** Time Signal and Weather Report. **6.50,** "Bruder Straubinger": Operetta in Three Acts (Eysler), followed by Dance Music and Photo-telegraphy Transmission.

VILNA (426.7 metres); 1.5 kW.—**3.0,** News in Lithuanian. **3.25,** Programme relayed from **Warsaw. 4.0,** Service from the Ostra Brama Chapel. **5.0** Programme relayed from **Warsaw. 6.0,** Dramatic Selection by Mr. Charles Wyrwicz-Wichrowski. **6.30,** Programme relayed from **Warsaw. 7.0,** Talk: National Education. **7.30,** Programme relayed from **Warsaw.**

WARSAW (1385.7 metres); 10 kW.—**3.25,** Talk by Prof. H. Moscicki. **3.50,** News. **4.0,** Programme relayed from **Vilna. 5.0,** Programme for Children. **6.0,** Miscellaneous Items. **6.20,** News. **6.30,** Wireless Review by Dr. M. Stepowski. **6.56,** Time Signal. **7.0,** Prof. St. Niewiadomski, Talk: The History of Polish Music. **7.30,** Concert of Polish Songs and Dances. In the Intervals: Theatre Notes. **9.0,** Aviation and Weather Reports, News, Police Announcements and Sports Notes. **9.30,** Dance Music from the Hotel Bristol. **10.30** (approx.), Close Down.

ZÜRICH (489 metres); 1 kW.—**6.15,** Time Signal and Weather Report. **6.17,** Quintet Selections. **7.10,** (approx.), Mandoline Selections and Songs to the Lute. **8.0** (approx.), Concert of Yodel and Orchestral Selections. **9.0,** Weather Report, News and Gramophone Selections of Dance Music.

SUNDAY, MARCH 3rd.

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

Programmes from Abroad.—

ALGIERS. Call PTT (353 metres); 1 kW.—12.30, Programme of Instrumental Music by the Wireless Orchestra, conducted by C. Cerlini. Overture to "Russlan and Ludmilla"—Opera (Michael Glinka).

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—**11.0 a.m.**, Chimes relayed from the Cathedral. 11.5 a.m., Weather Report and Forecast for Europe and North-East Spain and Aerial Route Notes. 1.30, Concert of Light Trio Music. Gramophone Records in the intervals. 2.45 to 5.0. No Transmission. 5.0, Opening Signal, followed by Concert of Symphony Music, relayed from the Gran Teatro del Liceo. Agricultural Bulletin and Market Prices in the intervals. 8.20, Popular Musical Selections by the Wireless Orchestra. 8.40, Sports Notes. 9.0 (approx.). Close Down.

BERGEN (365.9 metres); 1.5 kW.—**9.30 a.m.**, Divine Service with Sermon. 11.30 a.m., Meteorological Report and General News and Announcements. 7.0, Concert of Orchestral Music. 7.20, Organ Recital by Kahtor Karoten Solheim, relayed from the Cathedral. 7.50, Talk on Topical Events. 9.0, Meteorological Report, followed by Late News and Announcements and Time Signal. 9.15, Dance Music Programme 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,648.3 metres); 40 kW.—**7.55 a.m.**, Church Chimes relayed from Potsdam. 8.0, a.m., Concert of Choral and Instrumental Music, relayed from Voxhaus, followed by Berlin Cathedral Chimes. 12.45 to 1.15, Experimental Transmission of Pictures. 1.30 to 2.30, Three Talks on Agriculture. 2.30, Talk. 3.0, Talk or Reading. 3.30, Musical Programme. 5.0, Topical Talk. 6.45 (approx.), Musical Selections, followed by Late News Bulletin and Music. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475.4 metres); 4 kW.—**7.55 a.m.**, Chimes relayed from Potsdam Garrison Church. 8.0 a.m., Morning Concert and Sermon, followed by Chimes from the Cathedral. 12.15 (approx.), Chess Talk. 1.30, Practical Hints and Information for Farmers. 1.45, Market Prices of the Week and Weather Forecast. 1.55, Agricultural Talk. 2.30, Fairy Tales for Children. 3.0, Talk. 3.30, Concert 5.30, Talk. 6.0, Talk. 6.45 (approx.), Musical or Dramatic Programmes, followed by Meteorological Report and Late News and Announcements, Time Signal and Sports News. 11.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—**9.30 a.m. to 10.30 a.m.**, Protestant Sermon. 12.0 Noon, Time Signal and Weather Report and Forecast. 12.5, Orchestral Selections. 6.29, Time Signal, Weather Report and Forecast and Football Intelligence. 6.30, Concert or Talk. 8.15, Concert of Sacred Music relayed from St. Nicolas' Cathedral, Freiburg. Selections by a Boys' Choir conducted by Jean Paul Haas and Organ Recital by Prof. J Gogniat. 8.45, Sports Notes, Late News and Announcements and Meteorological Report. 9.0, Orchestral Selections of Light Music. 9.40 (approx.), Close Down.

BEZIERS (211 metres); 0.6 kW.—**6.0**, Programme arranged by "La Radio Agricole Française." 8.45, Selections of Pathé and Pathé-Art Gramophone Records arranged by La Maison Relin-Missoles. 10.30 (approx.), Close Down.

BRUSSELS (512 metres); 1.5 kW.—**5.0**, Selections by the Orchestra of the Armenonville Tea Room. 6.0, Programme for Children. 6.30, Musical Selections by the Station Trio. 7.30, Le Journal Parlé de Radio-Belgique. 8.15, Musical or Dramatic Programme. 10.15, Late News and Announcements. 11.0 (approx.), Close Down.

BUDAPEST (555.5 metres); 20 kW.—**8.0 a.m.**, General News Bulletin and Beauty Culture Notes. 9.0 a.m., Divine Service Relay. 2.40 (approx.), Talk for Agriculturalists. 7.15, Concert of Light Music conducted by Tibor Polgár. The Blue Danube Waltz (Strauss).

COLOGNE (263.2 metres); 4 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Langenberg (462.2 metres) and Münster (265.5 metres).—**6.45 a.m.**, Lesson in Boxing. 7.5 a.m., Lesson in German Shorthand. 7.25 a.m. to 7.55 a.m., Lesson in Esperanto by Alfred Dormanns and Survey of Forthcoming Programmes. 8.0 a.m., Relay of Chimes. 8.5 a.m. to 9.0 a.m., Evangelical Morning Recital with Sermon and Choral and Instrumental Items. 10.0 a.m. to 10.30 a.m., Philological Talk on the German Language. 10.35 a.m. to 10.55 a.m., Talk. 11.0 a.m., Musical Programme. 12.0 Noon, Orchestral Selections. 5.0, Poetry Reading (Hans Reimann). 5.30, Talk. 5.50, Talk. 6.15, Talk. 7.0, Musical or Dramatic Programme followed by Late News Bulletin, Sports Results and Musical Selections. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—**8.30**, Concert of Vocal and Instrumental Music. 11.0, National Anthem followed by Meteorological Report. 11.15 (approx.), Close Down.

CRACOW (314.1 metres); 1.5 kW.—**9.15 a.m. to 10.45 a.m.**, Service relayed from the Cathedral. 10.56 a.m., Relay of Fanfare from the Church of Notre Dame, followed by Time Signal. 11.5 a.m., Meteorological Report. 11.10 a.m., Concert by the Warsaw Philharmonic Orchestra. 1.0 and 1.20, Two Agricultural Talks. 1.40, "La Chronique Agricole," by Dr. Wasniewski. 2.0, Meteorological Report. 2.15, Philharmonic Concert relayed from Warsaw. 5.20, Relay of Concert from Warsaw. 6.0, Miscellaneous Items. 6.20, Talk. 6.56, Relay of Time Signal from the Astronomical Observatory. 7.0, Fanfare relayed from the Church of Notre Dame. 7.15, Sports Intelligence. 7.30, Concert of Vocal Music rendered by the Gorlice Vocal Quartet with the collaboration of Soloists and with M. B. Wallek-Walewsky, the Composer, at the piano. Vocal Quartet: "The Uhlan's Farewell" (B. Wallek-Walewsky). 9.0 to 9.30, Programme relayed from Warsaw. 9.0, Aviation Route Conditions and Meteorological Report. 9.5, News supplied by the Polish Telegraph Agency. 9.20, Police Announcements and Sports Notes. 9.30, Orchestral Concert from the Pavillon Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—**8.30 to 11.0**, Relay of Cork Programme: Selections of Vocal and Instrumental Music. 11.0, National Anthem and Weather Forecast and Conditions. 11.15 (approx.), Close Down.

HAMBURG, Call HA (in Morse) (392 metres); 4 kW.—Programme relayed by Bremen (273 metres), Flensburg (219 metres), Hanover (566 metres) and Kiel (250 metres).—**7.15 a.m.**, Time Signal. 7.25 a.m., Meteorological Report and News and Announcements. 7.40 a.m., Contemporary Economic Problems. 8.0 a.m., Weekly Legal Talk. 10.0 a.m., Talk. 11.55 a.m. Time Signal from Nauen. 12.5 (for Hanover), Selected Gramophone Records. 12.5 (for Bremen), Sunday Concert. 1.0, Funkheinzelmann talks to the Children. 2.0, Musical Selections. 5.0, Concert. 6.40, Sports News and Announcements. 6.55, Weather Report and Forecast. 7.0, Musical or Dramatic Programme. 9.20, Inland Weather Report and Late News and Announcements. 9.40, Concert. 10.50 (for Bremen, Flensburg, Hamburg and Kiel), North Sea and Baltic Weather Report. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres): 5 kW.—**2.10**, Concert by the Concert Hall Orchestra, conducted by Dr. Willem Mengelberg, relayed from Amsterdam. 7.40, Relay of "Herbstmanöver," Musical Comedy (Emmerich Kálmán). 11.10 (approx.), Close Down.

HUIZEN (336.3 metres): 4 kW.—Transmits from 5.40 on 1,852 metres.—**8.5 a.m.**, Morning Service and Sermon: Preacher, Dr. J. C. V. Meischke; Selections by a Choir of Women's Voices. 9.10 a.m., Sacred Service Relay. 12.10, Concert of Trio Selections. 1.40, Talk. 2.10, Concert. 4.10, Programme for Hospitals. 5.30 (approx.), Relay (on 1,852 metres) of Church Service. 7.10, Talk. 7.50 (approx.), Concert. 9.10, News and Announcements. 10.25, Relay of Choral Epilogue, conducted by Mr. Jos. Pickkers. 10.40 (approx.), Close Down.

KALUNDBORG (1,153.8 metres); 7 kW.—Programme also for Copenhagen (339.8 metres).—**9.0 a.m.**, Morning Service, relayed from Copenhagen. 10.30 a.m. to 10.40 a.m. (Kalundborg only), Weather Conditions and Forecast from the Meteorological Institute at Copenhagen. 5.20, Talk. 5.50 (Kalundborg only), Weather Report from the Copenhagen Meteorological Institute. 6.0, Press Intelligence. 6.15, Time Signal. 6.30, Talk. 7.0, Relay of Town Hall Chimes from Copenhagen. 7.2, Relay from the Phœnix Theatre of The Co-Optimists' New Revue, "7 × 9," by Ludwig Brandstrup, Mogens Dam and Co., Music by Kai Normann Andersen; Conductor, Kai Normann Andersen; followed by Dance Music Programme by the Palace Hotel Orchestra, Copenhagen, conducted by Teddy Petersen; in the Interval at 11.0, Relay of Town Hall Chimes from Copenhagen. 11.30 (approx.), Close Down.

KATTOWITZ (416.1 metres); 10 kW.—**9.15 a.m.**, Divine Service Relay. 10.56 a.m., Time Signal, followed by Weather Conditions and Forecast. 2.15, Symphony Concert, relayed from Warsaw, Philharmonic Orchestra: Mass in E Flat Major (Franz Schubert). 6.0, Miscellaneous Announcements. 6.56, Time Signal. 7.0, Talk. 7.30, Concert. 9.0, Weather Report and Forecast, News and Announcements, and Sports Intelligence. 9.30, Dance Music Programme 10.30 (approx.), Close Down.

KAUNAS (2,000 metres); 7 kW.—**3.0**, Talk. 3.30, Talk on Vilno in Lithuanian and Polish. 4.0, Talk for Agriculturalists, by J. Ardickas. 5.0 and 5.30, Two Talks on Military Matters. 6.30, Musical or Dramatic Programme. 8.30 (approx.), Close Down.

KÖNIGSBERG (280.4 metres); 4 kW.—Programme relayed by Danzig (456 metres).—**8.0 a.m.**, Morning Recital. 9.56 a.m. (Danzig only), Meteorological Report. 10.0 a.m. (Königsberg only), Weather Conditions and Forecast. 1.0, Talk for Chess Players by P. S. Leonhardt. 2.0, Elementary Spanish Lesson by Kurt Metze, Lecturer in Spanish at the Technical Institute. 7.45, Popular Concert by the Wireless Orchestra, conducted by Erich Seidler, The Death of Othello, from Othello, Opera (Verdi), rendered by Bednarczik (Tenor). 9.10 (approx.), Late News and Announcements and Sports Intelligence.

LAHTI (1,504 metres); 35 kW.—Programme also for Helsingfors (374 metres).—**8.0 a.m.**, Relay of Divine Service. 9.50 a.m., News from the Press. 10.5 a.m., Musical Programme. 10.25 a.m., Musical Recital 10.50 a.m., Weather Forecast and Conditions, followed by Time Signal. 11.0 a.m., Relay of Divine Service in Swedish. 3.0, Concert by the Wireless Orchestra: Conductor, Erkki Linko. 4.57, Time Signal and Meteorological Report. 5.40, Finnish and Esthonian Programme. 7.45, Late News and Announcements in Swedish. 8.30 (approx.), Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Cologne (263.2 metres) and Munster (265.5 metres).—**6.45 a.m.**, Lesson in Self Defence by Dr. Ludwig Bach. 7.5 a.m., German Shorthand Instruction. 7.25 a.m., Lesson in Esperanto. 7.45 a.m., Esperanto Survey of Forthcoming Programmes by Alfred Dormanns. 8.0 a.m., Relay of Church Chimes. 8.5 a.m. to 9.0 a.m., Evangelical Morning Recital, with Sermon and Choral and Instrumental Solos. 10.0 a.m. to 10.30 a.m., Philological Talk by Fritz Worm. 10.35 a.m. to 10.55 a.m., Talk. 11.0 a.m., Musical Programme. 12.0 Noon, Concert Programme. 2.15, Talk by Doctor Martin Rockenbach: "Our Times in Literature." 5.30, Talk. 5.50, Talk. 6.15, Talk. 7.0, Musical or Dramatic Programme, followed by Late News Bulletin, Sports News and Light Music. 11.0 (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—Programme relayed by Dresden (276 metres).—**7.30 a.m.**, Organ Music relayed from a Church. 8.0 a.m., Morning Recital of Vocal and Instrumental Music. 10.0 a.m., Talk. 12.0 Noon, and 12.30, Two Agricultural Talks. 5.30, Talk: "The British Empire." 6.0, Talk. 7.0, Relay from the Thomaskirche of "The Last Supper"—Oratorio (Böhme), under the direction of Professor Gustav Wohlgemuth, followed by General News Bulletin, Sports Notes and Musical Programme. 11.30 (approx.), Close Down

LYONS (Radio Lyon) (291 metres); 1.5 kW.—**7.30**, "Le Journal Parlé," Press Communications and Review, Theatre Notes and Announcements. 8.0, Concert of Vocal and Instrumental Music: Selections from "Romeo and Juliet"—Opera (Berlioz), by the Station Orchestra. 10.0 (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (427 metres): 3 kW.—2.0, Relay of Chimes and Time Signal. 2.5, Concert by the Station Orchestra: "Der Rosenkavalier"—Suite (Richard Strauss), (a) Entry of the Knight and Duet, (b) Waltz, (c) Aria, (d) Scene, (e) Scene, (f) Trio, (g) Final Duet. 3.30 to 7.0, No Transmission. 7.0, Chimes Relay, followed by Dance Music Programme. 8.0, Talk: Famous Journeys. 8.30 to 10.0, No Transmission. 10.0, Relay of Chimes, followed by Time Signal. 10.5, Selection by the Station Orchestra. 10.30, Concert of Band Music relayed from the Hotel National. 12.30 a.m. (approx.), Close Down.

MILAN, 1MI (504.2 metres); 7 kW.—**9.0 a.m.**, Opening Signal, followed by English Lesson. 11.30 a.m., Time Signal. 11.32 a.m., Musical Selections by the Station Quartet. 12.30 to 3.0, No Transmission. 3.0, Opening Signal. 3.2, Concert of Popular Music: Selections from "Samson and Delilah"—Opera

Programmes from Abroad.—

(Saint Saëns) rendered by the Station Quintet. **7.30,** Time Signal followed by Official Announcements of the Station. **8.0,** Opera Relay. At end of Act One: "Town and Country," Talk by Ulderico Tegani. At end of Act Two: Sports Intelligence and General News Bulletin from the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (1,365 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Boden** (1,200 metres) **Göteborg** (346.8 metres), **Hörby** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (545.5 metres).—**9.15 a.m.,** Running Commentary on the National Skiing Race "Vasalopper," relayed from **Mora.** **10.0 a.m.,** Relay of Divine Service from **Stockholm.** **3.30,** Reading. **4.0,** Children's Programme. **4.55,** Relay of Town Hall Chimes from **Stockholm.** **5.0,** Evening Service relayed from **Stockholm.** **8.15,** Late News and Announcements and Meteorological Report. **10.** (approx.), Close Down.

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres) and **Nuremberg** (240 metres).—**10.0 a.m.,** Relay of Chimes from the Munich Town Hall. **10.10 a.m.,** Relay of the Weather Chart for Bavaria **3.0,** Orchestral Selections. **7.0,** Popular Sunday Concert by the Munich Konzertverein, relayed from the Tonhalle, Munich. **9.20** (approx.), Late News Bulletin, followed by Concert. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (333 metres); 1.5 kW.—**8.30 a.m.,** French Lesson, conducted by Professor Etienne Verdier. **9.0 a.m.,** Morning Recital of Religious Music. **3.45,** Children's Corner. **4.0,** Popular Concert with Vocal and Instrumental Items. **4.30,** Time Signal. **7.30,** Talk on Topical Events. **7.50,** Bulletin of the Naples Harbour Authorities. **8.0,** Time Signal. **8.02,** Programme of Operatic Music. Selection from "The Barber of Seville"—Opera (Rossini); Duet for Tenor and Baritone, rendered by R. Rotondo and R. Aulicino. **9.0,** Sports Intelligence. **9.55,** Calendar and Survey of Forthcoming Programmes. **10.0** (approx.), Close Down.

OSLO (497 metres); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres), **Notodden** (297 metres), **Porsgrund** (456 metres) and **Rjukan** (242 metres).—**9.20 a.m.,** Carillon. **10.0 a.m.,** Relay of Divine Service from the Garrison Church. **6.15,** Weather Conditions and Forecast followed by Press News and Announcements. **7.0,** Time Signal. **8.30,** Meteorological Report and General News Bulletin. **8.45,** Topical Talk by a Journalist. **9.0,** Musical Selections. **10.30** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,488 metres); 5 kW.—**7.56 a.m.,** Time Signal on 32.5 metres. **5.0,** Pasdeloup Concert. **7.10,** Meteorological Report. **7.20,** Le Journal Parlé consisting of Sports Notes, Police History by Detective Ashelbé and Racing Results supplied by "Paris Sport." **7.56,** Time Signal on 32.5 metres. **8.0 to 8.50,** "La Farce de Maître Patelin" (15th Century), with notes on the origin of French Comedy.

PARIS (Petit Parisien) (336 metres); 0.5 kW.—**8.45,** New Gramophone Records. **8.50,** Lecture. **8.55,** News and Announcements. **9.0,** Concert with the collaboration of artistes of the Opéra and the Opéra-Comique. **9.25,** General News and Announcements. **9.30,** Concert of Symphony Music under the direction of M. Estyle, of the Paris Conservatoire. Hungarian Rhapsody No. 1 (Franz Liszt). **10.0** Late News Bulletin. **10.10,** Orchestral Concert. **11.0** (approx.), Close Down.

PARIS (Radio LL.) (370 metres); 1 kW.—**12.30,** Programme arranged by Radio Liberté. General News and Announcements. **12.40,** Musical Selections. **1.0,** Carillon de Fontenay. **2.30,** Communications from the "Radio Agricole Française." **3.0,** Programme of Dance Music arranged by "Les Etablissements Radio LL." **9.0,** Concert of Russian Music from the Works of Nicolas and Alexander Tchrepnine, conducted by General de Gorlenko. **10 0,** Carillon de Fontenay. **10.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (1,769 metres); 15 kW.—**8.0 a.m.,** General News and Announcements and Press Review. **8.30 a.m.,** Exercises in Physical Culture conducted by Doctor Diffre. **12.0 Noon,** Address by Father Lhande, followed by Concert of Religious Music. **12.30,** Press News and Announcements. **12.45,** Programme by the Albert Locatelli Orchestra with Humorous Interlude by Bilboquet. Selections from the "The Show Boat": Musical Play (J. Kern). **3.30,** Selection of Gramophone Records provided by "L'Industrie Musicale." News Bulletin in the interval. **6.30,** Agricultural Intelligence. **6.45,** Pathé Programme. **7.30,** Press Communications. **7.45,** Guignol Radio Paris. **8.30,** Cafe-Concert Radio Paris. In the intervals: Late News Bulletin and News from the Evening Papers. **10.30** (approx.), Close Down.

Sunday, March 3rd.

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

PARIS (Radio-Vitus) (299 and 37 metres); 1.5 kW.—**10.0 a.m.,** Vocal Selections. **10.20 a.m.,** Pianoforte and Organ Recital. **10.40 a.m.,** Symphony Music. **11.0 a.m.,** Chamber Music. **11.20 a.m.,** Selections for Violin and 'Cello. **11.40 a.m.,** Modern Dance Music and Popular Selections. **12.0 Noon,** Close Down.

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—**4.0,** Sessions Clock Chimes. **4.1,** Church Service. **7.0,** Relay of the Roxy's Symphony Hour from **New York.** **8.0,** Symphony Concert. **9.0,** Recital of Organ Music by Dr. Charles Heinroth, Musical Director at the Carnegie Institute. **9.45,** Evening Service from the Shadyside Presbyterian Church. **11.1,** Concert by the William Penn Hotel Orchestra. **11.30,** Programme arranged by the Whittall Anglo-Persians relayed from **New York.** **12.0 Midnight,** Sessions Clock Chimes. **12.1 a.m.** (Monday), Evening Service relayed from the Calvary Protestant Episcopal Church with Address by the Pastor, E. J. Van Etten. **1.0 a.m.,** Enna Jettick Melodies relayed from **New York.** **1.15 a.m.,** Collier's Radio Hour from **New York.** **2.15 a.m.,** Relay of Concert by the Utica Jubilee Singers from **New York.** **2.45 a.m.,** El Tango Romantico relayed from **New York.** **3.15 a.m.,** Longines Time from **New York.** **3.30 a.m.,** (approx.), Close Down.

POSEN (336.3 metres); 1.5 kW.—**9.15 a.m. to 10.45 a.m.,** Relay of Cathedral Service. **11.10 a.m.,** Time Signal. **11.15 a.m. and 11.35 a.m.,** Agricultural Talks. **11.55 a.m.,** Talk for Peasant Women. **3.0,** Symphony Concert relayed from **Warsaw.** **6.0,** Bulletin of the Catholic League of Polish Youth. **6.20,** Relay of Talk from **Warsaw.** **7.5,** Miscellaneous Items. **7.30,** Musical Programme. **9.0,** Time Signal followed by Sports Intelligence. **9.15,** Pianoforte Recital by Mademoiselle Gertrude Konatkovska, Professor at the Posen Conservatoire. Rhapsody in E Flat Major Op. 119. No. 4 (Reger). **9.40,** Dance Music Programme. **11.0** (approx.), Close Down.

PRAGUE (343.2 metres); 5 kW.—**8.0 a.m.,** Morning Recital of Religious Music. **9.0 a.m.,** Agricultural Programme. **9.30 a.m.,** Agricultural News. **10.0 a.m.,** Morning Concert. **3.30,** Musical Selections. **4.30,** Programme for Workers. **5.0,** Miscellaneous Programme for German Listeners. **9.0,** Time Signal, General News and Announcements and Sports Intelligence. **9.15,** Theatre Notes. **9.20,** Concert of Light Music. **10.30** (approx.), Close Down.

RABAT, Call PTT (414 metres); 2 kW.—**12.30 to 2.0,** Concert by the Station Orchestra. **4.0 to 5.0,** Military Music. **8.0,** Le Journal Parlé and General News and Announcements. **9.15,** Talk and Sports Intelligence by M. Barrier. **10.25** (approx.), Dance Music Programme from "La Chaumière de Rabat" or Relay of European Stations. **11.0** (approx.), Close Down.

RIGA (528 metres); 4 kW.—**9.15 a.m.,** Morning Service, relayed from the Mara Church. **12.0 Noon,** Programme for Children of Songs, Music and Stories. **2.30,** Talk. **3.0,** Musical Programme. **4.0 to 6.0,** Four Talks. **6.0,** Concert of Orchestral Music: Conductor, Janis Medin. **8.0,** Weather Conditions and Forecast. **8.30,** Music by the Orchestra at the Café de l'Opéra, followed by Late News Bulletin. **10.0** (approx.), Close Down.

ROME, Call 1RO (443.8 metres); 3 kW.—**8.30 a.m.,** Opening Signal. **8.32 a.m.,** German Lesson for Beginners. **9.0 a.m. to 9.45 a.m.,** Vocal and Instrumental Recital of Religious Music. **10.0 a.m.,** Relay with Introductory Address from the Casa di Dante. **12.0 Noon,** Opening Signal. **12.5 to 1.0,** Musical Selections by the Station Trio. **1.0 to 4.0,** No Transmission. **4.0,** Opening Signal. **4.5 to 5.30,** Concert of Popular Music. **6.50,** News Bulletin and Agricultural Report. **7.15,** Sports Intelligence and Various Announcements. **7.29,** Time Signal. **7.45,** Relay of "The Girl of the Golden West" (Puccini) with the collaboration of the Wireless Choir and Orchestra. **9.50,** Late News and Announcements. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (19.56 metres); 30 kW.—**3.30,** Relay of Divine Service. **6.30,** Programme by the Peerless Reproducers, relayed from **New York.** **8.30,** Selections of Organ Music by Elmer A. Tidmarsh, relayed from the Union College Memorial Chapel, Schenectady, N.Y. **9.0,** Dr. S. Parkes Cadman: Relay of Address for Men from **New York.** **10.30,** Twilight Voices, relayed from **New York.** **11.0,** Stetson Parade: Selections by the American Legion Band, relayed from **Boston, Mass.** **12.0 Midnight,** The Old Company's Programme of Vocal Music from **New York.** **12.30 a.m.** (Monday), Relay of Programme from the Capitol Theatre, **New York.** **2.0 a.m.,** Talk: "Our Government," by David Lawrence, Editor of the "United States Daily," relayed from **Washington, D.C.** **2.15 a.m.,** Relay of the Atwater Kent Hour from **New York.** **3.15 a.m.,** Programme from **New York.** **5.15 a.m.** (approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (369.9 metres); 2 kW.—**2.0,** Programme by the Station Orchestra, followed by Popular Gramophone Records and Selections of Spanish Music. **3.0 to 9.30,** No Transmission. **9.30,** Orchestral Concert, followed by Programme of Flamenco Songs and other Vocal Items. **11.30** (approx.), Close Down.

STAMBOUL (1,200 metres); 5 kW.—**5.0,** Concert of Turkish Music. **7.0,** Selections by the Station Orchestra. **8.30,** Late News and Announcements. **9.45** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (383 metres); 8 kW.—**12.45,** Concert and Instrumental Solos. **1.0,** Time Signal. **1.5,** Continuation of Concert. **1.45,** General News Bulletin from the Press. **8.0,** Parisian Exchange Quotations, Market Prices and News Budget supplied by "La Dépêche" et "Le Petit Parisien." **8.30,** Concert. **9.0,** Time. **9.5,** Orchestral Concert, arranged by L'Association des Commerçants radio-electriciens du Midi: Selections from "La Dame Blanche," Opera (Boieldieu), (a) Viens, gentille dame, (b) Déjà la nuit plus sombre. **10.15,** North African Notes, followed by Late News Bulletin. **10.30** (approx.), Close Down.

VIENNA (520 metres); 15 kW.—Programme relayed by **Graz** (354.2 metres), **Innsbruck** (455.9 metres), **Klagenfurt** (455.9 metres), and **Linz** (250 metres).—**9.20 a.m.,** Choral Selections by a Boys' Choir, conducted by Prof. H. Müller. **10.0 a.m.,** Concert of Orchestral Music. **2.15,** Experimental Phototelegraphy Transmission. **6.30,** Relay from the Grosse Musikvereinsaal of the "German Requiem," for Soloists, Mixed Choir and Orchestra (Johannes Brahms), followed by Concert Programme and Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

VILNA (426.7 metres); 1.5 kW.—**9.10 a.m. to 10.45 a.m.,** Relay of Divine Service from the Cathedral. **10.56 a.m. to 4.15,** Programme relayed from **Warsaw.** **10.56 a.m.,** Time Signal, followed by General News and Announcements. **11.10 a.m.,** Symphony Music by the Philharmonic Orchestra. **1.0 to 2.0,** Three Talks for Agriculturists. **2.15,** Mass in E Flat Major (Franz Schubert), conducted by Prof. P. Maszynsky, rendered by the Philharmonic Orchestra, Mixed Choir and Soloists. **4.30** (approx.), Children's Corner. **6.0,** Gramophone Selections. **6.20,** Talk, relayed from **Warsaw.** **6.45,** Time Signal and Late News and Announcements. **9.0,** Aviation Notes and Meteorological Report, relayed from **Warsaw.** **9.20,** Police Announcements and Sports Intelligence, relayed from **Warsaw.** **9.30,** Dance Music Programme from the Oaza Restaurant, **Warsaw.** **10.30** (approx.), Close Down.

WARSAW (1,385.7 metres); 10 kW.—**9.15 a.m.,** Divine Service, relayed from a Cathedral. **10.56 a.m.,** Time Signal and Relay of Fanfare from the Church of Notre Dame at **Cracow,** followed by Notes for Aviators and Meteorological Report. **11.10 a.m.,** Symphony Concert by the Philharmonic Orchestra. **1.0 to 2.0,** Three Talks for Agriculturists. **2.0,** Weather Conditions and Forecast. **2.15,** Concert of classical Music by the **Warsaw** Philharmonic Orchestra. **6.0,** Miscellaneous Items. **6.20,** Talk: "In the Land of the Crescent, the Sphinx and the Pyramids." **6.45,** General News. **6.55,** Time Signal. **7.0 to 7.25,** Talk: "Intellectual Diversions." **8.45,** "Moving House in the Ether," Marionette Play (Strzetelsky), Music adapted by F. Lubinsky. **9.0** (approx.), Aviation Notes and Weather Report and Forecast. **9.5,** Late News and Announcements. **9.20,** Police Notices and Sports Intelligence. **9.30,** Dance Music Programme from the Oaza Restaurant. **10.30** (approx.), Close Down.

ZÜRICH (389 metres); 1 kW.—**10.0 a.m.,** Concert of Orchestral Music. **11.29 a.m.,** Time Signal, followed by Meteorological Report. **11.30 a.m.,** Latest Gramophone Selections. **3.0,** Relay of Concert by the Carletti Orchestra from the Carlton Elite Hotel. **6.30,** Time Signal. **6.33,** Protestant Sermon. **7.30** (approx.), Programme of Popular Songs, rendered by Otto Schreiber (Baritone), accompanied by the Station Orchestra with Otto Strauss at the Piano. **9.0,** Late News and Announcements and Press Service from the "Neue Züricher Zeitung." **9.40** (approx.), Close Down.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent

"London Regional."—The Battle for Power.—Licences.

Activity at Brookman's Park.

Hitherto Brookman's Park has been associated with the activities of a dim and distant future. With the delivery last week of the first of the heavy machinery the place has suddenly become a concrete reality. The scaffolding is now being removed and concrete bases are being sunk to take the two pairs of steel lattice masts.

There is no truth in the suggestion that a new method of modulation will be used. Brookman's Park will incorporate the principle of low power modulation now being employed at 5GB.

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Signals Next May.

There are strong hopes at Savoy Hill that the first test signals from Brookman's Park will go out before the end of May. Indeed, there are optimists who think that the station will be in working order in time for the General Election.

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A Wipe Out Effect?

Residents on the northern outskirts of London are beginning to wake to the possibility that the London Regional will have a tremendous wipe-out effect. Meanwhile those listeners in the Midlands who are clamouring for a speedy choice of site for the Northern Regional would further their own interests by remaining silent until we have seen the effects of placing the first regional station within a few miles of a highly populous district.

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"Hunt the Slipper."

Intense excitement was created recently by the appearance of the B.B.C. mobile transmitter on a lonely moor near Bacup, and photographs of the "secret" station appeared in the Press. But the engineers have once more departed noiselessly and the game of "hunt the slipper" must begin once more. I learn that the Bacup site has not necessarily been discarded.

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B.B.C. at Geneva.

Captain Eckersley and Admiral Carpendale are at present in Geneva, representing the B.B.C. at a conference of the Union Internationale de Radiophonie to consider the effects of the Brussels Plan.

The report of the U.I.D.R. will be laid before the Convention of Governments which will meet at Prague in April. Before then, however, it is expected that the Union will make a determined effort to bring about a closer adherence to the new scheme. It is generally agreed that the Brussels Plan is perfectly practicable if *all* stations can be induced to support it. At the moment there are many truants, though a number of these have indicated that their intentions are honourable and that they are merely waiting until their technical arrangements permit of a wavelength change.

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A Polish Giant.

The one factor which always threatens the wavelength schemes of the U.I.D.R. is the thirst for kilowatts, and the next ten years will probably see the need for a new plan which will concern itself more with the limitation of power than the distribution of wavelengths. The broadcasting authorities of Poland—a country with a greater area than Great Britain and Ireland—are hoping to provide crystal reception for all their countrymen by means of a 50-kilowatt station at Warsaw. Work on the new station is to be started this year.

FUTURE FEATURES.

2LO and 5XX.

MARCH 5TH.—A. J. Alan: "A Sea Trip."
MARCH 6TH.—"Squirrel's Cage." a play by Tyrone Guthrie

Daventry (5GB).

MARCH 3RD.—"The Creation" (Haydn), parts 1 and 2.
MARCH 7TH.—"The City," a London panorama devised by Alfred Dunning.

Cardiff.

MARCH 8TH.—Spanish Music.

Manchester.

MARCH 8TH.—"The Web," a play by T. Stirling Boyd.

Glasgow.

MARCH 9TH.—Annual Concert of the Glasgow Caledonian Strathspey and Reel Society, relayed from St. Andrew's Hall

Aberdeen.

MARCH 5TH.—Songs and Story of the Gael.

Belfast.

MARCH 9TH.—Running Commentary on Ireland v. Wales International Rugby Match, relayed from Ravenhill Park.

A short-wave transmitter of 0.75 kilowatt is nearing completion at Posen, and tests are shortly to be made on 30.5 and 38.5 metres. The station will relay the programmes of Posen and Warsaw.

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A Licence Jump.

There is jubilation at B.B.C. headquarters over the P.M.G.'s licence figures for January. At the end of that month the total number of licences issued amounted to 2,684,941, marking an increase of approximately 70,000 over those for December. With the increase of 50,000 recorded in December the B.B.C. can contemplate an increase of an eighth of a million in two months, representing probably half-a-million listeners.

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The Explanation.

Savoy Hill would like to attribute the receiving boom to the growing popularity of the programmes, but I think it would be fair to take into account the enterprise of the wireless trade and the steady improvement in the broadcast receivers available to the public.

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A Novelist and the Microphone.

There is still a good deal of discussion as to whether broadcast drama can be accepted as a new art form, worthy of special development. Those who champion broadcast drama are naturally eager that it should receive serious recognition from established authors. The latest writer for the microphone is William Gerhardi, the famous novelist, who is now engaged in the preparation of a broadcast play, to be produced by Val Gielgud.

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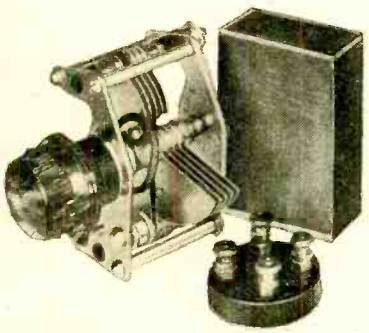
President Hoover's World Broadcast.

Listeners to the Schenectady stations 2XAD and 2XAF in the early hours of March 5th will hear the inaugural address of President Herbert Hoover, together with running commentaries on the ceremonial procession at Washington. The broadcasting stations of the United States are co-operating on this occasion to send a detailed description "to virtually every nation in the civilised world," according to Mr. M. H. Aylesworth, President of the National Broadcasting Company.

A Review of Manufacturers' Recent Products.

TWO NEW POLAR COMPONENTS.

The two components under review, namely a fixed potentiometer and the "Volcon" variable condenser, have been designed primarily for use in regenerative circuits. The first mentioned consists of a high resistance, tapped in two places nominally at a $\frac{1}{4}$ and a $\frac{1}{2}$ of the total resistance measured from the end which is connected to the positive L.T. bus bar. It is possible, however, to arrange for $\frac{1}{3}$ of the filament voltage to be applied to the grid of the valve by connecting the grid return circuit to the centre tapping and short-circuiting the portion between the $\frac{1}{4}$ tap and L.T.– terminal, or alternatively ignoring the latter and connecting the L.T.– bus bar to the $\frac{1}{4}$ tapping. Similarly, $\frac{2}{3}$ of the filament voltage can be obtained by reversing the connection to the ends of the resistance, taking the grid return to the centre tap and short-circuiting that portion between the $\frac{1}{4}$ tap and the terminal marked L.T. negative.



Polar fixed potentiometer with two tappings and the "Volcon" reaction condenser. The maximum capacity is 0.0001 mfd. The size may be compared with the matchbox alongside.

The resistance of the sample tested was found to be 2,570 total; 593 ohms between the $\frac{1}{4}$ tap and L.T.– terminal and 1,040 ohms between L.T.– and the centre tapping. This agrees reasonably well with the makers' figures, which gives the total resistance as about 3,000 ohms. The price of this component is 2s.

The "Volcon" is a midget variable condenser occupying a panel space of 2½in. × 2½in. and a depth of 2in. only over terminals. The vanes and end plates are stamped from sheet-brass, and by keeping the mass of metal as small as mechanical strength will permit, a low minimum capacity is assured. Measurements revealed the minimum as 8 micro-mfds., while the maximum capacity was found to be 0.000113 mfd., this comparing favourably with the maker's figure of 0.0001 mfd. Phosphor bronze ball bearings are fitted and the end thrust is taken by a single ball of generous size. A flexible pig-tail lead ensures good electrical connection to the moving vanes. Single hole fixing is adopted, and an ebonite nut and bush supplied for use with metal panels.

The attention given to the removal of all unnecessary metal renders this component eminently suitable for use in short wave sets, while its small dimensions should appeal to those particularly interested in portable receivers, where space is strictly limited.

The makers are Messrs. Wingrove and Rogers, Ltd., 188-189, Strand, London, W.C.2, and the price is 5s. 6d.

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LISSEN "SUPER" TRANSFORMER.

The modern tendency in L.F. transformer construction is to make use of subdivided and spaced windings to reduce self-capacity to the lowest possible value. This practice has been adopted in the Lissen "Super" transformer, with the result that unusually high primary and secondary inductances have been obtained without introducing deficiencies into the amplification characteristic through self-capacity. At 920 cycles the measured impedance of the primary of the specimen under test was 745,000 ohms, equivalent to an inductance of not less than 129 henrys.

The N.P.L. curve for this transformer was taken under amplifying conditions with the primary energised from a P.M.1.L.F. valve and the secondary feeding into a loaded power output valve. The transformer has a rising characteristic which peaks at about 5,000 cycles. Between 200 and 2,000 cycles the amplification is sensibly uniform, but there is a gradual falling off below 200 cycles. The following figures taken from the N.P.L. curve serve to indicate the deviation from the average at various frequencies :—

Frequency.	Amplification (following P.M.1.L.F.).
30	6.5
50	12.0
100	19.0
200	25.0
2,000	28.0
5,000	34.0

The transformer ratio is 3.5 : 1 in the general purpose model, but a 2½ : 1 ratio

Lissen "Super" transformer, ratio 3.5 : 1.

is also available for use after high impedance detector valves.

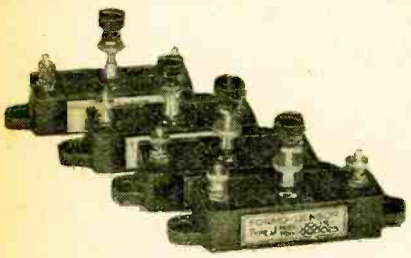
Tested under receiving conditions in a well-designed amplifier operating a moving-coil loud speaker, the performance was of a very high standard and was characterised by crispness and brilliance. We have no hesitation in saying that the performance of this transformer will fill the requirements of the most exacting critic.

The price is 19s. and the makers are Messrs. Lissen, Ltd., Friars Lane, Richmond, Surrey.

FORMO-DENSORS.

Formo-Densors have been in production now for some time, but recently the entire range has been redesigned and four new models now replace the previous "A" and "E" series. To prevent confusion with the earlier design, the new types are marked F, J, G, and H respectively, the price of the first three mentioned being 2s. each and the size H 3s.

This type of component is familiarly known as a variable-fixed condenser as the capacity can be varied between certain limits. In the new models a locking device enables the capacity to be fixed when the most suitable value for the particular position the condenser occupies has been found.



Redesigned Formo-Densors for baseboard mounting.

The plates are cut from springy brass foil interleaved with sheets of mica, the whole being enclosed in a cleanly moulded bakelite case provided with two terminals and lugs for baseboard mounting.

Test Results.

Type.	Marked Values.		Measured Values.	
	Max. Cap. Mfd.	Min. Cap. Mfd.	Max. Cap. Mfd.	Min. Cap. Mfd.
F.	0.00015	0.000003	0.000142	0.000004
J.	0.0003	0.000025	0.000315	0.000013
G.	0.001	0.00015	0.00108	0.000123
H.	0.002	0.001	0.0018	0.000695

The maximum capacities were found to come within 10 per cent. of the marked values, but the minimum showed a somewhat larger deviation, this being due, no doubt, to the nature of the construction as the minimum capacity is governed by elasticity of the foil and its ability to return to its former shape after compression.

With but one exception the minimum capacities were found to be less than the marked values, thus giving a larger capacity change than the stated limits indicate.

The makers are the Formo Co., Crown Works, Cricklewood Lane, London, N.W.2.

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THE AMPLIFORMER.

The manufacture of this component, which was formerly known as the "Multiformer," has been taken over by Messrs. K.N. Electrical Products, Ltd., 87, Wardour Street, London, W.1. Its principal function is that of a low-frequency coupling device in which the system of coupling can be rapidly altered by means of interchangeable units, and a full description of the removable iron core and the method of picking up contacts was given in our issue of February 1st, 1928. At that time three systems of coupling were possible, viz., transformer (with adjustable ratios), resistance capacity coupling and choke capacity coupling. Additional units are now available, and the range of utility has been considerably extended. The transformer can be adapted for intermediate frequency work in a superheterodyne receiver, as well as input and output work in conjunction with gramophone pick-ups and loud speakers. By connecting the windings in series the unit can be converted into a useful choke, and the slight air gap incidental to the form of construction adopted will considerably improve the characteristics when the windings are required to carry also a heavy direct current.

A "potential divider" unit is now supplied which enables the Ampliformer to be used as a D.C. mains eliminator. In addition to the potential divider unit, one of the transformer windings is also used and performs the function of a smoothing choke. The potential divider is provided with a single tapping, and the makers will adjust the tapping point to any specified percentage of the total resistance if the required value is stated when ordering. The external connections are wired so that the "series" method of connection is obtained when the resistance unit is reversed. Smoothing condensers have to be connected externally, but these are generally incorporated in the receiver before the eliminator is added.

A very complete book of instructions showing every conceivable application is supplied with each instrument. In it will be found a curve showing the inductance given by windings of various sizes. Measurement showed these figures to be on the high side by about 40 per cent., due, no doubt, to a rather larger than normal air gap in the core of the particular specimen tested. The measured inductances of a few representative windings were as follows :—

Turns.	Inductance (henrys).
3,000	6.58
4,000	9.64
6,000	21.5
12,000	59.7

Using the instrument as a low-frequency transformer, reproduction of excellent quality was obtained with a low-impedance valve, using the 4,000-turn coil as the primary and the 12,000-turn coil as the secondary.

The Ampliformer is a component of great educational value, and with it the beginner should be able rapidly to acquaint himself by direct comparison with the relative merits of the more important methods of L.F. coupling.

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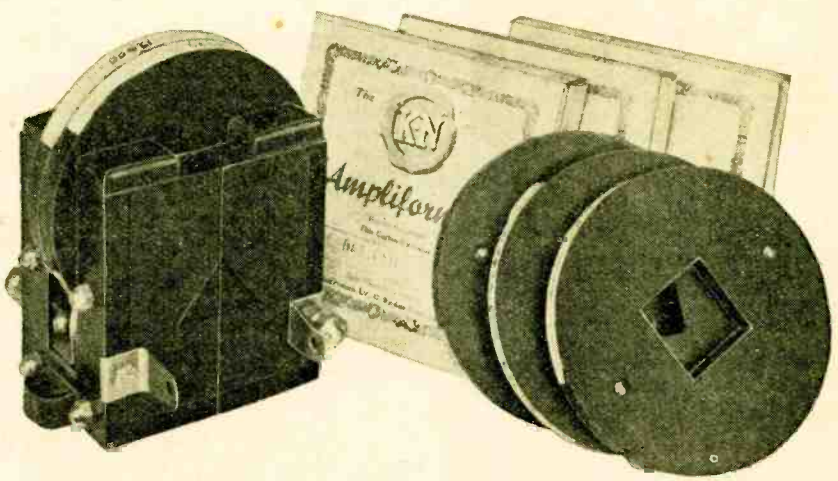
CYLANITE.

In our issue of November 14th last we reviewed some insulating material of this name, which closely resembled polished ivorine in appearance. The makers are now producing this material in a variety of colours, all handsomely grained and highly polished. As mentioned previously, the substance is primarily intended for covering the fronts of ebonite, metal or wood panels, but there are numerous other uses to which this material can be put, and these will readily suggest themselves to the reader.

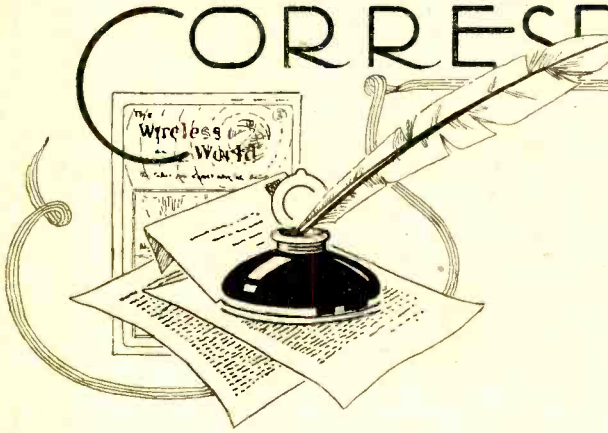
The insulating properties are of a very high order, and the material can be cut and drilled without flaking or splitting. A test for insulation resistance was made by passing two screws through holes drilled ¼in. apart and held firmly in position by small nuts. With a potential difference of 250 volts between these, the current flowing was found to be less than 10^{-7} ampere ($\frac{1}{10}$ microamp), showing that the insulation resistance is greater than 2,500 megohms between these points. Similar results were obtained from samples of the same material finished in different colours.

The makers are Messrs. Marsh and Wright, 5, Royal Arcade, Weymouth, and the price is 3s. per square foot.



The Ampliformer, a versatile component which may be used for the following purposes: L.F. transformer, I.F. transformer, L.F. choke, choke capacity coupling, resistance capacity coupling, H.T. battery eliminator.

CORRESPONDENCE.



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

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

TELEVISION AND STILL PICTURES.

Sir,—Illness has prevented me from contributing earlier to the interesting correspondence which has been appearing in the pages of *The Wireless World* on the subject of television and still picture reception.

One is sorry to notice the line taken by certain correspondents who seem to think that television is being deliberately "crabbed" either by the individual experimenter or by the B.B.C. This is a clear case of persecution mania or of the inferiority complex, for no one in his senses could possibly wish for anything but its rapid and successful development. Television, once it reaches the stage which makes it suitable for general use, will undoubtedly be the biggest and most interesting forward step yet made in wireless.

That time, however, does not seem yet to have arrived, and the man in the street has grown a little tired of being told, in face of the facts, that it has. For this reason he now goes ever prepared with that grain of salt which experience has shown to be necessary. In taking up this attitude he is not showing himself antagonistic to television; he is merely demonstrating that he does not wish again to be told that practical television is here, only to find when he goes to the exhibition that a wire has to be used between transmitter and receiver.

So far as I know no practical demonstration of television has yet been given by radio. The B.B.C. has been accused of lack of goodwill for declining to allow one of its stations to be used for transmissions. But in view of the comparatively enormous band of frequencies required, what other course could they possibly adopt? It would seem that no broadcasting authority which subscribed to the Geneva Plan or subscribes to the present Brussels Plan could possibly make use of Baird television for very obvious reasons.

The only reason why the B.B.C. and the public at large have "taken" up the Fultograph is that *it works*. No rash claims have ever been made for the still picture receiver, which was not placed upon the market until it had been so developed that it was a thoroughly satisfactory machine, as nearly foolproof as anything electrical can be. It may be useful to sum up the comparative merits and demerits of television and still picture broadcasting. The position is roughly this.

Television.

The only service for listeners is that provided by the experimental transmissions of the Baird Company. No European broadcasting authority can make use of it without breaking away from the agreement on which the Brussels Plan is founded. The cheapest form of receiver is priced £20; but this needs a low tension input of 6 volts and a *minimum* high tension voltage of 350.

The Fultograph.

The cost of the instrument is £22 15s., and it needs no outside batteries. The low tension current drain is intermittent from 0.1 to about 0.6 ampere, whilst the H.T. drain never exceeds a few milliamperes. Upkeep costs are therefore negligible. The instrument is simplicity itself to operate, and the user is assured at once of three sources of picture supply—Daventry, Königswusterhausen and Vienna—with others to come in the near future. A frequency band of only two kilocycles is required for the transmissions; there is therefore nothing to prevent any broadcasting authority from adopting the Fultograph system.

On the principle that a bird in the hand is worth two in the bush we should indeed be foolish if we did not avail ourselves of still picture reception to the full and resolve to let television bide until such time as it becomes something more than an interesting process better suited to the laboratory than to the living-room. Practical still picture reception *is* here, and there can be no doubt that we shall shortly have such interesting developments as the illustrated news bulletin and the illustrated talk.

I must confess that one far from technical point puzzles me very much. At the moment Baird Television shares stand at more than double their par value. whilst those of Wireless Pictures, Ltd., fetch a little more than half their issued price. Can any reader explain why this should be so?

Berkhamsted. R. H. WATSON.

Sir,—It is extremely kind of Mr. Moseley to point out my ignorance of the marvels of television, but I seem to be in very good company. Apart from all the eminent scientists and engineers who have criticised existing systems of television, one has not noticed that any of the editors and technical experts in the wireless press seem to be aware of the achievements of Mr. Moseley and his friends. It is certainly most interesting that for the comparatively few pounds required to build (and operate) a still-picture receiver, it is possible to build and operate a "televisor" which will give images as large as those of the Fultograph, of much better quality, "*and instantaneously.*"

I will only add that a recent critic wondered why a donkey was chosen for demonstration, and found it was meant to be a face.

Mr. Moseley would be more convincing if he would concentrate more on the scientists and engineers whom we know and less on unnamed Members of Parliament and "eminent men and women."

Woking. G. M. PART.

Sir,—During the Wireless Exhibition I had the opportunity of seeing Mr. Baird's television demonstration and also still picture transmission on the same day. In my opinion the quality of the moving picture was quite as good as that of the still picture. But the impression left on my mind was that television represents an art that has limitless possibilities, whilst the reception of still pictures from the point of view of the average man is of fleeting interest and merely an interesting toy.

My curiosity and interest in the still picture was fully satisfied by seeing it demonstrated the one time. As for television, I feel that if a good public transmission were available I should like to be possessed of a receiver. Television, to my mind, is the very thing to which those many wireless enthusiasts who have plumbed the depths of "sound" wireless will turn if the opposing elements (which it is difficult to believe are materially disinterested) will let us have it.

Purley. C. W. CARR.

EMPIRE BROADCASTING.

Sir,—Since the publication of my letter on Empire Broadcasting in your issue of February 20th certain figures in connection with the Post Office accounts have been published, which bear relation to the argument in my letter, particularly with regard to the financial aspect of Empire Broadcasting.

You have doubtless seen the figures relating to the receipts from wireless licences, but, briefly, of the £1,234,898 gross receipts £154,362 was absorbed in expenses, while only £1,427, less than 1 per cent. of the cost of expenses, was devoted to modernising spark stations, and considerably over £200,000 was paid in to the Exchequer, before passing over £824,237 to the British Broadcasting Corporation.

Though unacquainted with the actual figures when my letter was written, the argument is entirely confirmed by these figures. Apart from that, however, the item for Post Office expenses seems to call for some comment. Doubtless in any editorial remarks you may consider it advisable to make this point will come in for its share of attention.

BURNDEPT WIRELESS (1928), LIMITED,
(S. G. Scroggie, B.Sc., A.M.I.E.E., Chief Engineer.)

STANDARD FREQUENCY NOTES.

Sir,—Referring to letters from C. R. Mason and A. C. Armstrong, I wonder greatly that they, and your many other correspondents, keep on bothering that impenetrable State-owned pachyderm, the B.B.C., and do not chase more responsive game.

Why do they not prevail on some of the leading gramophone companies to put out some special discs giving the whole gamut of musical frequencies on various musical instruments?

These companies now claim with their new recording apparatus to get as low as 30 cycles on laboratory tests.

While I admit their commercial discs do not attain this range, I see no reason why it could not be done for a special series.

Your correspondents could then, using a suitable pick-up, test their sets and loud speakers all day long, and their gramophones too.

Dublin. S. S.

Sir,—It would be of considerable service to experimenters if one of the gramophone companies could be induced to produce a record or set of records giving various musical notes at a constant voltage with aural announcements of the frequencies played or about to be played. This would, used with a pick-up, enable the response of loud speakers and amplifiers to be estimated by the average experimenter, who has no means of installing or calibrating a generator of low-frequency oscillations.

At the same time something similar might be done by the B.B.C., an occasional lecture by a research engineer interpolated with suitable noises of registered frequencies, the transmitted frequency in all cases being announced. It may be argued that a feature like this would only have a limited audience, but the same may be said of a great deal of material broadcast, e.g., girl-guide bulletins, and again the recent series of biological lectures from 5XX on Tuesdays; the last-named can surely have had only a very small audience.

A feature of the kind described might awaken the interest of many who have not hitherto given a thought to the question of good reproduction. F. D. HARRIS.

Garches, France.

[Such records (H.M.V.) will, we understand, shortly be available through the Gramophone Company.—Ed.].

"BAD NOTES."

Sir,—I was amazed to see, while reading the transmitter notes and queries, that your correspondent suggested that the Belgian Amateur Stations should use "Bad Notes," because they refuse to use the prefixes.

If a note is so bad that it is illegible, it must of necessity cause a great deal of interference to other stations, and for this reason is to be strongly deprecated.

It is most important that, having regard to the narrowness of the new "Bands," all stations should use notes as pure as they can possibly be made.

Your correspondent is evidently not a transmitter, or he would most certainly not make such an absurd suggestion.

H. CECIL PAGE (G6PA).
Teynham, Kent. (7th District Area Manager.)

[We, of course, agree with the above comment on "bad notes," but we think the writer has misinterpreted the implication in the note referred to!—Ed.]

Club News.

An Active Month.

Slade Radio (Birmingham) have carried out an active programme during the past few weeks.

On February 7th *The Wireless World* new "Empire Three" short-wave receiver was the subject of a demonstration and lecture given by Mr. N. B. Simmonds. The quality was good, and proved that a receiver could be designed for the dual task of picking up signals on both the broadcast and short-wave bands.

Valuable hints on the calculation of the correct values of receiving components were given by Mr. J. W. Walker in a lecture entitled "Inductance and Capacity as Applied to Wireless Receivers."

On February 21st Mr. F. E. Henderson, A.M.I.E.E., of the General Electric Company, Ltd., lectured on the "Super Power Valve and the Pentode."

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

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Loud Speaker Kit Construction.

Amateurs who are interested in the construction of their own loud speakers were well catered for in a lecture given before the Bec Radio Society on February 12th by Mr. A. R. Turpin, of Messrs. Goodman's, Farringdon Street, E.C., in which the large variety of parts and complete kits available to the public were described. At the previous meeting of the Society Mr. F. E. Henderson, of the General Electric Company, dealt with the screened grid valve and the Pentode, afterwards demonstrating the G.E.C. "Screened Grid Three," which gave excellent volume on Daventry with an aerial consisting of only three yards of flex.

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

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Standardising Valve Nomenclature.

The history of the valve from the days of the bright emitter "R" type down to the new pentode was carefully outlined by Mr. H. L. Bowen, of the Mullard Company, at the last meeting of the Golders Green and Hendon Radio Society. The lecturer sounded a warning against the danger of overloading the pentode, which many users treated as if it were a super-power device with unlimited powers of amplification. The subsequent discussion revealed the keenness with which amateurs are anticipating the arrival of a standardised nomenclature in valves. At present the amateur must submit to a *régime* of "Blue Stripes," "Red Lines," "Gold Stars," "Pyramids," etc., etc.

Hon. Sec., Lt.-Col. H. Ashley Scarlett, 60, Pattison Road, N.W.2.

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An Amalgamation.

The vexed question of leaky grid *versus* anode bend rectification was discussed by members of the Leytonstone and South Woodford Radio Societies on February 11th. The general conclusions were that anode bend rectification fully justified its inclusion in the wireless set when following a good stage of high-frequency amplification, such as that supplied by a screened grid valve.

The fusion of the Leytonstone and South Woodford Radio Societies took place at the beginning of the year, and the results of the union have already fully justified the step. Meetings are held at the headquarters of the South Woodford Society.

Hon. Sec., Mr. E. J. Turbyfield, F.L.A.A., 42, Alexandra Road, South Woodford, E.18.

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Wembley Wireless Society.

The Wembley Wireless Society is carrying out an interesting programme during the present session, and several well-known lecturers have been "booked" to appear within the next few weeks. Meetings are held on Fridays at 8 p.m. at Park Lane School.

Hon. Sec., Mr. H. Comben, 24, Park Lane, Wembley.

The Putney Wireless Club.

A special effort to increase membership is being made by the Putney Wireless Club, which meets every Wednesday at 7.30 p.m. at the Putney Literary Institute, West Hill, Putney, S.W.18. Lectures and demonstrations are given by well-known radio manufacturers, and the popular feature is the weekly morse class.

Full particulars are obtainable from the Hon. Sec., Mr. J. P. Longhurst, 27, Santos Road, S.W.18.

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Loud Speaker History.

A special cabinet to obviate the use of a baffle was shown by Mr. A. D. Gay in his recent demonstration of moving-coil loud speakers before the Croydon Wireless and Physical Society. The lecturer gave a thorough technical description of the operation of moving-coil loud speakers and also included an interesting historical review from the earliest types of loud speaker to those produced to-day.

On February 18th Mr. T. A. F. Iserbyt lectured on "Reflection on Ultra-short Wavelengths."

Hon. Sec., Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2.

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Power from A.C. Mains.

A lecture on "Power from A.C. Mains," kindly supplied by the Marconiphone Co., Ltd., provided an interesting evening for members of the South Croydon and District Radio Society at a recent meeting. The lecture, which was copiously illustrated with lantern slides, dealt first with the attributes of the ideal wireless set operating with one switch. Then the various problems which had first to be overcome were dealt with in turn, particular attention being given to the supply of H.T. and L.T. A lucid description was given of different types of H.T. eliminator, and the question of L.T. current was then discussed. The new Marconiphone A.C. valves, namely, KHI and KHL, were illustrated, the slides clearly exhibiting the principle of indirect filament heating.

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

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.

Renewing Aerial Wire.

I notice that several strands of my aerial are broken, and presume it will be necessary to renew it. Do you recommend me to obtain covered wire? Would this confer any advantage?

S. G. B.

From the electrical point of view there is no advantage in using covered wire. It has, moreover, the disadvantage that its "windage" is increased by the thickness of the covering, and so it is more likely to carry away in a strong wind. This does not apply to a coating of enamel, which does something to prevent corrosion and does not add appreciably to the thickness of the conductor.

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An "Open" Grid Circuit.

My receiver comprises an anode bend detector followed by two resistance-coupled stages. After working well for some time, it has developed a mysterious fault, which so far I have been unable to trace. All grid and plate circuits have been tested systematically in the manner you have recommended on several occasions, and everything seems to be normal. Anode current passed by the output and first L.F. valves is the same as before, but a milliammeter connected in series with the detector-anode circuit shows a higher reading than usual, and the current is not changed by variation of detector bias. It seems to me that the trouble must be associated with this part of the receiver, but I cannot understand what is wrong, as the valve works well in another set.

D. C. L.

It seems certain that the grid circuit of the detector valve is not "closed." As you have apparently tested the external components, and the valve itself seems to be beyond suspicion, there can be little doubt that a disconnection exists in the valve holder, and you will probably find that the grid pin is not fitting properly in its socket.

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Simple Reaction Circuit.

Is it possible to use an "Everyman Four" aerial-grid transformer in a reacting detector circuit without the need for any extra coil? I seem to remember having seen something of the sort in a back number, but cannot remember the details: I should like to try it, as I have a spare transformer.

G. M.

We cannot trace the publication of specific information on this subject, but similar arrangements have been discussed. As a matter of fact, the coil as it stands is not suitable, but by reversing the direction of the windings of the aerial coil (it must be in the opposite direction to that of the secondary) the transformer may be used in a highly satisfactory type of circuit, details of which are shown in Fig. 1.

You will observe that the detector grid condenser is not connected to the extreme end of the winding; when making use of a low resistance litz-wound coil, it is better to reduce damping by making this junction to a point that will include about two-thirds of the total number of turns in the grid circuit. This is not essential, and if preferred, you can follow the conventional method of connection. A reaction condenser of comparatively large capacity (at least 0.0003 mfd.) will be necessary, in view of the small number of turns in the combined reaction-aerial winding.

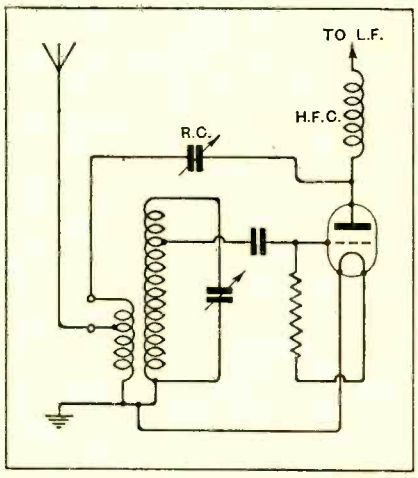

Fig. 1.—Simple but effective detector circuit with common aerial-reaction windings.

RULES.

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

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

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

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

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

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

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

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A Screen Grid "A.C.3."

I understand that the new Cosmos AC/S. screen grid H.F. amplifying valve is now available, and should like to modify my "A.C.3" by replacing the present high-frequency stage by one of these valves in conjunction with a suitable coupling. Could you give me any advice on this subject?

B. E. V.

Your problem is somewhat similar to that of "S. F. B.," and you are referred to our reply to him in last week's issue, but, due to the very high amplification obtainable with the special valve you propose to use, it will be necessary—unless you are satisfied with amplification much below the possible maximum—to make the screening still more complete. To be on the safe side, we recommend that both input and output ends of the H.F. stage should be separately screened. You are referred to an article entitled "Valve Current from the Mains" in our issue for February 13th.

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An Old Timer.

My four-valve set, with a tuned anode H.F. stage, detector, and two transformer-coupled L.F. amplifiers, has given good service for nearly four years, but I find it insufficiently selective, in spite of the fact that my situation is almost ideal for distant reception. I believe it is possible to improve matters in this respect by altering the aerial coupling; can you give me a few hints as to how to proceed with these modifications?

E. de C. L.

We expect that your set does not include any neutralising arrangement, and that it is stabilised largely by the damping of a directly coupled aerial. If this is so, the addition of a more selective aerial coupling will remove a good deal of this loading, and uncontrollable instability will result. We are sorry to be unhelpful, but think our best course is to advise you to abandon your idea of modification and to use as many of your existing components as possible in rebuilding your set to a more modern design.

Great Expectations.

Will you please refer me to a description of a two-valve portable set capable of giving loud speaker reception of the "local" stations (2LO, 5GB, 5XX), and headphone reception of a few Continental stations?

L. R. H.

We fear that a two-valve self-contained set can hardly be expected to give the performance you require. In conjunction with an exceptionally large frame aerial it might be possible to receive the three British stations mentioned in daylight, and some foreign transmissions after dark, but this result could only be obtained by excessive use of reaction, and quality would certainly be poor.

We do not think that the desired results could consistently be attained with anything less ambitious than a three-valve combination of H.F. amplifier, detector and one L.F. stage.

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Difficult Conditions.

Can you recommend a good circuit arrangement for use in Cornwall, where I understand conditions are far from good? I should not object to the use of a frame aerial, as I believe that this helps to eliminate morse interference, but at the same time I should prefer a fairly simple set.

W. F. G.

For equal performance in the matter of selectivity as compared with an open aerial set, the use of a frame means that the receiver itself must be much more sensitive, and consequently more elaborate and expensive. Moreover, it does not altogether follow that the directional properties of a frame will completely eliminate intereference from shipping, because in the part of the country you mention this interference may come from several directions.

It is always difficult to give definite advice on these matters, but perhaps the most suitable set for you would be a four-valve combination of H.F. amplifier, detector, and two L.F. stages, with extremely selective circuits, and an outside aerial. Efforts should be concentrated on maximum efficiency of the long-wave side. As an alternative, we suggest a frame aerial set with two tuned H.F. stages with screen grid valves, and anode bend detector, and one transformer-coupled L.F. stage; with a large frame, this should be sufficiently sensitive, provided the H.F. couplings are well designed, but it will be obviously more difficult to construct and to operate.

o o o o

Short-wave Adaptor.

In an attempt to modify my set for short-wave reception, I propose to reduce the effective capacity of the 0.0005 mfd. tuning condenser to about 0.00015 by inserting a fixed condenser in series. If you consider this to be a good plan, will you recommend a suitable value for the added capacity?

F. McK.

It is almost impossible to tune a short-wave set with the comparatively large capacity of 0.0005 mfd., so some alteration will be necessary. We consider that your suggested method of modification is quite in order. The nearest standard capacity to give the resultant value you require is 0.0002 mfd.

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A Bias Fallacy.

A common anode voltage of 60 is applied to the three valves in my receiver. The valves are suitably biased for working at this voltage, but I am told that I am ruining them by doing this, and that I should employ at least 100 volts. Is this correct?

H. J. P.

You have been misinformed. Valves are not harmed by working them at a lower anode voltage than the maximum specified; on the whole, their life is increased by adopting this procedure, as it is by using negative bias. Of course, quality would be improved by increasing anode voltage to 100 or more (with commensurate increase of bias), but this is another matter altogether.

Where the Milliammeter Fails.

A milliammeter connected in the plate circuit of the output valve is widely used as an indication of distortion, but can it be relied upon to show the form of distortion due to using an output filter choke with insufficient current-carrying capacity?

E. C. M.

Practically speaking, this is a case where the meter fails completely; it will give no indication as to whether saturation is taking place.

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Paying for Results.

In spite of the fact that my eliminator is an extremely simple and inexpensive one, I have had very good results from an ordinary cone loud speaker; there has been no noticeable "hum." Since changing over to a moving-coil instrument, the position is completely altered, and the hum is sufficiently serious to be annoying. The trouble is not in any way associated with the supply to the field winding, as this is fed from a separate accumulator. Can you make any suggestions as to the cause?

J. McE.

We expect that your original loud speaker was deficient as a reproducer of the lower audible frequencies, which are probably well reproduced by the moving-coil instrument. We fear that you will find it necessary to include more liberal smoothing arrangements.

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Resistance Coupling and the Pentode.

Would the arrangement of an anode bend detector, resistance-coupled to a pentode, be satisfactory, or would the detector overload before the pentode was fully loaded?

J. V. B.

This is a very practical circuit combination, and the difficulty you suggest is not likely to arise if the constants of the detector circuit and its coupling components are in accordance with present-day practice.

WHO'S WHO IN THE ETHER.

E. M. (Coulsdon).—Undoubtedly Kovno, which is the only broadcasting station above Huizen in the long-wave band. Opens and closes transmissions with a fanfare of trumpets. **J. T. (Muswell Hill).**—Yes, Radio Paris relayed on February 17th for the first time a sacred service and sermon from Nôtre Dame, Paris. **Grace (Reading).**—Stockholm now invariably abbreviates its call to Stockholm-Motala (pronounced *Mott-allah*); as a rule, the Swedish stations close early (about 10 to 10.30 p.m.). **H. D. (Hammersmith).**—This musical note you heard "something like morse" was the picture transmission from Vienna, usually given at the end of the evening programme and news broadcast, any time after 10 p.m. G.M.T. **L. H. (Bromley).**—Madrid (EAJ7), a relay of dance music from the Hotel Naçional. Frequently relayed by San Sebastian and Seville. **B. G. (N.W.10).**—No, this was Brussels, *not* Radio Toulouse, although this latter station is still working on about 500 metres. The high-power station does not appear to be working every day, and this would account for your receiving Brussels at weaker strength on some evenings. **S. V. H. (Beeston, Notts).**—Not a Spanish station, but Bordeaux-Radio-Sud-Ouest, which announces in both French and Spanish. It is said to be working on 450 metres. **A. J. (Brondesbury).**—Definitely Milan. Relays of operatic performances are regularly taken from the Scala Opera House, but the title of the work broadcast is seldom published in the advance programmes. **H. V. W. (Salisbury).**—Your details are too vague, some estimate of WL must be given; if you cannot do this, state between which two definitely logged stations you have received the transmission. We regret we are unable to trace. **L. R. (Ilford).**—Ljubljana, now on 580 metres. The German language heard at 6.30 p.m. G.M.T. was a lesson. Interval signal: the call of the cuckoo. **H. E. (Cardiff).**—Radio Paris, early transmission 6.45 a.m. of physical exercises, repeated at 7.30 a.m., and followed by a reading of cuttings from morning papers (studio Press bulletin). **B. D. (Plymouth).**—Budapest, a relay from a local restaurant, almost nightly from about 10 p.m. G.M.T. **McD. (Killochan).**—Possibly Falun, own transmission, but we cannot confirm. The interval signal is a striking of a bell (twenty-two strokes to the minute). **F. L. (Yeovil).**—Radio Maroc, slightly under Kattowitz, at times well heard. Yes, during the recent spell of cold weather and snow many stations have been subject to fading. **C. F. P. (Newcastle).**—Goeteborg, relaying programme from Stockholm. The announcer pronounces the name Ghairteborry. **A. C. (Malakoff, Paris).**—If your wavelength is correct, Dublin; the puzzling language is Irish; announcements are also made in English. **J. O. (Mertsham, Surrey).**—Königswusterhausen (February 16th) a relay from the Lunapark, Berlin, of the International swimming races (Germany v. England). **A Reader (Charterhouse).**—The Budapest interval signal is played on a musical box, and is variable. It has already been changed twice since its initial installation. **P. J. B. (Maidstone).**—(1) Cannot confirm, but quite possibly the short-wave transmitter at Motala (Sweden), on 98 metres, as Stockholm frequently relays 5XX; (2) The Radio Corporation of America short-wave transmitter at Rocky Point, Long Island, New York (call: W2XG, on various wavelengths); (3) Monte Grande, Buenos Aires, working with Europe (if with Nauen—Germany—15.02 metres; replies from the German station on 14.8 metres). **T. H. R. (Deal, Kent).**—Munich, on Sunday, February 10th, stopped its programme to include a relay of Melbourne (Australia). The transmission was also taken by Nurnberg, Augsburg and Kaiserslautern, which latter station you heard.

JAY COOTE.