The Wireless World AND RADIO REVIEW

(16th Year of Publication)

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ELECTRICAL REPRODUCTION OF SOUND.

ELECTRICAL reproduction of sound dates from the coming of the telephone, and it may seem strange that the gramophone waited until broadcasting had demonstrated the possibilities of electrical sound reproduction before adopting this means of reproducing recorded music from gramophone records. Stranger still does it appear when we discover that, although the sound was reproduced by mechanical means, Edison's first phonographs were driven by an electric motor, the clockwork motor, as applied to the gramophone, superseding the electrical motor at a later date.

Broadcasting in the early days was generally regarded as a serious rival of the gramophone, and many experts prophesied that when music was freely broadcast the demand for gramophone records would undoubtedly fall off. Whether or not broadcasting is entirely responsible, the fact remains that the gramophone has enjoyed a period of unparalleled popularity running concurrently with the development and spread of broadcasting. The explanation of this is probably to be found in the fact that broadcasting has served to stimulate the interest of the public in music generally.

The reproduction of broadcasting by means of electrical equipment and loud speakers had reached a very high standard of perfection before electrical methods of reproduction began to be applied to the gramophone commercially, and there is no doubt that the result of the adaptation of this principle has opened up a new and important field in the reproduction of recorded sound. There is the added advantage that the electrically reproducing gramophone and the radio set have much of their equipment in common, the combination entailing very little additional cost. In fact, one may expect that in the near future the single instrument, whether a gramophone or a wireless set, will be almost entirely replaced for domestic use by the radio-gramophone combination.

Look for the Essentials.

The present number of *The Wireless World* is a clear indication of the extent to which the electrically reproducing gramophone is superseding the earlier mechanical equipment. There are to-day a large number of very high-grade instruments available on the market, but, as one would naturally expect, there are some others where the importance of the electrical side has been very much neglected, and the manufacturer seems to count solely upon the attractive external appearance of his equipment to effect sales. This is a very short-sighted policy, for the principles of low-frequency amplification are now so well known that there is no possible excuse for attempting to sell an inferior product, and we believe that the public generally would much prefer that the essentials should be sound, even at the expense, perhaps, of a modification in the external appearance which questions of cost might necessitate.

Readers have recently urged, through the Correspondence columns, that the B.B.C. should transmit audible notes of standard frequency as a means of assisting the listener and experimenter to test the performance of his receiving equipment. The alternative suggestion was also made that gramophone records should be prepared which would fulfil the same purpose. We have recently had the opportunity of using a series of such records, prepared by The Gramophone Company, and a similar series, we understand, will shortly be available to the public. In experimental work a great many applications for these records may be found, and, in particular, they have been used by us in preparing the comparative data on the performance of pick-ups published elsewhere in this issue.

RADIO-GRAMOPHONE COMBINATION

A Gramophone Amplifier with Provision for Broadcast Reception.

By H. B. DENT.

MANY of the new electrically cut gramophone records have reached such a high standard of perfection that the ordinary method of playing hardly does them justice, and the deficiencies inherent in the system impart quite a different colouring to the reproduction. Although careful design of the sound box coupled with the use of logarithmic horns has greatly improved matters, the electrical means of reproduction using a really good amplifier and loud speaker is undoubtedly the ideal way of obtaining a true rendering of the electrical recordings.

During the past year or so manufacturers of wireless sets have realised the advantages gained by electrical reproduction, and many now make provision for the use of a gramophone pick-up. This subject has received, also, considerable attention in *The Wireless World*, and towards the end of last year a gramophone amplier, operated entirely from the supply mains, was described.[1] In the past it has been the policy to regard gramophone reproduction as a side issue, the apparatus being essentially a wireless set. In the present case, however, the order of things is being reversed, and the equipment described is first and foremost a gramophone amplifier with provision for receiving broadcast matter from a near-by station. In view of this, the wireless side may not conform with all that has come to be regarded as good wireless practice, and the disposition of the associated components has been made subservient to the requirements of the gramophone equipment.

The theoretical circuit.

To give greater emphasis to this fact, the cabinet chosen is designed on gramophone lines. Moreover, this enables the turn-table, motor, and other gramophone accessories to be accommodated more easily than would be the case if a standard wireless cabinet had been used. It will be noticed from the illustrations that a spring motor is fitted; also, batteries have been catered for in preference to electrical equipment throughout. All electrically operated sets must be designed either for D.C. or A.C. supply mains, but battery-driven apparatus is independent of the nature of the domestic electric supply. The spring motor is economical to run, and initial costs are lower.

The original idea was to build a good amplifier with the gramophone equipment housed in the same cabinet, and provide a simple aerial circuit for outside broadcast reception. This, however, was to be subsidiary to the main apparatus, although actually a part of it, and the requirements of the wireless side were not to be allowed to influence, in any way, the design of the amplifier. It was thought that two valves would give ample volume for gramophone reproduction, and a simple detector, with perhaps reaction for those not very favourably situated in respect to a broadcast station, would answer the purpose in this case, especially as reception from the local station only would be required. A two-valve amplifier could be built having a good frequency characteristic, and excellent results would be assured. But electrical pick-up devices appear to have altered considerably since last the writer experimented with them, as first tests quickly revealed. The majority worked admirably with this simple arrangement, but there were many that required three valves to give volume comparable with that obtained from the ordinary gramophone.

Having decided that three valves were necessary, the next point that required clearing up was how to maintain the same high standard of quality as obtained from the original two-valve amplifier without seriously impairing the sensitivity of the radio portion, and thereby necessitating adding to the total number of valves. While admitting that broadcast reception is only of

[1] *The Wireless World*, December 5th, 1928.

Radio-Gramophone Combination

secondary importance, the fact that many users may be 50 miles or more from a main station had to be considered. The only obvious way out of the difficulty was to effect a compromise.

The design decided on subsequently was one which would give reasonably good sensitivity for wireless reception and still maintain a high standard of quality when reproducing gramophone records. The electrical output from the various pick-up devices varies widely, and some means of volume control must be available, otherwise serious overloading will occur. Where, then, should the volume control go, and what form should it take? There are many courses open, but a detailed treatment of the merits and shortcomings of each would be beyond the scope of this article. Having reviewed the several arrangements applicable to this particular case, it was decided that control should take place between the first and second valves. This choice had the additional advantage over many of the alternative arrangements, in that the volume control could be used for both outside reception as well as for gramophone reproduction. The theoretical diagram of the arrangement finally decided on is given in Fig. 1.

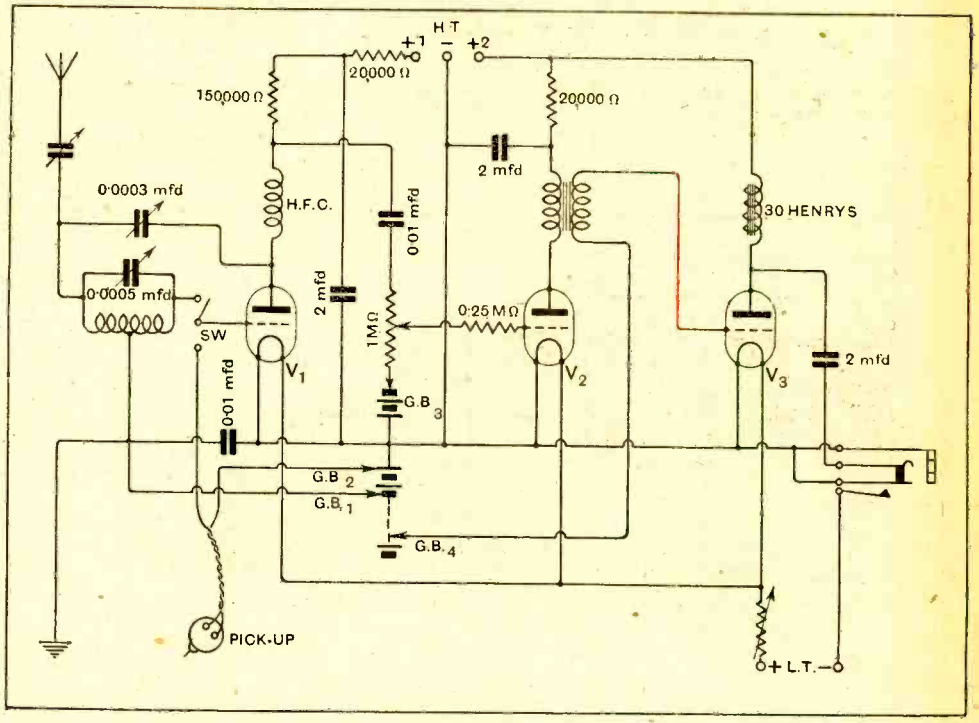


Fig. 1.—The theoretical circuit diagram. The semi-fixed aerial condenser is variable between 0.000025 mfd. and 0.0003 mfd.

For outside broadcast a regenerative detector followed by a straightforward two-stage L.F. amplifier is used, and by throwing over a simple single-pole switch, all three valves are employed as amplifiers for the gramophone pick-up.

The aerial circuit comprises a centre-tapped plug-in coil tuned by a 0.0005 mfd. variable condenser; any good make of coil may be used, and a No. 60, or its equivalent, will be required. The centre point of the

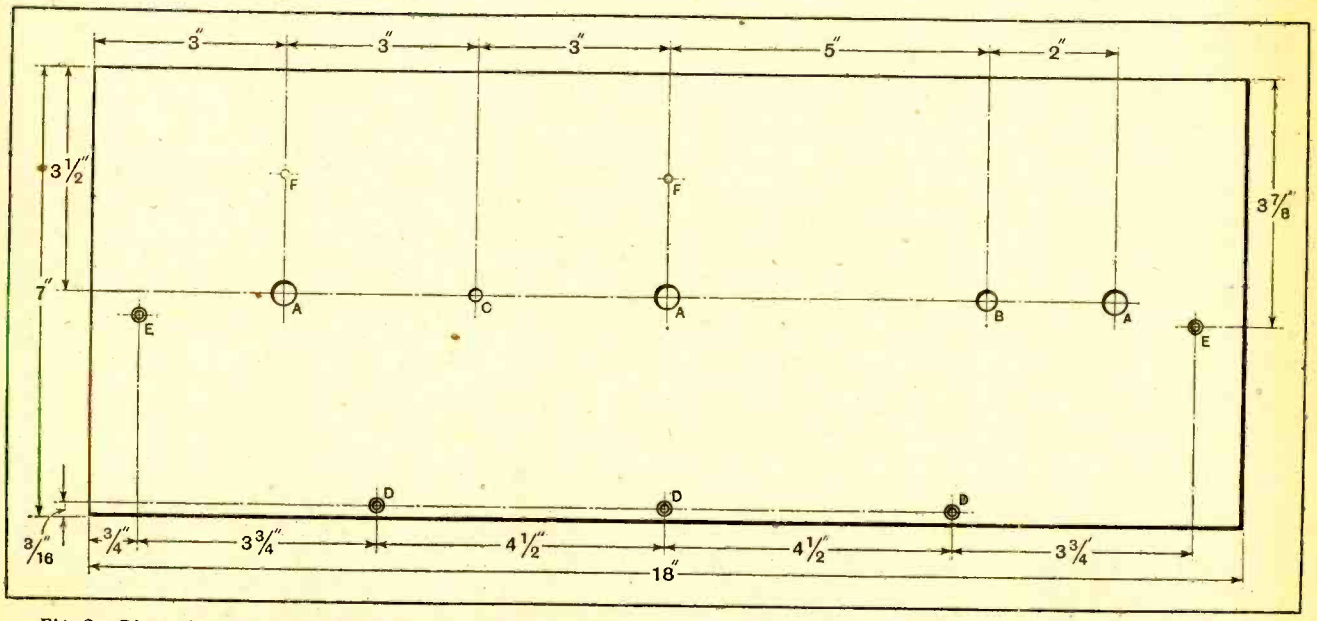


Fig. 2.—Dimensions and drilling data for the panel. A=3/8in. dia.; B=5/16in. dia.; C=3/16in. dia.; D=1/8in. dia., countersunk for No. 4 wood screws; E=1/8in. dia., countersunk for No. 6 B.A. screws; and F=1/8in. dia.

Radio-Gramophone Combination.—coil is connected to the earth and L.T. negative of the first valve *via* the grid bias battery; anode bend rectification is employed, therefore, but for no particular reason other than that this method is least likely to introduce distortion, although perhaps being not quite so sensitive as the leaky grid method. Sensitivity, however, does not concern us here. Beyond the first valve there is little that requires comment, as the subsequent stages follow conventional practice. The following points, however, are of some importance, and should be borne in mind when constructing the set.

The one megohm potentiometer in the grid circuit of the second valve is an Igranic "Megostat," and as this is provided with a graded resistance track it is essential to adopt the connections shown on the practical wiring plan. Unless this component is connected the correct way round the control of volume will be unsatisfactory, as for three-quarters of the movement no effect will be noticed. The last quarter revolution, however, will reduce the output from maximum to a mere whisper, whereas the control should begin to take effect on first rotating the knob. Decoupling resistances and large capacity by-pass condensers have been fitted in each anode circuit, with, of course, the exception of the output stage, and it would be courting trouble to omit these.

It has not been thought necessary to fit a filament

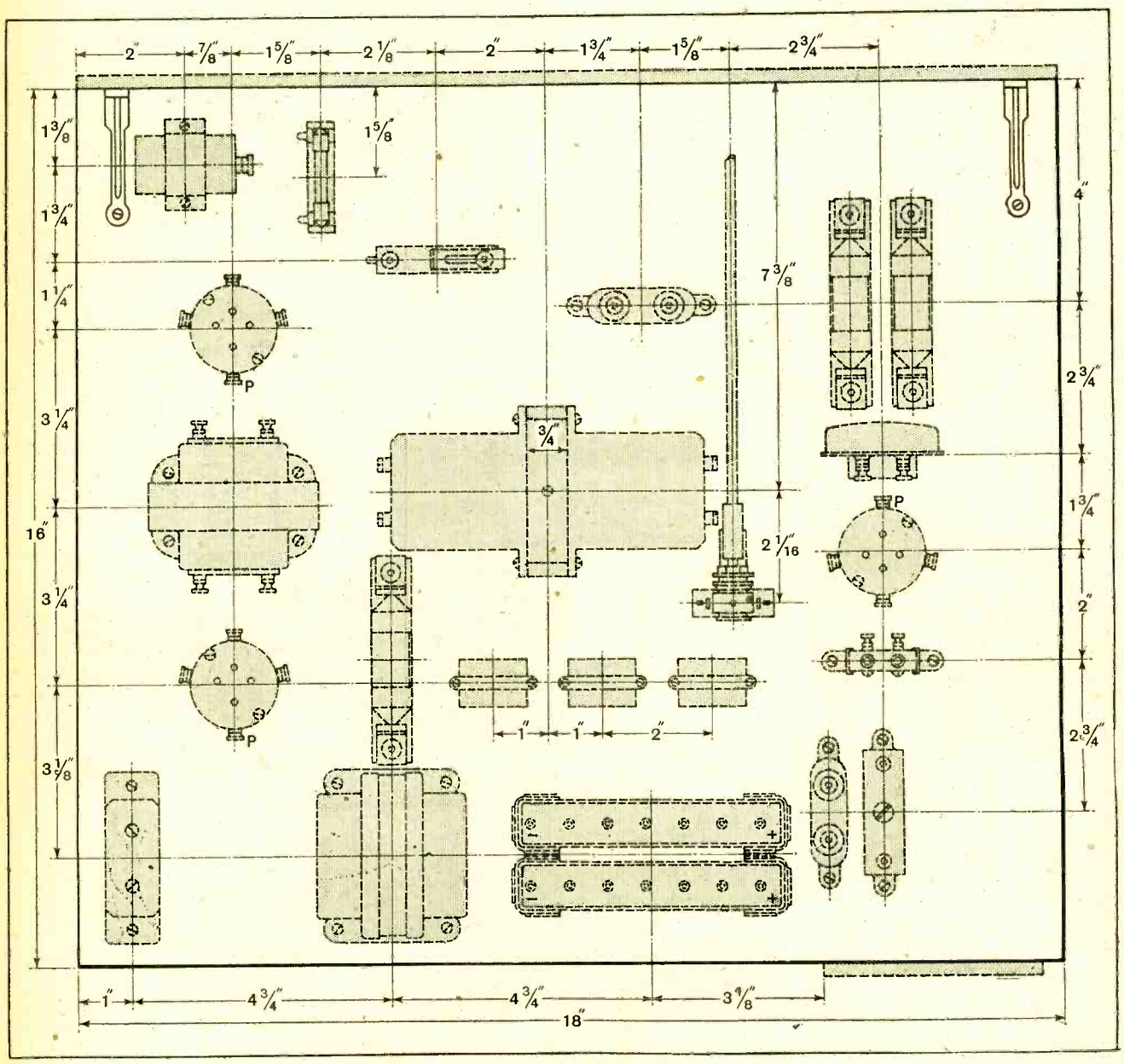


Fig. 3.—Layout of the components on the baseboard.

LIST OF PARTS.

1 Baseboard, 18" × 16" × ⅜".
1 Ebonite Panel, 18" × 7" × ¼".
1 Ebonite terminal strip, 1½" × 4" × ¼".
1 Single coil holder (Lotus).
1 Coil, No. 60, centre tapped (Lewcos).
1 Variable condenser, 0.0005 mfd. (Utility "Mite").
1 Variable condenser, 0.0003 mfd. (Utility "Mite").
2 Dials for above.
1 Grid leak. 0.25 megohms (Loewe).
1 Variable high resistance, 1 megohm (Igranic "Megostat").
1 H.F. choke (Igranic).
1 Formo-Dens r, 0.000025/0.0003 mfd. (Formo).
2 Fixed condensers, 0.01 mfd. Mica (Dubilier B775).
3 Fixed condensers, 2 mfd. 500 D.C. test (Hydra).
3 Valve holders (Burton).
1 Jack, open circuit filament control (Igranic P.65).
1 Plug (Igranic P.40).
1 Semi-fixed resister, 6v. 0.7 amps. (Peerless No. 810).
1 L.F. transformer (Lissen "Super").
1 L.F. choke 30 henrys (Ferranti B1).
3 Porcelain 2-way connectors (Athol).
1 Porcelain grid leak holder (Bulgin).
2 "0" cells (Ever-Ready).
2 Grid bias batteries, 9 volts (Hellesen).
2 pairs of grid bias clips (Bulgin No. 1).
2 Yards Varlac cable (Flexible Electric Cords Ltd., Queensway, Ponders End, Middlesex).
1 Pair 3" panel brackets (Camco).
1 Anode resistance, 150,000 ohms and holder (Dubilier).
2 Anode resistance, 20,000 ohms. and holder (Dubilier).
1 Single-pole double-throw switch (Wearite).
3/16" Brass rod, 9" length, handle for above.
1 Motor and turntable, Type B.28 (Collaro, Ltd., Culmore Works, Culmore Road, S.E.15).
1 Gramophone pick-up and tone arm (B.T.H.).
1 Gramophone cabinet, 18" wide, 18½" deep, 9⅜" high, with lid 3" depth (Camco).
2 Terminals (Godwinex).
9 Wander plugs (Clix).
2 Spade ends (Clix).
2 Dial indicators (Bulgin).
Quantity No. 18 S.W.G. Copper Wire, Sistoflex, Screws, etc.

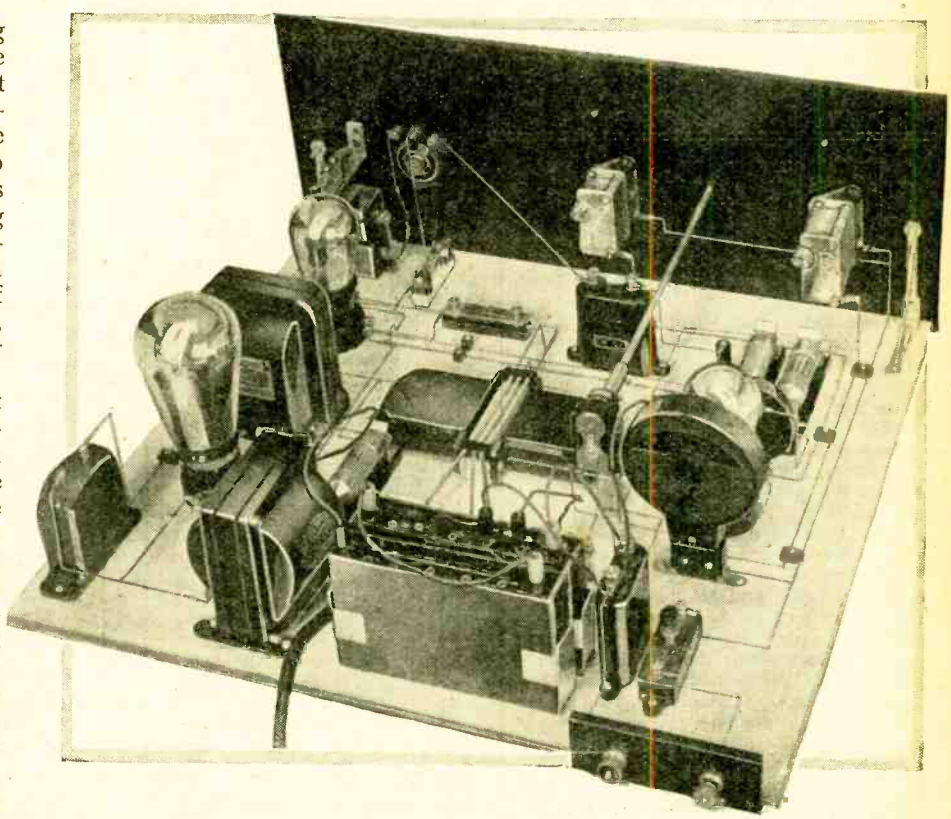
Approximate cost of parts (excluding valves and cabinet), £13.

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.

switch, as the loud speaker plug can be made to switch on the valves when inserted in the jack. Incidentally, the H.T.– is common to the L.T.– of the accumulator, although in the theoretical diagram this is shown, for convenience, as being connected to the negative busbar on the valves' side of the jack. In practice it makes no difference whatsoever to which side of the switch this is attached, as the circuit will be completed *via* the accumulator and positive filament wiring.

Investigation over a long period has proved that the high tension battery does not suffer harm by being left connected to the set with the valves unlit, and there is no object in complicating matters by introducing extra switching to completely isolate both batteries. The only danger is a breakdown in the dielectrics of any of the by-pass condensers, but this is not likely to occur with high-class components.

The construction should not present any difficulty, as particular attention has been given to the layout and choice of the components. The amplifier and receiving circuits are assembled on a baseboard 18in. × 16in. and a panel 18in. × 7in., which when completed slides into the cabinet containing the gramophone equipment. The set can be tested and adjusted, if necessary, outside the cabinet, and access to every part is easily obtained. The only constructional work necessary, apart from assembling, is in connection with the switch. It was not considered wise to fit a switch on the panel and run long leads from the grid of the detector valve, as this might introduce undesirable coupling and possibly lead to instability, especially as there will be three low-frequency amplifiers in use most of the time. Unfortunately there has not been any demand for switches capable of being operated from the panel but with the contacts some dis-



Rear view of the amplifier removed from the cabinet. Note the method of mounting the two 2 mfd. condensers to make room for the motor.

Radio-Gramophone Combination—

tance away, so recourse had to be made to devising a means of achieving this without unduly complicating the construction. The component used was a standard switch made by Messrs. Wright and Weaire, which was slightly modified and fitted with an extension connector to the spindle which would allow this to be extended to any length required. The constructor should obtain a length of $\frac{3}{16}$in. brass rod which can be cut to the size given in the detailed drawing of the switch parts.

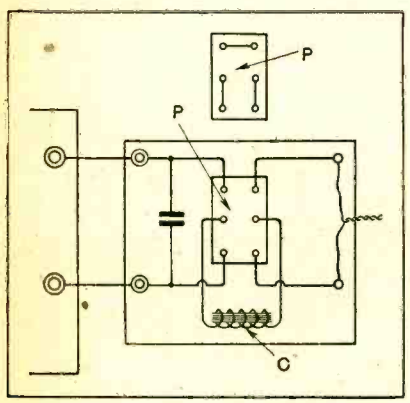
A terminal batten carrying a row of terminals may confer some advantage on the score of convenience, but it does not enhance the appearance of the set, so in this case a departure from general practice has been ventured on and all battery connections made by a seven-wire cable. The requirements could have been met by a five-way connector, but it was thought desirable to duplicate the L.T. leads, thereby lowering the resistance and preventing any appreciable voltage loss in the wires. Each lead has a distinguishing colour, and they have been allotted as follows: Black and blue, L.T. – ; red and white, L.T. + ; green, H.T. – ; brown, H.T. + 1 (H.T. for the first valve); and yellow, H.T.2 (for the second and third stages). Wander plugs and spade terminals finish off the free ends of the wire and inside the set they terminate at porcelain connectors screwed to the baseboard. L.T. – and H.T. – leads are joined together at the set and attached to the L.T. – inset in one of the porcelain connectors. The only terminals used are for aerial and earth.

So far we have been on familiar ground, as the constructional work has been essentially in accordance with wireless practice, but the next stage will be more to the liking of gramophone enthusiasts than to wireless wizards.

(To be concluded.)

D.C. Mains Supply Units.

When using a D.C. eliminator unit it is desirable that the smoothing-choke should be in series with the main that is not earthed. Owing to the fact that in



Method of switching a smoothing choke in a D.C. eliminator. (No. 300,383.)

certain cases, i.e., in three-wire supply systems, sometimes the positive main is earthed and sometimes the negative, it is not easy to comply with this condition unless a choke is inserted permanently in both leads, which is an unnecessary expense.

The figure shows an arrangement for reversing the position of a single choke C so that it can be inserted in either of the main leads as desired. The eliminator is first connected up with the mains so that current of the correct polarity passes to the set, and the six-point plug is then taken out, rotated, and reinserted in position to place the choke C in series with the correct main, the electrical continuity of the other main being meanwhile maintained. (Patent No. 300,383.)

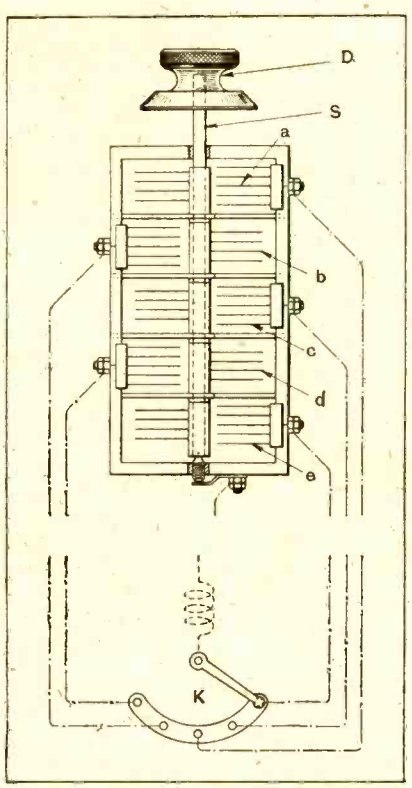
o o o o

Tuning Control.

A compound condenser is so arranged that a switch controlled selection may be made of any one of five differently tuned circuits. Five separate condensers *a-e* are mounted on a common spindle S.

PATENT NOVELTIES.

Each set of moving vanes is mounted on a separate sleeve which can be friction-clutched at will to the spindle S and adjusted to the required setting by the knob D. Leads are taken from each condenser to a control switch K, by means of which any given broadcast programme,



Switch-controlled selection of five differently tuned circuits. (No. 296,591.)

corresponding to the setting of the condensers *a-e* can be selected at will. (Patent No. 296,591.)

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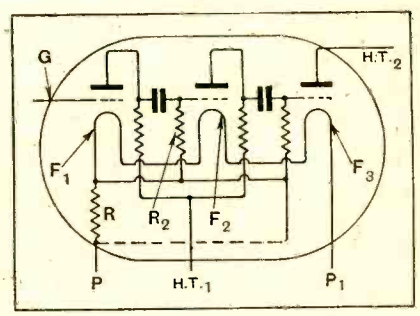
Multi-stage Valves.

Developments in the multiple-unit or Loewe type of valve are worth noting in view of the appearance of these somewhat unorthodox amplifiers on the British market for the first time. The figure illustrates a new three-stage model designed for direct operation from the electric mains. The resistance-capacity couplings are of the usual compact type mounted inside the bulb, the plate voltages for the first two stages being drawn from the lead HT1, whilst the power valve is fed from the point HT2.

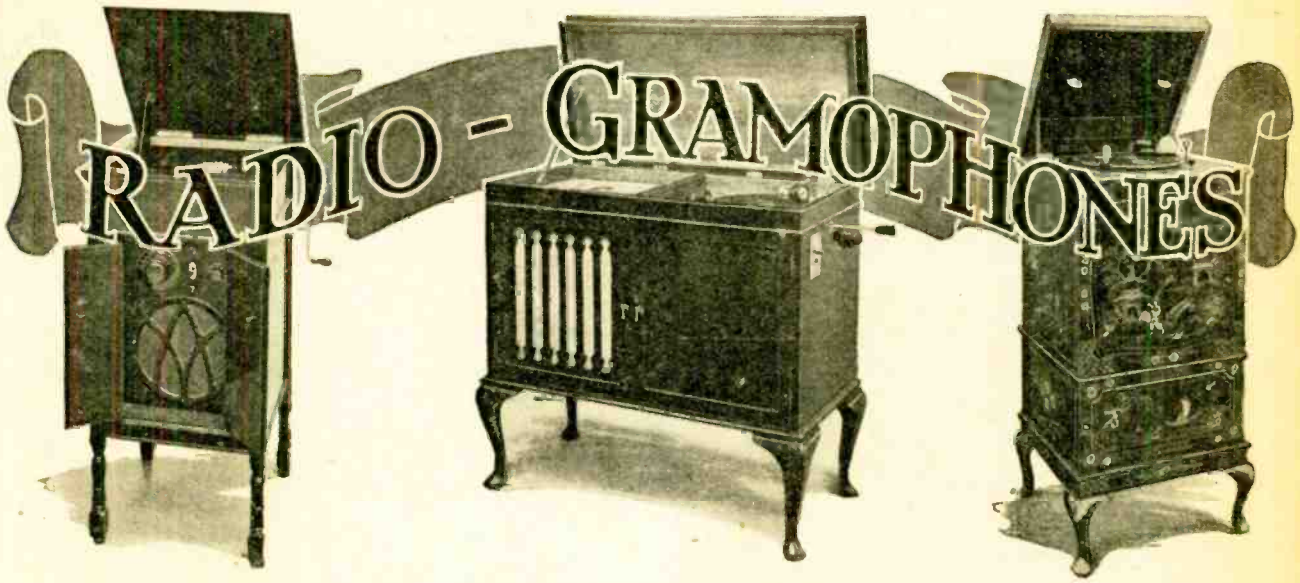
The three filaments F1, F2, F3 are all arranged in series across the two terminals P, P1. A biasing resistance R may be inserted in series with the filament lead P, to give an extra negative bias on the grid of the power valve if necessary, as shown by the dotted-line internal connection. The grid-bias for the



A Loewe multiple valve for mains operation. (No. 298,136.)

second stage is secured by connecting the leak resistance R2 to the negative pole of the preceding filament. The input lead to the first grid is shown at G. In this way the total external connections for the triple-stage valve are reduced to five, or only one more than in the standard type of three-electrode amplifier.

(Patent No. 298,136.)



RADIO-GRAMOPHONES

Commercial Equipment Reviewed.

SO varied are the tastes of those who avail themselves of the amenities of broadcasting that it is little wonder that an entire programme usually does not find favour with all listeners. The desire for an alternative programme with the items chosen at will has led to the development of the radio-gramophone—a self-contained instrument of dual purpose in which signals obtained either from the ether or a gramophone record are fed through an amplifier to a loud speaker.

Belonging to another category called "Electrically Reproducing Gramophones," there are a number of equipments on the market in which no provision has been made for the reception of broadcast; they are chiefly elaborate units for cinemas, clubs, and dance halls where the choice of music must be in keeping with the "atmosphere" and where broadcast programmes are seldom suitable.

That an electrically cut record should be reproduced electrically seems an obvious corollary, and here it should be pointed out that the loud speaker quality in those cases where a demonstration was given was all that could be desired. But the fact that many millions of pounds of public money have been subscribed and that there has been an extensive advertising campaign in connection with a number of new companies launched with the object of developing radio-gramophones ought not to be permitted to throw dust in the eyes of the prospective purchaser, who should not be unduly influenced by the attractive external appearance of a highly polished cabinet and so ignore the possibility that the interior may accommodate inferior components and an obsolete electrical circuit.

Such radio-gramophones do exist, but happily they are in the minority. Being mostly infants it is perhaps natural that some of them should have growing pains. Acoustic reaction between the loud speaker and the valves was noticed in a number of cases; its prevention must be difficult in view of the fact that the whole cabinet is often set into vibration on loud passages. The elimination of needle scratch by an absorption circuit which is effective at about 6,000 cycles has only been attempted by a few manufacturers, and hardly appears to be necessary when judged by the pleasing results obtained in its absence.

The general layout of these units is somewhat similar throughout the cases reviewed. The gramophone pick-up is in practically every case shunted by a high-resistance potentiometer the slider of which is connected to the grid of the input valve to give a volume control. If the input valve for gramophone reproduction is the first L.F. valve for radio, only one volume control is required. Provision is made in some instances for ordinary gramophone reproduction through a sound-box, tone arm and trumpet, thus allowing for the day when the valve amplifier is out of action, due either to a fault or to the absence of batteries on charge. In many of the more elaborate units the motor and valves are mains-driven. A simple trip is used to break the mains circuit when the pick-up needle has reached the end of the record.

The Electric Gramophone with Two Turntables.

It is becoming a recognised practice to feed the filaments of super power output valves with raw A.C.; the earlier valves are chosen with indirectly heated cathodes or fed from a trickle-charged L.T. accumulator.

A large number of all-mains cinema electrically reproducing gramophones are finding their way on to the market; they are equipped with two turntables and a double potentiometer fader which brings in the new record while fading out the old without any hiatus being aurally perceptible. The radio circuits show little originality; a few receivers were equipped with screen-grid valves, including the new indirectly heated AC/S valve, but only in isolated cases was there a serious attempt to obtain a high-stage magnification from two such valves. In the following pages the essential technical details of twenty-six equipments are given.

Radio-Gramophones.—

S. G. BROWN.

A dual-turntable cinema equipment known as the "Electrogram" (as illustrated) is marketed at £175. No provision is made for radio. The complete equipment, including grid bias, is mains-operated, and 400 volts is obtained for the last valves from A.C. mains, whilst for D.C. a rotary converter will be supplied. Two Brown pick-ups are used, and an ingenious double potentiometer, known as a "fader," and operated by one knob, is of particular interest, for as the scenes change

The "Electrogram" dual turntable cinema equipment made by S. G. Brown.

in the cinema one record can be faded out as the other is faded in, the change being imperceptible. Either one or two moving coil speakers can be used, the field current being obtained from the mains. A three-valve amplifier, consisting of an H.L.-point-8 valve transformer-coupled to two L.S.5As in parallel (with choke filter output), bears evidence that careful attention has been paid to the safe accommodation of large grid swings to avoid overloading; a demonstration amply justifies this assumption.

S. G. Brown, Ltd., Western Avenue, North Acton, London, W.3.

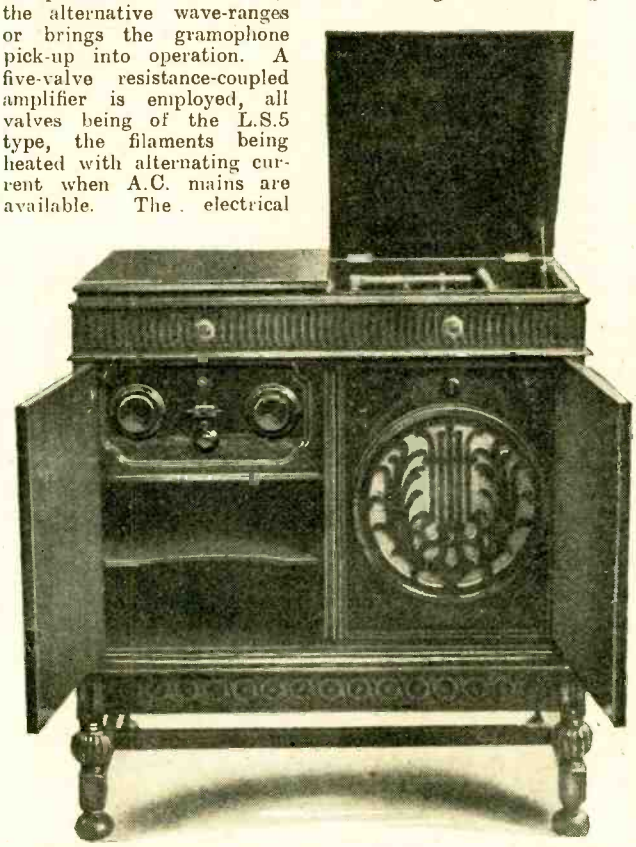
C.A.C.

Radio-gramophones from 35 guineas to £95 are marketed. The lower-priced models have mechanical motor and battery-operated valves, whilst those at the higher prices are completely mains-driven. The £75 model illustrated incorporates a B.T.H. pick-up and a G.E.C. universal (D.C. or A.C.) motor and an automatic device which cuts out the motor and breaks the valve current when the record has been played. A pilot light gives warning when the motor is running and also serves as a series resistance to reduce the mains voltage. A ½-megohm variable resistance (volume control) shunts the pick-up output, which is fed to four Cosmos A.C. valves. Batteries (except grid bias) are replaced by a Cosmos eliminator, and a choke-filter unit feeds the final output to an "Ultra" balanced armature with folded exponential horn loud speaker. For radio, five valves are employed—the first, an H.F. valve, being the new indirectly heated screen-grid valve (AC/S) which is carefully screened in a copper box. The three L.F. valves are coupled by the "C.A.C. coupler," which consists of 47-gauge Eureka wire-wound transformers without any iron core. The coupling between primary and secondary is tight, so that there is probably considerable capacity between these windings. No attempt to explain this unorthodox amplifier can be made here, but suffice it to say that very considerable volume is available and that the high notes do not appear to be missing, as might be the case if a conventional multi-stage resistance amplifier were employed. An indoor or outdoor aerial is required for radio, whilst for tuning there are two controls, together with a capacity control of reaction.

City Accumulator Company, 1A, New London Street, London, E.C.3

CANTOPHONE.

Both radio reception and electrical gramophone reproduction are provided in the Cantophone. A change-over switch gives the alternative wave-ranges or brings the gramophone pick-up into operation. A five-valve resistance-coupled amplifier is employed, all valves being of the L.S.5 type, the filaments being heated with alternating current when A.C. mains are available. The electrical



C.A.C. radio-gramophone. The gramophone motor and valves are mains operated.

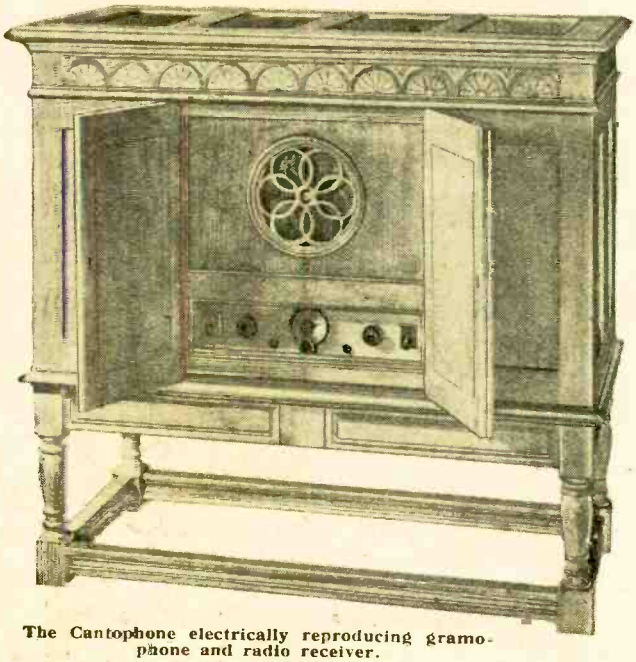
pick-up is a Woodroffe, and the moving coil loud speaker a Magnavox. When used for radio reception, the first valve becomes the detector, and is used in conjunction with self-contained frame or outside aerial. The price is 95 guineas when supplied with walnut cabinet measuring 3ft. 4in. in height, 2ft. 8in. wide, and 1ft. 8in. deep.

The Cantophone Wireless Company, Remo House, 210, Regent Street, London, W.1.

CELEBRITONE.

This company specialises in electrically reproducing gramophones and does not manufacture radio-gramophones. The domestic models, ranging in price from £47 10s. to £67 10s. according to finish, are equipped with automatic trips to break the electric motor circuit and both H.T. and L.T. valve feeds when the pick-up has reached the end of the record. The £55 model (the type illustrated) has a B.T.H. pick-up and electric

Radio-Gramophones.—motor and a moving coil loud speaker with mains-energised field. The amplifier is interesting and is well proportioned to accept the successively growing signal voltages. There are four valves; the first two are H.L.610 valves coupled in choke push-pull to two P.625 valves, also in choke push-pull. For A.C. mains the H.T. requirements are obtained from gas arc

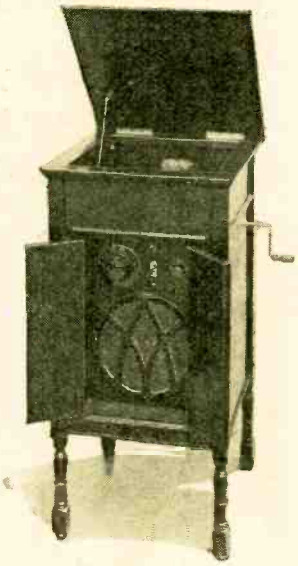


The Cantophone electrically reproducing gramophone and radio receiver.

rectifiers and the L.T. accumulators are trickle charged. In the more ambitious electric gramophones for dance halls and clubs produced by this firm, the H.T. and L.T. are derived from rotary converters. Throughout the range of apparatus examined there was evidence of the most accepted modern practice, and the loud speaker performance was adequate in volume and faithful in reproduction.

Celebritone, Ltd., Commerce House, 72, Oxford Street, London, W.1.

Celebritone electrically reproducing gramophone. An automatic trip cuts out the motor when the record is finished.



Two-valve radio-gramophone manufactured by Celebrity Gramophones, Ltd.

CELEBRITY.

For the modest sum of £18 15s. a self-contained radio-gramophone, known as the "Chelsea," is being sold by this company. Housed in an oak or mahogany pedestal cabinet (illustrated) is a hand-wound gramophone motor and turntable, also a two-valve transformer-coupled amplifier. The first valve, which also serves as a detector when the unit is switched over to radio, is a steep-slope P.M.D. type valve, which is followed by a pentode coupled to a balanced-armature cone loud speaker. Capacity-controlled reaction is provided, and a switch allows the short or long waveband to be received on the single tuning dial. The valve filaments and anodes are battery fed.

Celebrity Gramophones, Ltd., 179/181, Bermondsey Street, London, S.E.1.

CLIFTOPHONE.

A Super Cliftophone has been devised for reproducing at full volume organ and orchestral music without distortion. It is a double turntable equipment

Cliftophone double turntable model.

fitted with the Cliftophone pick-up, a feature of which is the provision of a parallel link motion to ensure a perfect tracking action. The equipment is entirely mains-operated, for which purpose a motor generator is supplied with appropriate smoothing circuits.

Cliftophone and Records, Ltd., 61, South Side, Clapham Common, London, S.W.4.

C.W.C.

A radio-gramophone with clockwork motor and battery-operated valves is marketed at £45 to include royalties. The radio set has an internal frame aerial, the orientation of which is arranged by a knob on the top panel. A screen-grid valve is coupled to the detector, which, in turn, is coupled by two L.F. valves to a G.E.C. cone loud speaker. The last valve is a pentode. The controls include two tuning dials, capacity reaction and a potentiometer volume control across the G.E.C. pick-up. For the electrical reproduction of records the last two valves only are used. One winding of the gramophone

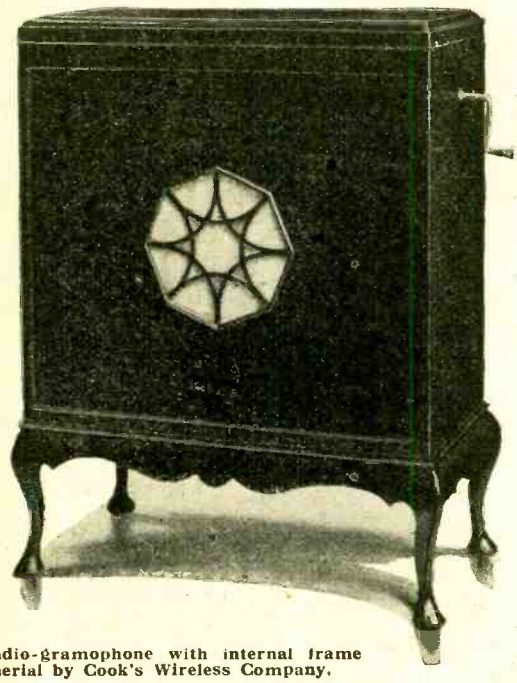
Radio-Gramophones.—

motor will suffice to play four 10in. records, which can be housed in a special compartment holding eighteen.

Cook's Wireless Co., Ltd., 23, St. Helens Street, Ipswich, Suffolk.

DUBILIER.

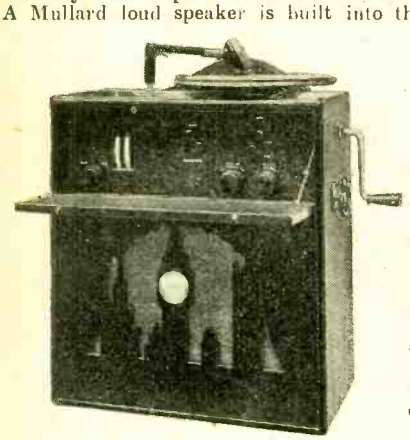
The Westminster radio-gramophone belongs to the category of transportable wireless receivers with a gramophone unit incorporated. The turntable and pick-up are exterior to the cabinet and the motor is housed within the receiver. The price is 40 guineas, complete with four valves, royalties and all accessories. For radio there is a frame aerial (both wave-



A radio-gramophone with internal frame aerial by Cook's Wireless Company.

bands are provided for) coupled to the detector by two screen-grid valves, the second of which only is tuned. The problem of using two screen-grid valves in a portable set has been tackled in earnest. The screening box has no fewer than six compartments, and even the switches are screened. The two tuning controls are arranged as adjacent thumb dials, which can be treated as a differential ganging scheme. The radio volume control is interesting, and consists in varying the screen volts by a decoupled variable resistance in the screen circuit. A Mullard loud speaker is built into the cabinet, and is fed from a pentode output valve.

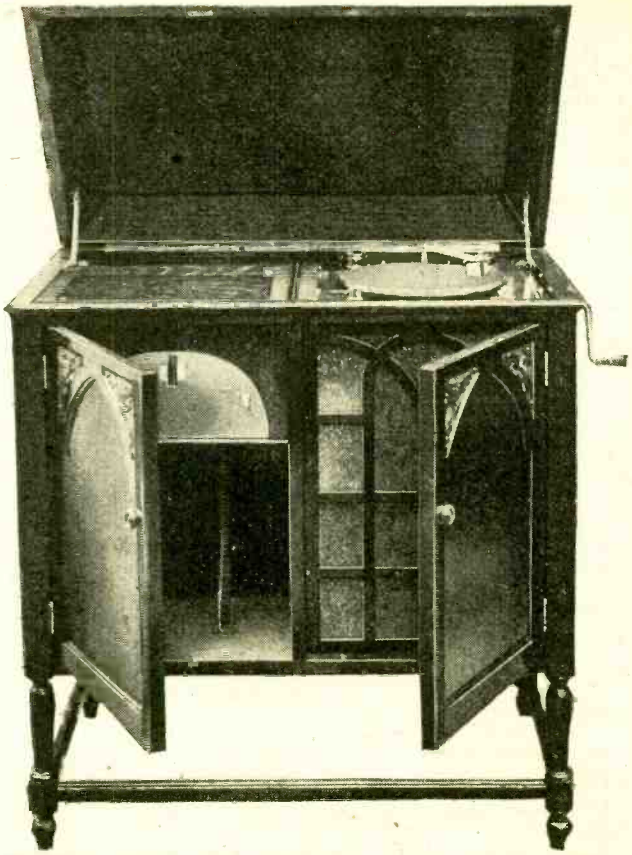
Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.



The "Westminster" transportable radio-gramophonemade by Dubilier.

EDISON BELL.

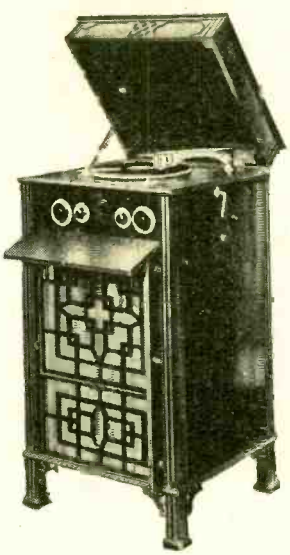
A console model radio-gramophone at £65 is available. For radio an outside aerial is required. High-frequency amplification is carried out with a screen-grid valve coupled to a detector, which, in turn, is coupled by two L.F. stages through a



The Edison Bell All-Mains radio-gramophone. A screen-grid valve is employed.

choke filter to a moving coil loud speaker, the field winding of which is energised from the mains. The last stage has two super-power valves in parallel with 300 volts H.T. Both L.T. and H.T. are derived from lighting mains. A feature of interest is a pitch-control. There is a hand-wound Garrard motor permanently fitted in an oil bath, or the apparatus can be supplied with an electric motor to order. As regards tuning, the panel is fitted with a triple-thumb control; the left-hand dial is the aerial tuner, the centre is reaction, and the right hand H.F. tuning. At the bottom of the panel is a thumb-control wavelength switch, also a thumb control for volume.

Edison Bell, Ltd., Glengall Road, Peckham, London, S.E.15.



Electramonic Home Combined Model (mahogany).

ELECTRAMONIC.

The radio receiver embodied in the Electramonic combined radio-gramophone is of modern design, in that it incorporates two screen-grid amplifying stages. As a result the radio receiver is exceedingly sensitive when used with the enclosed frame aerial. Two tuning controls are provided, together with reaction and volume adjustments. A two-range switch provides for reception on both wave ranges. Provision is made for connecting an elevated aerial. The loud speaker is a Celestion cone. When used for gramophone reproduction, the detector and

Radio-Gramophones.—
two L.F. stages form a three-stage amplifier. A rigid tone arm of unique design is fitted, the end being arranged to rotate to facilitate needle changing. Battery-operated models are available with hand-wound gramophone motors, or, alternatively, the mains-operated set comprises electrically-driven turntable, together with battery eliminator. A trickle-charger is provided for the filament heating battery. The price of the electrically-operated model in mahogany or walnut cabinet is £82.

The Electramonic Co., Ltd., Bear Gardens, Park Street, Southwark, London, S.E.1.

FERRANTI.

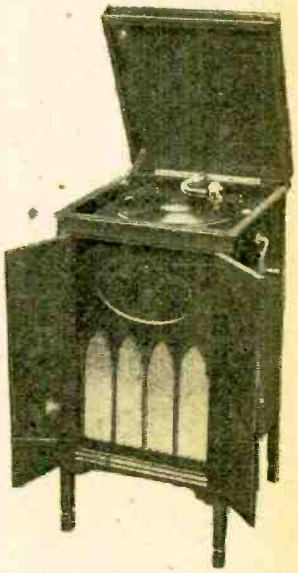
Although not built into an elaborate cabinet and sold to the consumer the ambitious radio-gramophone equipment of this company finds itself at nearly all the exhibitions where loud speaker demonstrations are allowed. At the British Industries Fair at the White City, for instance, more than 150 loud speakers on various stands accepted by wire the radio or gramophone transmissions from the Ferranti amplifiers. For radio an H.F. transformer-coupled screen-grid valve was followed by an anode bend detector, in the plate circuit of which was a milliammeter to give warning of distortion by under-loading and evidence of grid current by overloading. The rectified signals were then passed on to two stages of

The generous His Master's Voice equipment.

push-pull—the first having two DEL610 valves, and the second four L.S.5A valves in parallel push-pull; milliammeters were wired into the plate circuits to reveal rectification and grid current. The filaments of the L.S.5A valves were heated with raw A.C., but the earlier valves derived their filament current from accumulators. To prevent any acoustic reaction the detector valve was entirely enclosed in a leaden chamber. When dealing with large signal amplitudes, it is possible for the gettering on two adjacent push-pull valves to obtain an electrostatic charge and cause a high-pitched whistle; this was prevented by covering the valve bulbs with tin-foil and earthing it. The illustration on page 253 shows only one panel out of the four paralleled panels usually employed.

Ferranti, Ltd., Hollinwood, Lancashire.

The Igranic electrically reproducing gramophone. Indirectly heated cathode valves are used in the early stages.



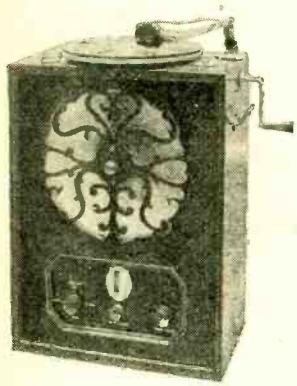
Lissen battery-operated radio-gramophone.

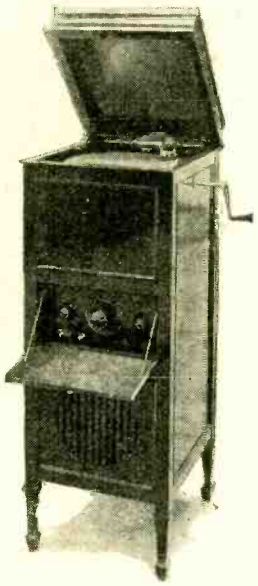
H.M.V.

As the forerunner of electrically reproducing gramophones, the H.M.V. equipment is of generous design. It comprises three units, the playing desk, the amplifying equipment, and the loud speaker. Unlike many electrically reproducing

The radio-gramophone equipment made by Lock-Atkinson.

Radio-Gramophones.—equipments which are assembled from standard accessories, all of the component parts are designed and manufactured by the Gramophone Co. The pick-up is of original design, the two poles of the polarising field being presented to the centre and rim of a small steel disc. Flexing of the diaphragm about a centre point is such that the pick-up is differential in its action. Oil of suitable viscosity fills the interior, introducing





(Above) M.P.A. transportable radio-gramophone.

(Right) The pedestal radio-gramophone equipment manufactured by Ormond.

damping in a more satisfactory manner than can be obtained by spring tensioning or rubber cushions. The pick-up arm is balanced by a counterweight. The low-resistance winding of the pick-up is shunted by a variable resistance, which serves as a volume control. An electric motor drives the turntable. For housing apart from both the playing desk and the loud speaker is the amplifying unit, which comprises a two-stage amplifier with a generous push-pull output. A rotary machine provides an alternating current supply, which is stepped up and rectified to provide the high anode voltage. The loud speaker diaphragm is 30in. in diameter and is of extremely thin stretched aluminium sheet. Drive is by moving coil. The price of the complete outfit for alternating current operation is £250, or with A.C. motor generator £285.

The Gramophone Co., Ltd., 363-367, Oxford Street, London, W.1.

The Panatrope electrically reproducing gramophone. The valves are mains-fed as is also the field magnet of the moving coil loud speaker.

IGRANIC.

Retailing at £65, an electric gramophone is now being marketed by this company. The gramophone turntable and motor are housed in a separate cabinet, which can be bought apart from the other equipment. In the illustration this unit can be seen on the top of the amplifier cabinet. A Phonovox pick-up is used and a potentiometer serves as a volume control. The tone-arm has a balance-weight in order to obtain the maximum possible life from each record. The motor, which is of the induction type, is A.C. mains-fed, as also are the valves. The two-valve amplifier contains a Cosmos A.C./G. valve, followed by a B.12 valve. A single R.H.1 valve provides 425 volts rectified H.T., and a Magnavox loud speaker is incorporated. For radio work a separate receiver and outside aerial are required. A dual turntable cinema equipment at £165 is available in which the double fader is an interesting feature.

Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.

LISSEN.

According to finish, the radio-gramophones available are retailed from £30 to £32. A Lissen pick-up is used with an orthodox variable high resistance as volume control both for gramophone and radio. A three-valve equipment is embodied for radio, the last two valves being used as a gramophone amplifier. An outside aerial is required for broadcast transmissions, which are amplified at high frequency by a screen-grid valve coupled by tuned anode to a leaky grid detector, which in turn is transformer-coupled to a pentode. Reaction is provided

Phantestra radio-gramophone with pentode output.

and variations in capacity of different outside aerials are partially balanced out by a variable series aerial condenser. Super-sized H.T. batteries of 180 volts are supplied. The gramophone can be played, if necessary, through sound conduits without electrical amplification.

Lissen, Ltd., Friars Lane, Richmond, Surrey.

LOCK ATKINSON.

A five-valve radio-gramophone equipment housed in a figured walnut cabinet is available, selling at 36 guineas. On the gramophone side a Loewe pick-up and a hand-wound Garrard motor are used, whilst the last three valves form the amplifier. The loud speaker is an elliptoid cone with an eccentric point of application of energy so as to minimise the vibration nodes.

Radio-Gramophones.—

Should the thermionic amplifier be temporarily out of action there is provided an ordinary soundbox, tone arm and trumpet for direct gramophone reproduction. For radio there is an enclosed frame aerial, which is swung by means of a knob from the control panel and in which waveband switching is arranged. The high-frequency amplifier contains two aperiodic choke-coupled stages so that only one tuning dial is needed for the receiver. Leaky grid detection and Reinartz reaction are employed, and the last two stages are resistance- and transformer-coupled respectively. Owing to careful decoupling it is claimed that no L.F. oscillation takes place even when the H.T. dry-cell battery develops a high internal resistance.

Lock Atkinson Wireless Company, 95, *Great Titchfield Street, London, W.1.*

The Peto Scott Radiogram de Luxe.

M.P.A.

A neat portable radio-gramophone unit about the size of a typical transportable wireless receiver is being exploited by this company. It is known as the "Octroda" and sells at 18 guineas, including royalties but without batteries. For radio, three valves are used—the high-frequency stage being a screen-grid valve coupled by tuned anode to a leaky grid detector. The output valve is a transformer-coupled triode. An outside aerial and earth are necessary, as no frame aerial is provided. In spite of the fact that there is a screen-grid valve, only a single tuning dial is employed. There is a separate volume control for radio and for gramophone reproduction, and an M.P.A. cone loud speaker is built into the lower part of the cabinet. The gramophone turntable and the pick-up are at the top of the cabinet and exterior to it, while the motor is inside, but well away from the high-frequency components. The "Ethatrope" cinema electric gramophone, with dual turntable, is an innovation, for it is fashioned as a desk at which an operator can sit and create remarkable "effects." The whole apparatus is mains-controlled, and in the larger model four moving coil loud speakers are supplied. There is a master control for fading out one record and bringing in another without any aural evidence of the change, and individual control allows one record to be superimposed on the other. These models sell at 200 and 250 guineas.

M.P.A. Wireless, Ltd., 62, *Conduit Street, London, W.1.*

The Thermion combined gramophone and radio equipment.

The Radio-Tri-Phone gramophone amplifier. Two tone arms are provided.

ORMOND.

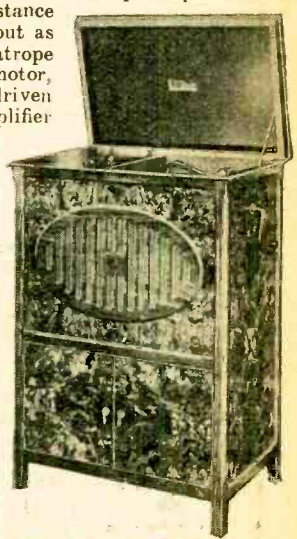
The console and pedestal radio-gramophones sell at £50 and £45 respectively. The technical details of the two models are the same. A Woodroffe pick-up with potentiometer volume control and a clockwork Garrard motor are employed. The gramophone amplifier has one input valve followed by two valves in transformer push-pull. The radio section of the equipment has four valves, which, for local station reception, are fed from an internal frame aerial. If distant stations are desired an outside aerial and earth should be employed. Short and long waves are obtained optionally by a switch and capacity-controlled regeneration is provided. The amplifier is battery-fed, three-treble capacity (180 volts) H.T. units being supplied. An Ormond loud speaker is built in behind an attractively finished grille.

The Ormond Engineering Co., Ltd., 199-205, *Pentonville Road, King's Cross, London, N.1.*

PANATROPE.

There are five models from 40 guineas upwards. The Junior De Luxe (illustrated) sells at £80, and is essentially an electrically reproducing gramophone, with no radio frequency equipment included. If a separate wireless detector and aerial are available there is, however, provision by means of plug and jack for broadcast reproduction. B.T.H. pick-ups are used in all models and high-resistance potentiometers are used throughout as volume controls. The Panatrope under review has a mechanical motor, but for £8 extra an electrically driven motor can be obtained. The amplifier contains three valves transformer-coupled as two stages; a B7 valve is followed by two B12's in parallel. The filaments are heated by raw A.C., resulting in almost imperceptible hum, whilst the anodes of the two parallel valves are fed at 240 volts from two R.H.1 rectifying valves. The loud speaker is a moving coil Rice-Kellogg with mains-driven field. Comprehensive screening of the rectifier equipment has been effected to prevent magnetic coupling. Besides a dual turntable cinema equipment there is an elaborate model at £135 entirely mains-operated with one B7 valve and three B12 valves in parallel with

The portable Triotone radio-gramophone.

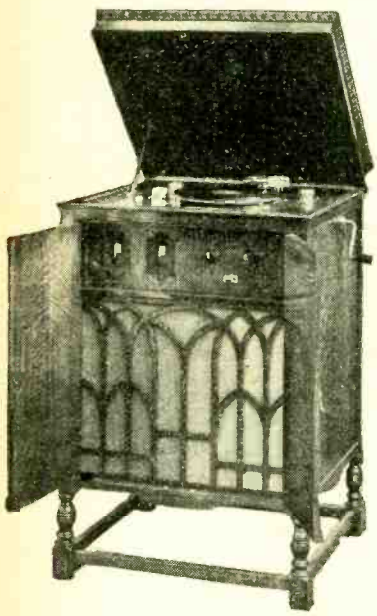


The five-valve Symphony radio-gramophone with internal frame aerial.

Radio-Gramophones.—450 volts H.T. The volume from this gramophone when demonstrated was adequate for dance halls and public meetings.
British Brunswick, Ltd., 15-19, Cavendish Place, Regent Street, London, W.1.

PETO-SCOTT.

Peto-Scott combined radio and gramophone equipments are available in five models. For the home constructor there is the Adaptagram, which takes the form of a cabinet 3ft. in height by 23in. by 17in., fitted with turntable and gramophone motor and provided with accommodation ready to receive as a unit one or other of the popular receiving sets. The Radiogram Popular is a table model with spring-operated motor and battery-connected receiving set. Complete with valves, electrical pick-up, and cone type loud speaker, this self-contained equipment sells at 19 guineas. Another model, the Radiogram Senior, is fitted with two valves, the output being a pentode. The loud speaker is of the exponential type. The Radiogram de Luxe is an A.C. mains operated equipment. It embodies a five-valve receiver with totally enclosed frame aerials. A moving coil loud speaker of the Rice-Kellogg type is provided. The price of this model is 120 guineas, and the external details of construction can be gleaned from an accompanying illustration. A still more generous outfit is the Radiogram Club Model, selling at 165 guineas.



The Universal radio-gramophone. The model illustrated is known as the "Fidelatone," and contains a non-resonant exponential horn.

Peto-Scott Co., Ltd., 77, City Road, London, E.C.1.

PHANTESTRA.

There are two radio-gramophones—the "Home" model at £35 and a model with electrically driven turntable at £37 10s. A B.T.H. pick-up is used, and shunted across it is a variable high resistance to act as a volume control. To minimise needle-scratch a shunt absorption circuit has been embodied which is effective at about 6,500 cycles. It is claimed that the harmonics above this frequency are fully passed. The amplifier consists of an L.F. valve transformer-coupled to a pentode which is directly coupled to a cone loud speaker with balanced-armature movement. For local radio reception a self-contained capacity-screen aerial is provided, but for distant reception an outside aerial and earth are advisable. There is a switch to change from short to long waves, and the reaction control is of the Hartley type.
Phantestra, Ltd. (Renn's Gramophone and Wireless Company), 22½, Cazenove Road, London, N.16.

RADIO-TRI-PHONE.

As the name would imply, the radio-gramophone manufactured by this company has three functions. As two tone arms are supplied, ordinary non-electrical gramophone reproduction can be obtained, whilst the second tone arm carries a magnetic pick-up for electrical amplification of records, and a third control brings a radio receiver into commission. An Igranic pick-up is used in conjunction with a potentiometer volume control. The last two valves of a total complement of three serve for gramophone amplification. The motor is mains-driven. A Tri-phone loud speaker is built in behind a grille; the cone is made of chemically treated rawhide. For radio there is a regenerative detector followed by two L.F. valves.
Radio Tri-Phone, Ltd., 6, Broad Street Place, London, E.C.2.

SYMPHONY.

According to finish the prices of this company's radio-gramophones range from 32 to 48 guineas. The model illustrated, which has a special lower compartment for carrying records, is marketed at 48 guineas. For gramophone reproduction three Six-Sixty 2-volt valves are used, coupled by two Igranic L.F. transformers. The loud speaker is a Symphony reed-driven cone, and the H.T. is supplied by two 60-volt double-capacity dry cells. For radio five valves are employed, of which two are coupled by aperiodic H.F. chokes—a practice which was well known in portable sets. This system requires only one tuning dial for a frame aerial which is provided within the cabinet, and which is controlled as regards orientation by a knob on the top panel. The long-wave frame is mounted at right angles to and on the same axis as that for short waves. Leaky-grid detection is used, and regeneration is obtained by capacity-controlled feed-back.
Symphony Gramophone and Radio Co., Ltd., 23-24, Warwick Street, London, W.1.

THERMION.

The radio receiver and electrically reproducing gramophone are contained in a pedestal cabinet measuring 2ft. 4in. by 2ft. 4in. by 3ft. 8in. high. On the top horizontal panel is the radio tuning gear and control levers, as well as the gramophone equipment. Behind double doors on the front is the loud speaker grille centrally placed in the baffle board. Three valves are used in an orthodox amplifying circuit consisting of resistance followed by transformer coupling, an arrangement which experience has shown avoids the high note loss associated with an all-resistance coupled amplifier combined with the compensating effects of a single transformer stage. Parallel connected valves of the L.S.5A or P.625A type are provided for the output, a special coupling having been designed to match them to the requirements of the Rice-Kellogg loud speaker. Energising current for the loud speaker field is provided in respect of the mains-operated model by a metal rectifier which is also available for trickle charging the filament heating battery. For radio

The Watmel pedestal radio-gramophone known as the "Orthotone."

Radio-Gramophones.—
reception the first valve becomes the detector, while the tuning circuit is novel and improved sensitiveness is claimed for it. The use of an outside aerial is intended. In mahogany or walnut cabinet the price is 77 guineas, and the inclusion of H.T. eliminator equipment is extra.

C. Haddon Poupard and Co., Ltd., Thermion Works, Ilford, Essex.

TRIOTONE.

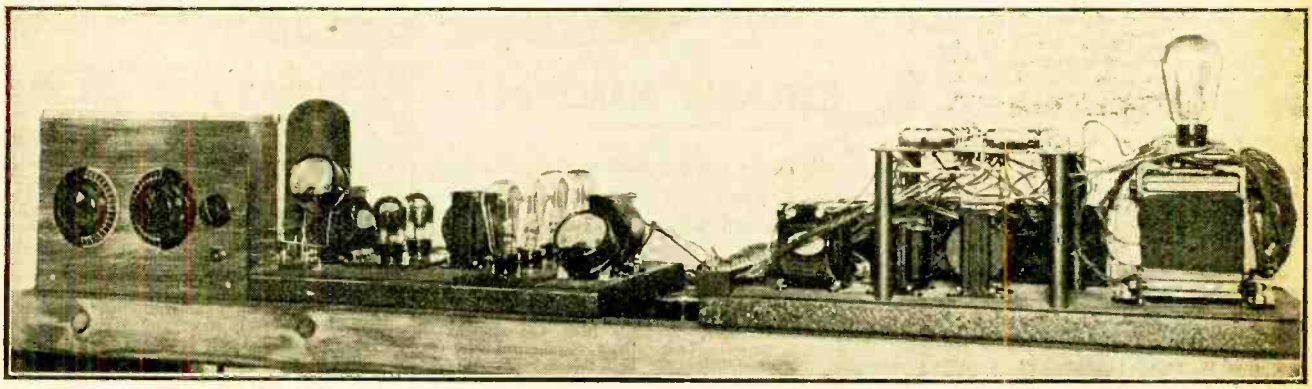
An attractive product of this company is a small portable compact suitcase radio-gramophone covered with pigskin, the selling price of which complete is 18 guineas. The gramophone turntable and motor and the five-valve radio receiver are entirely contained within the case, as also are the necessary batteries. In view of the small overall dimensions, this is no mean achievement. The arm holding the pick-up (a Triotone product) has a plug fitting, and, when inserted into a socket in the panel, cuts out the first three valves, leaving the last two, which are transformer-coupled for gramophone amplification. For radio a frame aerial is included in the lid, and should distant stations be wanted provision is made for attaching an outside aerial and earth. The equipment includes two H.F. valves, which are aperiodically coupled by chokes to a regenerative detector working on the leaky-grid principle. A National loud speaker is built into the lid, which when closed cuts off the filament current. The circumference of the aperture below the turntable has one semi-circle inscribed with 180° for condenser control and another 180° for the speed control of the motor. The H.T. battery voltage is 100. A more ambitious all-mains cabinet model is made at £75, a noteworthy feature of which is a double rotatable unit at the end of the tone arm with two needles diametrically opposite—one for electrical reproduction and the other for playing by the ordinary sound box.

Triotone, Ltd., 41, Wigmore Street, London, W.1.

UNIVERSAL.

A small table electric gramophone with exponential horn loud speaker is marketed at £12 12s. By the addition of a crystal it can be cheaply converted to a radio receiver. Radio-gramophones are available from £35, the model illustrated being known as the "Fidelatone," retailing at £45, including H.T. and L.T. accumulators. Mains equipment and electric motor are £15 extra. For gramophone reproduction three valves are used, coupled respectively by R.C.C. and transformer, and a potentiometer in the pick-up circuit provides an efficient volume control. Choke-filter output is used to feed the signals to a loud speaker of the logarithmic variety, having a hard outer shell and a soft core to prevent resonances; it is known as the "Racon" horn. A Murkham pick-up is employed. For radio work a throw-over switch brings an S.625 screen grid valve into circuit. Generous aluminium screening is provided, and this, together with the use of Dubilier Toroid coils, should prevent stray couplings. The aerial (outside) and the H.F. coupling are separately tuned, and reaction is capacity controlled. A feature of considerable interest to the owner of a "Fidelatone" is the provision of 180-volt H.T. accumulators, for which a service scheme of replacement can be arranged.

The Universal Gramophone and Radio Co., Ltd., 105, Torriano Avenue, Kentish Town, London, N.W.5.



One panel of the Ferranti demonstration equipment capable of working about 50 loud speakers. Either radio or gramophone amplification is arranged.

WATMEL.

The "Orthotone" radio-gramophone, in pedestal cabinet, is priced at 75 guineas complete. A Watmel pick-up is used, in which the tracking of the needle has received special attention; a series of cone and ball joints eliminate mal-alignment. Both filament and plate current are derived from the mains, but a hand-wound motor is used. A single variable high resistance acts as a volume control for both radio and gramophone, the electrical amplification for the latter being carried out by a dual-impedance coupling containing an anode and grid choke followed by paralleled output valves. The loud speaker consists of a balanced armature movement combined with an 8ft. logarithmic horn made of special non-resonating material. On the radio side an outside aerial is required to feed the regenerative detector, which can be tuned to either short or long waves. The "Orthotone Imperial" is a wireless receiver with three valves, having also incorporated in the same pedestal cabinet an ordinary gramophone in which electrical reproduction is not effected. The price is 25 guineas.

Watmel Wireless Co., Ltd., Imperial Works, High Street, Edgware, Middlesex.

CLUB NEWS.

Modern Loud Speakers Compared.

A demonstration of modern loud speakers aroused much interest at the last meeting of the North Middlesex Radio Society. A representative collection of the latest types was on test, each instrument being heard several times on speech and music. The discussion showed that there is considerable diversity of opinion as to the relative merits of both moving coil and reed drive loud speakers. An interesting feature of the demonstration was the test of a new type of cone manufactured by Messrs. L. I. Warwick, of Hornchurch. Thanks are due to Messrs. Lang and Squire, Ltd., and Messrs. Donotone, Ltd., who loaned a moving-coil speaker and reed-drive speaker respectively.

Hon. Sec., Mr. E. H. Laister, "Endcliffe," Station Road, Winchmore Hill, N.21.

Modern H.F. Amplification.

The high degree of efficiency attained in modern high-frequency amplification was the theme of a lecture given by Mr. R. Fearce at the last meeting of the Swindon and District Radio Society. The lecturer illustrated the many types of H.F. amplification used in recent years. Following the lecture a demonstration was given on a receiver employing one stage of H.F. detector, and two stages of L.F. amplification, excellent results being obtained with Continental broadcast programmes.

Hon. Sec., Mr. M. Hill, "Windyridge," Okus, Swindon.

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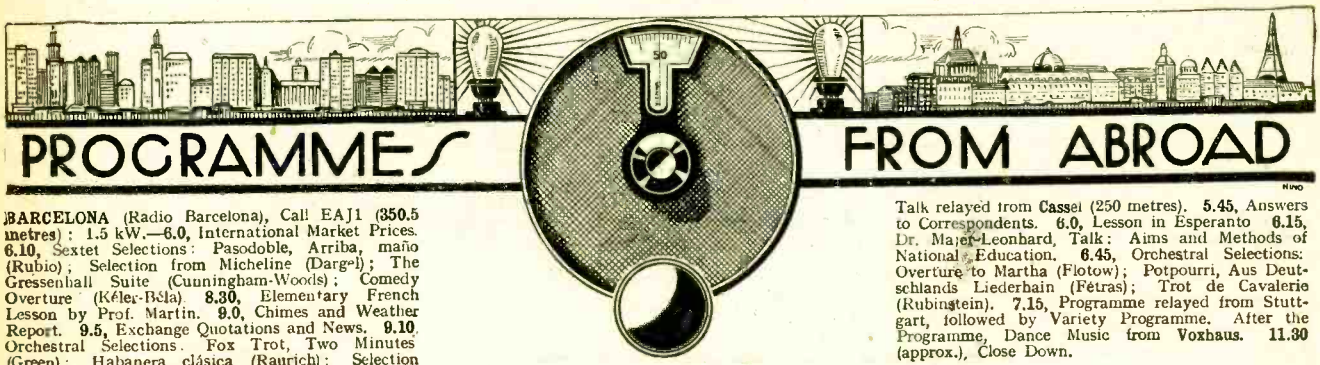
Obsolete Wireless in a Hospital.

The Ilford and District Radio Society has organised a fund to provide the Ilford Emergency Hospital with new wireless apparatus, three members of the Society having inspected the present gear and found it obsolete.

At the Society's meeting on January 17th, Mr. Alford (2DX) lectured on the "Super Heterodyne," and demonstrated the "Igranic Supersonic Seven." A keen discussion followed on the merits and demerits of straight and "crooked" circuits.

Hon. Sec., Mr. C. E. Largen, 16, Clements Road, Ilford.



PROGRAMMES FROM ABROAD

SATURDAY, MARCH 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,** International Market Prices. **6.10,** Sextet Selections: Pasodoble, Arriba, maño (Rubio); Selection from Micheline (Dargel); The Gressenhall Suite (Cunningham-Woods); Comedy Overture (Kéler-Béla). **8.30,** Elementary French Lesson by Prof. Martin. **9.0,** Chimes and Weather Report. **9.5,** Exchange Quotations and News. **9.10,** Orchestral Selections. Fox Trot, Two Minutes (Green); Habanera clásica (Raurich); Selection from Gigantes y cabezudos (Caballero); Fox Trot, Waiting for the moon (Brown); Charleston, China (Packay-Bee); Fox-Trot, Yearning (Davis). **10.0.** Programme relayed from **Madrid,** EAJ7.

BERGEN (360.9 metres) : 1.5 kW.—**5.30,** Programme for Children. **6.0,** Programme for Girls. **7.0,** Orchestral Concert. **7.50,** Topical Talk. **8.0,** Mr. Eek Larsen, Talk. Monastic Life in the Middle Ages. **8.30,** Song Recital by Victor Fearnley. **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.** Talks for Women. **3.30.** Programme relayed from **Hamburg. 4.30.** Herr W. Steinkopf, Talk: The Civil Servant and Parliament. **5.0,** Herr Fritz Tejessy, Talk. The Worker and his Mother Tongue. **5.30,** Elementary Spanish Lesson. **5.55,** Dr. F. Schönemann, Talk: Civic Education in America. **6.20,** Prof. Leo Kestenberg, Talk: The Musical Foundations of Contemporary Life. **7.0,** "Country" Programme. Potpourri, Rheintscher Sang (Hanemann); Tenor Solos (a) Von Rüdesheim bis Heidelberg (Stolz), (b) Rheinsehnsucht (Krome); Loreley Paraphrase (Nesvadba); Der deutsche Rhein; Stolzenfels am Rhein (Meissler); Tenor Solos, (a) Bein Rolandseck an grünen Rhein (Ehrlich), (b) Mädelchen vom Rhein (Fliess); Drinking Song from Der lachende Ehemann (Eysler), followed by Programme from **Voxhaus.**

BERLIN (Voxhaus) (475.4 metres); 4 kW.—**9.10.** Market Prices. **9.15 a.m.,** Weather Report, News and Time Signal. **10.0 a.m.,** Gramophone Records and 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,** Max Vollmberg, Talk: German Coffee and Sugar Plantations in Central America. **3.0** Talk by Leopold Lehmann—The Mint. **3.30,** Orchestral Concert: Overture to Erlenhügel (Kuhlau); Ballad, Das Grab auf der Heide (Heiser); Selection from The Tales of Hoffmann (Offenbach); Czardas from the Opera, Der Geist des Wojewoden (Grossmann); Oriental Suite (Popy); Two Selections from Feramors (Rubinstein); Waltz, Tourbillon (Mattei); Potpourri, Bitte recht freundlich (Ralph), followed by Advertisement Notes. **5.10,** "Revolt in Men's Dress"—Sketch, Advertising Programme. **5.30,** Dr. Ernst Folz, Talk: Methods of Modern Retail Trade Businesses. **6.0,** Dr. Richard H. Stein, Talk: English and American Music with Pianoforte Illustrations. **6.30,** Herr Oswald Riedel, Talk: The Eastern Frontiers of Germany. **7.0,** Variety Programme, 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,** Dr. Arthur Schweizer, Talk: The Banking Profession, relayed from **Basle** (1,034 metres). **7.0,** Topical Talk. **7.15,** "The Betrothal by Lantern Light"—Musical Play (Offenbach). **8.0,** Concert by the Kursaal Orchestra. **8.45,** News and Weather Report. **9.0,** The Kursaal Orchestra. **9.40,** Dance Music. **11.0** (approx.), Close Down.

BRESLAU (321.2 metres); 4 kW.—**4.45,** Film Review of the Week by Hans Baldung and M. Lippmann. **5.25,** Herr Hans-Joachim Plehn, Talk in Esperanto: Silesian Plants. **5.35,** Talk from **Gleiwitz** (326.4 metres). **6.20,** Shorthand Lesson for Beginners. **6.50,** Topical Debate. **7.15,** Concert of Light Music: Orchestral Selection, Overture to Lysistrata (Lincke); Xylophone Solo, Gallop, Der Klapperschlangeningleur (Krüger); Violin Solos (Kreisler), (a) Liebesleid, (b) Liebesfreud; Xylophone Solo (Peter); Orchestral Selections (a) Marquisette (Lindsay-Theimer), (b) Ballet Scene (Luigini); Der Lindenbaum (Schubert); Orchestral Selection; Waltz, Roses of the South (Joh. Strauss); Blumenlied (Lange); Kujawiak (Walter); Serenade from Les Millions d'Arlequin (Drigo); Tango, Ilona, Orchestral Selection, Potpourri, Viennese Folk Music (Komzák); Song, Ich habe den Frühling gesehen; Orchestral Selection from The Merry Widow (Lehár); Polka-Mazurka, Der Specht (Kahnt); Orchestral Selection, March, Under the Star-Spangled Banner (Sousa). **9.0,** News and Announcements. **9.30,** Dance Music. **11.0** (approx.), Close Down.

BRÜNN (432.3 metres); 2.5 kW.—**6.6,** Concert from the Works of Schubert: Overture to Rosamunde; Symphony in B Minor; Marches Op. 51. **6.45,** Programme from **Prague. 8.0,** Cabaret Programme. **9.0,** Programme from **Prague. 9.20,** Programme Announcements and Theatre Review. **9.25,** Popular Concert relayed from **Bratislava** (299.8 metres).

BRUSSELS (512 metres); 1.5 kW.—**5.0,** Concert relayed from the Armenonville Tea rooms. **6.0,** Elementary English Lesson. **6.25,** Intermediate English Lesson. **6.45,** Pianoforte Recital. **7.20,** Gramophone Selections. **7.30,** La Radio-Chronique. **8.15,** Concert from the Works of Camille Saint-Saëns. **10.15,** News, Esperanto Report and Close Down.

BUDAPEST (555.5 metres); 20 kW.—**4.40,** Orchestral Concert of Light Music: Selection from Il Seraglio (Mozart); Caucasian Sketches (Ippolitov); Prelude (Járnefeld); Scènes pittoresques (Massenet); Overture to Nabucco (Verdi). **6.0,** Talk: The History of the Waltz. **7.0,** "Csongor és Tünde": Studio Play (Vörösmay). **8.15,** Time Signal and News. **9.15** Weather Report and Band Concert. **10.15,** Concert of Tzigane Music from the Café Spolarich.

CRACOW (314.1 metres); 1.5 kW.—**4.0,** Prof. Asanka-Japoll, Talk: Castiglione. **4.25,** Mr. J. Regula, Talk: Foreign Politics of the Past Week. **4.55,** Programme for Children by Mr. Ziembinsky. **5.50,** Miscellaneous Items. **6.10,** Wireless Talk by Mr. Jean Kazirod. **6.56,** Time Signal from the Astronomical Observatory. **7.0,** Chimes 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,** F. H. Boland, B.A., LL.B., Talk: Irish Trade Openings in the United States. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Selection from The Enchanted Forest (d'Indy) by the Augmented Station Orchestra. **8.20,** Contralto Solos by Annie Broadhurst. **8.40,** Romance sans paroles (Saint-Saëns) by the Augmented Station Orchestra. **8.50,** Tenor Solos by P. J. O'Toole. **9.0,** Sonata Recital by Lorna Thompson. **9.15,** "The Counter Charm": Sketch by Eva Brennan and Company. **9.45,** Vocal Duets by Joan Burke and Kitty Fagan. **10.15,** Ballet Suite, The Rake (Quilter) by the Augmented Station Orchestra. **10.30,** News, Weather Report and Close Down.

FRANKFURT (421.3 metres); 4 kW.—**3.35,** Orchestral Concert of Modern Dance Music. In the Interval: News and Announcements. **5.30,** Horticultural Talk relayed from **Cassel** (250 metres). **5.45,** Answers to Correspondents. **6.0,** Lesson in Esperanto. **6.15,** Dr. Major-Leonhard, Talk: Aims and Methods of National Education. **6.45,** Orchestral Selections: Overture to Martha (Flotow); Potpourri, Aus Deutschlands Liederhain (Fétras); Trot de Cavalerie (Rubinstein). **7.15,** Programme relayed from Stuttgart, followed by Variety Programme. After the Programme, 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** (568 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: Man in the Time of the Renaissance and Reformation, relayed from **Kiel** (250 metres). **3.30,** Concert of Pianoforte and Orchestral Selections. **4.30,** Orchestral Concert of Request Items. **5.30,** Ludwig Selpien, Talk: International Labour Organisation. **6.0,** "Eibenschütz probt": What happens between the Programmes. **6.55,** Weather Report. **7.0,** Programme of Songs and Recitations in Dialect. **9.30,** Weather Report, News and Programme Announcements. **10.0,** Concert relayed from the Café Wallhof. **10.50,** North Sea and Baltic Weather Report.

HILVERSUM (1,071 metres); 5 kW.—**9.40 a.m.,** Time Signal and Daily Service. **11.40 a.m.,** Police Announcements. **11.55 a.m.,** Concert of Trio Music **1.40,** Musical Programme relayed from the Tuschinski Theatre, **Amsterdam,** under the direction of Max Tak, with Pierre Palla (Organ). **3.40,** Italian Lesson by Mr. Giovanni Rizzini. **4.40,** French Lesson by Mr. Raymond Latont. **5.40,** Time Signal. **5.41,** Concert of Trio Music. **6.25,** German Lesson by Mr. Edgar Grün. **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.—**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. v. Spaandonk. **6.30,** Catholic Bulletin. **6.40,** Elementary English Lesson. **7.10,** Dressmaking Lesson. **7.40,** Talk by Dr. Huddleston Slater. **8.0,** Orchestral and Vocal Concert: Sonata No. 4 (Corelli); Sonata No. 2 (Corelli); Song (Stradella); Sonata No. 1 (Corelli); Eine kleine Nachtmusik (Mozart); Overture to Idomeneo (Mozart); Air from The Magic Flute (Mozart); Minuet (Boccherini); Scherzo (Schubert); Last Spring (Grieg); Solveig's Song (Grieg); The Death of Asa (Grieg); De vogel in 't woud (Taubert); Suite (Gilson). **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: Overture to Le Roi l'a dit (Delibes); Waltz, Die Gräfenberger (Gung'l); Nocturne (Tchaikovsky); Barcarolle (Tchaikovsky); Barberina (Lindsay-Theimer); Berceuse (Szulc); Indian Intermezzo, Iswara (Siede); Reading by Carl Schionning; Waltz from Die Kaiserin (Fall); Spanish Suite, La Feria (Lacôme); Au soir de la vie (Pesse); Minuet (Palmgren); Valse bluette (Miche); March (Urbach). **4.40.** Exchange Quotations. **4.50,** Talk by Mr. H. Mosegaard. **5.20,** Medical Talk by Dr. Hans Heckscher. **5.50,** Weather Report. **6.0,** News. **6.15,** Time Signal. **6.30,** Henning Kehler, Talk: Roman History. **7.0,** Chimes from the Town Hall. **7.2,** Mr. A. Bergmann, Talk - Tivoli, followed by Orchestral Concert. **8.15** (approx.), News. **8.30,** Reading by Johannes Andresen, from the Works of Vilh. Krag. **9.0.** Concert of Light Music: Overture to The Nuremberg Doll (Adam); Waltz, Sylva (Spacek), Pictures from Scandinavia (Juel-Frederiksen); Idéale (Tosti); Processional March (Siede); On the Bosphorus (Lincke); Selection (Macbeth); Cadiz March (Valverde). **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.—**3.0,** Gramophone Selections. **4.0,** Music Lesson by Prof. F

Programmes from Abroad.—

Sachse. **4.25,** Children's Letter Box. **4.55,** Programme for Young People. **5.50,** Miscellaneous Announcements. **6.10,** Talk by Prof. K. Simm. **6.56,** Time Signal. **7.0,** Talk by Prof. Asanka Japoll. **7.30,** Programme relayed from **Warsaw. 9.0,** Weather Report and News. **9.30,** (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).—**12.5,** Orchestral Concert: March, Junges Blut, frischer Mut (Yardner); Waltz (Gilbert); Overture to The Maid of Artois (Balfe); Selections from Lucrezia Borgia (Donizetti); Minuet (Paderewsky); Hungarian Rhapsody No. 2 (Liszt); Russian Song (Lalo); Selection from Boccaccio (Suppé). **1.30,** Household Hints. **2.0,** Programme for Children, by Els Vordemberge. **2.40,** Wireless Talk by Herr P. Brüls. **3.0,** Josefa Hüttenmeister, Talk for Young People: We will preserve Peace. **3.20,** Dr. Teleky, Talk for Women: The Influence of Industrial Work on Children, Young People, and Women. **3.40,** Gustav Halm, Talk: The Turkish Eulenspiegel. **4.0,** Talk by Alfred Gürteler, Legal Regulations for the Election of the Members of Industrial Councils. **4.20,** English Lesson by Prof. Hase. **4.45,** Gramophone Selections. **5.30** Dr. Stulz, Talk: How to reach an understanding of Historical Events. **6.15,** Talk for Workers: Workers' Benevolent Societies. **6.40,** Dr. Lips, Talk: The Development of Culture. **7.0,** Variety Programme, followed by News, Sports Notes, Business Announcements, Light Musical Selections and Dance Music. In the Interval, at **9.30,** (approx.), Relay of the Fourth Dortmund Six Days' Racing from the Westphalian Hall, **Dortmund. 12.30 a.m.** (approx.) (Sunday) Close Down.

LEIPZIG (361.9 metres) : 4 kW.—**3.30,** Orchestral Concert. **4.45,** Wireless News and Talk. **5.20** Weather Report and Time Signal. **5.30,** Programme relayed from **Konigswusterhausen. 5.55,** Labour Market Report. **6.0,** "Der Opernball"—Operetta (Heuberger), relayed from the Opera House, **Chemnitz,** followed by 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 and Time Signal, followed by "El Caserio"—Musical Comedy (Guridi). 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,** C. Ardau, Talk: Industrial Review. **7.25,** News and Announcements. **7.30,** Time Signal, News and Introductory Talk to the following Transmission. **7.45** (approx.), "Norma"—Opera (Bellini). In the Intervals—Readings from Fedra (D'Annunzio), 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 to 7.30,** Programme relayed from **Göteborg. 4.0** Orchestral Concert of Light Music. **5.0,** Programme for Children. **5.45,** Cabaret Programme. **6.45,** Sonata for Violin and Pianoforte No. 5 in E Flat Major (Mozart) **7.0,** Cabaret Programme. **7.30,** "Skilsmässa"—Play (Hedvig Nenzén). **8.0,** Topical Talk. **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,** Vocal and Instrumental Concert. **5.35,** Labour Market Report. **6.0,** Answers to Correspondents. **6.35,** Vocal Selections from **Nuremberg. 7.0,** Concert by the Station Orchestra, Elizabeth Hallstein (Soprano) and Sandro Vitoschy (Tenor): Overture to Opernball (Heuberger); Waltz Song (Joh. Strauss); Potpourri of Die Puppenfee (Bayer); Air from Paganini (Lehár); Waltz (Millöcker); Two Airs from Friederike (Lehár); Potpourri of The Mikado (Sullivan). **8.0,** Programme of Old-time Humorous Songs. **8.40,** "Jewels"—Sketch (Struve). **9.20,** News and Announcements. **9.45,** Orchestral Concert from the Hotel Stadt Wien. **11.0,** (approx.), Close Down.

NAPLES, Call 1NA (333 metres) 1.5 kW.—**7.30,** Time Signal, Wireless Talk, Announcements and Harbour Notes. **7.45,** Relay of an Opera from the San Carlo Royal Theatre. **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.

Wireless World

Saturday, March 9th.

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

6.15, Weather Report and News. **6.30,** Talk and Recitations—Nature Fables (Wergeland). **7.0,** Time Signal and Orchestral Concert. Round the World (Yoshitomo); Dance of the Witches (MacDowell); Humoresque (Dvorak); Recitations; Trumpet Solo, Die Post im Walde (Mittelbach); My Lady's Minuet (Wood); Chanson triste (Tchaikovsky); Serenade (Reidarson); Cavatina (Raff); Recitations; Stéphanie Gavotte (Czibulka); Two Youthful Hearts (Enders); Quintessence (Morena); Sonja March (Jacobson). **8.30,** Weather Report, News and Topical Talk. **9.0,** Accordian Trio Recital. **9.30,** Gramophone Dance Music from the Hotel Bristol. **11.0** (approx.), Close Down.

PARIS (Ecole Supérieure) Call FPTT **(450 metres)** ; 0.5 kW.—**5.0,** Pasdeloup Concert from the Théatre des Champs Elysées. **6.30,** Radio Journal de France. **8.0,** M. Lassalle, Literary Talk. **8.15,** Talk: Chartres Steeple. **8.30,** Gala Concert from the Salle des Fêtes du Journal, followed by News, Time Signal, Weather Report and Dance Music from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(1,485 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) M. René Casalis: Sunday Sports, and Talks by other contributors.

PARIS (Petit Parisien) **(336 metres)** ; 0.5 kW.—**8.45,** Gramophone Selections, Talk and News. **9.0,** Concert: Overture to Madame Favart (Offenbach); Waltz No. 4 (Dvorak); Prelude à l'après midi d'un faune (Debussy); Dances from Prince Igor (Borodine); Adoration (Filipucci); Scène montagnarde (Rousseau); Under blue Skies (Hirchmann); A Flemish Wedding (Beuchsel). In the Intervals at **9.25 and 10.0,** News.

PARIS (Radio-Paris), Call CFR **(1,769 metres)** ; 15 kW.—**12.30,** Programme of Dance Music. **2.0,** Exchange Quotations. **3.30,** Exchange Quotations and Market Prices. **3.45,** Programme of Dance Music. In the Interval at **4.0,** M. Denis d'Ines, Talk: The Art of Declamation. **4.45,** Exchange Quotations and News. **5.25,** Religious Address by Pastor Marc Boegner, relayed from the Protestant Church at Passy. **6.30,** New York Exchange Quotations and Agricultural Report. **6.45,** Gramophone Selections. **7.30,** Pianoforte Lesson by M. Pierre Lucas. **7.45,** Metal Prices and News. **8.0,** Talk: The Prospects of the Costume Museum. **8.15,** Musical Selections. **9.0,** Programme of Dance Music. In the Intervals: News. **10.30** (approx.), Close Down.

PITTSBURGH, Call KDKA **(63 and 27 metres)** ; 25 kW.—**11.30,** Gold Spot Pals from **New York. 12.0 Midnight,** Chimes and University Address. **12.15 a.m. Sunday,** Home Radio Club Meeting. **12.30 a.m.,** Gems of American Literature. **12.45 to 3.0 a.m., New York** Relay. **12.45 a.m.,** Talk: A Week of the World's Business. **1.0 a.m.,** Programme by the Purol Company Band. **1.30 a.m.,** Interwoven Entertainers. **2.0 a.m.,** Pan Americana. **2.30 a.m.,** Selections by the Seven-Elevens Dance Orchestra. **3.0 a.m.,** Time Signal and Orchestral Concert from the Fort Pitt Hotel. **3.30 a.m.,** Weather Report and Orchestral Concert from the William Penn Hotel.

POSEN (336.3 metres) ; 1.5 kW.—**6.5,** Pianoforte Recital. **6.35,** Recitations of Polish Poems. **7.0,** Miscellaneous Items. **7.30,** Programme relayed from **Warsaw.** In the Intervals: Theatre and Cinema Notes and News. **9.0,** Time Signal and News. **9.30,** Cabaret Concert: Selections for Mandoline Orchestra (Siede and Suppé); Songs (Massenet, Chaminade and Godard); Pianoforte Solo; Orchestral Selections; Songs (Jones, Moszkovsky, and Felix); Songs (Wiehler and Benatzky); French Overture (Kéler-Béla). **11.0,** Concert arranged by Maison Philips. **1.0 a.m.** (Sunday), Close Down.

PRAGUE (343.2 metres) ; 5 kW.—**6.0,** Chimes and News. **6.5,** Concert of Wind Instrument Music. **6.45,** "Matej Kopecky": Drama (Novak), preceded by Short Introductory Talk by Prof. Vesely. **8.0,** Programme relayed from **Brünn. 9.0,** News and Announcements. **9.25,** Popular Concert relayed from **Bratislava** (299.8 metres).

ROME, Call 1RO **(443.8 metres)** ; 3 kW.—**7.30,** Report of the International Labour Office at Geneva. **7.45,** Concert by the Band of the Royal Guardia di Finanza: Corteo Mistico (Bossi); Descriptive Suite, Festa di nozze (Manente); "Le Poilu"—One Act Comedy (Hennequin); Prelude to Loreley (Catalani); Indian March from L'Africaine (Meyerbeer); Ronda tripolina (Billi); Talk: Literature and Art; Norwegian Dances Nos. 2 and 6 (Grieg); Rusticanella (Cortopassi); Waltz Suite, Mon Rêve (Waldteufel). **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. 1.0 a.m.,** Selections by the Hotel Van Curler Orchestra. **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 from the Hotel Van Curler. **5.0 a.m.** (approx.), Clos 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: Selection from La Bayadère (Kálmán); Selection from La fille de Madame Angot (Lecocq); Russian Dance (Tchaikovsky); Hopak (Moussorgsky); Selection from Fra Diavolo (Auber). **8.30,** News and Close Down.

STUTTGART (374.1 metres) ; 4 kW.—**2.0,** Concert from the Works of Mozart **3.35,** Thé Dansant from the Pavilion Excelsior. **5.0,** Time Signal and Weather Report. **5.15,** Herr L. Leibfried, Talk: The Torture of Witches. **5.45,** Prof. Wilser, Talk: The Latest Theories on the Origin of Mountains. **6.15** Dr. Venzmer, Talk: A Stroll through the Native Quarters of Shanghai. **6.45,** Book-keeping Lesson by Dr. Wolff. **7.15,** "Oi-Oi"—Scenes from Student Life after a Drama by Andreieff. **8.30,** Cabaret Programme: March, Alte Semester (Lindsay); Rosen und Frau'n (Grothe); Wer weiss ob deine Augen lügen (Krome); Es gibt nur einen deutschen Rhein (Ostermann); Tanz um die Liebe (Oscar Straus); "Just a Quarter of an Hour"—Sketch (Gabor); Fox-Trot, Barbara (Cowler); Vier Worte möch' ich dir jetzt sagen (Erwin); Zum letztenmal sag' ich zu dir, ich liebe dich (May); Ein Prosit der Liebe, ein Prosit dem Wein (Profes); Pst Fräulein (Oetvös); Fox-Trot, Lene Lehmann (Profes); "The Umbrella"—Grotesque (Bekefi); Fox-Trot, Marschpotpourri (Robrecht); Frauen darf man nie fragen (Potter); Heiteres aus Sachsen (Dittrich); Männer, was seid ihr komisch (Gilbert); Eilali, eilali, e.lala (May); Fox-Trot, Wenn zwei Blondinen (Ralph). **9.45,** Dance Music from **Voxhaus. 11.0,** Military Band Concert. **12.30 a.m.** (Sunday), Experimental Relay of American Stations.

TOULOUSE (Radiophonie du Midi) **(383 metres)** ; 8 kW.—**12.45,** Concert. **8.0,** Exchange Quotations and News. **8.30,** Symphony Concert: Danse des Sylphes (Berlioz); Hungarian March (Berlioz); Overture to Egmont (Beetnoven); Selection from Der Bettelstudent (Millöcker); Selection from Die Fledermaus (Strauss); Overture to Light Cavalry (Suppé). **9.0,** Selection of Military Music: Marches des boucliers (Courtade); Le vieux grenadier (Courtade); Le Fringand (Parès); Le Troubadour (Sellenick); Brilliant chasseur (Courtade); Au bord du Tage (Courtade). **9.20,** Songs from Opera-Comique: Air from Thais (Massenet); Gavotte from Manon (Massenet); Berceuse and Duet from Louise (Charpentier); Two Songs from Mignon (Thomas); Song from Rigoletto (Verdi). **9.45,** Programme of Dance Music. **10.15** North African News. **10.30** (approx.), Close Down.

VIENNA (520 metres) ; 15 kW.—**6.5,** Herr Alois Mentasti, Talk: The Vienna Fair. **6.25,** Chamber Music: Pianoforte Trio in D Minor (Rachmaninoff); The Dumky-Trio (Dvorak). **7.25,** Time Signal and Weather Report. **7.30,** "A Washerwomen's Ball"—Humorous Selection from an Old Viennese Carnival Entertainment (Skurawy), followed by Phototelegraphy Transmission.

WARSAW (1,385.7 metres) ; 10 kW.—**4.25,** Dr. M. Henzel, Talk: Works of Art in Warsaw. **4.55,** Programme relayed from **Cracow. 5.50,** Miscellaneous Items. **6.10,** Wireless Talk by Dr. M. Stepovsky. **6.35,** News. **6.56** Time Signal. **7.0,** Prof. St. Niewiadomsky, Talk: Polish Music. **7.30,** "Paganini"—Operetta in Three Acts (Lehár). In the Interval, Theatre Notes. **9.0** (approx.), Aviation Notes, Weather Report, News, Police Announcements and Sports Notes. **9.30,** Dance Music from the Hotel Bristol. **10.30** (approx.), Close Down.

ZÜRICH (488 metres) ; 1 kW.—**6.17,** Songs to the Lute by Ernst Schlott. **7.0.** Variety Programme. **9.0,** Weather Report and News. **9.10,** Gramophone Dance Music.

SUNDAY, MARCH 10th.

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, Symphony Concert of Instrumental Music by the Wireless Orchestra. Conductor: C. Cerlini (Flautist)

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—11.0 a.m., Relay of Chimes from Barcelona Cathedral. 11.5 a.m., Meteorological Report for Europe and North East Spain and Route Notes for Aviators. 1.30, Concert by the Station Trio. 2.45 to 5.0, No Transmission. 5.0, Opening Signal followed by Symphony Concert relayed from the Gran Teatro del Liceo. In the intervals: Agricultural Reports and Market Prices. 8.0 Weekly Talk arranged by the San Isidro Catalonian Institute of Agriculture. 8.20, Programme of Light Music by the Wireless Orchestra. Triumphal March, No. 1 (S. Raurich). 8.40 Sports Chronicle. 9.0 (approx.), Close Down.

BERGEN (365.9 metres); 1.5 kW.—9.30 a.m., Relay of Church Service and Sermon. 11.30 a.m. Weather Report and Forecast and General News Bulletin. Talk, by N. Kiaer: "Dragon Worship and Its Significance in China." 7.50, Talk on a Topical Subject. 9.0, Weather Report and Forecast followed by General News Bulletin and Time Signal. 9.15, Programme of Dance Music. 11 0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1648.3 metres); 40 kW.—7.55 a.m., Relay of Church Chimes from Potsdam Garrison Church. 8.0 a.m., Choral and Instrumental Recital relayed from **Voxhaus,** followed by Berlin Cathedral Chimes. 12.45 to 1.15, Experimental Picture Transmission. 1.30 to 2.30 Three Talks for Agriculturists 3.0, Talk or Reading. 3.30 Relay of Concert. 5.0, Talk on a Topical Subject. 7.0 (approx.), Literary or Dramatic Programme followed by General News Bulletin. 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475.4 metres); 4 kW.—7.55 a.m. Relay of Chimes from Potsdam Garrison Church. 8.0 a.m., Sacred Morning Recital with Address followed by Chimes from the Cathedral. 12.15 Talk by E. Nebermann: "Modern Chess-Playing." 1.30, Practical Notes and Communications for Agriculturists. 1.45, Weekly Market Prices Digest and Meteorological Forecast. 1.55, Talk on an Agricultural Topic. 2.30, Reading of Fairy Stories. 3.0, Talk. 3.30, Musical Programme. 5.30, Talk. 6.0, Talk. 7.0 (approx.) Concert or Play followed by Weather Report and Forecast and General News Bulletin, Time Signal and Sports Intelligence, 11.30 (approx.), Close Down.

BERN (407 metres); 1.5 kW.—9.30 a.m. to 10.30 a.m., Catholic Address. 12.0 Noon, Time Signal and Meteorological Report. 12.5, Musical Selections. 2.30, Concert by the Kursaal Orchestra. 6.29, Time Signal, Meteorological Report and Football Results. 6.30, Reading or Talk. 7.0, Violin Recital by Walter Kagi with Eduard Hanneberger at the piano. 8.45 (approx.), Sports Intelligence, Late News Bulletin and Weather Report and Forecast. 9.0 (approx.), Orchestral Programme. 9.40 (approx.), Close Down.

BEZIERS (211 metres); 0.6 kW.—6.0, "La Radio Agricole Française" Programme. 8.30, Sports News and Announcements. 8.45, Programme arranged by La Maison Kelin-Missoles of Pathé and Pathé-Art Gramophone Selections. 10.30 (approx.), Close Down.

BRUSSELS (512 metres); 1.5 kW.—5.0, Concert relayed from the Armenonvillé Tea Room. 6.0, Entertainment for Children. 6.30, Musical Programme by the Station Trio. 7.30, La Radio-Chronique. 8.15 Concert by the Station Orchestra. Selections from 'The Merry Widow"—Operetta (Lehár). 10.15, General News Bulletin from the Evening Papers. 11.0 (approx.), Close Down.

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 Self Defence. 7.5 a.m., German Shorthand Lesson by Hans Molitor. 7.25 a.m. to 7.55 a.m., Esperanto Lesson and Survey in Esperanto of Forthcoming Programmes. 8.5 a.m. to 9.0 a.m., Catholic Morning Festival with Address, and Choral and Instrumental Numbers. 12.0 Noon, Orchestral Concert. 1.30, Talk. 1.50, Talk. 3.05, Talk. 5.50, Talk. 6.20, Talk. 6.40, Talk by Ernst Toller "Intellectual Tendencies of German Drama." 7.0, Concert or Play followed by Late News and Announcements, Sports Notes and Concert of Light Music. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—8.30, Vocal and Instrumental Concert. 10.20, Soprano Solos rendered by Fedora Turnbull. 11.0, National Anthem followed by Weather Report and Forecast. 11.15 (approx.), Close Down.

CRACOW (314.1 metres); 1.5 kW.—6.15 to 10.45 a.m. Relay of a 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., Concert from the Philharmonic Hall, **Warsaw.** 1.0 and 1.20 Talks for Agriculturists. 1.40, 'La Chronique Agricole,' by Dr. Wasniewski. 2.0, Weather Report and Forecast. 2.15, Relay of Concert by the **Warsaw** Philharmonic Orchestra. 4.30, Talk. 4.55, Italian Lesson by Doctor Nelly Nuci. 5.20, Concert relayed from **Warsaw.** 6.0, Various Items. 6.20, Talk. 6.56 Time Signal relayed from the Observatory. 7.0, Relay of Fanfare from the Church of Notre Dame. 7.15, Sports Bulletin. 7.30, Concert of Vocal and Instrumental Music "The Blessed Damozel"—Lyrical Poem for Soloist and Choir of Women's Voices. Words by D. G. Rossetti. Music by Claude Debussy Rendered by the Pupils of the Helena Zboinska-Ruszkowska School of Singing with Madame Mela Sacewiez at the Piano. 9.0 to 9.30, Programme relayed from **Warsaw.** 9.0, Aviation Routes Report and Weather Forecast. 9.5 News Bulletin from the Polish Telegraph Agency. 9.20, Police Notices and Sports Chronicle. 9.30, Programme from **Warsaw.** Orchestral Concert from a Restaurant. 10.30 (approx.) Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—8.30 to 11.0, Relay of **Cork** Programme. Concert of Vocal and Instrumental Music. Miss M. Emphy: Pianoforte Solos. 11.0, National Anthem and Weather Report and Forecast. 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., Weather Report and Forecast and General News Bulletin. 7.40 a.m., Talk Economic Problems of To-day. 8.0 a.m., Legal Talk. 10.0 a.m. Talk. 11.55 a.m. Time Signal from **Nauen.** 12.05 Sunday Concert. 12.05 (for **Hanover**), Concert of Gramophone Records. 12.05 (for **Bremen**), Concert by the Station Orchestra. 1.0, Programme for Children. 2.0, Musical or Literary Programme. 5.0 Concert by the Scarpa Orchestra. 6.40, Sports Intelligence. 6.55, Weather Conditions and Forecast. 7.0, Relay of Opera or Play. 9.25 (approx.), Inland Meteorological Report and General News Bulletin. 9.40. Concert. 10.50 (for **Bremen, Flensburg, Hamburg** and **Kiel**) Weather Report for North Sea and Baltic. 11.0 (approx.), Close Down.

HILVERSUM (1,071 metres); 5 kW.—12.10, Orchestral Concert. 1.40, Talk: Dramatic Criticism 2.10, Orchestral Programme, conducted by Willem Mengelberg, relayed from the Concert Hall, **Amsterdam.** 3 40. Musical Programme. 7.40, Time Signal. 7.41, Relay of La Juive"—Opera (Halévy). 11.10 approx.), Close Down.

HUIZEN (336.3 metres; 4 kW.—(Transmits from 5.40 on 1,852 metres).—8.5 a.m., Church Service with Address. 9.30 a.m., Relay of Morning Service 12.10, Concert by the Station Trio. 1.40, Talk. 5.30, Church Service relayed on 1,852 metres from **Amsterdam.** Sermon by Doctor C. F. Westermann. 7.10, Talk. 9.10, General News Bulletin. 10.25, Choral Epilogue Relay, 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., Relay of Church Service from **Copenhagen.** 10.30 a.m. to 10.40 a.m. (Kalundborg only), Weather Report and Forecast from the Meteorological Institute at **Copenhagen.** 12.0 Noon. German Language Lesson. 12.30, French Language Lesson. 2.30 Concert. 5.20, Talk. 5.50 (**Kalundborg** only). Weather Report from the **Copenhagen** Meteorological Institute. 6.0. Press News and Announcements. 6.15, Time Signal. 6.30, Talk. 7.0, Relay of 'The Barber of Seville"—Opéra-comique in Two Acts (G. Rossini), produced by Egisto Tango. Followed by Programme of Dance Music by the Palace Hotel Orchestra, **Copenhagen.** Conductor 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 11.10 a.m., Orchestral Concert. 1.0, Talk. 1.20 and 1.40, Agricultural Talks. 2.0, Meteorological Report. 6.0, Miscellaneous Items. 6.56, Time Signal. 7.0, Humorous Talk. 7.20, Concert relayed from **Warsaw**: May Song (A. Eleztovitch) rendered by M. Bregy (Tenor) with Professor Woten at the Piano. 9.0, Weather Conditions and Forecast, General News Bulletin and Sports Notes. 9.30. Programme of Dance Music. 10.30 (approx.), Close Down.

KÖNIGSBERG (280.4 metres); 4 kW.—Programme relayed by **Danzig** (456 metres).—8.0 a.m., Sacred Morning Festival. 9.56 a.m (**Danzig** only): Weather Report and Forecast. 10.0 a.m. (**Königsberg** only): Meteorological Forecast. 10.5 a.m. Talk: Training in Musical Appreciation. 11.55 a.m. International Time Signal rom Nauen followed by Meteorological Report. 1.0, Chess Talk by P. S. Leonhardt. 2.10 (approx.), Spanish Lesson for Beginners by Kurt Metze, Lecturer in Spanish at the Technical Institute. 7.0, Concert of Operetta Music by the Wireless Orchestra and Chour conducted by Karl Hrubetz: Duet from "Nanon" (R. Genée); Wenn ich dein liebes Auge seh. 9.0 (approx.), General News Bulletin and Sports Notes and Results.

LAHTI (1,504 metres); 35 kW.—Programme also for **Helsingfors** (374 metres).—7.0 a.m., Relay of Church Service in the Finnish Language. 9.50 a.m. General News Bulletin. 10.5 a.m. Concert of Vocal and Instrumental Music. 10.25 a.m., Musical Selections. 10.50 a.m. Meteorological Report followed by Time Signal. 11.0 a.m., Church Service Relay in the Swedish Language. 3.0 Programme by the Wireless Orchestra conducted by Erkki Linko. 4.57 Time Signa and Weather Report and Forecast. 6.45, Concert by the Wireless Orchestra: Le pas des fleurs (Delibes). 7.45, General 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. 7.5 a.m., Lesson in German Shorthand by Hans Molitor. 7.25 a.m., Lesson in Esperanto. 7.45 a.m. Review of Forthcoming Programmes by Alfred Dormanns. 8.5 a.m. to 9.0 a.m., Catholic Morning Festival including Address and Choral and Instrumental Numbers. 12.0 Noon. Concert of Orchestral Music. 1.30, Talk. 1.50, Talk. 3.05, Talk. 6.20, Talk. 7.0, Concert of Italian Music rendered by the Station Orchestra, conducted by Herr Buschkött. Scarlattiana (Cadella) rendered by Gertrud Bamberger (Piano st) and the Orchestra. 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., Morning Festival of Vocal and Instrumental Music. 12.0 Noon and 12.30, Two Talks for Agriculturists. 4.0, Musical Programme. 6.0, Talk. 8.0, "Salome"—Play (Oscar Wilde). German Translation by Doctor Kiefer. Producer: Hans Peter Schmiedel. Conductor, Wilhelm Rettich. Followed by News and Announcements, Sports Intelligence and Concert. 11.30 (approx.), Close Down.

LYONS (Radio Lyon) (291 metres); 1.5 kW.—7.30, "Le Journal Parlé" including General News Bulletin and Press Review, Forthcoming Theatre Programmes and Announcements. 8.0, Vocal and Instrumental Musical Selections by the Station Orchestra. 10.0 (approx.), Close Down.

MADRID (Union Radio) Call EAJ7 (427 metres): 3 kW.—2.0, Chimes relayed from the Gobernacion and Time Signal. 2.5, Selections by the Station Orchestra. 3.30 to 7.0, No Transmission. 7.0, Relay of Chimes followed by Programme of Dance Music. 8.0, Talk: Famous Travels. 8.30 to 10.0, No Transmission. 10.0, Chimes Relay followed by Time Signal. 10 5, Concert by the Station Orchestra Dance from "Prince Igor" Opera (Borodine). 10.30, Musical Selections by a Band relayed from the Hotel National. 12.0 Midnight, Chimes 12.5 a.m. (Monday), Concert (continued). 12.30 a.m. (approx.) Close Down.

MILAN, 1MI (504.2 metres); 7 kW.—9.0 a.m., Opening Signal followed by English Language Lesson. 11.30 a.m. Time Signal. 11.32 a.m., Concert by the Station Quartet. 12.30 to 3.0 No Transmission. 3.0, Opening Signal. 3.2, Variety Concert with the collaboration of the Station Quintet. 4.40 Programme for Children: "Labour and Beauty," Music by C. Pedran. 7.30, Time Signal followed by Official Wireless Announcements. 8.0, Relay of an Opera from the Scala Theatre. At the end of Act One, Talk: "Town and Country" by Ulderico Tegani. At end of Act Two: Sports Bulletin and News and Announcements from the Stefani Agency. 10.30 (approx.) Close Down.

Programmes from Abroad.—

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 **Lundsvall** (545.5 metres). **10.0 a.m.**, Divine Service Relay from **Stockholm. 4.55**, Town Hall Chimes relayed from **Stockholm. 5.0**, "The Blue Bird"—Play (Maurice Maeterlinck) **8.15**, General News Bulletin and Weather Report and Forecast. **8.40**, Concert of Instrumental Music. **10.30** (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 relayed from the Munich Town Hall. **10.10 a.m.**, Transmission of the Bavarian Weather Chart. **10.25**, Time and Weather Report and Forecast. **10.30** (approx.), Concert. **6.5**, Relay of "Aïda"—Opera (G. Verdi). **9.25** (approx.), Late News and Announcements, followed by Concert. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (333 metres) ; 1.5 kW.—**8.30 a.m.**, French Language Lesson by Professor Etienne Verdier. **9.0 a.m.**, Recital of Sacred Music. **3.45**, Programme for Children. **4.0**, Popular Concert of Vocal and Instrumental Music. **4.30**, Time Signal. **7.30**, Transmission of Radiogiornale. **7.50**, Announcements by the Naples Harbour Authorities. **8.0**, Time Signal. **8.02**, Concert of Operatic Music. Vocal and Instrumental Items: Selections from "Tristan and Iseult"—Opera (Wagner) ; Prelude and Death of Iseult rendered by the Station Orchestra. **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.**, Sacred Service Relay from the Garrison Church. **6.15**, Weather Report and Forecast, followed by General News Bulletin. **7.0**, Time Signal. **8.30**, Weather Report and Forecast, News and Announcements. **8.45**, Talk by a Journalist on a Topical Subject. **9.0**, Musical Programme. **11.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (450 metres) 0.5 kW.—Programme relayed at intervals by the following stations: **Bordeaux** PTT (275 metres), **Eiffel Tower** (1,485 metres), **Grenoble** (416 metres), **Lille** (269 metres), **Limoges** (285 metres), **Lyons** PTT (475.2 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse** PTT (260 metres).—**8.0 a.m.**, General News Bulletin and Time Signal. **9.25 a.m.**, International Time Signal and Weather Report and Forecast. **1.30**, Orchestral Concert arranged by the General Association of French Wireless Listeners. **2.30**, Concert of Symphony Music relayed from the Assembly Hall of the Paris "Le Journal." **4.0**, Pasdeloup Symphony Concert relayed from the Théâtre des Champs Elysées. Conductor: M. Rhené Bâton. **6.30**, "Le Radio Journal de France." **8.15**, Talk under the auspices of the Union of French Associations. **8.30**, Concert of Orchestral Music followed by News and Announcements, Time and Meteorological Report and Programme of Dance Music from the Coliseum de Paris. **12.0 Midnight**, Close Down.

PARIS (Eiffel Tower), Call FL (1,485 metres) ; 5 kW.—**7.56 a.m.**, Time Signal on 32.5 metres. **5.0**, Pasdeloup Concert. **7.10**, Weather Report and Forecast. **7.20**, Le Journal Parlé," including Police History, Sports Chronicle, News of the Day and Racing Results from Paris Sport." **7.56**, Time Signal on 32.5 metres. **8.0** to **9.0**, "La Comedie des Ebakis"—16th Century Play (Jacques Grévin).

PARIS (Petit Parisien) (336 metres) : 0.5 kW.—**8.45**, Latest Gramophone Selections. **8.50**, Talk. **8.55**, General News Bulletin. **9.0**, Concert with items by artistes of the Opera and the Opéra-Comique. **9.25**, General News Bulletin. **9.30**, Programme of Symphony Music, conducted by M. Estyle of the Paris Conservatoire: "Romance in G" (Beethoven), for Violin and Orchestra, rendered by M. Bellanger (Violinist), Soloist from "La Société des concerts du Conservatoire. **10.0**, Late News and Announcements. **10.10**, Concert of Orchestral Music. **11.0** (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 Culture Lesson, directed by Doctor Diffre. **12.0 Noon**, Sermon by Father Lhande, followed by Recital of Sacred Music. **12.30**, Press Intelligence. **12.45**, Concert by the Albert Lejatelli Orchestra. Humorous Item by Bilboquet in the interval. Selection from "Hans, the Fluteplayer" (Gannel). **3.30**, Concert with Gramophone Records, arranged by "L'Industrie Musicale." News and Announcements during the intervals. **6.30**, Agricultural Chronicle. **6.45**, Pathé Half Hour of Gramophone Music. **7.30**, News from the Press. **7.45**, Radio Paris Circus. **8.30**, Musical Programme. Late News and Announcements and Evening Press Bulletin in the intervals. **10.30** (approx.), Close Down.

Sunday, March 10th.

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 Recital. **10.20 a.m.**, Pianoforte and Organ Music. **10.40 a.m.**, Concert of Symphony Music. **11.0 a.m.**, Selections of Chamber Music. **11.20 a.m.**, Violin and 'Cello Recital. **11.40 a.m.**, New Dance Music Programme and Light Music. **12.0 Noon**, Close Down.

PITTSBURGH, Call KDKA (63 and 27 metres) ; 25 kW.—**4.0**, Sessions Clock Chimes. **4.01**, Divine Service Relay. **6.30**, Time followed by Allegheny Memorial Park Programme. **7.0**, The Roxy's Symphony Orchestra. **8.0**, Mu-Sol-Dent Orchestra. **9.0**, Organ Recital by Dr. Charles Heinroth, Musical director at the Carnegie Institute. **9.30**, McKinney Manufacturing Co. Programme from **New York. 9.45**, Service at the Shadyside Presbyterian Church. Address by Hugh Thomson Kerr, Pastor. **11.0**, Time. **11.1**, The William Penn Hotel Orchestra. **11.30**, Whittall Anglo-Persians Programmes from **New York. 12.0 Midnight**, Sessions Clock Chimes. **12.1 a.m.** (Monday), Evening Service from the Calvary Protestant Episcopal Church. Sermon by the Pastor, E. J. Van Etten. **1.0 a.m.**, Relay of Enna Jettick Melodies from **New York. 1.15 a.m.**, Collier's Radio Hour from **New York. 2.15 a.m.**, Concert by the Utica Jubilee Singers relayed from **New York. 2.45 a.m.** Relay of El Tango Romantico from **New York. 3.15 a.m.**, Longines Time relayed 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.**, Divine Service Relay. **11.10 a.m.**, Time Signal. **11.15 a.m. and 11.35 a.m.**, Talk for Agriculturists. **11.55 a.m.** Lecture for Peasant Women. **2.0** Relay of Passion Music from Posen Cathedral. **3.0**, Concert of Symphony Music relayed from **Warsaw. 5.20**, Concert of Polish Music rendered by the Choir of the Union of Polish Youth and Soloists: Song, Tears (Zarzycky) rendered by Mme. Krygier-Bernacka (Soprano). **6.0**, Report of the Catholic League of Polish Youth. **6.20**, Talk relayed from **Warsaw. 7.05** Various Items. **7.30**, Concert. **8.0** Literary Programme relayed from **Warsaw. 8.15**, Concert. **9.0**, Time Signal followed by Sports Notes. **9.20**, Programme of Light Music. **11.15** (approx.), Close Down.

PRAGUE (343.2 metres) ; 5 kW.—**8.0 a.m.**, Morning Festival of Church Music. **9.0 a.m.**, Programme for Agriculturalists. **9.30 a.m.**, Agricultural Talk. **10.0 a.m.**, Musical Selections. **11.0 a.m.** Popular Concert. **12.0 Noon**, Talk on Trade and Industry. **12.15**, Sociological Talk. **3.30**, Orchestral Concert. **4.30**, Workers' Programme. **5.0**, Variety Programme of German Listeners. **9.0**, Time Signal, General News Bulletin and Sports Notes. **9.15**, Theatre Review. **9.20**, Programme of Light Music. **10.30** (approx.), Close Down.

RIGA (528 metres) ; 4 kW.—**9.15 a.m.**, Divine Service in Latvian relayed from the Mara Church. **12.0 Noon**, Programme of Story, Music and Song for Children. **2.30**, Agricultural Talk. **3.0**, Orchestral Concert conducted by Arved Parups. **4.0 to 6.0** Four Talks. **6.0** Concert of Popular Music conducted by Janis Medin. **8.0**, Meteorological Report. **8.30**, Concert by a Cafe Orchestra. At the end of the Concert, News and Announcements. **10.0** (approx.), Close Down.

ROME, Call 1RO (443.8 metres) ; 3 kW.—**8.30 a.m.**, Opening Signal. **8.32 a.m.**, Elementary German Lesson. **9.0 a.m. to 9.45 a.m.** Recital of Religious Music with Vocal and Instrumental Items. **10.0 a.m.**, Programme from the Casa di Dante with Introductory Address. **12.0 Noon.** Opening Signal. **12.5 to 1.0**, Concert by the Station Trio. **1.0 to 4.0**, No Transmission. **4.0** Opening Signal. **4.5 to 5.30.** Variety Concert of Popular Music. **6.50**, News and Announcements and Agricultural Talk. **7.15**, Sports Bulletin and Various Communications. **7.29**, Time Signal. **7.45**, Selections from "Tannhäuser". Opera (Wagner), rendered by Soloists and the Station Choir and Orchestra. **9.50**, Late News Bulletin. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (19.56 metres) ; 30 kW.—**6.30**, Peerless Reproducers' Programme relayed from **New York. 8.30**, Relay of Recital of Organ Music by Elmer A. Tidmarsh from the Union College Memorial Chapel, Schenectady N.Y. **9.0**, Sermon for Men by Doctor S. Parkes Cadman relayed from **New York. 10.30**, Relay of Twilight Voices from **New York. 11.0**, Stetson Parade. The American Legion Band relayed from **Boston, Mass. 12.0 Midnight**, The Old Company: Vocal Selections with Doctor Sigmund Spaeth relayed from the Capito. Theatre, **New York. 2.0 a.m.**, Talk: "Our Government," by the Editor of the "United States Daily," relayed from **Washington D.C. 2.15 a.m.**, The Atwater Kent Programme from **New York. 3.15 a.m.**, Studebaker Programme relayed from **New York. 3.45 a.m.**, Musical Programme. **5.15 a.m.** (approx.), Close Down.

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

TOULOUSE (Radiophonie du Midi) (383 metres) ; 8 kW.—**12.45**, Concert of Instrumental Music. **1.0**, Time Signal. **1.5**, Concert (continued). **1.45**, News Bulletin supplied by "Le Télégramme" "L'Express" and "Le Midi Socialiste." **8.0**, Exchange Quotations, Market Report from Paris and News Budget supplied by the Parisian Press. **8.30**, Musical Selections. **9.0**, Time Signal. **9.10**, Concert of Vocal and Orchestral Music, arranged by L'Association des Commerçants Radio-électriciens du Midi: Selections from "Mireille"—Opera (Gounod), (a) Farandole from Act II, (b) Choeur des Saintes-Marie. **10.15**, North African Intelligence, followed by Late News and Announcements. **10.30** (approx.), Close Down.

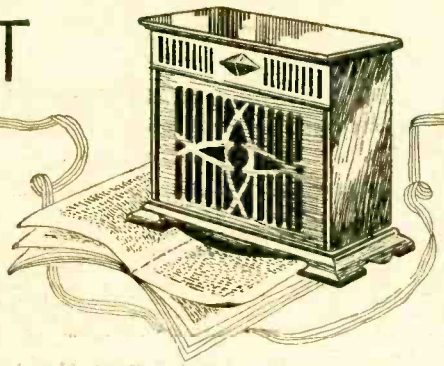
VIENNA (520 metres) ; 15 kW.—Programme relayed by **Graz** (354.2 metres), **Innsbruck** (455.9 metres), **Klagenturt** (455.9 metres), and **Linz** (250 metres).—**9.10 a.m.** (approx.), Recital of Organ Music. **10.0 a.m.**, Musical Programme. **2.30**, Experimental Photo-telegraphy Transmission. **6.30**, "Die Füchse Gottes"—Play in Five Acts by Otto Brües, produced by Doctor Hans Nüchtern. Followed by Concert of Light Music and Experimental Picture Transmission. **10.30** (approx.), Close Down.

VILNA (426.7 metres) ; 1.5 kW.—**9.10 a.m. to 10.45 a.m.**, Sacred Service relayed from a Cathedral. **10.56 a.m. to 4.30**, Programme relayed from **Warsaw. 10.56 a.m.**, Time Signal, followed by General News Bulletin. **11.10 a.m.**, Concert organised by the Education and Cultural Department of the Magistrature of Warsaw: Suite, Impressions d'Italie (Charpentier), (a) Serenade, (b) A la fontaine, (c) Naples. **1.0 to 2.0**, Three Agricultural Talks. **2.15**, Concert by the Philharmonic Orchestra, relayed from **Warsaw. 4.30** (approx.), Programme for Children. **6.20**, Relay of Talk from **Warsaw. 6.45**, Time Signal and General News Bulletin. **9.0**, Aviation Notes and Weather Report and Forecast relayed from **Warsaw. 9.20**, Police Communications and Sports Notes relayed from **Warsaw. 9.30**, Programme of Dance Music from the "Oaza" Restaurant **Warsaw. 10.30** (approx.), Close Down.

WARSAW (1,385.7 metres ; 10 kW.—**9.15 a.m.**, Relay of Sacred Service from a Cathedral. **10.56 a.m.**, Time Signal and Fanfare relayed from the Church of Notre Dame at **Cracow**, followed by Communications for Aviators and Weather Report and Forecast. **11.10 a.m.** Concert of Symphony Music by the Philharmonic Orchestra. **1.0 to 2.0**, Three Talks on Agriculture. **2.0**, Meteorological Report. **2.15**, Symphony Concert relayed from the Philharmonic Hall. **4.30**, Talk. **5.55**, Talk. **6.0**, Various Items. **6.20**, Talk: "In the Land of the Crescent, the Sphinx and the Pyramids." **6.45**, General News Bulletin. **6.55**, Time Signal. **7.0 to 7.20**, Talk: "Intellectual Amusements." **8.20**, Popular Concert, conducted by J. Ozimiusky. Orchestral Selection, Fantasia on Themes from "Madame Butterfly"—Opera (Puccini). **9.0**, (approx.), Aviation Notes and Meteorological Report. **9.5**, Late News Bulletin. **9.20**, Police Communications and Sports Notes. **9.30**, Programme of Dance Music from the "Oaza" Restaurant. **10.30** (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.**, Concert of Gramophone Records. **3.0**, Concert by the Carletti Orchestra, relayed from the Carlton Elite Hotel. **6.30**, Time Signal. **6.33**, Religious Address. Programme from **Basle** (on 1,034 metres), Concert by the Elizabeth Church Choir. Requiem (Joseph Haydn), for Soloists, Choir, Orchestra and Organ. **9.0**, General News Bulletin and News Bulletin supplied by the "Neue Züricher Zeitung." **9.40** (approx.), Close Down.

CURRENT TOPICS



Events of the Week in Brief Review.

DR. FLEMING'S KNIGHTHOOD.

The whole wireless fraternity, amateur and professional, welcomes the inclusion in the New Year Honours List of the name of John Ambrose Fleming, Esq., M.A., D.Sc., F.R.S., whose knighthood comes as a timely recognition of brilliant service. The inventor of the thermionic valve has the rare satisfaction of knowing that the world's indebtedness to him continues to grow.

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CONCERTS FROM RIGA.

Probably few British listeners have heard Riga, but an opportunity will occur in the near future when the station, according to present plans, doubles its power to provide better reception throughout Latvia.

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AN AUSTRIAN REVIVAL.

The erection at St. Peter, in the neighbourhood of Graz, of the old 7-kilowatt Vienna (Rosenhuegel) transmitter is now nearing completion, and the station is being formally opened in a few days' time. Work is also being hurried on the installation of the new Salzburg broadcast transmitter.

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WIRED WIRELESS FOR RUSSIA.

The Russian Soviet is reported to have under consideration the development of wired wireless to popularise broadcasting in remote country districts. There were 326,285 registered wireless sets in Soviet Russia on October 1st last, and it is hoped that wired wireless will increase this number to a million.

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MARCONI ROYALTY APPEAL.

At the hearing of the Marconi Company's appeal in the Chancery Division last week against the Patent Office decisions regarding wireless royalties payable by the Brownie Wireless Co. and the Loewe Radio Co., Mr. Justice Luxmore adjourned both cases pending the drawing up of a formal order by the Comptroller-General of Patents. His Lordship gave liberty to the Marconi Company to amend their petition in any manner that might be necessary when the order was made.

Counsel for all the parties interested said they were willing to assist the Comptroller in every way possible. It was hoped to get the order drawn up in the next week or so.

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A RECORD.

Major Oakeley, J.P., of Eynsham, claims to have received identifiable transmissions from eighty-two British and foreign broadcasting stations at loud-speaker strength. In each case the station announcement has been heard. Is this a record?

WE'RE GETTING ON.

"Visor" is the newly invented American word for a television receiver. Another step towards television!

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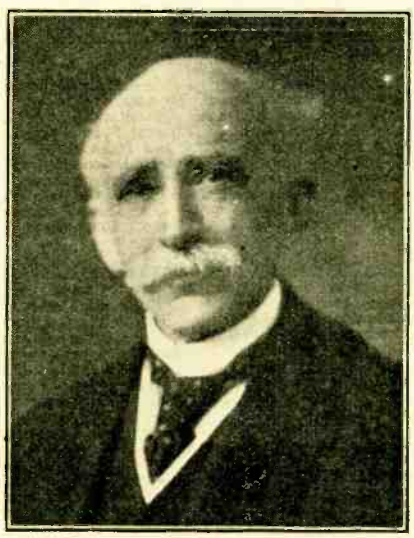
SWISS BROADCASTING UPHEAVAL.

According to Swiss wireless journals, proposals are being put forward to the Post and Telegraph Authorities with a view to the complete reorganisation of the Swiss broadcasting system. The general opinion favours the installation at Gros de Vaud and at Subrental of two high-power stations to work on 406 and 489 metres, the two exclusive wavelengths allotted to Switzerland. These stations would serve respectively the French- and German-speaking portions of the country, but, in order to make the system adequate, it might be necessary to put up relay stations at Berne, Basle, Geneva, Sion, Zurich, Coire, Tessin and St. Gall, such stations to take the high-power programmes and to retransmit them on two common wavelengths.

EASTER HOLIDAYS.

Owing to the Easter Holidays the latest date upon which small advertisements can be accepted for our issue of March 27th is Wednesday, March 20th.



A NEW YEAR HONOUR. Dr. J. A. Fleming, F.R.S., inventor of the thermionic valve, who has received the honour of knighthood.

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BIGGER MARCONI DIVIDEND.

At the annual meeting of the Marconi International Marine Communication Co., Ltd., on March 11th, the shareholders will be asked to approve of a final dividend of 7½ per cent., making a total dividend for the year 1928 of 15 per cent., as against 12½ per cent. for 1927.

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THANKS.

The Vicar of St. Jude's, Bethnal Green, writes to thank readers of *The Wireless World*, including two anonymous donors, for gifts received in response to the recent appeal for spare apparatus for his lads' wireless club.

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AUSTRALIA'S BIGGEST SHOW.

The largest radio exhibition yet held in Australia will open its doors at the Melbourne Exhibition Building on April 13th, and will run for a week. The Wholesale Radio Association (Victoria) are the organisers.

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ADVANCE IN FILM TRANSMISSION.

M. Mihaly, the Hungarian experimenter whose new system of film transmission has aroused tremendous interest in Germany, claims that his earlier apparatus has been improved upon by the discovery that it is not necessary to transmit 10,000 elements a second. Between 900 and 1,400 are sufficient, he claims, "suggestion" supplying all the deficiencies.

With the new system, a picture 3½in. by 4¾in. can be picked up on a receiver costing about £5. A picture 8in. by 9in. could be obtained on a £20 instrument.

The patent is owned by the Telehov Company of Berlin.

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AMERICAN HOPES.

C. Francis Jenkins, the American inventor of a system of film transmission, recently informed the Federal Radio Commission that he was endeavouring to produce a "television" receiver at the same cost as an ordinary loud speaker, the instrument being attached to a conventional radio receiver. The picture transmitted would be equivalent to a newspaper "screen" having 48 lines to the inch, and could be transmitted in a 10 kilocycle band. When asked how synchronisation would be obtained, a representative of Mr. Jenkins replied that this was "a trade secret."

It is understood that the Radio Corporation of America is opposed to the Jenkins system on the ground that it would cause interference to other broadcasting.

Gramophone Pick-ups

Technical Data as a Guide to the Choice of a Suitable Type for an Existing Set.

IN choosing an electrical pick-up the first consideration is sensitivity, and in the table below the voltage output at several representative frequencies has been given for each type. It is difficult to draw a line between those pick-ups requiring two and those requiring three stages of amplification for adequate loud speaker volume, but, in general, we would recommend three stages for all outputs above 0.5 volt R.M.S. in the accompanying table of relative voltages. Two stages are sufficient for outputs above 0.5 volt R.M.S., and in both cases a volume control is permissible.

The relative outputs at the frequencies given must not be taken as a final criterion of performance, as they do not disclose resonances, but it will serve as a rough guide in selecting a pick-up which will tend to correct deficiencies such as high- or low-note loss if these are known to exist in the L.F. part of the receiver. The figures were obtained with the aid of constant frequency, constant output records similar to those which will be shortly obtainable from The Gramophone Company, Ltd. (H.M.V.). In these records the amplitude of the groove is inversely proportional to the frequency, and the A.C. output should, therefore, be constant. Below 200 cycles the amplitude has to be curtailed in order to keep the pitch of the spiral groove within practical limits. Even so, the average pick-up has the greatest difficulty in following the groove at the lower frequencies, and some had to be forcibly held down to get a reading at 250 cycles.

Make.	Volts (R.M.S.)			
	250 cycles.	1,000 cycles.	2,000 cycles.	4,000 cycles.
Amplion	0.1	0.1	0.15	—
B.T.H. (Cliftophone)	0.85	0.4	0.55	0.8
Blue Spot	0.85	0.4	0.25	—
Brown No. 3 (*Tone Arm Model*)	0.15	0.2	0.35	0.15
Brown No. 2	1.4	0.74	1.6	—
Burndept	0.1	0.05	0.05	0.08
Celestion	0.38	0.28	0.35	—
Donotone	0.32	0.2	1.1	—
Edison Bell	0.95	0.4	0.7	—
G.E.C.	0.35	0.25	0.85	—
Igranic	0.56	0.25	0.6	—
Igranic (*Tone Arm Model*)	0.8	0.4	0.85	0.15
Loewe	0.15	0.05	0.05	—
Magnum	0.4	1.23	0.25	0.35
Murkham	0.6	0.3	0.15	—
Philips	2.7	1.53	1.04	—
R.I. and Varley	0.3	0.35	—	—
Vesshof	1.09	0.6	0.85	—
Webster	1.5	0.75	0.6	0.5

Although every effort has been made to include all well-known makes at present on the market, there are a few models which are not immediately available. These will be reviewed later in the "Laboratory Tests" section of this journal.

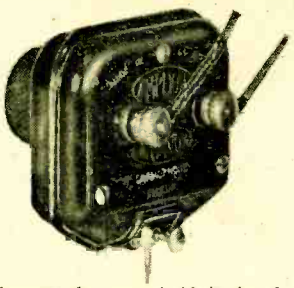
In the table of outputs, the omission of a figure does not imply that the pick-up does not give any response at this frequency, but that the voltage output was too small to be measured with accuracy by means of the apparatus used in the tests. The minimum readable voltage was 0.05 volt R.M.S.

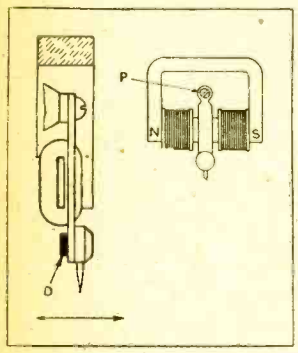
In the drawings showing the principle of operation, the direction of motion of the needle has been indicated by a double arrow, the axis of vibration (not necessarily a pivot) by P, *damping (usually rubber) by* D, *and adjustments by* A.

Gramophone Pick-ups.—

AMPLION.

Simplicity is the keynote of design in the Amplion pick-up. The moulded shell contains a simple single-acting reed movement in which the pick-up coils are attached to the pole pieces of the permanent magnet. Damping in the form of a rubber pad is applied to one side of the reed only, the pressure being adjusted by means of a screw at the back of the needle holder. Thus the damping pad also serves as a means of adjusting the gap between the reed and the pole pieces. Although satisfactory results are obtainable with two valves, three valves





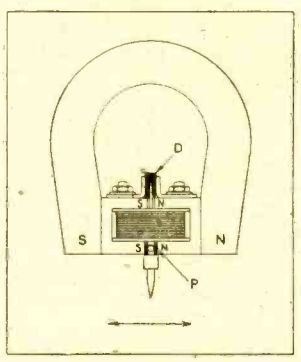
should be used if it is desired to incorporate a volume control.

Graham Amplion, Ltd., 26, Savile Row, London, W.1.

Price: 35s. complete with adaptor.

B.T.-H., CLIFTOPHONE.

This type pick-up is used by the Cliftophone Company as well as the B.T.-H., the former fitting their well-known parallel action tone arm, and the latter a tubular telescopic tone arm. The cobalt steel permanent magnet is of generous cross-section, and the pole pieces are arranged to give differential variations of the magnetic field which are converted to electrical energy in the pick-up coil surrounding the armature. The armature is of small dimensions, which would lead one to expect good reproduction of high frequencies.



This surmise is confirmed by test, and the output at 4,000 cycles is practically the same as at 250 cycles. The movement is lightly damped, and record wear is very low. In every respect a first-class job.

British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.

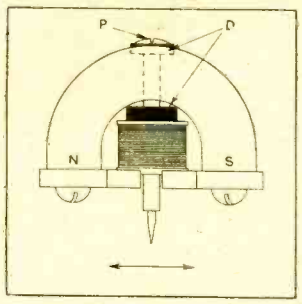
Price: With tone arm, £2 5s.

Cliftophone and Records, Ltd., 95, Park Street, London, S.E.1

Price: With tone arm, £3 3s.

BLUE SPOT.

A compact unit with a semicircular permanent magnet of unusual cross-section and tapered pole pieces. The armature is cylindrical and is held in a rubber-packed gland in the permanent magnet. Both the armature and the pole pieces are copper-plated to prevent sticking. An additional damping ring is fitted between the pick-up coil and the magnet. The output is comparatively high, being 0.85 volt at 250 cycles. As the frequency increases, the output falls off progressively, and at 4,000 cycles is less than 0.05 volt. How-

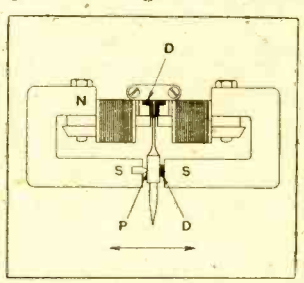


ever, the general level is sufficiently high to give satisfactory results with two valves. We understand that at the moment the entire output of the factory is being absorbed by manufacturers of gramophones.

F. A. Hughes and Co., Ltd., 204-206, Great Portland Street, London, W.1.

BROWN.

The two models tested are Type No. 3, an entirely new model, with aluminium tone arm, and Type No. 2, a cheaper model, for fitting to existing tone arms. Both models are notable for their high-grade workmanship and finish, and the "Super" model (No. 3) is of unusually interesting design. Two distinct magnets are arranged to give a differential variation of flux, and the armature, which is of very small dimensions, is milled from the solid, leaving reinforcing ribs at each

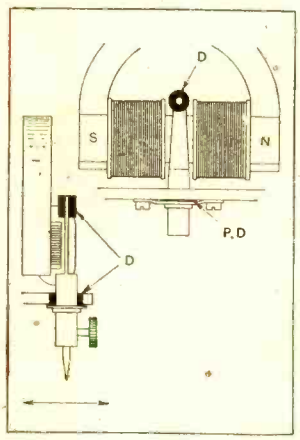


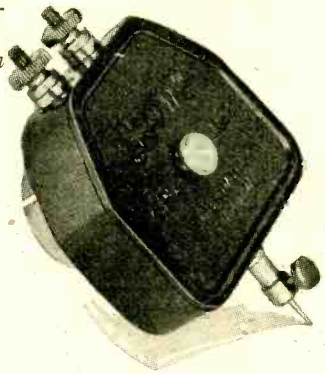
side. The pivot consists of a knife-edge let into the face of one magnet, and the reed is held against it by a small block of rubber. The output is about 0.2 volt, and the frequency characteristic is remarkably good, the output being the same at 4,000 as at 250 cycles, with an increase at 1,000 and 2,000 cycles. Connections are made through a plug and socket joint in the end of the tone arm, and the unit is easily removed for inspection. The cheaper model (type No. 2) is of the single acting-reed type, and is more sensitive, the output being more than sufficient for a two-valve

Gramophone Pick-Ups.—

amplifier. The movement is not quite so free as in the No. 3 model, but is not so restricted as to cause damage to records. At the price it is a very good proposition, and can be recommended for general use.

S. G. Brown, Ltd., Western

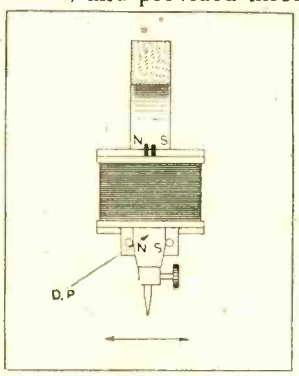




Avenue, North Acton, London, W.3.
Price: Model No. 3, £4; Model No. 3 with tone arm, £5 5s.; Model No. 2, 28s.

BURNDEPT.

This pick-up, which was at one time probably the most sensitive on the market, has been modified to give a smaller output, and now foots the list as far as sensitivity is concerned. The table shows, however, that the frequency characteristic is excellent, and provided three valves are used, a very fine performance will be obtained. Experiments show that with two valves the volume was sufficient for a small room, but it is safest

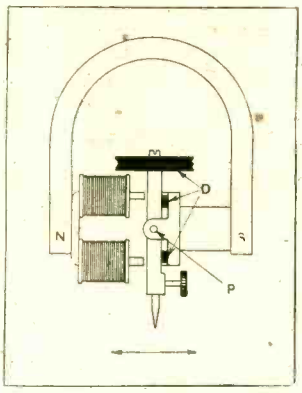


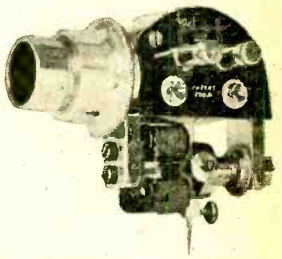
to play for safety and use three valves when a volume control can be used. The movement is heavily damped, and the upper pole pieces are set at an angle of 90 degrees to the plane of the permanent magnet. An interesting feature of this pick-up is the mounting of the movement, which is entirely supported on rubber inside the moulded shell. As a result the unit is exceptionally free from mechanical noise.

Burndept Wireless (1928), Ltd., Blackheath, London, S.E.3.
Price: £1.

CELESTION.

The principle of this pick-up was developed by Mr. J. B. Woodroffe, and is almost too well known to need description. The armature, which is pivoted centrally, is allowed exceptionally free movement and is damped at its upper extremity by attachment to a rubber band. The output is fairly uniform up to 2,000 cycles, and is sufficient to operate a two-valve amplifier; three valves should be used if it is desired to incorporate a volume control. The workmanship is above the average and can be fully appreciated, as the movement is unenclosed.



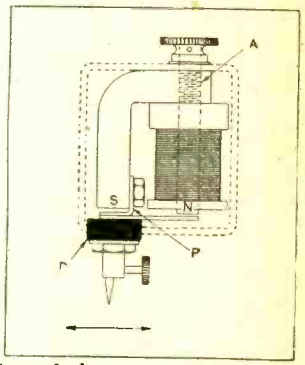


For many years this has been regarded as the standard pick-up, and is used by many electrical gramophone manufacturers.

Celestion Radio Company, London Road, Kingston-on-Thames.
Price: £4 4s.

DONOTONE.

This is probably the lightest and certainly the smallest pick-up on the market. It is claimed that the light weight (2½ oz.) tends to reduce record wear, but, in our opinion, the weight could be increased with advantage, as it was found necessary to increase the pressure in order to prevent chattering at 250 cycles. There is a marked resonance at about 2,000 cycles, which is probably due to the method of mounting the reed. This is supported on a fairly rigid angle bracket, which exerts a considerable restoring force. The air gap is adjustable by means of a



threaded core inside the pick-up coil, and the tests were carried out with the movement set for maximum sensitivity.

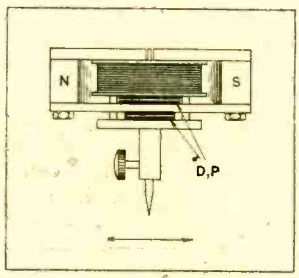
The Donotone (Regd.) Loud Speakers, 40, Furnival Street, Holborn, London, E.C.4.
Price: £1.

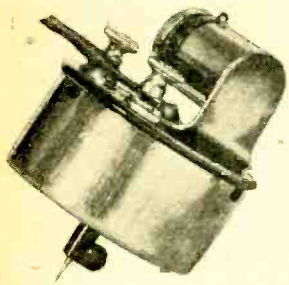
EDISON BELL.

The output from this pick-up is more than sufficient for two valves, and the output is good up to 2,000 cycles, after which it tends to fall off. The differential movement is rather on the stiff side, and there was a tendency to jump the groove on the 250-cycle record. Above this frequency the needle follows the groove quite

Gramophone Pick-ups.—

satisfactorily. Although the shape of the unit suggests that the needle is at right angles to the record, the length of the needle holder permits the pick-up to be inclined at the correct angle



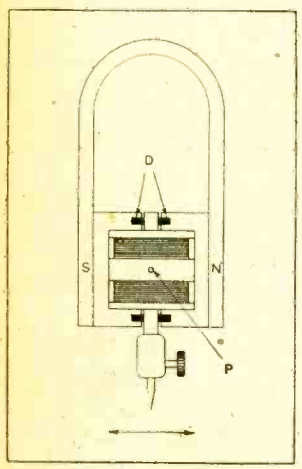


without fouling the record. The unit is supplied complete with valve adaptor, flex and twin connector.

Edison Bell, Ltd., Glengall Road, London, S.E.15.
Price: 27s. 6d.

G.E.C.

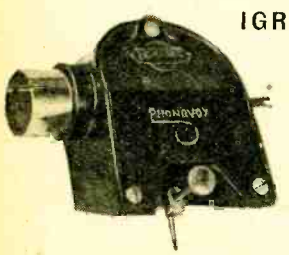
The balance armature is pivoted centrally between two pick-up coils, the pivot bearing consisting of rubber tubing clamped between the faces of the ebonite coil formers. Additional damping is provided by rubber inserts let into the face of each pole piece. The reproduction of frequencies up to 2,000 cycles is good, and the output shows a marked increase between 1,000 and 2,000 cycles.



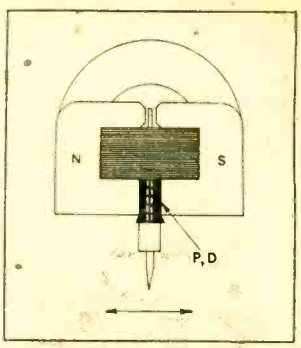
The tone arm connector is mounted on rubber to prevent the transfer of mechanical vibration to the tone arm.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.
Price: £1 15s.

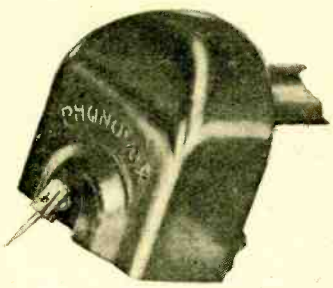
IGRANIC.



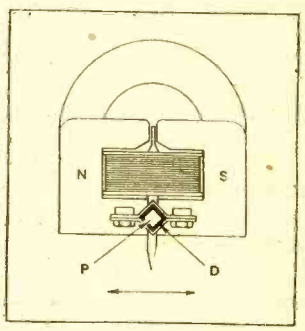
The Igranic-Pacent "Phonovox" is available in two patterns, one as a pick-up for attachment to existing tone arms, and the other as a complete unit with balanced tone arm. The principle is the same in both cases and consists of a differential movement with the pick-up coil surrounding the armature, which moves between laminated pole pieces. In the tone arm model, however, the method of pivoting the armature is slightly different. The lower part of the armature is of square section and is bent at right angles to fit between two clamping plates lined



with rubber. The characteristics of both models are very similar, the output being the same at 250 and 2,000 cycles, with a dip at 1,000 cycles. The tone arm



model tested was more sensitive and gave a readable output at 4,000 cycles, whereas the other model gave a reading below the sensitivity of the measuring instrument, *i.e.*, 0.05 volt.

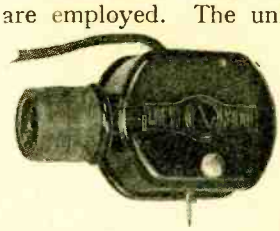


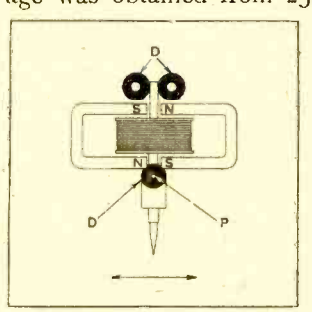
Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.

Prices: De Luxe Tone Arm Model, £2 2s. Phonovox pick-up only, 21s.

LOEWE.

The armature in this pick-up is tubular and is pivoted a short distance above the needle. Damping is applied near the pivot and also at the upper extremity of the armature. The movement is differential, and two separate permanent magnets are employed. The unit is of small dimensions and the output is correspondingly low. A readable voltage was obtained from 250





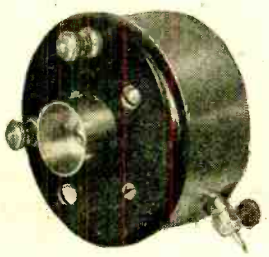
to 2,000 cycles, but above this the voltage output was too small to give a reliable reading with the voltmeter used. However, with a three-valve amplifier excellent results with ample volume was obtained.

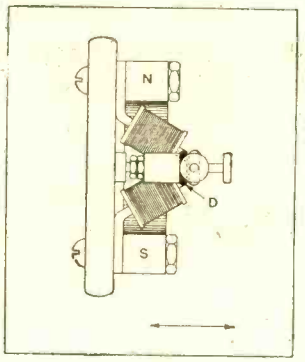
Loewe Radio Co., Ltd., 4, Fountayne Road, Tottenham, London, N.15.
Price 18s. 6d.

Gramophone Pick-ups.—

MAGNUM.

The movement is of the single-acting reed type, with inclined pole pieces carrying the pick-up coils. The reed is damped on the underside by a rubber pad which is mounted on an ebonite pillar the height of which is adjustable. It is thus possible to vary the air gap to prevent chattering. The movement is fairly stiff, but the output is more than sufficient for two valves and reaches a maximum in the vicinity of 1,000 cycles. The reproduction of high notes in this pick-up is well above the average, and quite a considerable reading was obtained from the 4,000 cycle record.



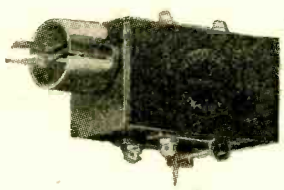


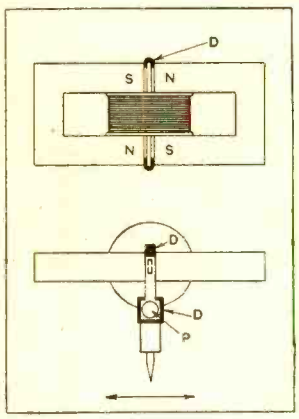
Burne Jones and Co., Ltd., 288, Borough High Street, London, S.E.1.

Price: £1 15s., including valve adaptor and extra tone arm adaptor.

MURKHAM

The movement of this pick-up is unique inasmuch as the armature moves as a whole in a direction parallel to the magnetic field. In other respects the principle is similar to that of other differential movements; there are two permanent magnets, and the pick-up coil surrounds the armature. The dimensions of the unit are small, and the construction is unusually solid and compact. The output falls off gradually as the frequency is increased, and the general level requires three rather than two valves. At present the complete output of these pick-ups is being absorbed in the complete radio-gramophone sets made by this company.

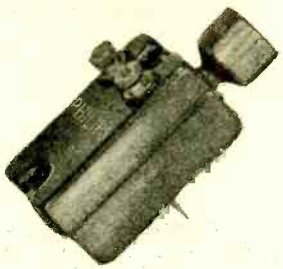


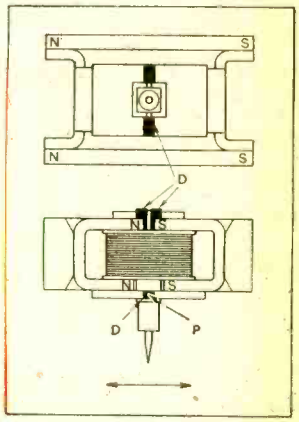


Universal Gramophone and Radio Co., Ltd., 105, Torriano Avenue, Kentish Town, London, N.W.

PHILIPS.

The output from this pick-up is well above the average and is more than sufficient for two valves. The makers supply a two-valve amplifier for use with this pick-up, employing a pentode output valve and a special volume control. The constant frequency records show that on open circuit the output falls slightly from 250 to 2,000 cycles and then rapidly to 4,000 cycles. It is probable, however, that the response would be modified when used in conjunction with the Philips volume control. The movement is differential and the magnet system consists of two bar magnets connected with specially shaped pole pieces. An interesting feature is the needle holder, which is in the form of a quick-acting chuck with an eccentric movement which does not employ a set screw.



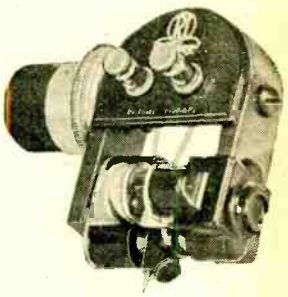


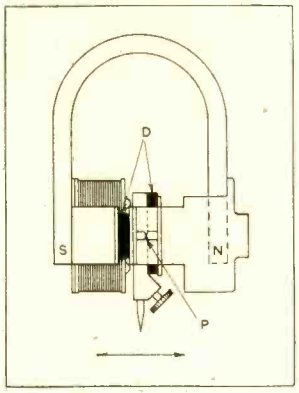
Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2.

Price: £2 10s.

R.I. AND VARLEY.

The armature is centrally pivoted in a position parallel to the pole faces which carry the pick-up coils. A thin spring steel strip riveted to the armature prevents side play. The damping is well distributed and is applied at four points, but the movement is quite free and allowance has been made for the development of unusually wide amplitudes. The output is fairly constant up to 1,000 cycles, but falls off at 2,000 and 4,000 cycles. The unit is well finished, and a moulding carrying the output terminals is fixed to the permanent magnet. The R.I. instructional booklet gives many technical details relating to this pick-up.





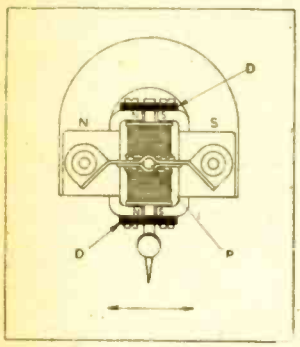
R.I. and Varley, Ltd., 103, Kingsway, London, W.C.2.

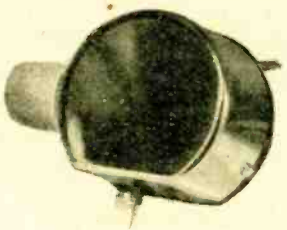
Price: £3 3s.

VESSHOF.

A compact magnet of generous cross-section carries the balanced armature movement, the spindle of the

Gramophone Pick-Ups.—armature being carried by substantial plain bearings. Rubber damping is applied at each end of the armature and the whole movement is mounted on a moulded base and protected by a plated



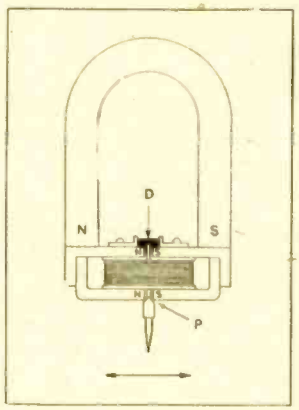


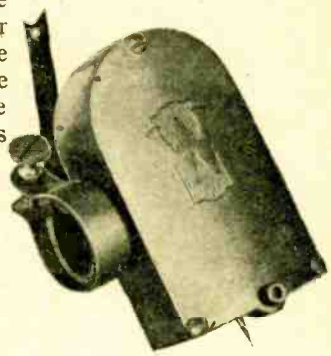
dust cover. The performance is very good and the pick-up tends to correct for the restricted amplitude of low notes on the average record.

H. Joseph, 96, Victoria Street, London, S.W.1.
Price: 37s. 6d.

WEBSTER.

This pick-up is of American origin; it has a remarkably good frequency characteristic and the sensitivity is also above the average. The greatest response is given on the lower frequencies, and this tends to correct the limitation of amplitude on the record at low frequencies. The decrease of A.C. output with increase of frequency is gradual, and at 4,000 cycles, the upper limit of the tests, there is still a considerable response. The lightness and small dimensions of the armature are no doubt responsible for this result. The armature is mounted on knife-edge pivots, and adjustable damping is applied at its





upper extremity. The method of adjusting the damping is interesting, two cams being employed to compress the rubber blocks at each side of the reed.

The Rothermel Corporation, Ltd., 24/26, Maddox Street, London, W.1.
Prices: Tone arm model, £4 4s. Pick-up and external volume control, £3 3s.

WHO'S WHO IN THE ETHER.

Wavelength Alterations and Additions.

AUSTRIA.

Station.	Metres.	Kc.
Klagenfurt	219	1370
Innsbrueck	282	1060

BELGIUM.

Schaerbeek (Brussels)	250	1200

GREAT BRITAIN.

Leeds	250.8	1158
Sheffield	270.3	1109

CZECHO-SLOVAKIA.

Bratislava	298.2	1006

FRANCE.

Petit Parisien (Paris)	333	900
PTT Lyons	470	638
Radio Vitus (Paris)	322	930
Radio Toulouse	541	554

(This wavelength is not definite, as station is still testing).

GERMANY.

Münster	267.8	1120
Bremen	329.7	910
Königswusterhausen and Norddeich	1650	182
Danzig	456	658

JUGO-SLAVIA.

Ljubljana (Laibach)	580	517

LITHUANIA.

Kovno	2020	148.4

POLAND.

Station.	Metres.	Kc.
Posen	336	893

TURKEY.

Stamboul	1230	243.8

ADDITIONS.

BELGIUM.

Liege (Radio Wallonie)	280	1070
Arlon (Radio Arlon)	312	960

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ANSWERS TO CORRESPONDENTS.

C. A. H. (Chorlton, Manchester).—Radio Toulouse. On 18/2 news bulletin at 10.15 p.m., and on 19/2 dance music, followed by news. This station is now working on about 540 metres. **G. A. T. (Eastbourne).**—You have made a mistake. Yes, this is the Hilversum station; your details absolutely tally with the programmes. On Sunday, Feb. 10, a concert was given by the Brandes' firm (announcements in Dutch and English) including the items you mention, namely, *Roses of Picardy* and selection from *No! No! Nanette*. On Feb. 18, at 7 p.m., this station gave an English lesson for beginners. Dial-reading for Hilversum you give as 68, whereas that for Kalundborg (which is on a *higher* WL) as 33½. Surely you have reversed these, or you probably hear Motala (a relay of Stockholm) on the former reading, Kalundborg on the latter, and Hilversum on 16. **J. H. (Richmond).**—Aerodrome transmission (900 m.). You heard Croydon giving direction and position to French 'plane, probably in foggy weather. **D. H. C. (Croydon).**—These are fog beacons that you hear on 1,000 m., G G G (— — • — — • — — •), Round Island Lighthouse, Scilly Isles; also G G M (— — • — — • — —), Bar Lightship, at entrance to Mersey, G C M (— — • — • — • — —), Casquets Lighthouse, near Alderney, and others. **F. S. (Hemsby).**—We regret, but your details are too vague, and we cannot trace without some estimate of WL. You can ascertain this by comparing the condenser readings of your "mystery station" with those of other transmitters you have definitely identified. Or, perhaps you could give the nearest stations above and below the station you mention. **C. L. (Beeston, Notts).**—Yes, this was Posen. Every Saturday night this station works late (until about 1 a.m Sunday). **H. R. B. (Teignmouth).**—(1) If you mean Radio Toulouse, then Budapest Gipsy Orchestra relayed from Grand Hotel Britannia. (2) The only German station within your limit is Frankfurt, but it closed down before midnight. We are inclined to believe that the tattoo was a gramophone record, and possibly a test by the transmitter. (3) PTT. Lyon, own transmission, including special radio review.

JAY COOTE.

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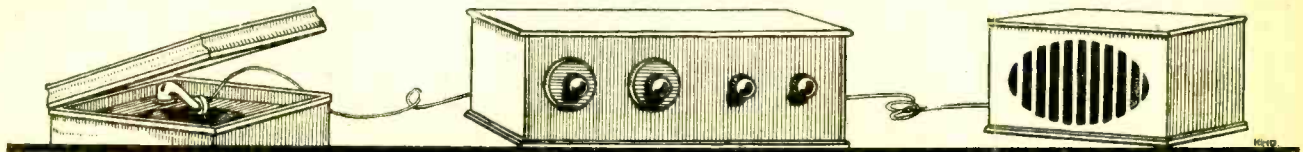
BROADCASTING MAP OF EUROPE.

We have recently been sent a copy of a Broadcasting Map of Europe, compiled by Cossors, which also gives a list of European broadcasting stations. This map should be very useful to those who are interested in distant reception, and the map will be sent on receipt of 2d. for postage to any reader who applies to Cossors for it.

There have been, we observe, a number of changes in wavelengths and other details since the list which accompanies the map was compiled, but no doubt these points will be rectified in any future printings.



FITTING A PICK-UP

Hints on Adapting Existing Sets for Gramophone Reproduction.

IN spite of the present tendency to reduce the sensitivity of pick-ups, it is true to say that any conventional receiver capable of giving loud speaker reproduction of radio signals can be converted to act as an electrical gramophone.

An article printed elsewhere in this issue shows that a number of pick-ups require three amplifying stages; thus, with the average set having two L.F. valves, it will sometimes be necessary to convert the detector to act as an amplifier. Of course, in the case of the two-valve det.-L.F. set there is no alternative to this form of connection, and, moreover, a fairly sensitive type of pick-up should be chosen.

The problem of conversion, in its simplest aspect, is to devise a convenient method of connecting the pick-up in series with a source of biasing voltage between grid and filament either of the first L.F. valves, or, more often, of the detector. In cases of uncertainty it is better to err on the side of excessive magnification; too-loud signals may easily be reduced in strength by means of a suitable control, but volume cannot readily be increased beyond its normal maximum. Records are not absolutely uniform, and some latitude in the matter of amplification is highly desirable.

Practical methods of putting these alterations into effect are shown in Fig. 1. There are an almost infinite number of ways of making the necessary circuit changes: as a rule it will be most convenient to keep the pick-up permanently attached to the set, but sometimes it will be considered preferable to provide sockets into which a plug fitting may be inserted.

The first diagram (a) indicates the method of procedure when alterations are to be made to a leaky grid rectifier; although a valve operating in this way is the most difficult to convert, it will be seen that additions to be made are by no means extensive. All that is required is a switch, or a plug-and-socket arrangement, whereby the grid may be changed over from its usual connection (to grid condenser and leak) to the pick-up; the circuit is completed to filament through a bias battery, which may consist of a single dry cell unless the detector valve has a lower impedance than usual. This method is also applicable when the detector follows a tuned-anode H.F. amplifier.

Modified Detector Circuits.

Alterations to an anode bend detector are shown in Fig. 1 (b). With the switch in the "radio" position, the low-potential end of the tuned circuit is returned to filament direct through the full grid bias voltage, while for "gramophone" reproduction it is completed through the pick-up and a lower voltage tapping.

A still simpler form of alteration is possible where detector grid voltage is controlled by means of a potentiometer (Fig. 1 (c)). All that is necessary in this case is to provide a switch by means of which the pick-up may be short-circuited when not in use. When potentiometer settings for the alternative methods of reproduction have been determined, it is convenient to mark appropriate positions of the control knob.

A little consideration will show that it is both easier and safer to modify a detector grid circuit when an

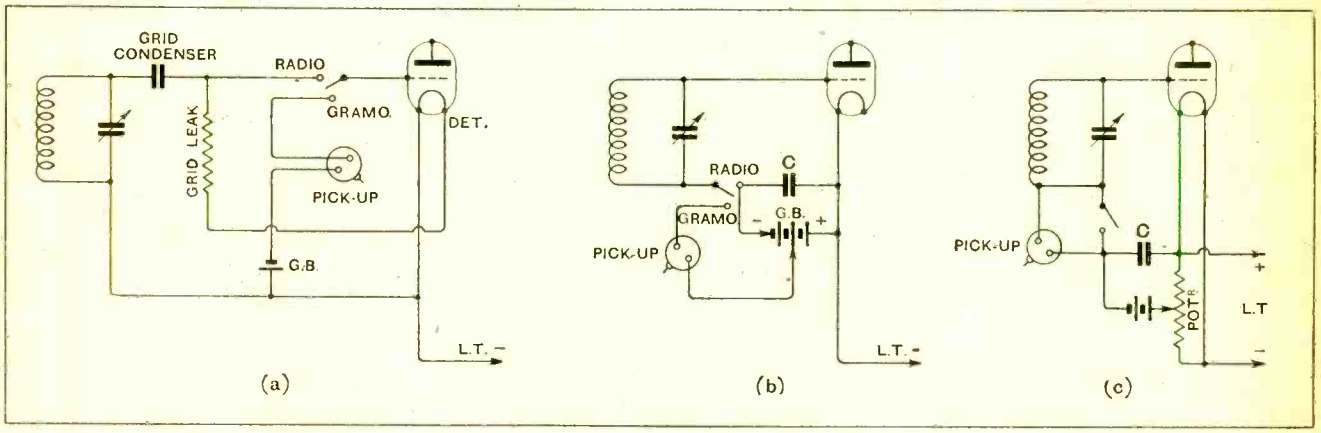


Fig. 1.—Converting the detector for amplification: methods of connecting a pick-up in its grid circuit.

Fitting a Pick-Up—

anode bend rectifier is used than when the valve operates as a grid rectifier. In the latter case, it must be realised that the switch is at high oscillating potential, and is, indeed, in one of the " danger points " of the circuits. Care must therefore be taken to avoid long wandering leads, and, moreover, it is as well to choose a switch of small dimensions, as a large mass of metal is undesirable. In order to avoid all risk of impairing the performance of the set as a wireless receiver, it is consequently recommended that the switch should be fitted to a small block of ebonite, which may be mounted on the baseboard in close proximity to the grid terminal. It is realised that this is less convenient than a panel switch, which, however, should not be included unless it can be wired with short leads.

A suitable method of mounting a baseboard switch is shown in Fig. 2. The base may be raised on short-distance pieces, and dimensions may be reduced sufficiently to allow it to be accommodated in the restricted space usually available in an existing set. Where the plug-and-socket method is preferred, the two sockets necessary, with their projecting soldering tags, may be mounted in a similar manner.

As already suggested, no special precautions are necessary when inserting a pick-up in the grid circuit of an

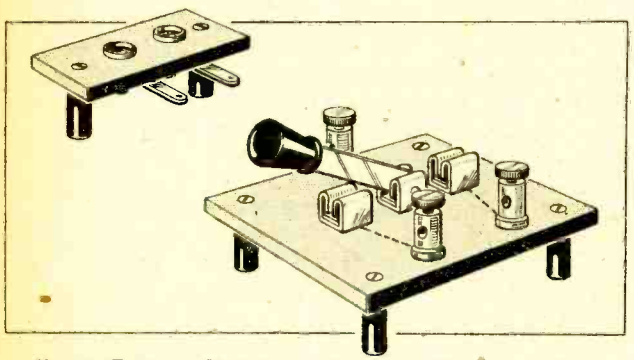


Fig. 2.—Terminal block and switch for baseboard mounting.

anode bend detector: this is for the reason that the extra wiring, etc., is at low oscillating potential, and, if the usual care is taken in regard to good insulation, there is little chance of introducing trouble. It will accordingly be permissible to mount the change-over switch in an accessible position on the panel, although the lead to the centre contact should not be excessively long.

Changing Over the Amplifier Input.

If only in the interests of economy, provision must be made—if it is not already included—for switching out any valve (or valves) not in use while the set is being used for gramophone work.

In cases where it is decided that sufficient magnification will be afforded by the existing L.F. amplifier without impressing the detector into service, the methods of connection shown in Fig. 3 may be used. The first (a) is applicable when the preceding valve is coupled by means of a resistance or choke; diagram (b) shows the connections for a transformer-coupled valve. We are not dealing with radio-frequency potentials in these two circuits, but must nevertheless take reasonable precautions, and must not use excessively long leads.

Several typical *Wireless World* sets which include anode bend detection after an H.F. stage, using plug-in transformers, lend themselves very readily for gramophone reproduction. To make the conversion, all we have to do is to switch off the H.F. valve, remove the transformer, set its tuning condenser to minimum, and connect the pick-up by means of a length of flex wire fitted with suitable plugs to the sockets across which the

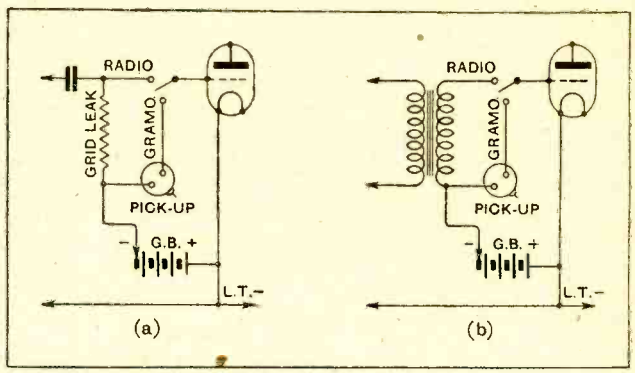


Fig. 3.—How to connect a pick-up to an L.F. amplifying valve.

transformer secondary is usually connected—they are usually marked " G " and " F." Before commencing operations, it will be necessary to readjust detector valve bias to the voltage applicable to amplifying conditions.

Some form of volume control is practically essential, and unless the receiver already includes a device of this sort—which will not be thrown out of circuit by adding the pick-up—it will be necessary to add some means either for restricting the input to the set or reducing its overall magnification. The use of a variable shunt resistance, connected directly across the pick-up, is certainly the most popular method, and is probably as satisfactory in practice as anything else. Suitable

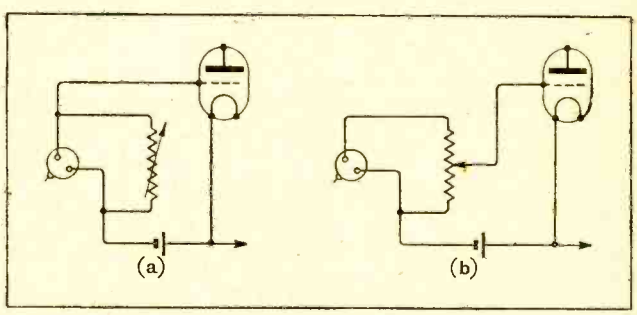


Fig. 4.—Parallel resistance and potentiometer methods of volume control.

resistances, with a maximum value in the order of 500,000 ohms, are readily obtainable. As an alternative, we have the use of a high-resistance potentiometer: these two methods are shown in Fig. 4. The control may either be embodied in the set, or connected directly across the pick-up.

BROADCAST BREVITIES

By Our Special Correspondent.

The Gramophone on Trial.—B.B.C. Television Test.—A Paris Feud.

Broadcast Gramophone Recitals.

The bonds of brotherhood between broadcasting and the gramophone are being strengthened by the attention which the B.B.C. is bestowing on gramophone recitals specially intended to assist listeners in their choice of records. The average programme time devoted to gramophone music varies weekly from 10 to 11 per cent.

In the Correspondence Department at Savoy Hill I found that the number of appreciatory letters grows from week to week. In the week ending February 23rd not one grumble was received, whereas not very long ago there were frequent allegations that the B.B.C. was transmitting gramophone records with the idea of programme economy.

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Looking Ahead.

At one time the charge was not unfounded, though to-day practically every gramophone transmission is for the sole purpose of helping the gramophile. But, leaving economy out of the question, it seems quite feasible that the next year or two will see a sufficient improvement in gramophone reproduction to allow the gramophone to step into the regular programmes. To judge from a recent experiment at *Radio Toulouse*, the time may be nearer than people imagine.

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Broadcast Gramophone Test.

The Toulouse experiment was the outcome of a flying visit by the famous French singer, Mlle. Ninon Vallin, who, with an orchestra of fifty-four instrumentalists in the Capitole Theatre, provided operatic selections which were broadcast.

At the conclusion of each item *Radio Toulouse* transmitted a gramophone rendering of the identical piece as it had been recorded a few weeks previously by the same artiste and the same orchestra.

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The "Spiritual" Gramophone.

The mass of correspondence from listeners indicated that, although there was a difference between the "flesh and blood" rendering and the "spiritual" output from the gramophone, such difference was only just perceptible. Indeed, in a subsequent test, when the changes were unannounced, listeners were at variance as to whether the performance was real or gramophonic!

The organisers of the test are convinced that gramophone reproductions of large orchestras are more satisfying than direct broadcasts by small instrumental combinations of three or four players.

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Threat to Professional Musicians.

What professional broadcasters—musicians and entertainers—are thinking about the approaching perfection of the gramophone must be piquant and pungent and unprintable.

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A Lesson in Acoustics.

To judge from the performances of "Lakmé" broadcast from the Parlophone studio last week, the gramophone is making a respectable effort to repay its debt to broadcasting. Acoustically the results were quite equal to, if not better than, anything that the B.B.C. studios can give us. One noticed particularly the "stereoscopic" effects.

The Parlophone studio has been used previously for broadcasting; let us hope it will either be used again or that the B.B.C. will construct a studio with similar characteristics.

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B.B.C. Television Test.

The Postmaster-General is being asked in Parliament this week for information regarding tests carried out by the B.B.C. with the Baird television system. The first experiment took place on the morning of Saturday, February 23rd, between 11 and 11.30, 2LO being the transmitter. A further test was scheduled for Tuesday, March 5th.

At the time of writing, the B.B.C. courteously declines to discuss the results.

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Are Listeners Really Satisfied?

In view of the widely accepted belief that satisfied people are silent and that the malcontents make the noise, I was surprised by the correspondence statistics at Savoy Hill for the week ending February 23rd. Of a total of 1,613 letters received on the subject of programmes, 1,543 contained eulogistic comment. Only seventy letters were critical.

This surely points to two possibilities. Either the old maxim is reversed and the malcontents are holding their peace, or (forgive a trembling hand) the vast majority of listeners really are satisfied! If the latter, how long is it going to last?

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British Ether More Peaceful.

The latest survey by the B.B.C. engineers at Keston, coupled with correspondence from listeners, shows that the wavelength situation in Britain has greatly improved in the last fortnight. Even Newcastle listeners are happier, the "wipe out" effect of Nuremberg no longer being felt within 5NO's service area.

The single wavelength working by Bournemouth and three of the relays is now giving satisfactory results.

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Another French Broadcasting Feud.

I hear that the latest move in the feud between the Eiffel Tower and Radio Paris broadcasting stations has been made by the French Catholics. They have formed a Comité catholique de la radiophonie, the business of which will be to intervene whenever the convictions and feelings of Catholic listeners are disregarded by any broadcasting station.

As reported in the Press, the present trouble arose three weeks ago, since when, it is alleged, the Lenten sermons from Notre Dame, broadcast by Radio Paris have been wilfully interfered with by Eiffel Tower. The skirmishes take place on Sunday afternoons. Take your seats gentlemen. Eiffel Tower, 1,488 metres Radio Paris, 1747.2 metres.

FUTURE FEATURES.

2LO and 5XX.

MARCH 13TH.—"Francesca da Rimini," a play by Gabriele d'Annunzio, translated by Arthur Symons.

MARCH 15TH.—B.B.C. Symphony Concert, relayed from the Queen's Hall.

Daventry (5GB).

MARCH 10TH.—A Midland Composers' Programme.

MARCH 14TH.—"Love Magic," a comedy by G. Martinez Sierra.

MARCH 16TH.—"I Pagliacci," relayed from the Alhambra, Bradford.

Cardiff.

MARCH 11TH.—"Bow Bells," a true Londoner's night.

Manchester.

MARCH 14TH.—Hallé Concert, a Choral evening.

Glasgow.

MARCH 12TH.—Performance of the Winning Play in the Scottish Community Drama Festival.

Belfast.

MARCH 11TH.—A Ship's Concert, relayed from H.M.S. Caroline (by permission of Captain the Marquis of Dufferin and Ava).

Records for the Gramophone Amplifier

A Selection Suited to Electrical Reproduction.

Users of electrically reproducing gramophones are well aware that particular records give preferable results to others, such differences not being discernible with the ordinary gramophone. The following selection made among recently issued records has been drafted, bearing in mind the merit of the results obtainable when using pick-up and amplifier.

PIANO.

Probably the most difficult instrument both to record and to reproduce satisfactorily is the piano.

As a result of electric recording many types of records have improved in character to an amazing degree. The technical perfection of organ, orchestral, military band and many vocal records is really astounding, but up to the present piano records do not seem to be quite so good. Now and again each of the gramophone companies will issue a piano record which has a very natural tone, but a later record by the same artist recorded quite frequently under the same conditions will be musically very interesting, but the tone will not be like that of any real piano. It is not difficult to appreciate why this state of affairs exists. When, say, the middle C of a piano is struck the resultant sound contains not only the fundamental but also many harmonics. Speech and the sounds of the majority of instruments contain harmonics to a certain extent, but the sound of a piano is very rich in them. Consequently, for the recording to bear a true relation to the original sound the fundamental and all the harmonics must be recorded, and, also very important, must be recorded in their correct ratio.

The majority of the piano records have what one might call too rich a tone, resembling more a harp than a piano, which would seem to indicate that the upper harmonics have been over-amplified. This distorted tone is not unmusical, and the bulk of piano recordings can be listened to with pleasure.

The piano often has its most natural tone when it is heard in the background as the accompaniment to a vocal item.

Among the records which have a very natural tone is that of the Hungarian Rhapsody No. 6 (Liszt), played by Levitsky (H.M.V. D.1383). On this record the middle register tones seem to have rather more body than usual. The most consistent H.M.V. artist, however, is Backhaus. Practically every one of his recordings is good, two of his best records being Caprice Espagnole (Moszkowski) (H.M.V. D.B.1130) and Marche Militaire in E flat (Chopin) (H.M.V. D.B.1125). Myra Hess has a beautiful touch, and her record Chorale Prelude (Bach) (Col. D.1635) is particularly good. William Murdoch consistently records for Columbia Company, and his records always come up to a high standard. His latest record, Minstrels (Debussy) (Col. 5167), is a good example of his technique. Two interesting sets of piano records are twelve of Chopin's Nocturnes played by Leopold Godowsky (Col. L.2164-71). The playing is prefaced by an address on Nocturnes by Ernest Newman, whose voice has been heard over the radio. In the Parlophone list of piano records Forest Murmurs (Liszt), played by Prof. Pembaur (Parlo. E.10717) and Vienna Blood, played by Karol Szreter (E.10780) are certainly among the best. A good Brunswick record is Brailowski's Pastorale (Capriccio) (Scarlatti-Tausig) (Bruns. 80038). The piano tone is crisp and the staccato tones record well.

In passing it may be noted as an almost invariable rule that pianists having a crisp, clear staccato touch record most effectively. Where sustained notes are played, permitting the strings of the piano to reverberate for an appreciable time—in which circumstances harmonics may be expected to be produced—the recording is not nearly so satisfactory.

ORCHESTRAL.

Although equipment having the acoustic output of a public address system is not required in the average home, yet a reserve of power to carry the amplifier over peaks and musical climaxes is very desirable. Now that super power valves of the Osram L.S.5A, P.625A, B.T.H. B.12, and Mullard D.F. A.9 class are readily available it is a source of satisfaction to be able to leave the volume control set and then to enjoy the lights and shades of orchestral music as it had been played in the first instance. With an amplifier having only a moderate output it is necessary during the playing of an orchestral record to adjust the volume control from time to time to avoid overloading, in much the same manner as the B.B.C. through their control room level up broadcast music. The majority of orchestral recordings issued now are excellent, and in the H.M.V. list the Philadelphia Symphony Orchestra still produce the finest records for the Gramophone Company. Their best recent records are Rimsky-Korsakov's Scheherazade (H.M.V. D.1436/40) and Cesar Frank's D Minor Symphony (H.M.V. D.1404/8). The precise playing of this orchestra is remarkable, and in the Scheherazade recording the tone colour is extremely good. Record No. D.1437 of this series demonstrates the manner in which electrical reproduction gives a natural tone to pizzicato passages. The only British orchestras which seem in any way comparable with the Philadelphia are the Hallé Orchestra—well known to wireless listeners—and the Royal Philharmonic Orchestra, both of which are recorded by the Columbia Company. In the Hallé Orchestra recordings the natural tone of the strings is usually the most outstanding feature. The Royal Philharmonic orchestral recordings, while not so well drilled as the American orchestras, have splendid wood wind and brass instrumentalists. In these and other Columbia orchestral recordings it is found that, although volume is ample and the recording decidedly robust, the chatter and high-pitched resonance whine from the pick-up is rather less than usual. Of the Hallé records the Rosamunde Series—Alfonso and Estrella Overture, Ballet Music and Entr'actes (Col. L.2122/5)—illustrate the excellence of this orchestra. The Royal Philharmonic Orchestra, conducted by Weingartner, have recorded several works, and in particular Symphony in E Flat, No. 39 (Mozart) (Col. 9450/2), may be quoted as one of their best. Another excellent recording is Symphony No. 34 in C (Mozart) (Col. 2220/2). This latter work was conducted by Sir Thomas Beecham. The star orchestra in the Parlophone list is undoubtedly that of the orchestra of the State Opera House, Berlin, three of whose records of outstanding brilliance are (E.10633/5) music from Lohengrin and Die Meistersinger. A later excellent recording by the same orchestra is The Moldau (Smetana) (E.10794/5). Recordings of a full orchestra not of symphony style which are worthy of hearing are L'Arlesienne—Incidental Music—played by the

Records for the Gramophone Amplifier.—Orchestre Symphonique de Paris (Col. 4988/92) and Scène de Ballet—Marionettes—played by the New Light Symphony Orchestra (H.M.V. B.2754).

LIGHT ORCHESTRAL.

Music of this character, sometimes called "tea-time music," is probably the most popular of all. In practically all of the examples that follow there is a sparkle and brilliance in the recording, playing, and in the music itself that is readily appreciated by even the most unmusical. The J. H. Squire Celeste Octet, whose records come in this class, have two particularly good ones in Mignon—Polonaise; Introduction et Romance (Col. 9507) and Chant Sans Paroles (Tchaikowsky) (Col. 9608).

In the Polonaise the tone of the strings is clear and natural. Marek Weber provides music of a similar style for the H.M.V. Company. His Potpourri of Waltzes (H.M.V. C.1544) and the Victor Oloff Sextet's To a Wild Rose (H.M.V. B.2690) are both records which can be recommended. The charm of Viennese waltzes is evident in the records of the Dajo's Bela Orchestra, two of whose best records are Roses of the South (Parlo. E.10751) and Vienna Blood (Parlo. E.10740).

Light orchestral music of quite different character is recorded by the Bournemouth Municipal Orchestra in Two Imps (Col. 9505) and Fluttering Birds (Col. 9471). The first features a xylophone duet and the second a piccolo duet. Excellent reproduction from these records was obtained with several different makes of pick-ups

BAND.

Steady improvement in the recording of military bands and brass bands has been made. The majority of the companies seem to concentrate on producing extra loud volume records. Although the extra volume is not required by pick-up users, many first-class records entirely suitable for electrical reproduction have been produced. In the H.M.V. Company's list Creatore's Band and the Coldstream Guards' Band set a high standard. Traviata Selection (C. 1530) and Cavalleria Rusticana Selection (C.1540) are good examples of the style of the former band, and the La Source Ballet (Delibes) (B.2798) is perhaps the best record of the latter. The Columbia Company's best band records are produced by the Grenadier Guards' Band and the Royal Air Force Band. Good records of the Grenadier Guards' Band are the New Gilbert and Sullivan Selection (9495) and the Merrie England Selection (9607). An effective record of the Royal Air Force Band is Invercargill March on No. 5138. The Garde Republicaine Band of France have produced one record, Carmen Entr'acte (Col. 9504), in which the recording of the side drum and tambourine is very clear. The Parlophone Company have issued several records played by a Massed Military Band. Old Comrades on E.6053 and Our Marines on E.6112 demonstrate the tone of the euphonium and also the side drum. The recording is extremely vigorous.

OPERATIC.

In the list of operatic soprano records recently issued those of two artists stand out. Elizabeth Rethberg's Elsa's Dream from Lohengrin (H.M.V. D.1420) and Eva Turner's Ritorna Vincitor from Aïda (Col. 2150) are absolutely first-class records. In each case the top notes of the singer are entirely free from any tendency towards nasalness. Another good soprano record is Ocean, Thou Mighty Monster, from Oberon, sung by Florence Austral (H.M.V. D.1504) Of contralto records Maria Olczewska's Mon Couer s'ouvre à ta voix (D.1465) is the best of the more recent issues. The operatic singer much more than the ordinary vocalist has gained by the introduction of electrical recording. Records are now made in the appropriate atmosphere of a theatre, quite often during a public performance, and invariably have a full-sized orchestra and chorus. The recent tenor and baritone records have nearly all been produced in such circumstances, and typical examples are O sommo Carlo, from Ernini, sung by Franci, Palet and Urbini (H.M.V. D.B.1138), Revedrai, from Aïda, sung by Granforte and Dal Monte (H.M.V. D.B.1153), and Nume Custode E Vindice, from Aïda, sung by G. Arangi Lombardi, Francesco Merli and Chorus (Col. L.2066). Other operatic recordings which should be noted are the Gigli—de Luca duets O Mimi, tu piu from Bohème and Solenne in Quest from Forza Del Destino (H.M.V. D.B.1050), and the De Luca Galli-Curci duet Dite Alla—Imponete from Traviata (D.B.1165). Several good records of opera in English have been released recently, including the complete recording of Cavalleria Rusticana, sung by the Principals and Chorus of the British National Opera Company (Col. 5127/36). Isolated recordings of opera in English which should be noted are Give Me Thy Hand, from Don Giovanni, sung by Miriam Licette and Dennis Noble (Col. 9503), and Browning Mummery's Flower Song from Carmen (H.M.V. C.1419).

Each of the Gramophone companies issue at intervals records of well-known operatic choruses; these are usually more remarkable for the sheer output of sound rather than their musical value. Such records, if the pick-up can follow, are decidedly effective. Examples of this class of record are Aïda Grand March, by the La Scala Chorus and the Milan Symphony Orchestra (Col. 9606) and Soldiers' Chorus (Faust) (H.M.V. B.2624), also recorded by the same artists. A similar ensemble record, although not operatic in character, is that of the choral setting of Strauss's famous waltz, Blue Danube, sung by the Sieber Choir with Grand Symphony Orchestra (Parlo. E.10793).

VOCAL.

Although electrical recording has not had a marked effect on vocal records, the following improvements may be noted: The piano accompaniment has become more natural in tone, and in the case of "bird" songs in which the vocalist is accompanied by a flute or piccolo obbligato, reproduction is far superior to that of non-electrical recordings of similar subjects. Improvement is noted most in the recording of quartettes, trios, etc. In the February Columbia list a complete recording of Liza Lehmann's song cycle, In a Persian Garden, is given. The singing of Harold Williams in Myself When Young, and Hubert Eisdell in Ah! Moon of My Delight, call for comment as regards the technical perfection of their voice production, but it is in the two quartettes, Wake! For the Sun Who Scatter'd into Flight and The Lion and the Lizard Keep, that the work rises to its greatest height. In the quartettes named the voices of Dora Labbette and Muriel Brunskill sound better than in their solo passages. (Col. 9598/02.)

John McCormack, who has recently been much in the public eye, is a singer who has a matchless style, which is heard to good account in his record Just for To-day (H.M.V. D.A.929). Peter Dawson is another singer who, like McCormack, has made gramophone records almost since the commencement of recording. His later records are as successful as his earlier ones, and in particular Drake's Drum (H.M.V. B.2743) and Delaware's Farewell (H.M.V. B.2759) may be quoted as typical examples of his robust style of singing. Chaliapine has always been an attractive gramophone artist, and one of his most recent recordings, Death and the Maiden (H.M.V. D.B.1184), is as fine a record as any he has previously made. The appreciation of Norman Allin's magnificent voice steadily grows, and his Erl King (Col. L.2038) and Messmates (Col. 5140) and John Coates' Knotting Song (Col. 9506) demonstrate the high standard of modern vocal gramophone records. No *résumé* of vocal records would be complete without the inclusion of records by Paul Robeson, whose voice is heard to perfection in Sinner, Please Doan' Let (H.M.V. 2771) and Seem Lak' to Me (H.M.V. B.2777).

As has been noted in the Operatic Section, soprano and contralto recordings have now a more natural tone, and the following have all been tried with different makes of pick-ups and have given satisfaction. La Paloma, sung by Galli-Curci (H.M.V. D.A.1002); The Lost Chord, sung by Essie Ackland (H.M.V. C.1599); Solveig's Song, sung by Dora Labbette (Col. 9577); and The Shepherd on the Rock, sung by Bella Baillie (Col. 9613). In the latter record the soloist is accompanied by Charles Draper on the clarinet, and, as stated above, the combination of soprano and wood wind is most effective.

ORGAN.

Organ records demonstrate to a marked degree the superiority of electrical recording over the older methods. The output from a pick-up played on organ records is large, but no difficulty in connection with pick-up chatter is experienced. The prominence of bass tones is usually a notable feature, and what may be called the solidarity of the reproduction is always surprising to those who have not heard the latest records of this section. Organ records which can be recommended are Edouard

Records for the Gramophone Amplifier.—
Commette's Fantasia G minor (Bach) (Col. 9552) and Toccatas (Boellmann and Gigout) (Col. 9497), both of which are played on Lyons Cathedral organ, and Regd. Foort's Land of Hope and Glory (Elgar) (H.M.V. C.1529).

Despite the derision of highbrow musicians, the popularity of cinema organ records shows no sign of decreasing. Now that the use of the vox humana stop is kept within moderate limits, there are several of these records which can be fully recommended. Jesse Crawford has two records which are very effective in Dance of the Blue Danube (H.M.V. B.2833) and Just Like a Melody out of the Sky (H.M.V. B.2825). Quentin MacLean, playing on the organ at the Shepherd's Bush Pavilion, has made good records of the well-known Merchant of Venice incidental music (Col. 9585/6). A further decidedly effective cinema organ solo is I Loved You Then, played by Emil Valaszco (Parlo. R.264).

SYNCOPATED VOCAL.

Records of this character enjoy a wide popularity, the extent of which can be gauged by the number of records issued. Layton and Johnstone have perhaps the longest list of such records, all of which seem to be of uniformly high standard. My One and Only (Col. 5184) and Just Like a Melody out of the Sky (Col. 5033) may be selected as good records from their list. The Revellers in Dusky Stevedore (H.M.V. B.2912) and Jack Smith's The Best Things in Life are Free (H.M.V. B.2766) are also effective recordings. The Parlophone Company issue several records of this type, of which Out of the Dawn, sung by Seger Ellis (R.267), and High Hat, sung by Leslie Hutchinson (R.261), are good examples. The Duncan Sisters have recorded their famous song, The Argentines, Portuguese, and the Greeks (H.M.V. B.2915), and those who heard the Trix Sisters broadcast will be glad to have I Hope I Don't Meet Molly (Col. 5183).

SYNCOPATED PIANO.

The tone of the piano in syncopated records is often quite as good as the tone of the piano in works of a more serious nature. Raie da Costa is a well-known pianist who regularly records syncopated music. Her best records are Roll Away Clouds (Parlo. R.225) and Crazy Rhythm (Parlo. R.231). The Man I Love, played by the Two Hoffmans (H.M.V. B.2808), and Lucky Girl Selection, played by Billy Mayerl (Col. 5178), can similarly be recommended.

SYNCOPATED ORCHESTRAL.

Although syncopated orchestras are not likely to compete with the ordinary symphony orchestra, there are one or two records played by well-known dance bands which are worthy of attention. A Suite of Serenades, played by Paul Whiteman (H.M.V. C.1600), Was it a Dream, played by the Dorsey Brothers and their Concert Orchestra (Parlo. R.226), and Virginia Selection, played by the London Theatre Orchestra (Col. 9596), are typical examples.

DANCE.

Dance records are of interest to the pick-up user, not only on account of their value as light entertainment, but also because instruments of the percussion group are freely used and serve to demonstrate the advantages of electrical reproduction. A short list of selected dance records is as follows :—

H.M.V. Doing the Raccoon, played by George Olsen and his Music (B.5576).
My Window of Dreams, Waring's Pennsylvanians (B.5578).
Col. Hot Bricks, Jack Payne and the B.B.C. Dance Orchestra (5205).
Laughing Marionette, Debroy Somers' Band (5038).
Parlo. Dusky Stevedore, Frankie Trumbauer's Orchestra (R.265).
Queja Indiana, Canaro's Band (R.210).
Bruns. When Polly Walks Through the Hollyhocks, Ben Bernie and his Hotel Roosevelt Orchestra (3882).

HUMOROUS.

Humorous records have risen from the frankly disappointing class to recordings of first rate quality. The appropriate atmosphere is perhaps better conveyed by electrical recording and reproduction. The following have been found to appeal to practically everyone to whom they have been demonstrated :—

Bedtime Story, Wish Wynne (H.M.V. B.2780).
Kate in the Call Box, Angela Baddeley (H.M.V. C.1581).
A Few Drinks, Leslie Henson (Col. 9529).
At the Races, Clapham & Dwyer (Col. 5201).
Grandma's Birthday Party, Mabel Constanduros (Electron 0271).
The Singing Lesson (Parlo. E.5500).

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.

INTERFERENCE.

Sir,—The powers that control broadcasting have been much occupied of late in altering the wavelengths of most European stations, with the result that the ethereal chaos is somewhat worse than before they commenced their labours.

To many thousands of exasperated listeners it must seem that they would have been better occupied in tackling the far more important question of compelling Morse transmitters, fixed and mobile, to keep to allotted wavelengths outside of the broadcast band.

No one denies that certain Morse transmissions, especially those from ships, are more important than broadcast entertainment, but there seems to be no reason why Morse transmissions should be allowed to wander at will over the entire broadcast band and to ruin reception of broadcast programmes.

It has been stated that one obstacle to the solution of this problem is the cost of replacing obsolete apparatus in use on many ships, but, surely, the cost of up-to-date wireless equipment must be infinitesimal in comparison with the capital sums invested in shipping and the daily turnover of the companies concerned.

It would be interesting to know why one particular fixed Morse transmitter is permitted to work almost incessantly on the same wavelength as Budapest and to ruin reception of programmes from that station.

It would be equally interesting to know the identity of this station, which must be the cause of constant annoyance to many thousands of listeners, as it is to myself.

While writing this letter I have been compelled to switch off an excellent programme from Madrid owing to violent Morse interference, which in this case covered half the short-wave band.

"DUAL FIVE."

Bournemouth.

Sir,—With reference to the correspondence *re* Morse Interference, I am in entire agreement with the remarks made by "Jigger" in your issue of January 9th, 1929.

It is not realised that, whilst the more general use of I.C.W. by ship and shore stations will solve some of the selectivity problems of the coastal listener, it tends all the time to make the handling of traffic more difficult for operators, due to the sharper tuning. I have noticed many instances of ships missing QSLs from GLV owing to sharpness of tuning, and it is certain there will be considerable jamming when more stations are using I.C.W. and tuned dead on 600 m. The stations already

using I.C.W. appear to get over the difficulty by using slightly different wavelengths (GKZ is lower than GLV), but with the passing of time the trouble will increase, and one wonders just how all the stations will get their traffic through.

In passing, might I greet "Jigger" as another who has not entirely forsaken 600 metres and who can still find pleasure in reading the different ships whose notes become quite familiar after a time and seem like old friends? There is no thrill in wireless to equal that of receiving the S.O.S. signal and to follow it through until the "all clear—resume" signal.

Accrington. T. COOPER (2ATC).

Sir,—The suggestion of Mr. K. Younghusband in your issue of February 6th, that each country should be given an inclusive width of wavebands is most attractive. The difficulty would be to induce any country to consent to be limited to a higher or lower frequency, with the known advantages and disadvantages of either.

To many listeners and especially those near the sea, the problem of interference is not so much the heterodyning of broadcasting stations as the use and abuse of antiquated spark apparatus. One small tramp whose skipper has lost his bearings (or his laundry!) will sow discord over a hundred miles' radius and completely spoil the reception of many thousands of listeners for a whole evening. Until the licence-payers' interests in this respect are protected the co-ordination of European wavelengths is of secondary importance. One can sometimes escape the heterodyne, but that desolating Morse swamps everything in spite of frames and wavetraps. GEORGE BOAG.

Aguilas, Spain.

RECEPTION OF AMERICA.

Sir,—The following details of reception of American medium wave broadcasting stations may prove of interest to your readers. As I have not listened for them since last winter, I am unable to say whether I struck an exceptional night or whether conditions are gradually improving. Certainly signal strength between 11.30 p.m., Monday, February 4th, and 2 a.m., Tuesday, February 5th, appeared greater than on any occasion that I have listened to these stations since the winter of 1921. The call signs were identified of WGY Schenectady, WJZ Bound Brook, KDKA Pittsburg, WEAF New York City, WPG Atlantic City, WLW Cincinnati, all of which worked a M.C. speaker at moderate strength by 1.30 a.m. approximately. Later Seattle KJR was tuned in at excellent phone strength, together with three other stations, which I was unable to identify. I was using a standard Everyman Four with a very poor aerial.

Newcastle-on-Tyne. J. DALE ADAMS.

TELEVISION.

Sir,—In *The Wireless World* of January 30th three of your correspondents express their disagreement with a letter of mine which you published in the issue of January 16th, wherein I suggested that really satisfactory definition in a "television" picture of reasonable size would seem to demand an inordinately wide sideband.

The whole matter turns on what we consider "satisfactory" definition; without some standard test this is merely a matter of opinion. I suggest that a numerical value, called say the "figure of merit" of a picture transmission (television or still) could be allotted to any system in the following manner.

Let some standard printer's type be selected, and a piece of matter printed therefrom be photographed to any suitable degree of enlargement that the advocates of a particular system would like. (A photographic enlargement of a *Times* leader would be easily reproducible.) Let this enlargement be set up in the transmitter, in the place of the "dummy" used for television adjustments, and examine the image in the receiver. Then the "figure of merit" would be defined as the number of legible letters simultaneously visible in the receiver.

Mr. Moseley states that "it is possible to televise a picture of equal size and cost to that given in still' pictures *but of far better quality* and instantaneously" (italics mine). Does he seriously suggest that under the test I have proposed the "figure of merit" of a televised picture would be higher than that of a "still" picture? If not, "better quality" seems to have no meaning whatever; yet from memory of the September demonstrations of the Television Co. compared with recent "still" transmissions, one would guess that the "figure of merit" of a still transmission would be at least *several hundred times* that of a television image.

As an ideal to aim at, I suggest that it should be possible to place a page of *The Wireless World* in front of the transmitter and receive a legible image of the whole page in the field of view at once; this would be comparable with the "figure of merit" of a modern cinematograph picture, and would amount to about 5,000 legible letters; even a tenth of this, or 500 legible letters, might be good enough to start a public transmission, but we are very far from this yet.

It would be interesting to know :—

(*a*) The best "definition figure" the Baird Television Co. can get, a photograph of the image in the receiver under these conditions would be most convincing (if the image is sufficiently free from "wobble" to be photographed at all).

(*b*) The number of vertical strips per picture, and of pictures per second under the test.

(*c*) The actual width of sideband required for the test.

Unfortunately, the Television Co. seems very shy of giving any technical information of this nature. Failing an official pronouncement, may I hope that Mr. Moseley will give us a rough estimate?

I do not suggest that television *as at present worked* needs an inordinately wide sideband, I only suggest that it appears very probable that it *would* do so if the "figure of merit" of definition were reasonably good; but at present these "far better quality" television pictures are not shown in demonstrations, and one may be pardoned for doubting their existence. The B.B.C. is understood to have refused the Baird Co.'s proposals for television broadcasts without giving technical reasons, saying in effect, "This is not good enough"; and in this they show their wisdom, for any suggested technical reasons only promote controversy; moreover they are unnecessary, for the Television Co. has only to produce an image with a "figure of merit" comparable with that of still pictures, when there is no doubt that they will be accepted. theory or no theory. *But the experiments required to improve definition will not be handicapped by lack of facilities; they can be made from one room to the next*, and until such experiments show a very much better result than we saw in September the B.B.C. would be very ill-advised to offer facilities. Development is not being "stifled," as Mr. Moseley suggests, because development has a very long way to go before there is anything that needs the assistance of the B.B.C. No amateur experimental receivers are capable of increasing the figure of merit of the *transmission* to, say, 100 times its present value.

At present, Mr. Gibbs states. the transmission of "at least the human face" could be done within normal sideband limits. This is about all we have got yet, and the image is comparable with that seen through the windscreen of a fast car on a bumpy road in a thunderstorm!

Cambridge. C. R. COSENS.

INTERFERENCE ON AMATEUR WAVEBAND.

Sir,—May I, through the columns of your journal, appeal to the sporting instincts of one or two London transmitters?

There are two stations in the S.W. and W. districts working together on the 152-172 metre band, using colossal power to communicate over a distance of less than four miles, with the result that other transmitters are compelled to close down.

I know of one case where a selective receiver, situated three miles from each of these transmitters, is so completely paralysed that it refuses to oscillate when either of these stations is working.

The two stations in question might at least show a little regard for their lower-powered neighbours, and reduce their power to a quite small amount for the short distance over which their experiments are carried out.

I feel sure that if this were done it would be greatly appreciated by transmitters, and, incidentally, listeners in the district.

"TEN WATTER"

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 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.

Cabinet Dimensions.

I have a well made cabinet, taking a panel measuring 12in. square; the depth is 9in. Can you recommend me a good circuit with two stages of H.F. amplification suitable for building into this space? F. A. E.

Your cabinet does not lend itself at all readily to the accommodation of a modern type of set with H.F. amplification. The aim nowadays is to ensure that the output and input ends of a receiver should be separated as widely as possible, and it would be a difficult matter to achieve this end in the space at your disposal. It might be possible to build a satisfactory set with complete screening by adopting a "double-deck" method of construction, but it would be a difficult matter to arrange for adequate spacing between the coils and screens.

o o o o

Instability.

I have just completed the "Kilo-Mag Four," and am troubled by the fact that it is impossible to obtain stability without dimming the filaments to such an extent that signal strength is altogether inadequate. Can you give me any help in locating the fault? O. L.

In cases where trouble has been encountered with this receiver, it has almost always been traced to the action of H.F. currents in the L.F. amplifier, and to assure yourself as to whether imperfect filtering is responsible for your own particular difficulties, we recommend you temporarily to modify the anode circuit of the detector in the manner shown in Fig. 1. Of course, the L.F. amplifier will be completely eliminated. The values given in the diagram are approximate; the anode by-pass condenser is increased in capacity, and a decoupling resistance R, of 500 ohms or more, is added, to ensure that a minimum of H.F. current is flowing through the phones.

If complete stability is attained with this arrangement, you can rest assured that your trouble is the usual one, and you must accordingly look to the effectiveness of the by-pass condensers in the anode circuit of the detector, and the stopping resistance inserted in series with the grid of the L.F. amplifier. The H.F. choke must also be suitable, and it is best to use for this purpose a component with a limited external field, such as that chosen for the original set. A slight increase in the capacity of the anode by-pass condenser may be tried, but this should hardly be necessary.

If, on the other hand, the set is not stable with phones in the anode circuit of the detector, it may be necessary to remove a few turns from the primaries of the H.F. transformers, but this should not be carried to the point where a considerable reduction in signal strength is evident. Before making any drastic

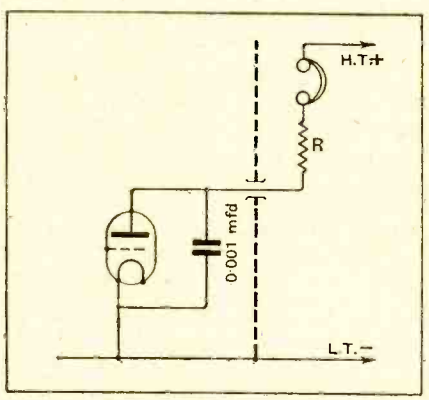

Fig. 1.—Locating instability: modified detector anode circuit.

alterations, the various anode and screen by-pass condensers should be tested, and, if possible, different H.F. valves should be substituted. Naturally you will assure yourself that the lid of the screening box is fitted properly, and that the aerial lead-in is not passed close to the output end of the set.

RULES.

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

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

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

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

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

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

"Excess Stability."

My five-valve set, with two neutralised H.F. stages, seems to be too stable (if the expression is permissible). With the neutralising condensers completely disconnected, it does not oscillate unless the anode voltage for the H.F. valve is raised to a figure slightly above the manufacturers' recommended maximum. Although the receiver works well enough up to a point—my local conditions are good—I am afraid that its performance is not as good as it should be, and should welcome your advice. H. D. S.

The whole object of a neutralising system is to prevent self-oscillation; the fact that this is not produced when your neutralising condensers are disconnected shows either that the H.F. couplings are poorly designed, or at any rate unsuitable for the valves with which they are being used, or that there is some serious fault in the set.

As both stages seem to be "over-stabilised," it would seem at first sight that this fault is probably in a part of the circuit common to each, and it may be that the H.T. voltage applied is very much less than you think. If this assumption is correct, the remedy is obvious.

If the valves are being operated under suitable conditions, and the couplings are properly designed, you must look for high-resistance connections and leakages, particularly in the grid circuits of the H.F. and detector valves.

o o o o

Coils and Screens.

I am endeavouring to design a set with a single H.F. amplifier, which is to be completely screened. My aim is high efficiency combined with reasonable compactness, and I am in doubt as to how near the coils of the H.F. transformers (both wavebands are to be covered) may be placed to the metal. Can you give me a definite ruling on this point? H. S. R.

It is hardly possible to dogmatise on this subject, and, indeed, your question is rather difficult to treat without entering into a lengthy discussion. Briefly, however, you will generally be safe if you maintain a spacing of at least 1½in.; at any rate, the high-potential ends of the coils should not be nearer than this to the metal screen.

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TELEVISION.

AT the time of writing special interest attaches to the subject of television, for the reason that facilities for a demonstration of the Baird system, utilising the broadcasting transmitters, which was previously refused by the B.B.C., have recently been given at the express request of the Postmaster-General. A demonstration was conducted employing the transmitters of 2LO, London, and the experimental transmitting station at Marconi House, the one for the speech transmission and the other to transmit the actual television picture. A television receiver was installed to enable the Postmaster-General to observe the results, whilst another receiver was put up at the offices of the B.B.C. We now await a statement on the results of that test which is promised by the Postmaster-General.

Our Impressions of Television.

We recently had the opportunity of spending an afternoon with Mr. Baird, when he kindly showed us the results obtained with transmission and reception in his offices in Long Acre, and also a reception test, the receiver being installed at the Engineers' Club, in Coventry Street, about half a mile distant. In the case of the reception at the Engineers' Club, we were informed that the picture transmission was on 200 metres approximately, and the speech transmission which accompanied the image on 250 metres.

There is no doubt that the demonstration was a marked improvement, as far as steadiness of the picture and consequent *appearance* of sharpness and greater detail, over the demonstration which we witnessed at Olympia during the Radio Show last autumn. During the test the speech signals were tuned out, and in place the transmission of 2LO, which was then proceeding, was brought in without interference with the 200-metre television image. A demonstration with line links was given us this time at the offices in Long Acre, and the head-and-shoulders image of the subject being transmitted was approximately equal in detail and definition to that received over the wireless link. An interesting example showing the degree of definition which is possible was given when a pocket watch with bold figures was held up at the transmitter, and the time could be read at the receiver; the actual figures were not individually visible, but their position was clear and the position of the hands could easily be seen.

Since the image is viewed through a magnifying lens and the internal mechanism was not disclosed to us, it is somewhat difficult to define the impression of the size of the image, but it would perhaps be safe to say that the image of the head and shoulders of a subject appeared as slightly under the size of a passport photograph, and the image was clear enough for the face to be recognisable on meeting the subjects of the transmissions face to face after the demonstration, though, in a witness box, one would probably decline to give evidence of identification.

What the P.M.G. Must Decide.

So far then we have endeavoured to describe the present state of development of the Baird system. The immediate concern is what will be the findings of the Postmaster-General, for it is understood that he will make a decision as to whether or not facilities are to be given for the system to be exploited through the stations of the B.B.C. It must be remembered that a subject to be transmitted in the present state of development, so that reasonable detail of the head and shoulders can be reproduced, must be located within a very short distance of the scanning disc of the transmitter, and be subjected to the passage of a flickering light in a darkened or semi-darkened room. When the object to be transmitted is at any distance from the apparatus, then the definition is not so good, and the value of the light passing through the scanning disc is, of course, reduced. This would imply that at present for the image of an after-dinner speaker to be transmitted whilst giving his address would be a most unpleasant ordeal, not to be undertaken lightly, and, similarly, any attempt to put over a complete scene such as a theatre performance seems impracticable.

The Postmaster-General will have to decide whether present results justify the means which will have to be applied to obtain these effects in the homes of listeners. And we presume that, before coming to a decision, he will be entitled to have full technical information regarding the system, and not be expected to depend solely on the *results* as witnessed by him. We might go so far as to anticipate the nature of the statement which the Postmaster-General will issue, and suggest that it will be to the effect that the demonstration which he witnessed is of first-class scientific interest, and that he looks forward to greater developments in the future, but that for the present he does not feel that he would be justified in authorising the use of two stations of the B.B.C. for the regular transmission of images when, for purposes of development work, such transmissions and the use of B.B.C. high-power stations is not necessary. It may be that a compromise will be suggested by recommending B.B.C. transmissions outside ordinary broadcasting hours.

DYNAMIC RESISTANCE

The Tuned Circuit in its Relationship to Receiver Design.

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

IN any high-frequency amplifier the properties of the tuned circuits employed are of the very highest importance, for it is upon them that the excellence or otherwise of the amplifier as a whole must eventually depend. For high amplification it is necessary that the losses in the tuned circuits should be kept down to a minimum, while for intelligent design it is also required to know the exact magnitude of these losses. Their numerical expression is usually made in terms of "equivalent series resistance," or, as it is more shortly called, "high-frequency resistance," and the lower the resistance of the tuned circuit the greater will be the amplification afforded by the receiver in which it is embodied.

For the calculation of the amplification afforded by the receiver at different wavelengths, however, the high-frequency resistance is not used directly; in place of it another conception—that of "dynamic resistance"—is employed. The two are related, of course, and the relationship is at first sight rather an odd one, for a low high-frequency resistance corresponds to a high dynamic resistance, and *vice versa*. In the present article an attempt will be made to show, on physical rather than the usual mathematical grounds, how this curious relationship arises, and to indicate its importance from the point of view of receiver design.

As material upon which to base our discussion, we will use the three simple tuned circuits of Fig. 1. Each of these, as will be seen, includes a coil L and a condenser C. The first, at (*a*), is supposed to be entirely devoid of high-frequency resistance; that is to say, a high-frequency current of any magnitude can flow round it without losing any of its energy. In (*b*) there is a small resistance *r* inserted into the circuit to represent the high-frequency resistance that is inseparable from any practical coil and condenser that we may use in building a receiver. In (*c*) this resistance has been taken out again, but another resistance R has been connected in parallel with C. Our interest at the moment lies in the relationship between *r* and R.

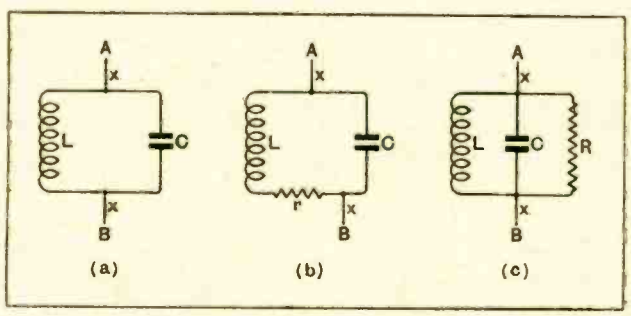

Fig. 1.—Three simple tuned circuits. In (a) there is no high-frequency resistance. In (b) the series resistance r represents the high-frequency resistance inseparable from any coil and condenser under practical conditions, whilst in (c) the resistance r has been replaced by R in parallel with C.

In discussing these circuits we will limit ourselves to a consideration of their behaviour when energised with currents to which they are exactly tuned. This restriction has the great advantage that we can then forget entirely the frequency of the current, and need take very little notice of the values of the inductance L and the capacity C. The circuits, in fact, may then be treated from the point of view of Ohm's very simple law.

Oscillatory Circuit Simply Explained.

We will begin by assuming that a small high-frequency voltage is induced into the resistance-free circuit of Fig. 1 (*a*). Since the circuit has no resistance, the current flowing in it will be unlimitedly large, even though the voltage induced into it is quite small. This large current can be exactly paralleled by a direct-current case; one volt, applied to a resistance of one-millionth of an ohm, will result in a current of $\frac{1}{1/1{,}000{,}000} = 1{,}000{,}000$ amperes. Obviously, if the resistance were decreased to an even smaller figure, the current would rise to even higher values than that mentioned. We will, therefore, assume that a large high-frequency current (we need not specify its exact value) is flowing in our resistance-free tuned circuit.

If the voltage has been induced into the circuit by coupling a turn or two of some other coil to L, the current will be made to flow in the coil, while the condenser C, at the moment when the current begins to flow, will as yet be uncharged. Starting with this current, and imagining the source of voltage already removed, let us trace out the cycle of events in the circuit.

Dynamic Resistance.—

The current flowing through L has produced a magnetic field round the coil, as must always happen when any current flows through any coil. The presence of this magnetic field is indicated by the lines of force shown passing through the coil in the diagram of Fig. 2 (*a*). This current has another effect in addition to the production of this field; as it flows it passes into the condenser C, and so charges it up. As the current continues to flow, the voltage on the plates of the condenser rises steadily, and as this voltage must of necessity be

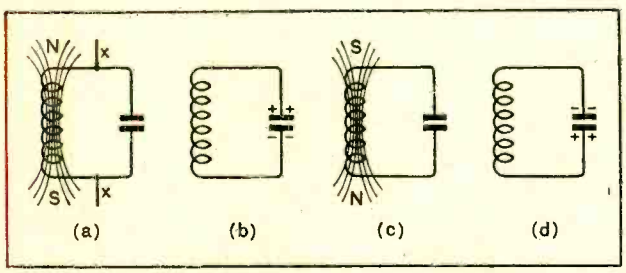

Fig. 2.—The cycle of events in a tuned circuit. The current flowing through the coil produces a magnetic field (a) and at the same time charges up the condenser (b); the current gradually ceases and the magnetic field around the coil vanishes. Now that the condenser plates are fully charged up, a current starts to flow through the coil in the opposite direction and creates a magnetic field with polarity reversed (c). At (d) the condenser plates are charged at an opposite polarity to (b).

in opposition to the current flowing, by degrees the current will stop, leaving the condenser highly charged. The magnetic field round the coil will then have vanished owing to the stoppage of the current that called it into being; the energy of this field has now taken the form of an electric charge on the plates of the condenser, as is indicated in Fig. 2 (*b*).

But matters cannot stop there, for the difference of potential between the plates of C will once more start a current in the coil, though this time in the opposite direction. Once again the magnetic field round L appears, though now with its polarity reversed, and this reaches its maximum by the time the charge on the condenser has completely expended itself in accelerating the current round the circuit. The state of affairs in the circuit at this stage is indicated in Fig. 2 (*c*), which shows that the energy originally picked up by the circuit is now once again evident as a magnetic field, the form in which it started on its varied career.

The Resistance-free Circuit.

When the charge on the condenser is exhausted, the current cannot simply stop, because that would entail the immediate disappearance of the magnetic field, and we know that energy cannot vanish into nothingness in this fashion. Now that the charge on the condenser has gone, the magnetic field takes over the task of driving the current, which thus continues on until once more the condenser is fully charged up, though this time in the opposite direction, as shown in Fig. 2 (*d*). This again is not a condition of equilibrium, and the current will once more begin to flow in its original direction, bringing the circuit back into the condition shown in Fig. 2 (*a*). And so the cycle of events goes on, electricity continually surging round the circuit, charging the condenser, bouncing out of it again, and gathering in the coil a speed which compels it, through the action of the magnetic field, to continue its rush until the condenser is fully charged up once more.

In a resistance-free circuit such as this there are two important things to notice. First, the current will go on flowing for ever, for the energy in the circuit, though continually being converted from a magnetic field into an electric charge and back again, is never lost. Secondly, the current flowing upwards through the coil is at every instant exactly equal to that flowing downward into the condenser. This is a good deal more important than it looks, as we shall see if we consider what would happen if we were to try to put a current from outside through the tuned circuit from the wires *x*, *x*, in Fig. 1 (*a*). If we made any such attempt, we should fail completely, for any current that might flow downwards through L as a result of our efforts would be exactly counterbalanced by an equal current flowing upwards into C, so that no resultant current would flow through the circuit from A to B.

Tuned Circuit a Barrier.

The same property of the circuit can be seen from another point of view which is less directly based on the mathematical expressions used to convey the behaviour of such a circuit. Suppose no current to be flowing in the tuned circuit, and that a high-frequency voltage (of the correct frequency, of course) is applied to A and B. This would charge the condenser to a voltage equal to that of the source, and for the brief space of time required for this a current would flow along the leads *x*, *x*. Owing to the fact that there is no source of loss in the circuit, the voltage initially impressed from outside would never fall below its original value, so that at every successive moment the voltage on the condenser would automatically be exactly that of the external voltage applied across A and B. There would thus be no voltage-difference between A and the end of the tuned circuit to which it is connected, and no voltage-difference between B and its end of the tuned circuit. Where there is no voltage-difference there can be no tendency for a current to flow, so that after the first instantaneous current, necessary to start the self-maintaining oscillations in the tuned circuit, no further energy will be drawn from the external source from which the circuit is excited.

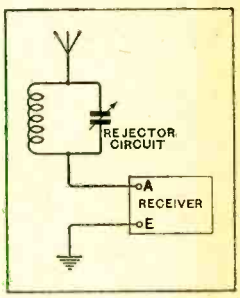

Fig. 3.—If a tuned circuit has no resistance it is a barrier to currents of the frequency to which it is tuned. The rejector circuit here shown makes use of this function.

Thus the tuned circuit, providing it has no resistance, is a *complete* barrier to currents of the frequency to which it is tuned. This accounts for the name "rejector circuit," by which a circuit of the type shown is often known, and supplies the *modus operandi* of the common type of wave-trap shown in Fig. 3.

Dynamic Resistance.—

It will easily be understood that if a resistance *r*, as suggested in Fig. 1 (*b*), is interposed in the path of the electricity that is surging round our tuned circuit, the conversion of electric charge into magnetic field and *vice versa* will cease to be complete. Every time the current flows round the circuit, no matter in which direction, it will have to pay toll to the resistance by losing to it a certain amount of energy in the form of heat. Thus the electric charge of Fig. 2 (*b*) will store slightly less energy than was present in the magnetic field of 2 (*a*), and the field at 2 (*c*) will contain a trifle less energy than the charge of 2 (*b*), and so on through all the successive changes.

The amount of electrical energy in the circuit will, therefore, diminish with the passage of time, and the electrical oscillations will die away. Owing to the fact that the whole of the current flowing has to pass through *r*, and to the extreme rapidity of the alternations of current, it is found that, even if only a minute percentage of the available power is converted into heat each time the current flows through the circuit, the oscillations will die away very rapidly. If, at 300 metres, only one-thousandth of one per cent. of the energy is absorbed during each complete oscillation, after the lapse of one second, the current will have been reduced to about one twenty-thousandth of its original amount. These figures may perhaps help us to realise that even a small resistance inserted into the tuned circuit at *r* will have a very marked effect upon its behaviour.

Equivalent Resistance of a Tuned Circuit.

If we try to pass a current from outside through the circuit of Fig. 1 (*b*) our experiment will have a slightly different result from the similar trial on the resistance-free circuit. In this case, owing to the presence at *x*, *x* of an applied voltage, by virtue of which we are trying to drive a current through the circuit, the oscillations will not be permitted to die away in the manner just suggested, but must be maintained at an amplitude which keeps the alternating voltage on C equal to the applied voltage. To do this we shall have to supply power to the circuit as fast as it is used up (converted into heat) in *r*, and to supply this power a current must flow in the external circuit *x*, *x*. Moreover, the greater the value of *r* the more power must be supplied, and so the more current flows through the tuned circuit from outside.

We are thus led to a rather peculiar conclusion. It is evident that the circuit as a whole, regarded from the point of view of the leads *x*, *x*, will have a resistance, since the application of a definite voltage causes a small current to flow. As we have seen already, when the circuit has no *internal* resistance, Fig. 1 (*a*), it has infinite *external* resistance, for it allows no current from an external source to flow through it. Now that we have introduced an internal resistance *r*, its "external" resistance has dropped from an infinitely high value to one that is at least finite, for it will permit a current, great enough in magnitude to make up for the losses in *r*, to pass through it from an external source. Clearly, the larger *r* is made, the more current must be supplied from an external source to make good the losses; we have here the remarkable phenomenon of a circuit that allows more current to flow through it as its resistance increases.

This looks, at first sight, as though the tuned circuit were treating Ohm's law with positive contempt, but a closer examination shows that the circuit is not quite so self-willed as it looks. It possesses, in reality, *two* resistances; the one, *r*, is effective with regard to internally circulating currents only, and the other, which we have called the "external" resistance, applies only to currents fed in from outside. Providing that we are careful always to select the corresponding value of the resistance, we can use Ohm's law quite correctly for the determination either of currents circulating round the closed circuit or of currents passing through it from outside.

In Fig. 1 (*c*) there is another arrangement of tuned circuit *plus* resistance; the resistance R is here connected in parallel with the condenser; while, apart from this, both coil and condenser are assumed to be resistance-free, as in Fig. 1 (*a*).

For the sake of comparison with Fig. 1 (*b*) we will choose the value of R in such a way that oscillations induced into the circuit will die away neither more slowly nor more quickly than when we had *r* inserted in the tuned circuit itself. Whenever, in this new case, the condenser is charged up, the voltage on its plates will mainly be spent in driving a current through L as before, but some small fraction of the energy avail-

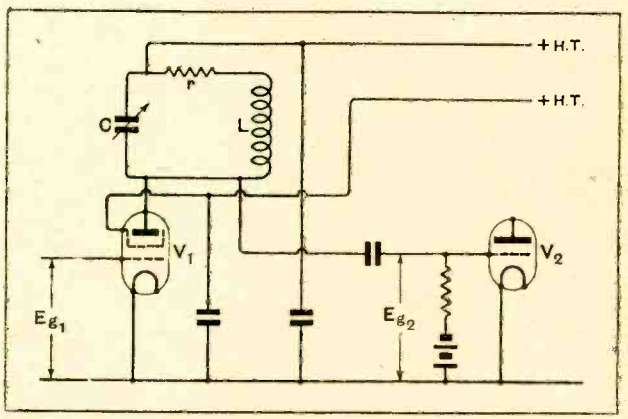

Fig. 4.—A screen-grid H.F. stage; to find the amplification obtainable we must use the dynamic resistance R in place of the series resistance r. The amplification = Eg_2/Eg_1.

able will be diverted into the new channel, driving a current through R. In the previous case we saw that a minute percentage absorption of energy in *r*, repeated afresh every time the current passed through it, caused the almost complete disappearance of all the energy in the circuit in a very short time, so that a small resistance had a very heavy damping effect on the circuit. In just the same way we need only to drain away a minute percentage of the energy in C at each successive oscillation to damp out the oscillations, so that, to have the same effect as *r* on internal currents, R need only be a very small leak—which is the same as saying that the resistance of R will be very high. From the point of view of internal currents, then, a high resistance R

Dynamic Resistance.—

connected in parallel will be equivalent to quite a small resistance r connected in series with the tuned circuit.

If we now look upon the circuit from outside, and try to pass a current through it along the leads x, x, we shall find a corresponding state of affairs. The combination of L and C, being free from resistance, will naturally pass no current, as we have already seen in connection with the first case discussed. R, however, is just an ordinary resistance, and consequently will pass current from the external source in a perfectly straightforward manner. To external currents, therefore, the circuit as a whole simply offers a resistance R.

Just as before, the current supplied from outside must make good the losses in the tuned circuit that the presence of R imposes; the external voltage by aid of which we are trying to drive a current through the circuit must maintain the voltage of the condenser at its own value. But for the leak through R the condenser would not need such external assistance, so that all the outside voltage has to do is to provide the leakage current which would otherwise damp out the oscillations.

Parallel or Dynamic Resistance.

It will be seen, therefore, that a value of parallel resistance R can be chosen such that it is exactly equivalent, as far as circulating currents are concerned, to a series resistance r. If this is done, then the two circuits are *also* equivalent from the point of view of an externally supplied current, for in both cases this must have a magnitude great enough to make up for the losses—which, if r and R damp out circulating currents equally, as has been stipulated, are the same in both cases.

Thus whenever we wish to consider the behaviour of a tuned circuit as a whole we imagine it to be constituted as Fig. 1 (*c*), and then, since the current flows through R only, we ignore L and C altogether, and deal with the whole as though it consisted simply of the resistance R. This, it will be agreed, is a very convenient simplification.

On other occasions, when we are more directly concerned with the behaviour of currents circulating within the tuned circuit, we imagine it to be constituted as in Fig. 1 (*b*), when any losses that are involved are summed up simply enough in r.

When we measure the high-frequency resistance of a circuit, it is done by inserting known resistances between the coil and the condenser—that is, by augmenting to a known amount the value of r that is naturally and inevitably present. Consequently, we get the result for the high-frequency resistance in the form of a value for r, on the supposition that there is no parallel resistance in the circuit. In practice, the high-frequency resistance is made up of a mixture of series and parallel resistances, the former being chiefly due to the former upon which the coil is wound and of the leads joining it to the condenser, while the latter are mainly to be ascribed to the imperfections of the insulating compounds connected across the circuit in valve holders and other such components. This mixture of sources of resistance does not matter in the least, for the value of series resistance we find by our measurement is that which, inserted in a tuned circuit with no losses at all, would give a tuned circuit having properties identical in all respects with those of the circuit actually measured. We acknowledge the artificiality of our numerical result by calling it the "equivalent series resistance" of the circuit, but so long as we are not concerned with hunting out and eliminating the various sources contributing to the total, but wish only to make the best use of the tuned circuit as it stands, this artificiality is of no consequence whatever.

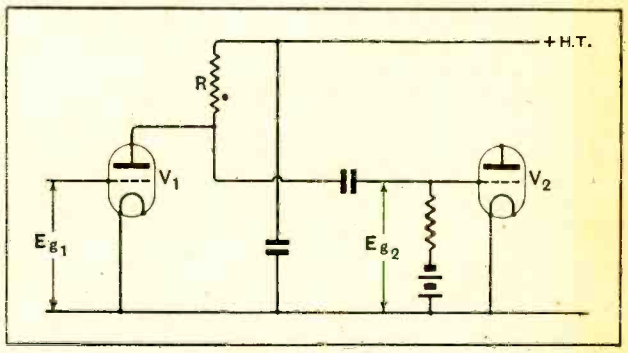

Fig. 5.—In this amplifier R fulfils exactly the role of the tuned circuit in Fig. 4; the two may be treated in exactly an identical manner.

As soon as we come to the application of the knowledge of the high-frequency resistance to the problems of set design, we find that we no longer have any great use for the equivalent series resistance, but require instead the equivalent parallel resistance, or, as it is more briefly called, the "*dynamic resistance*" R. Suppose, for example, we wished to calculate the amplification to be expected from a tuned-anode stage of high-frequency amplification, such as that of Fig. 4, where r is inserted to denote the equivalent series resistance of the tuned circuit. This arrangement is exactly analogous to the resistance-coupled stage of Fig. 5, and both are equivalent to the skeleton diagram of Fig. 6.

The amplification of the resistance-coupled stage is well-known to be $\frac{\mu R}{R+R_0}$, where μ and R_0 are respectively the magnification factor and A.C. resistance of the valve V_1. This result can be deduced immediately from Figure 6, and is based on a consideration of the voltage-drops produced on the two resistances R_0 and R by the A.C. component of the plate current.

In the high-frequency stage of Figure 4, the plate circuit is made up of R_0 and the tuned circuit in series, and we have to consider the plate current as flowing in succession through them. The high-frequency resistance, r, of the tuned circuit is not directly of use to us, because this is the resistance offered by the circuit to currents circulating round within it, whereas it is clear that we require its resistance to currents passing through it in the external circuit made up of valve-tuned circuit H.T. battery. If, making a too-hasty analogy with the resistance-coupled amplifier, we were to write $\frac{\mu r}{r+R_0}$ for the amplification of the high-frequency stage, we should therefore be entirely wrong; we want, not r, but the value of *dynamic resistance* that corre-

Dynamic Resistance.—

sponds with it. The amplification is, in fact, $\frac{\mu R}{R+R_0}$, where R is the dynamic resistance, as in Figure 1 (*c*), of the tuned circuit.

The relationship between *r* and R has already been shown qualitatively; it will be remembered that *r* is usually small, and R large, and, in addition that an increase in *r* leads to a decrease in R. A small excursion into mathematics shows that the quantitative relationship between the two is given by the equation:

$$R=\frac{L}{Cr}, \text{ or } r=\frac{L}{CR}$$

where *r* and R represent, as hitherto, the equivalent series resistance and the dynamic resistance respectively, L is the inductance of the coil in microhenrys, and C the capacity of the condenser in microfarads.

From this equation the value of dynamic resistance to be used in calculating the amplification of the stage for any particular wavelength can be calculated if we know *r* at the wavelength, and if we know also the inductance of the coil. Suppose, for example, that the coil has an inductance of 250 microhenrys and a high-frequency resistance of 10 ohms at 300 metres. To tune 250 μH to 300 metres, the capacity of C in the circuit must be .000101 microfarad; the dynamic resistance R is then $\frac{L}{Cr}=\frac{250}{.000101\times 10}=248{,}000$ ohms. The amplification provided by the stage of Figure 3 will in this case be $\frac{248{,}000\ \mu}{248{,}000+R_0}$ where μ and R_0 are, of course, the constants of V_1. By putting into this expression the figures for various valves one may see how the amplification attained depends, for the coil in question, upon the valve characteristics, and one may thus choose the valve that gives greatest amplification with the tuned circuit specified.

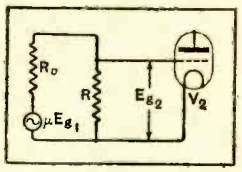

Fig. 6.—This scheme represents equally well either Fig. 4 or Fig. 5; in either case $\mu + R_0$ stand for magnification factor and A.C. resistance of V_1, while R stands either for the dynamic resistance of the tuned circuit or the anode resistance of Fig. 5.

It will be seen, from this sketched amplifier calculation, that if the dynamic resistance of a tuned circuit is known it may be treated, so long as we limit ourselves to considering the wavelength to which the circuit is tuned, as though it were a simple resistance of that value. On this basis the task of designing a high-frequency amplifier, usually considered so difficult, becomes comparatively easy, and its mode of operation becomes much easier to understand. But it is not always easy to discover, without making laboratory measurements, the exact numerical value of either the series or the dynamic resistance of a tuned circuit.

TRANSMITTERS' NOTES.

Amateur Call-Signs.

The inevitable but temporary confusion, caused by the general introduction of the new nationality prefixes in January, is gradually subsiding and transmitters are becoming accustomed to the new conditions, though a few countries have not yet formally adopted the regulations prescribed under the International Radiotelegraph Convention of 1927. Some Belgian amateurs, as mentioned in our issue of January 30th, still wish to retain the old prefix EB instead of ON, but, in general, transmitters all the world over are adopting the new system of prefix and call-signs.

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Geographical Distinction.

Several countries are following the excellent plan which has been found so serviceable in the United States of employing the figure following the nationality prefix to indicate the geographical position of a station. Thus, Sweden is divided into seven horizontal zones, distinguished by the figures 1 to 7 and Russia is divided into nine districts, as follows:—

1. Siberia: Omsk, Tomsk, Novosibyrsk, Jakutsk, Vladivostok, etc.
2. Central: Moscow, Nijni Novgorod, Rjaza, Tver, etc.
3. North-West: Leningrad, Archangel, Murmansk, etc.
4. Volga: Astrakhan, Saratov, Ulianov, Ural, etc.
5. Ukraine: Kiew, Moldavia, Kharkov, etc.
6. North Caucasus: Rostov, Krasnodar, etc.
7. Trans Caucasus: Georgia, Armenia, etc.
8. Central Asia: Tashkent, Semipalatmsk, etc.
9. Western: Minsk, Smolensk, etc.

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Denmark and Argentina.

Denmark, we understand, has chosen the prefix OZ in place of OU, and the Argentine Republic has taken LU in preference to LO, so that the ultimate list of prefixes will differ slightly from the provisional list which we published in our issue of June 6th, 1928.

The Argentine authorities appear to have adopted the expedient of making the old call-signs conform with Article 14 of the Regulations by transposing the figure from the end of the old to the middle of the new call-sign, thus AP5 becomes LU5AP. This does not seem an entirely satisfactory arrangement, as the figures have no geographical significance.

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Broadcasting Stations.

A correspondent points out that, under Article 14, no provision is definitely made for the call-signs of broadcasting stations, which presumably should come under the category of "fixed and land stations," and, therefore, should, strictly speaking, have a three-letter call-sign. We do not, however, imagine that there will be any immediate change in the well-known signs of existing broadcasting stations.

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New Call-Signs and Stations Identified.

G 2AI	W. J. H. Kempton, 18, Piedmont Rd., Plumstead, S.E.18. (Change of address.) Transmits on 21.1 and 42.2 metres and welcomes reports.
G 2RC	Alan Reid, 171, Reads Ave., Liverpool. (Change of address.)
G 2VV	(Ex 2BUW), J. N. Roe, Minydon, Ridgway Rd., Farnham, Surrey, works on 7,000 kC. waveband and wishes to arrange schedules with foreign telephony stations.
G 2ZN	(Ex 2ADC), J. E. Johnson, 7, Chestnut Ave., Walthamstow, E.17, transmits on 20, 40 and 160 metre wavebands.
G 5BS	G. W. Bradley, 8, St. Margaret's Terr., St. Leonards-on-Sea.
G 5DR	(Ex 2AQG), J. M. Deheer, Donna Nook, Kingsgate, Bridlington, E. Yorks.
G5GN	C. R. Green, 9, Ladbroke Gardens, London, W.11. (Change of address.)
G5UL	J. W. Coveney, 16, Rochester Gardens, Ilford, Essex. (Change of address.)
G6QF	A. M. Robertson, 60, Derbyshire Lane, Stretford, Manchester. (Change of address.)
G 6QL	P. H. Berry, 2, Ashburnham Gdns., Harrow-on-the-Hill. (Change of address.) Transmitting on 150 and 42 metre bands.
2AXI	E. R. A. Carr, 65, Eden Rd., Walthamstow, E.17.
2AYX	P. Taylor, 658, Osmaston Rd., Derby.
2BLX	Sigmn. J. Tyrell, No. 2 Platoon, D Coy., Training Battalion, Royal Corps of Signal Catterick, Yorks. (Change of address.)
	AUSTRALIA AND NEW ZEALAND.
2BX	R. G. Black, 31, Karepa St., Wellington, New Zealand. (Change of Address.)
2CK	G. Weynton, 1, Harcourt Flats, Brierley St. Cremorne, Sydney, Australia.

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Call-Signs Relinquished.

G 5CY and 6ZY, L. Gordon, 133, Old St., Ashton-under-Lyne.

A

The Valve as an Anode Bend Detector

Obtaining Maximum Efficiency with Large Inputs.

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

THE ever-increasing quest for selectivity and the desire for really high-quality reproduction from local stations make it almost imperative that a modern ambitious receiver should contain a high-frequency amplifier followed by an anode bend detector. The relative merits of the other three well-known methods of detection have been dilated upon at various times in this journal, but the two paramount qualities of selectivity and distortionless reproduction cannot be found combined satisfactorily in any one example. The advent of new valves with characteristics specially suitable for anode bend detection causes us to regard this form of rectification in a somewhat new light.

Up to a year or two ago a square-law relationship between input and output had been assumed because, with the weak inputs of one or two volts then obtained from a high-frequency amplifier, the signal was impressed almost wholly on the bend in the characteristic. It is believed that there are few places in England today where, with a reasonably good aerial and a well-designed screen-grid H.F. stage, a peak voltage of 10 is not available at the grid of the detector for at least one station. The experiments mentioned later in this article were carried out some 120 miles from 5XX, and with a single stage of H.F. considerably more than 10 volts (peak) could be obtained from that station. If large inputs of the order mentioned are arranged, signals of exceedingly high quality will be had, because the modulated portion of the carrier wave, representing the speech and music, will be almost entirely impressed on the straight part of the characteristic and the output will be proportional to the input.

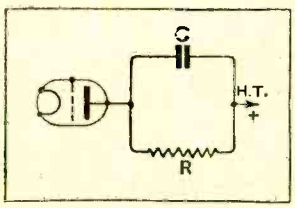


Fig. 1.—The anode load of an anode bend detector can be looked upon as a leaky condenser. The relation between C and R is important, for on it depends whether the audio-frequency envelope of the rectified carrier can be followed.

It is proposed in this article to discuss the design of the detector stage from the point of view of accepting large inputs and controlling the large output to suit the voltage-handling capacity of the L.F. valve which follows. Before proceeding any further it might be helpful to explain the process of anode bend detection[1] as it is now accepted. When a modulated high-frequency oscillation is applied to the grid it is rectified, that is, one half-cycle is suppressed (assuming 100 per cent. efficiency), so that the output consists of unidirectional impulses still at high-frequency. The useful L.F. component cannot be separated without a leaky condenser in the anode circuit, that is, a capacity C shunted by a resistance R, as shown in Fig. 1; R is the D.C. resistance of the transformer primary, the choke or the coupling resistance, whichever form of coupling be used. If no shunted capacity across the output load were present, *there would be no audio-frequency output from the detector.*

Capacity Value of "By-pass" Condensers.

This all-important condenser stores up the unidirectional impulses, but, unless the magnitude of the leakage path is such that energy leaks away to conform to the envelope of the rectified modulated wave, a lagging effect will occur producing distortion. In Fig. 2, A B F G D E represents a modulated envelope. If the relative values of C and R in Fig. 1 (C R is known as the time-constant) have been chosen correctly, the condenser discharge will conform to the dotted line, but if the capacity is too large or the leakage value too high, the rises of the envelope will be followed faithfully, but contact will be lost with the down slopes and a distorted wave such as A B C D E will result. To obtain theoretically perfect results the condenser should be large enough to maintain a good store of energy, so that the saw-teeth, e.g., at A B projecting into the H.F. waves are not too deep, which would result in a low *average* output, at the same time its capacity must not seriously affect the L.F. characteristic of the anode coupling

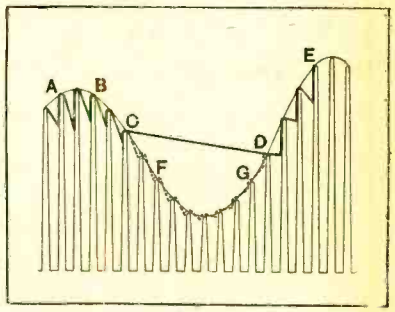


Fig. 2.—When the anode condenser is large and the leak has a high value (see Fig. 1) the energy cannot leak away fast enough, resulting in some such discharge as A B C D F. If the leak has a low value, such as in transformer coupling, the envelope A B F G E of the modulated carrier is followed more faithfully.

[1] *Journal I.W.T.*, Vol. 1, No. 4. "The Performance of Valve Detectors," by Medlam and Oschwald.

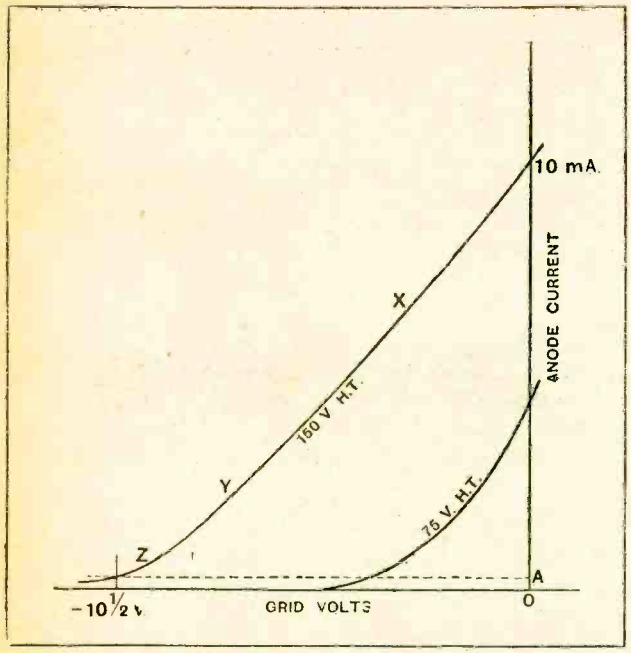
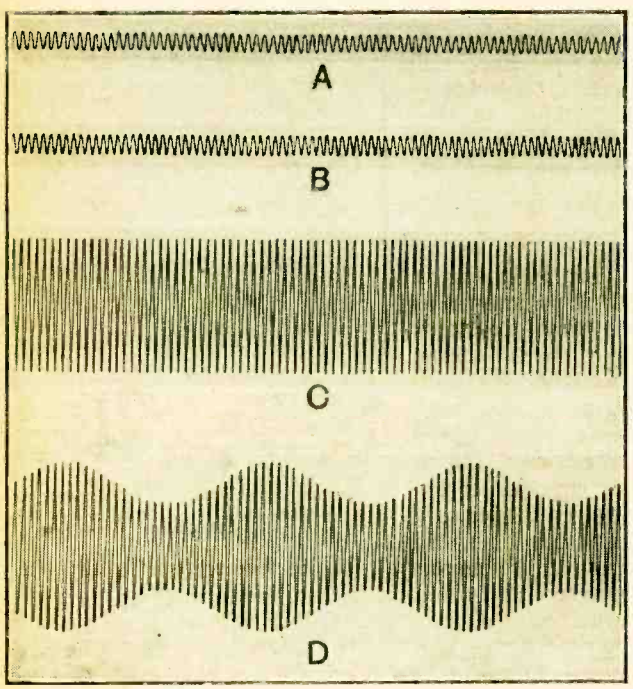


Fig. 3.—Two valve characteristics for typical modern anode bend detectors such as the PMD or DEL series. The 150-volt curve is sensibly straight for the greater part of its length whilst the 75-volt curve has no straight portion and is not suitable for anode bend detection.

component. The leak (R in Fig. 1) in the circumstances just mentioned must be as small as possible, otherwise we shall obtain a distorted wave, such as A B C D E (Fig. 2).



Courtesy Marconi's Wireless Telegraph Co., Ltd.

When a carrier wave is modulated by a low-frequency oscillation two side-bands A and B are formed which combine with the carrier-wave C and form a modulated wave D. Here about 50% modulation is illustrated.

These facts should help to explain why, with resistance-coupling, either the stage amplification must be made inefficient by using a very low value of coupling resistance (leak) or distortion takes place. With transformer coupling following anode bend detection the leak value, that is, the D.C. resistance of the primary will probably be from one to three thousand ohms necessitating a shunted capacity as large as possible (0.0003 to 0.0005 mfd.) but not so large as to affect the transformer characteristic at the higher audio-frequencies. The working conditions in the case of the transformer are the more satisfactory, and this type of coupling will be considered in this article. It is, perhaps, now clear

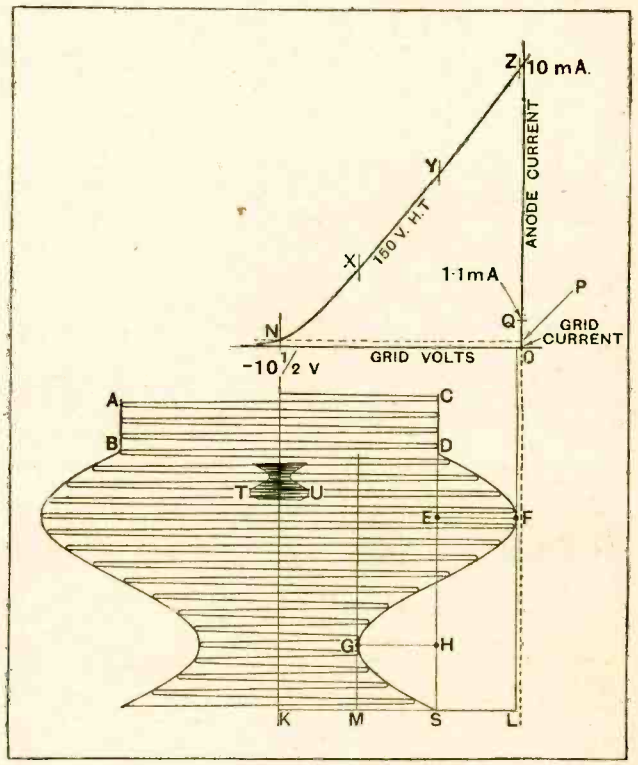


Fig. 4.—Diagram showing the application of a 10-volt (peak) 50% modulated carrier wave to an anode bend detector. Note that the total modulated swing ML is ⅔ of the peak KL.

that the loose statement that "a condenser is necessary to by-pass H.F." has no special meaning. The true by-passing action of the condenser is that associated with the alternating current which passes through the valve, due to, say, 10 per cent. of the half-wave which should be suppressed but is not, owing to 90 per cent. rectification efficiency.

We must now consider the choice of the valve. To accept 10 volts (peak) on the grid it is necessary that at maximum H.T. (usually 150 volts) a bias of minus 10½ to 12 volts produces a standing anode current of below, say, 0.2 mA. Taking Fig. 3, this means that the grid bias and hence the signal is applied well down on the bend resulting in a standing current A. The Mullard PMD and the Marconi and Osram DEL class conform to these characteristics and having steep slopes are excellent anode bend detectors. The static curve shown obeys a square law at about the point Y, a law

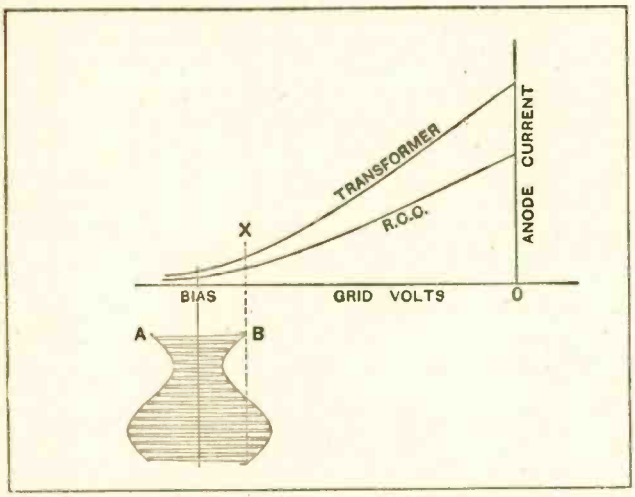
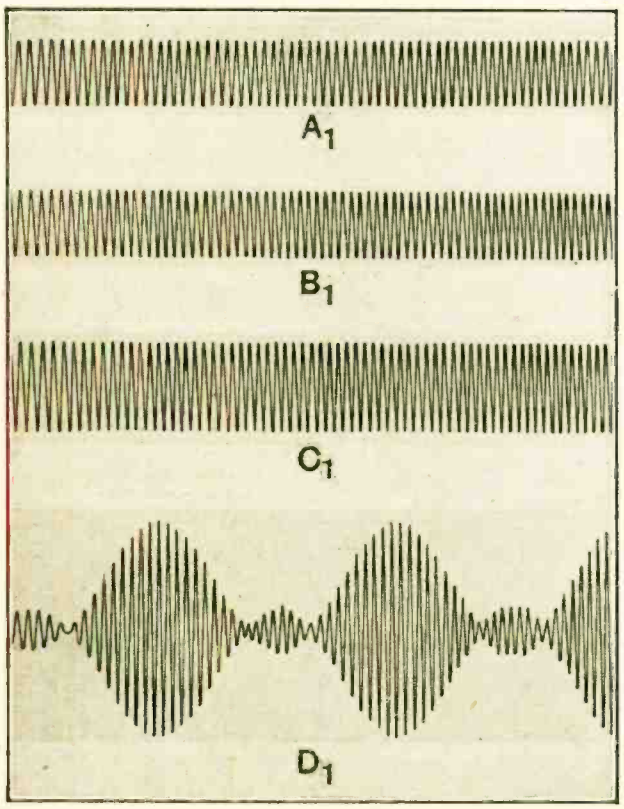


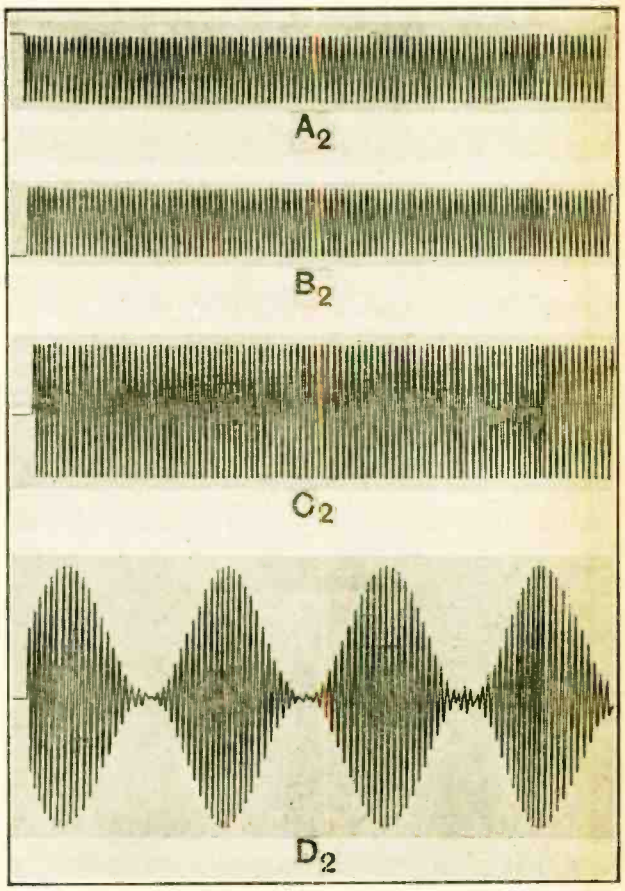
Fig. 5.—When applying a weak signal AB to an anode bend detector followed by a transformer the distortion is worse than when resistance coupling is employed. This is explained by the relative curvatures at X for two working valve characteristics. The increased impedance of the valve under these conditions makes transformer coupling again unsatisfactory.

to the power of about 5/2 at Z and to the power of about 3/2 at X; the latter straightens out under dynamic conditions to an approximate straight line. To obtain as straight a dynamic curve as possible when using a valve under amplifying conditions to prevent harmonics, an external anode load having a resistance many times



Courtesy Marconi's Wireless Telegraph Co., Ltd.

Over-control of the carrier C_1 results in a badly distorted wave D_1.



Courtesy Marconi's Wireless Telegraph Co., Ltd.

Fully controlled or 100% modulated carrier D_2 which cannot be efficiently rectified by an anode bend detector.

that of the A.C. resistance of the valve is used; in an anode bend detector the anode load to H.F. is capacitative and is a lesser resistance than that of the valve. This is a happy coincidence for it militates against too much flattening of the curve at the lower extremity.

As regards the impedance of an anode bend detector valve when used under large input conditions, it is apparent that the figure given by the makers at zero grid volts and 100 volts H.T. is exceeded under working conditions. Exact figures are lacking but it appears to be agreed that for signals which fill the grid base of a valve whose characteristic is similar to the curve XYZ in Fig. 3, an impedance not greater than twice that given by the makers is attained. When weak signals are applied, as in Fig. 5, the working impedance may be many times that given by the makers and if the receiver were incapable of delivering greater signals from the local station it would be unwise to follow the detector with a transformer, since low notes would not be reproduced. From the foregoing it will be evident that a valve with a low nominal impedance must be chosen, for when the figure is doubled the relative working impedances of valve and transformer primary must bear a sufficient ratio at the lowest frequencies to ensure distortionless results.

The transformer should have working primary

The Valve as an Anode Bend Detector.—

inductance of over 100 henrys and the valve's nominal impedance should not exceed 9,000 or 10,000 ohms, whilst the magnification factor should not be greater than 20 to avoid a high working capacity producing high-note loss. The small average anode current passed under anode bend conditions happily has the effect of keeping the transformer inductance high, as will be seen by examining Fig. 6, which shows that with a current of just over a milliampere the primary inductance of a well-known transformer is only reduced to approximately 170 henrys from a maximum of 200 henrys when no D.C. is flowing.

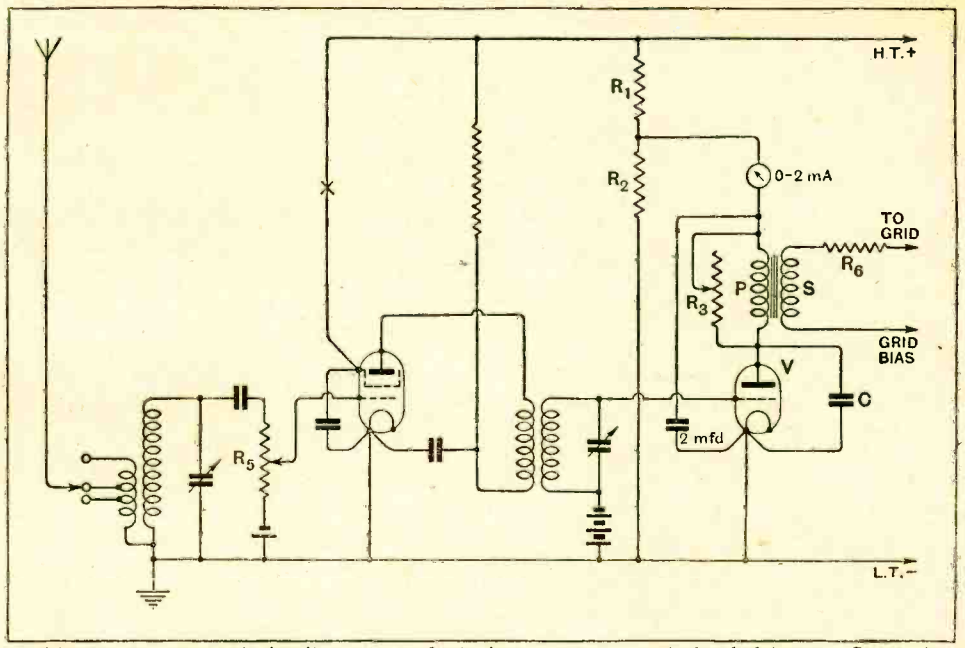


Fig. 7.—A suggested circuit to create large inputs for an anode bend detector. Constant maximum input without running into grid current is assured by the milliammeter, while the volume control R_3 prevents overloading of the third valve (not shown).

As the process of anode bend detection of broadcast transmissions is intimately connected with modulation, it will be as well to discuss this subject, since up to now we have tacitly assumed it. When a low-frequency oscillation representing speech or music is superimposed on a high-frequency carrier wave of fixed amplitude three high-frequency waves are sent out. One is a wave of the carrier frequency and the other two are side-bands, having frequencies which are respectively the sum and the difference of the frequency of the L.F. oscillation and that of the carrier. For tuning purposes these three waves can be visualised as being separate, since side-bands can be cut by a sharply tuned circuit, but for treating the subject of anode bend detection it is better to view the three waves as combined together to form a single entity or modulated carrier, the wavy envelope of which is the low-frequency oscillation which will form the output of the detector. In the three photographs are shown the relative amplitudes of side-bands and carriers to form the modulated waves D, D_1 and D_2. The wave forms were analysed by an integrating machine and in the case of A B C D a normal average of about 50 per cent. modulation is shown. In each case the first two waves are the side-bands, which combine with the carrier C (or C_1 or C_2) to form the modulated waves which are at the bottom of each of the illustrations.

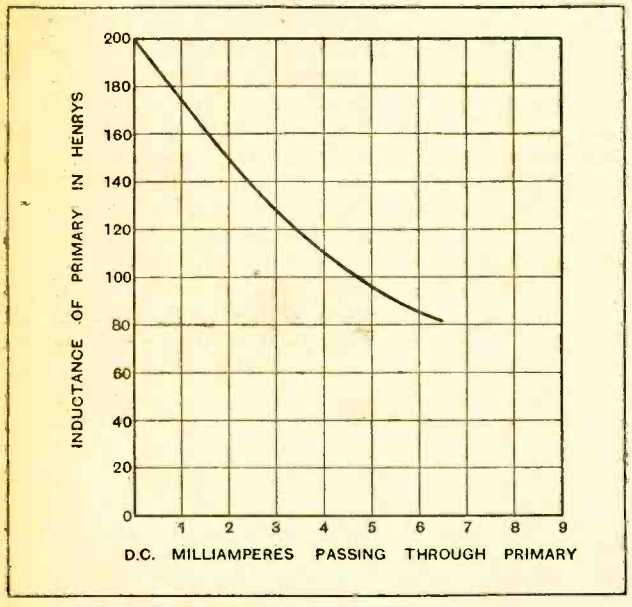


Fig. 6.—With the small anode current of 1 to 2 mA. passed by an anode bend detector the primary inductance of an intervalve transformer is not appreciably reduced. The curve is for an AF5 transformer.

At the present time the maximum peak modulation of 2LO is 80 per cent., that of 5GB is 100 per cent., while that of 5XX is about 85 per cent. The average modulation for which we must legislate is, however, about 50 per cent.; were it more than this the anode bend detector would begin to fail miserably, for some of the L.F. half-cycles would receive different treatment from others. In Fig. 4 a typical detector valve is biased at N ($-10\frac{1}{2}$ volts) and the standing anode current is P (say, 0.05 mA.); when an unmodulated carrier A B C D is impressed on the grid the anode current will rise far more for the positive half-cycle than it will decrease for the negative half-cycle. The result will be an increased average anode current. For simplicity of explanation a static curve for a PM6D valve is given but the dynamic curve is such that the average anode current is about 1.1 mA. for this, a value with 150 volts H.T. and $10\frac{1}{2}$ volts bias with an H.F. input, the peaks of which just do not run into grid current.

The Valve as an Anode Bend Detector.—

Let us assume that at B D the wave is modulated—someone starts to announce that a deep depression is advancing from Iceland—the modulated envelope on one side of the wave for 50 per cent. modulation will be DFGS, in which EF and GH have the same amplitude and are equal to 50 per cent. of the carrier peak KS. It will be noted that the total L.F. signal swing ML with 50 per cent. modulation is 66⅔ per cent. of the H.F. peak KL. It is the swing ML which should have linear amplification and should be impressed on the straight part of the characteristic (XYZ). This can only be done *when there is a straight part to the curve,* a condition only obtaining when the H.T. is near the maximum; furthermore, the amplitude of the H.F. peak KL must be sufficiently large to fill up the whole working curve provided F does not run into grid current, which is assumed to start at zero grid volts.

With a weak signal such as TU (Fig. 4) the modulated fringe would be impressed on the bottom bend, which is very undesirable; in this connection it might be suggested that a shorter curve obtained when using lower H.T. values would be better; actually the characteristics obtained much under maximum H.T. are curved throughout their length, and are unsatisfactory for anode bend detection. (See curve for 75 volts H.T., Fig. 3.) Although in Fig. 4 the envelope DFGS is symmetrical about DS, a slight rise in anode current occurs when the wave is modulated, due to the rate of change of slight curvature between Y and Z being greater than that of YX; EF causes a slightly greater current increase than the decrease due to GH.

Having chosen the best type of valve, a suitable L.F. inter-valve coupling, and having decided that for optimum performance a constant maximum input is necessary, it should be pointed out that a low-reading milliammeter in the plate circuit, as shown in Fig. 7, is almost a necessity to maintain high-efficiency rectification. To regulate low-frequency stage magnification a post-detector volume control R_3 is advised; this incidentally improves the transformer characteristic. Further considerations, together with practical details regarding this suggested anode bend circuit will be given in the concluding instalment.

(*To be concluded.*)

LABORATORY TESTS.
A Review of Apparatus.

R.I.-VARLEY "STRAIGHT-LINE" TRANSFORMER.

This transformer is made in two varieties, the "Four Terminal" and "Six Terminal," the latter being adaptable for a variety of purposes. The model under review is of the "Four Terminal" type, and is a straightforward intervalve coupling transformer. It is suitable for use after valves of A.C. resistance between 10,000 and 30,000 ohms, and the particular specimen tested had measured primary

R.I.-Varley "Four Terminal" straight-line transformer.

impedance at 920 cycles of 103,700 ohms, equivalent to about 18 henrys, on the assumption that the impedance is mainly inductive at this frequency. The transformation ratio is 3.5 : 1.

Tested under receiving conditions, the reproduction of the higher frequencies was found to be exceptionally brilliant, but there was a slight loss of bass when using a valve of 30,000 ohms A.C. resistance. This was only detectable after careful comparison, and would be remedied by the use of a valve of lower impedance.

The transformer is shrouded in a metal case, and terminals are fitted in an inclined position near the base. This gives good accessibility, and at the same time keeps wiring at a low level. The price of the "Four Terminal" model is 22s. 6d.

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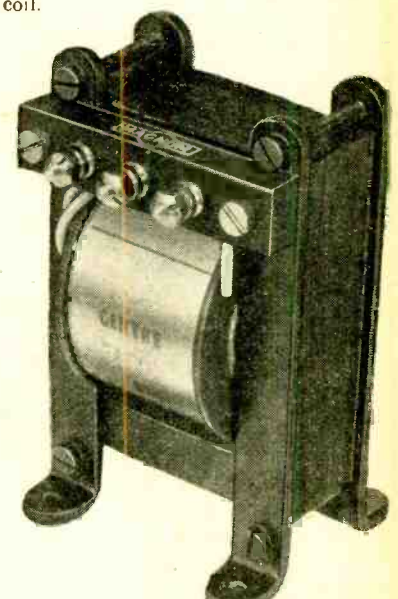
MAGNUM L.F. CHOKE.

This component has been designed principally for use in the output circuit of receivers embodying the choke-condenser feed arrangement, and is rated to have an inductance of 20 henrys when passing a current of 20 mA. The saturation current is stated to be 25 mA. The winding is centre-tapped so that the choke can be used in a similar capacity in a push-pull amplifier. Under these conditions the magnetising effect of the steady anode current through each half will balance out, and it is reasonable to expect that the total inductance will be somewhat greater than the value given above.

Measurements without D.C. flowing through the winding showed that the inductance of the whole coil at 920 cycles per second was 93.5 henrys, and that of each half 21.5 and 27 henrys respectively. It would appear that in the particular sample tested the tapping is slightly to one side of the electrical centre, and this will lead to the iron being magnetised to some extent under push-pull conditions.

In view of the high inductance value obtained without D.C. flowing, it is reasonable to expect that when passing a current in the order of that taken by the average power valve, an inductance of between 20 and 40 henrys will be obtained. The actual value will be governed, of course, by the magnitude of the steady current flowing through the coil.



Magnum centre tapped L.F. choke.

The dimensions of the choke are 3¾in. high, 3in. long, and 2in. wide, and the weight 1lb. 10oz. The makers are Messrs. Burne-Jones and Co., Ltd., 288, Borough High Street, London, S.E.1. and the price 15s.

BULGIN H.F. CHOKE.

The impedance curve of this choke is remarkably flat over the wavelength range from 200 to 3,000 metres. Over the lower broadcast band the impedance is slightly below the average, but this is easily overlooked in view of the uniformity of the curve as a whole. The following are the impedance values at a few representative wavelengths :—

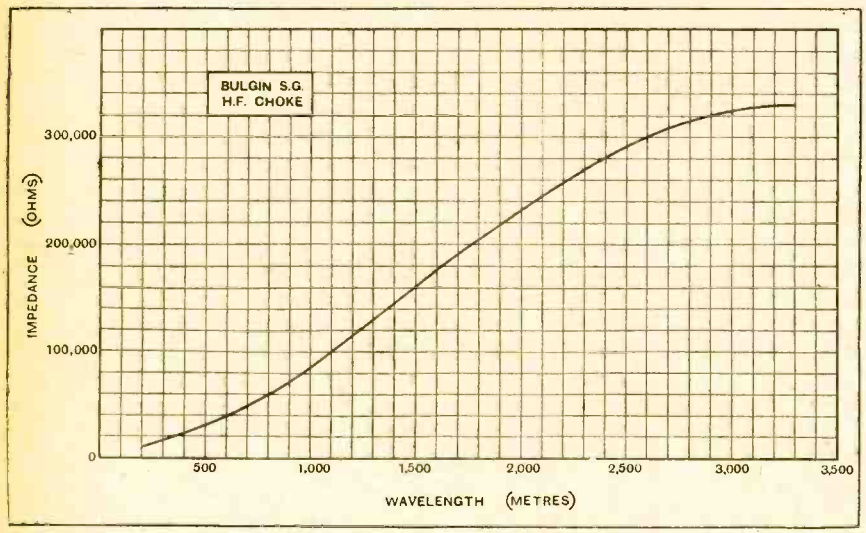
Wavelength. (Metres.)	Impedance. (Ohms.)
200	9,000
500	27,000
1,600	175,000

The curve indicates that resonance does not occur below 3,000 metres, and in this respect the choke is decidedly better than the average. The makers give the inductance and self-capacity as 154,000 microhenrys and 3 micro-mfd. respectively.

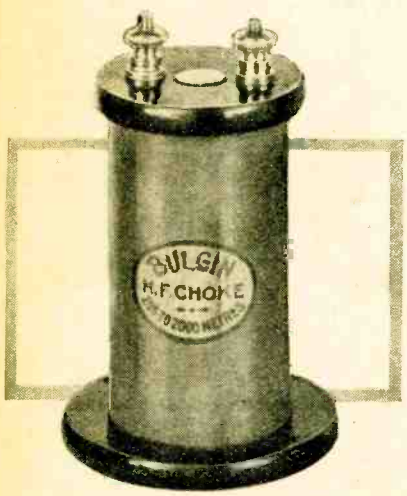
A fairly heavy gauge of wire is used, and the D.C. resistance of 520 ohms, therefore, indicates that the number of turns is above the average.

The mechanical design is neat, and the overall dimensions are only 1⅞in. × 2⅞in.

The makers, Messrs. A. F. Bulgin and Co., 9, 10, 11, Cursitor Street, London, E.C.4, state that the choke has been designed specially for use with screen grid valves, but it is equally suitable for general use on all wavelengths below 3,000 metres. The price is 6s. 6d.



Impedance curve of Bulgin H.F. choke ; external capacity 8 micro-mfd.



Bulgin High Frequency S.G. choke ; D.C. resistance 520 ohms.

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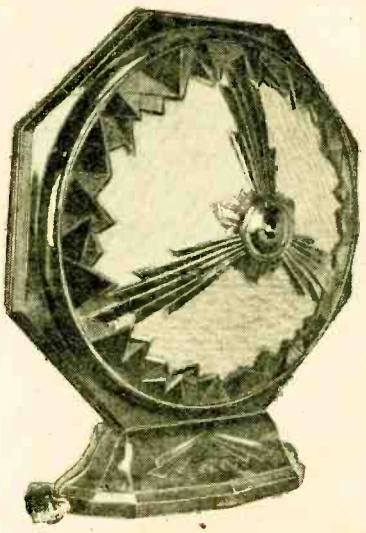
ELODÉN LOUD SPEAKERS.

From the performance of the Elodén loud speakers it is evident that broadcast listeners in Germany are no less exacting in their demands for good reproduction than we are in this country. Examination of the two models tested fails to reveal anything unorthodox in the design as the movements fitted are the familiar "Blue Spot" adjustable balanced armature units. The smaller of the two is being offered at £3 15s., and is a cabinet type loud speaker fitted with a shallow cone 8½in. in diameter. The diaphragm is glued direct to a baffle fixed to the inside of the cabinet, the usual supple mounting not being favoured in this case. In spite of the rigid nature of the assembly, the loud speaker is remarkably sensitive, will deliver considerable volume without signs of distress, and, moreover, is singularly free from cabinet resonance.

The Elodén cabinet type loud speaker.

The reproduction is crisp and clear, the response appearing by aural tests to be well balanced over the greater part of the musical scale with just a slight tailing-off at either end. These deficiencies, however, only show up when comparisons are made with high-class loud speakers of similar type or with moving-coil instruments.

The larger model, known as the "Elodén Compressor," is fitted with a 20in. cone mounted in a large bakelite moulding with a solid rim for protecting the edge of the diaphragm, but acoustically open on both sides. Radial arms support two massive bosses, one of which carries the movement, a balanced armature unit of the type mentioned above.



The "Elodén Compressor" bakelite moulded loud speaker.

The quality and volume should satisfy all but those who demand moving-coil performance, and this model is particularly suitable for use in large halls or for the reproduction of dance music. The price is £6 5s.

It was interesting to learn that some of these models were installed on the airship Graf Zeppelin for the entertainment of those on board during its historic trans-Atlantic flight.

The sole agency in the British Isles for these loud speakers has been acquired by Messrs. F. L. Lessingham, 13, Victoria Street, London, S.W.1.

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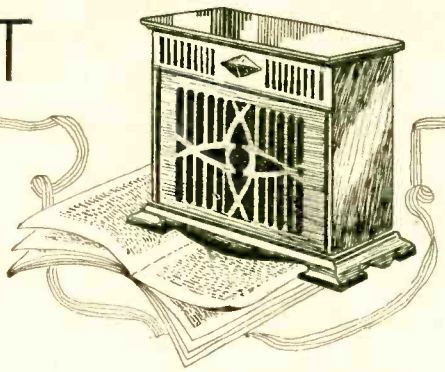
TRADE NOTE.

The "Kusha" gramophone pick-up arm, reviewed in our issue of January 16th last, has been standardised by the General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2, for use in their gramophone equipment.

CURRENT TOPICS



Events of the Week

NAIROBI'S NEW WAVELENGTH.

In a message to *The Wireless World*, the officials of the Nairobi (Kenya) broadcasting station state that the daily transmissions are now made on 31 and 400 metres.

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DEMONSTRATIONS AT OLYMPIA?

We understand that, in compliance with a growing demand that exhibitors at the Olympia Radio Show should be given demonstration facilities in the hall itself, the Radio Manufacturers' Association will shortly discuss a scheme for the erection of a number of sound-proof cubicles. The Olympia Show has been described rather irreverently as the "dumb show," and there is no doubt that the removal of this reproach would go far towards increasing the popularity of the event. The main difficulty is, of course, the elimination of electrical disturbance and extraneous noises.

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INTERNATIONAL SHOW AT BUCHAREST.

Rumania's first international wireless exhibition, to be held at Bucharest from April 15th to June 1st, provides an opportunity for the British manufacturer. Exhibits will be admitted duty free.

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LOUD SPEAKER PROGRESS.

"Loud Speakers and Their Development" is the title of a lecture to be given this evening at 8 o'clock at the Royal Society of Arts, John Street, Adelphi, London, W.C.2. The lecturer is Mr. R. P. G. Denman, M.A., A.M.I.E.E., of the Science Museum, South Kensington. Dr. W. H. Eccles, F.R.S., will preside.

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QTK.

News has been received which will interest the Bristol amateur who was recently mystified by the call "QTK" emanating from a Brazilian station. The Brazilian gave the translation: "Quit that kidding"; but he will now have to express himself in other terms, as, under the new Washington regulations, QTK stands for "What is the true bearing of . . . . relative to you?"

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IRISH LISTENERS INDIGNANT.

Resolutions condemning the present administration of Irish Free State broadcasting were passed at a listeners' mass meeting held in Dublin a few days ago. The meeting expressed the view that the broadcasting authorities were "out of touch with public opinion." Plans were put forward for the speedy erection of a regional station and for an extension of the present programmes to include musical transmissions in the afternoon.

A NEAT SIMILE.

"The opera glass of the loud speaker listener" is the description given to headphones in a German advertisement.

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AMERICAN AMATEURS PROVIDE STATE RELAY.

A time-honoured American custom whereby the greetings of State Governors are conveyed to the newly appointed President immediately after the ceremony was carried out last week by wireless amateurs under the auspices of the American Radio Relay League. Messages from the various governors were collected by amateurs residing in the State capitals and relayed from one transmitter to another across the country to Washington.

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A RIVAL FOR RUGBY.

Further progress towards the establishment of a transatlantic telephony service by beam has been made by the installation of a suitable transmitter at Montreal. Two-way conversations were carried on last week between Montreal and Bridgwater, Somerset. An interesting feature was the use of the Marconi-Matthieu Multiplex system, which enables telephony to be superimposed on the telegraphy circuit without interruption to either.

The present transatlantic telephony system is operated from Rugby, which uses 250 kilowatts compared with only 20 kilowatts required by a beam transmitter.

ANTIPODEAN CONCERTS. Mr. Bert Hinkler (right), the well-known Australian airman, with Mr. C. G. Allen after their recent successful experiment in receiving Melbourne while flying over Croydon.

in Brief Review.

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CABLE AND WIRELESS TO CO-OPERATE.

The projected transatlantic telephone cable will not, it is stated, be in any sense a rival to the existing wireless telephone service. The cable is to be laid by the American Telephone and Telegraph Company, with the approval of the British Post Office, and it is hoped that the service will be operating by the middle of 1931. The cable will act as an "understudy" to the wireless system when atmospheric conditions are unfavourable to the latter.

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A BELGIAN SHOW.

A wireless section will be included in the Sports and Touring Exhibition at Antwerp from March 30th to April 7th.

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U.S. TELEVISION RESTRICTION.

The Federal Radio Commission has decided to restrict television experiments to high frequencies outside the normal broadcast band, says a Washington message.

Doubt is being expressed regarding the authority behind this decision, as the Charter of the Commission expires this month and the Bill for its renewal is likely to be strongly opposed in Congress. It is contended that the Commission, in smoothing out the wavelength tangle, has completed its work and that radio control should now revert to the Department of Commerce.

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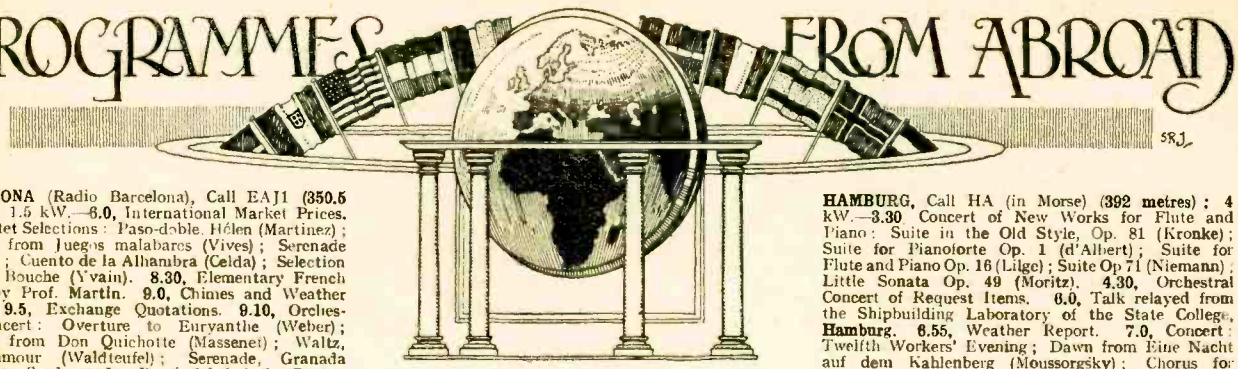
CANADIAN OPTIMISM.

A chain of high-power stations across Canada broadcasting a weekly programme from Britain, is the rosy prospect held out by Sir John Aird, chairman of the Canadian Broadcasting Commission, which is now returning home after an investigation of European broadcasting methods. In the course of the tour the Commission has visited the main Continental centres besides inspecting the work of the B.B.C.

At present Canada's stations are privately owned.

PROGRAMMES FROM ABROAD



SATURDAY, MARCH 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 : Paso-doble. Hólen (Martinez) ; Selection from Juegos malabares (Vives) ; Serenade (Renoux) ; Cuento de la Alhambra (Celda) ; Selection from Ta Bouche (Yvain). **8.30**, Elementary French Lesson by Prof. Martin. **9.0**, Chimes and Weather Report. **9.5**, Exchange Quotations. **9.10**, Orchestral Concert : Overture to Euryanthe (Weber) ; Serenade from Don Quichotte (Massenet) ; Waltz, Nid d'amour (Waldteufel) ; Serenade, Granada (Albéniz) ; Sardana, La Presó del Rei de França (Sancho-Marraco) ; Ballet del Panadés (Sancho-Marraco) ; followed by News. **10.5**, Programme relayed from **Madrid**, EAJ7.

BERGEN (**365.9 metres**) ; 1.5 kW.—**6.30**, Programme for Children. **6.0**, Programme for Girls. **7.0**, Orchestral Concert. **7.20**, Pastor Karl Marthinussen, Talk : Celebrated Men in the World of Thought—Lotze. **7.50**, Topical Talk. **8.0**, Orchestral Concert. **8.30**, Recitation by Kolbjorn Buoen, with Pianoforte accompaniment. **9.0**, Weather Report, News and Time Signal. **9.15**, Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1648.3 metres**) ; 40 kW.—**4.30**, Herr Pietsch, Talk : The German Institute for Research into Questions affecting the Civil Service. **5.0**, Dr. Gorn, Talk : The Occupational Diseases of Miners. **5.30**, Elementary Spanish Lesson. **5.55**, Dr. F. Schönemann, Talk : Civic Education in the United States. **6.20**, Prof. Marcuse, Talk : Something New concerning Heaven and Earth. **7.0**, "Country" Programme : Halloren March (Kaempfert) ; Katzbach March (Becker) : Heeresmarsch No. 10 ; Heeresmarsch No. 24 ; Heeresmarsch No. 106 ; Wir präsentieren (Ailbout) ; Präsentiermarsch der ehem. Matrosen Division (Prince Henry of Prussia) ; Feinde ringsum (Hackenberger) ; Alexandermarsch (Leonhardt) ; Weidmannsheil (Reckling) ; Revue Marsch (Reckling) ; Die Freundschaftsflagge (Blon) ; Entry of the Gladiators (Fucik) ; Hoch Heidecksburg (Hertzer). **8.0**, Waldemar von Baussnern Recital : Trio Sonata in G Major in old style for two Violins and Pianoforte ; Hungarian Sonata in A Major for Two Violins and Pianoforte ; the Composer at the Piano. **8.30**, Recital of Songs from the Works of Hugo Wolf : Dass doch gemalt all deine Reize wären ; Gesegnet sei das Grün : Wenn du mich mit den Augen streifst ; Ein ständchen euch zu bringen ; Weylas Gesang ; Fussreise ; Nimmersatte Liebe ; Nachtzauber ; Der Gärtner ; Heimweh ; followed by 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 a.m.**, Programme of Gramophone Records. In the Interval—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. Hans Lebede, Talk : Adalbert Matkovskys on the 20th Anniversary of his Death. **3.0**, Dr. Konrad Döring, Talk : The Importance of the Modern Music Hall and Circus. **3.30**, Anecdotes by Paul Morgan. **4.0**, Orchestral Concert : Overture to Don Juan (Mozart) ; Selection from The Gipsy Baron (Joh. Strauss) ; Tango, Süss singt die Geige (Rollins) ; Waltz, Dorfkinder from Zigeunerprimas (Kálman) ; Herzwunden (Grieg) ; An den Frühling (Grieg) ; Tanzrausch (Schmalstich) ; A Breath of Jasmine (Burke) : followed by Advertisiug Notes. **5.30**, Dr. Paul Frank, Talk : Medical Hygiene. **6.0**, Prof. Curt Sachs, Talk : German Musical Culture —Music and Wireless. **6.30**, Herr Oswald Riedel, Talk : German Land and German Culture. **7.0**, Evening Entertainment. **8.0**, Orchestral Concert : Potpourri of Hungarian Songs and Czardas ; Hungarian Cembalo Selections. **8.30**, Dr. Frey, Talk : Subterranean Berlin, followed by Time Signal, Weather Report, News, Sports Notes and Dance Music from the Hotel Esplanade. **11.30**, (approx.), Close Down.

BERN (**407 metres**) ; 1.5 kW.—**4.0**, Orchestral Concert. **6.30**, Cabaret Entertainment. **7.30**, Concert by Mme. d'Archambeau (Soprano), M. Cousin (Violin) and the Kursaal Orchestra. **8.45**, News and Weather Report. **9.0**, Selections by the Kursaal Orchestra. **9.35**, Programme of Dance Music. **11.0** (approx.), Close Down.

BRESLAU (**321.2 metres**) ; 4 kW.—**4.45**, Film Review of the Week by Hans Baldung and Dr. Heinz Hamburger. **5.25**, Hans Joachim Plehn, Talk in Esperanto. Silesian Plant Life. **5.35**, Reading. **6.5**, Shorthand Lesson. **6.35**, Contemporary Sketches from Upper Silesia, relayed from **Gleiwitz** (326.4 metres). **7.0**, Concert of Vocal and Orchestral Selections, followed by Dance Music. **9.0**, News and Announcements. **9.30**, Dance Music. **11.0** (approx.), Close Down.

BRÜNN (**432.3 metres**) ; 2.5 kW.—**6.0**, Programme from **Prague**. **6.5** Talk : Bank Speculations. **6.20**, "Adieu Mimi" : Operetta (Benatzky). **9.0**, Programme from Prague. **9.20**, Programme Announcements. **9.25**, Orchestral Programme from the Hotel Rosenbreier.

BRUSSELS (**512 metres**) ; 1.5 kW.—After 7.30 p.m., 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 Recital. **7.30**, La Radio-Chronique. **8.15**, Orchestral Concert under the direction of M. Martin Lunssens. In the Interval : Topical Talk. **10.15**, Press News and Announcements in Esperanto.

BUDAPEST (**545 metres**) ; 20 kW.—**4.10**, Literary Programme. **5.0**, Gramophone Concert. **6.0**, Talk and Recitations. **6.30**, A Play in the Studio. **9.15**, (approx.), Time Signal, News, Weather Report and Tzigane Music from the Grand Hotel Britannia.

CRACOW (**314.1 metres**) ; 1.5 kW.—**5.50**, News and Announcements. **6.10**, Dr. J. Regula, Talk : Review of the Foreign Politics of the Past Week. **6.56**, Time Signal from the Astronomical Observatory. **7.0**, Chimes from Notre Dame. **7.5**, See **Posen**. **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**, Readings by Dorothy Day. **7.45**, Irish Lesson by Seamus O'Duirinne. **8.0**, Russian Suite (Elukhan) by the Augmented Station Orchestra. **8.30**, "The Anniversary" : Play (Tchekov), by Katherine MacCormack and Company. **9.0**, Soprano Solos by Elizabeth Mellor. **9.10**, Scènes napolitaines (Massenet) by the Augmented Station Orchestra. **9.25**, Soprano Solos by Elizabeth Mellor. **9.35**, Flute and Violin Recital by P. Delaney and W. Rathborne. **9.50**, Contralto Solos by Sydney Jameson. **10.5**, Sérénade florentine (Godard) by the Augmented Station Orchestra. **10.15**, Bass Solos by H. J. MacCormick. **10.25**, Selections by the Station Orchestra. **10.30**, News, Weather Report and Close Down.

FRANKFURT (**421.3 metres**) ; 4 kW.—**5.10**, Reading from Lives of the Cæsars (Suetonius). **5.30**, Answers to Correspondents. **6.0**, Reading from the Chinese Novel, The Marvel of the Second Plum-Blossom. **6.30**, Lesson in Esperanto by Herr W. Wischhoff. **6.45**, Herr Herbert Scheffler, Talk : Animals in Literature. **7.15**, Variety Programme from **Cologne** (263.2 metres), followed by Dance Music from **Voxhaus**. **11.30 p.m.** (approx.), Close Down.

HAMBURG, Call HA (in Morse) (**392 metres**) : 4 kW.—**3.30** Concert of New Works for Flute and Piano : Suite in the Old Style, Op. 81 (Kronke) ; Suite for Pianoforte Op. 1 (d'Albert) ; Suite for Flute and Piano Op. 16 (Lilge) ; Suite Op 71 (Niemann) ; Little Sonata Op. 49 (Moritz). **4.30**, Orchestral Concert of Request Items. **6.0**, Talk relayed from the Shipbuilding Laboratory of the State College, **Hamburg**. **6.55**, Weather Report. **7.0**, Concert : Twelfth Workers' Evening ; Dawn from Eine Nacht auf dem Kahlenberg (Moussorgsky) ; Chorus for Young Voices ; Recitation, Industrie (Claudius) ; Talk ; Finale from the First Symphony in C Minor (Brahms) ; Chorus for Young Voices ; Recitation ; Slav nic March (Tchaikovsky). **8.0**, Variety Programme. **9.30**, Programme Announcements. Weather Report, News and Sports Notes. **9.55**, Concert of Band Music. In the Interval at **10.50**, North Sea and Baltic Weather Report. **11.20** (approx.), Close Down.

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**, under the direction of Max Tak, with Pierre Palla (Organ). **3.40**, Italian Lesson. **4.40**, French Lesson. **5.41**, Concert of Trio Music. **6.25**, German Lesson. **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.**, Sacred Recital. **11.55 a.m.**, 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**, Dressmaking Lesson. **7.40**, Talk. **8.0**, Symphony Concert, by the Inkasso Bank Orchestra, Amsterdam : Italian Serenade, Ma Napolitaine ; Overture to The Bohemian Girl (Balfe) ; Songs ; Suite, Sylvan Scenes (Fletcher) ; Flute and 'Cello Selection, Süsses Sehnen (Wenzel) ; Im Rosenhain (Formanovsky) ; Songs ; Hochzeitstag auf Troldhaugen (Grieg) ; Eine kleine Nachtmusik (Mozart) ; Songs ; Selection from The Queen of Sheba (Gounod) ; Le Nouveau Seigneur du village (Boieldieu). **9.10**, News and Close Down.

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**, English Reading by Mr. C. Campbell-MacCallum. **2.0**, Programme for Children. **2.30**, Instrumental Concert : March, Officer of the Fleet (Ryming) ; Waltz from Der Rosenkavalier (R. Strauss) ; Selection from The Pearl Fishers (Bizet) ; Träumerei (Schumann) ; Violin Solo, Cavatine (Raff) ; Cetonia Tango from Sommerfugle (Andersen) ; Venetian Serenade (Svendsen) ; Scandinavian Dance in A Major (Svendsen) ; Recitation by Jon Iversen ; Festpolonaise (Svendsen) ; Selection from Lilac Time (Schubert-Berté) ; Waltz from Die geschiedene Frau (Fall) ; Funeral March of the Marionet (Gounod) ; 'Cello Solo, Berceuse slave (Neruda) ; Valse triste (Sibelius) ; Spanish Patrol (Deshayes). **4.40**, Exchange Quotations and News. **4.50**, Talk. **5.20**, Talk by Thyra Jensen. **5.50**, Weather Report. **6.0**, News. **6.15**, Time Signal. **6.30**, Talk : Foreign Contemporary Literature. **7.0**, Chimes from the Town Hall. **7.5**, Readings. **7.30**, Cabaret Programme of Orchestral and Vocal Selections, Recitations, Readings and Talks, followed by News. **9.45**, Dance Music, relayed from the Industri Restaurant. **11.0**, Chimes from the Town Hall. **11.15** (approx.), Close Down.

KATTOWITZ (**416.1 metres**) ; 10 kW.—**4.0**, Music Lesson by Prof. F. Sachse. **4.25**, Children's Letter Box. **4.55**, Programme for Children. **5.50**, Announcements. **6.10**, Mr. K. Rutkovsky, Talk : Painting **6.45**, News and Time Signal. **7.0**, Programme from the Academy, dedicated to Marshal Pilsudsky. **9.0** Weather Report and News. **9.30**, Dance Music.

KAUNAS (**2,000 metres**) ; 7 kW.—**5.20**, Musical Interlude. **5.30**, Health Talk by Dr. Matulionis. **6.0**, Weather Report and News. **6.30**, Mandoline and Guitar Recital : Lithuanian Potpourri (Gudavicius) ; Lysistrata-Walzer (Lincke) ; When the Lilac Blooms (Heinecke) ; Fiameta (Minkus) ; Persian March. **7.15**, News and Announcements. **7.30**, Concert by Military Orchestra. **8.15**, Humorous Selection. **8.20**, Concert.

Programmes from Abroad.—

LAHTI (1,504 metres); 35 kW.—**4.57**, Time Signal. Weather Report and Press News. **5.15**, Talk. **5.35**, Orchestral Selections (Beethoven): (a) Romance in G Major, (b) Symphony in C Major, (c) Larghetto from the Second Symphony. **6.5**, Dramatic Selection. **6.45**, Organ Recital: Introduction and Fugue (Andersen); Kanteleeni (Melartin); Ráuhan rukous (Melartin); Two Songs (Kuula); Intermezzo (Kuula); Legende (Raitio); Two Selections (Hannikainen); Song, Rukous (Kothen); Passacaglia in F Sharp Minor (Granlund). **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**, Orchestral Concert: Overture to The Bartered Bride (Smetana); Waltz, Fürstenkind (Lehár); Fantasia on Slav Themes, Wolgageister (Leuschner); Autumn Dreams and Reverie (Leoncavallo); Tone Poem, Im Zigeunerlager (Sperber); Potpourri on the Works of Kreisler (Reznicek); Nibelungen-Marsch (Sonntag). **1.30**, Hints for the Housewife. **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**, Talk for Young People by Dr. Rudolf Mense. **3.30**, Martha Schippers, Talk for Women: The Protection of the Working Woman. **4.0**, Max Cohen-Reuss, Talk: The New Taxes and German Industry. **4.20**, English Lesson by Prof. Hase. **4.45**, Orchestral Concert: Overture to Ali Baba (Cherubini); Concerto for Flute and Orchestra (Reinecke); Waltz, Phönixschwingen (Joh. Strauss); A Folk Tale, Kikimora (Liadow); Polonaise (Liadow). **5.30**, Dr. Stulz, Talk: How do I reach an understanding of Historical Events? **5.50**, Lesson in Morse. **6.15**, Talk for Workers by Herr Albert Fuchs. **6.40**, Dr. Lips, Talk: The Development of Culture. **7.0**, 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.—**3.0**, Legal Talk. **3.30**, Concert by the Station Orchestra. **4.45**, Wireless News and Talk. **5.20**, Weather Report and Time signal. **5.30**, see **Königswusterhausen**. **5.55**, Labour Market Report. **6.0**, Dr. Theodor Wolff, Talk: Problems of the Circle. **6.30**, Dr. Fritz Kaphahn, Talk: The History of the Sentiment of Europeanism **7.0**, Selections from the Operetta, Der Rastelbinder (Lehár), followed by Humorous Programme. **9.0**, Time Signal, Snow Report, Weather Forecast, News, Sunday Programme Announcements and Sports Notes followed by Dance Music 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: Science. **8.25**, News and Announcements. **9.45**, Weekly Agricultural Report. **10.0**, Chimes, Time Signal and a Musical Comedy; 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.—**7.25**, News. **7.30**, Time Signal and Announcements, followed by "Ernani," Opera (Verdi); in the Intervals: Readings, Talk, 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), **Oster sund** (720 metres), **Sundsvall** (545.5 metres).—**4.0**, Concert of Light Music: Selection from Die Felsenmühle (Reisiger); Selection from Mignon (Thomas); Waltz from Zigeunerliebe (Lehár); Impression (Fiévet); Chanson Matinal (Fiévet); Andalusian Romance (Sarasate); Le Cygne (Saint-Saëns); Quintessence (Morena); March from The Little Dutch Girl (Kálmán). **5.0**, Programme for Children. **5.30**, Cabaret Programme. **6.30**, Talk: Professions and Professional Men. **6.45**, Sonata for Violin and Pianoforte No. 6 in G Major (Mozart) relayed from **Göteborg**. **7.0**, Operetta Programme by Carl Brisson and Orchestra. **8.15**, News and Weather Report. **8.45**, Topical Talk. **9.0**, Swedish Ballad Recital. **9.20**, Dance Music. **11.0** (approx.), Close Down.

MUNICH (536.7 metres), 4 kW.—Programme relayed by Augsburg (366 metres), **Kaiserslautern** (273 metres), and **Nuremberg** (240 metres).—**4.30**, Talk for Gardeners. **4.45**, Talk on Electro-Technics. **5.0**, Recital of Songs from the Works of Cornelius and Schillings. **5.35**, Labour Market Report. **6.0**, The Letter Box. **6.30**, Concert of Trio Music. **7.0**, Musical Pictures of Vienna. **9.0**, Orchestral Concert from the Hotel Reichsadler. In the Interval at **9.30** (approx.), News. **11.30**, Concert of Light Music: Overture to The Merry Wives of Windsor (Nicolai); Selection from La Tosca (Puccini); Ave Maria (Kahn); Violin Solo, Caprice Viennois (Kreisler); Gavotte (Meyer-Helmund). Waltzer-Momente 1 (Schütt); Song, Heidnischer Abend (Here); Selection from Lilac Time (Schubert Berté); Song, Sing me to Sleep.

Saturday, March 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**, Time Signal, Wireless Talk, Announcements, News, and Harbour Notes. **7.45**, Relay of an Opera from the San Carlo Royal Theatre. **9.50**, News. **9.55**, Calendar and Programme Announcements.

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: Stavanger-Gjaedern. **7.0**, Time Signal and Orchestral Concert. **8.30**, Weather Report, News and Topical Talk. **9.0**, Concert: Gallop (Oertel); Xylophone Selection from William Tell (Krüger); Selections for Mandoline Orchestra; Xylophone Solo, Spanish Waltz (Mitra); Madrigal (Florida); Ständchen (Heykens); Royal Gavotte (Reh); Cirkus Renz Galoppe (Peter). **9.30**, Dance Music. **11.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (453 metres); 0.5 kW.—**5.0**, Pasdeloup Concert from the Théâtre des Champs Elysées. **6.30**, Radio Journal de France. **8.0**, Talk by M. Géville. **8.15**, Legal Talk. **8.30**, Gala Concert from the Palais d'Orsay, followed by News, Time Signal, Weather Report and Dance Music, from the Coliseum de Paris. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (1,485 metres); 5 kW.—**4.0**, 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) M. René Casalis—Sunday Sports, (d) Mlle. Jacqueline Bertillon—Social Works; and Talks by other contributors.

PARIS (Petit Parisien) (336 metres); 0.5 kW.—**8.45**, Gramophone Selections, Talk and News. **9.0**, Concert: Overture to Pique Dame (Suppé); Selection from Chérubin (Massenet); Le Carnaval des animaux (Saint-Saëns); Die Dorfmusikanten (Mozart); Suite, Minnehaha (Coleridge-Taylor); Esquisse No. 2 (Aubert); Les Fêtes romaines (Fourdrain); 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. **3.30**, Exchange Quotations. **3.45**, Programme of Dance Music. In the Interval at **4.0 p.m.**, M. Denis d'Ines, Talk: The Art of Elocution. **4.45**, Exchange Quotations and News. **5.25**, Religious Address by Pastor Marc Boegner. **6.30**, New York Closing Prices and Agricultural Report. **6.45**, Programme of Gramophone Records: Waltz, Tales of the Vienna Woods (Joh. Strauss), by a Symphony Orchestra; Trio Selection, Le Tambour de Beçon (Borel-Clerc); Pianoforte Solo, Polonaise in A Flat (Chopin) by M. Vianna da Motta; Neapolitan Air, Reginella (Gaëtano Lama); Air from Cavalleria Rusticana (Mascagni); Cake-Walk (Debussy) by a Symphony Orchestra; Popular Russian Songs by a Balalaika Orchestra. **7.30**, Pianoforte Lesson by M. Lucas. **7.45**, Market Prices and News. **8.0**, M. Armbruster, Talk: L'Avenue de la Victoire. **8.15**, Concert of Prize-winning Songs of the Leopold Bellan Society: Bébé sait chanter (Bagnoli); Les Jeans de France (Prillard-Ferry an Gastond Duplant); La bonne chanson (Tupet-Gosset). **9.0**, Mario Cazes Programme. In the Intervals—News.

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—**11.30** Gold Spot Pals, relayed from **New York**. **12.0 Midnight**, Sessions Clock Chimes. **12.1 a.m.**, (Sunday), University of Pittsburgh Address. **12.15 a.m.**, Home Radio Club Meeting. **12.30 a.m.**, American Literary Gems. **12.45 to 3.1 a.m.**, **New York** Relay. **12.45 a.m.**, Dr. Julius Klein, Talk: A Week of the World's Business. **1.0 a.m.**, The Purol Band. **1.30 a.m.**, Interwoven Entertainers. **2.0 a.m.**, Pal Americana. **2.30 a.m.**, Seven-Elevens Dance Band. **3.0 a.m.**, Time Signal. **3.1 a.m.**, Orchestral Selections from the Fort Pitt Hotel. **3.30 a.m.**, Weather Reports. **3.35 a.m.**, Orchestral Selections from the William Penn Hotel.

POSEN (336.3 metres); 1.5 kW.—**5.50**, Talk for Women by Mme. S. Swidzinska. **6.5**, Concert by a Vocal Quartet: Songs by Grieg, Surzynsky, Gall, Walevsky, Zelensky and Kremer. **6.35**, Polish Poetry Recital. **7.0**, "A Night in Venice": Operetta (Joh. Strauss), relayed from **Bydgoszcz**; In the Intervals: Theatre and Cinema Notes and News. **10.0**, Time Signal and News. **10.30**, Musical Interlude. **11.0**, Orchestral Concert arranged by Maison Philips. **1.0 a.m.** (approx.) (Sunday), Close Down.

PRAGUE (343.2 metres); 5 kW.—**6.0**, Chimes and News. **6.5**, Talk: The Exhibition in Tabor for South Bohemia. **6.20**, Programme from **Brünn**. **9.0**, Time Signal, News, Sports Notes and Theatre Review. **9.25**, Programme from **Brünn**. **10.0**, Relay of Chimes.

ROME, Call 1RO (443.8 metres); 3 kW.—**7.30**, Giornale parlato, followed by Press Review. **7.45**, Concert by the Band of the Royal Carabiniers, Marcia eroica (Cirenei): Four Selections from Scènes pittoresques: Suite (Massenet); Musical Fantasia, Le Baiser (de Bainville); Two Selections from Sicilia canora: Suite (Mulé); Siegfried's Funeral March from The Twilight of the Gods (Wagner); Talk: The World of Literature and Art; Selection from Rigoletto (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. **11.28**, 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**. **1.0 a.m.**, Programme by the Studio Ensemble. **1.30 to 4.0 a.m.**, **New York** Programme. **1.30 a.m.**, Concert 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 from the Hotel De Witt Clinton, **Albany**. **5.0 a.m.** (approx.), Close Down.

STUTTGART (374.1 metres); 4 kW.—**3.30**, Thé Dansant from the Pavillon Excelsior. **5.0**, Time Signal and Weather Report. **5.15**, Talk: Papyrus Documents, relayed from **Freiburg** (577 metres). **5.45**, Dr. Leibfried, Talk: The Trial and Torture of Witches. **6.15**, Book-keeping Lesson by Dr. Wolff. **6.45**, Time Signal and Sports Notes. **7.0**, Musical and Literary Programme of Humoresques. **8.0**, Concert of Folk Songs and Popular Melodies from the **Karlsruhe** Festhalle. **9.15**, Cabaret Programme from the Bundeshalle, **Reutlingen**. **10.15**, News, followed by 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: Part I: Symphony Music; Overture to Mignon (Thomas); Prelude, Cortège and Air de danse from L'Enfant prodigue (Debussy); Selection from I Pagliacci (Leoncavallo); Two Selections from L'Arlésienne (Bizet); Selection from Rigoletto (Verdi). Part 2: Songs from Comic Opera; Anges du Paradis from Mireille (Gounod); Air from Cavalleria Rusticana (Mascagni); Air from La Tosca (Puccini); Recitative and Air of Asael from L'Enfant prodigue (Debussy); Quartet from La Bohème (Puccini); Air from Frasquita (Lehár). **9.20**, Selection of Bird Songs. **9.30**, Whistling Selections. **9.40**, Harpsichord Solo, Italian Concerto (Bach). **9.50**, Programme of Dance Music. **10.15**, North African News. **10.30** (approx.), Close Down.

VIENNA (520 metres); 15 kW.—**4.30**, Sonata Recital. **5.25**, Reading (Wertheimer). **6.0**, Talk: The Renaissance: Technique and Communications. **6.30**, Topical Talk. **7.0**, Time Signal and Weather Report. **7.5**, Concert of Strauss Music on the 125th Anniversary of the Birth of Johann Strauss, Sen.: Selections (Joh. Strauss, Sen.) (a) Radetzky March, (b) Waltz, Rheinklänge, from Loreley; Selections (Joh. Strauss, Jun.), (a) Overture to Die Fledermaus, (b) Wine, Women and Song, (c) Gavotte from The Queen's Kerchief, (d) Frühlingstimmen, (e) Mazurka from The Gipsy Baron; Selections (Jos. Strauss), (a) Aquarellen Walzer, (b) Ständchen, (c) Frauenherz: Mazurka, (d) Waltz, Dorfschwalben aus Österreich, (e) Polka, Feuerfest; Selections (E. Strauss), (a) Waltz, Widmungsblätter, (b) Serenade-Mazurka; Galopp (Joh. Strauss, Uncle); followed by Concert of Dance Music and Phototelegraphy Transmission.

VILNA (426.7 metres); 1.5 kW.—**4.50**, Programme for Children. **5.50**, Topical Talk by Mr. Tadhee Bialkovsky. **6.10**, Talk: National Education. **6.35**, Programme relayed from **Warsaw**. **7.0**, See **Posen**. **9.0**, Programme relayed from **Warsaw**.

WARSAW (1385.7 metres); 10 kW.—**4.0**, Talk on Etymology, by Prof. S. Szober. **4.25**, History Talk by Prof. H. Moscicki. **4.55**, Programme for Children. **5.50**, Miscellaneous Items. **6.10**, Wireless Review by Dr. M. Stepovsky. **6.50**, Time Signal. **7.0**, See **Posen**. In the Interval: Theatre Notes. After the Programme, Aviation and Weather Reports, News, Police Announcements and Sports Notes. **9.30**, Dance Music from the Hotel Bristol. **10.30** (approx.), Close Down.

SUNDAY, MARCH 17th.

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

Programmes from Abroad.—

BARCELONA (Radio Barcelona), Call EAJ1 (**350.5 metres**); 1.5 kW.—**11.0 a.m.**, Chimes relayed from Barcelona Cathedral. **11.5 a.m.**, Weather Report and Forecast for Europe and North East Spain and Notes on Route Conditions for Aviators. **1.30**, Musical Selections by the Station Trio. **2.45 to 6.0**, No Transmission. **6.30**, Recital of Tenor Songs interpreted by Eusebio Carasusan: Aria from "Il Seraglio": Opera (Mozart). **8.30**, Concert of Popular Music by the Wireless Orchestra. **8.40**, Sports Intelligence. **9.0** (approx.), Close Down.

BERGEN (**365.9 metres**); 1.5 kW.—**9.30 a.m.**, Church Service with Address relayed from the Cathedral. **11.30 a.m.**, Meteorological Report and General News and Announcements. **7.0**, Concert of Orchestral Music. **7.50**, Topical Talk. **8.0**, Musical Recital by Mrs. E. Hals Andersen (Pianist), Mr. Arve Arveson (Violinist) and Mr. Kurt Müller ('Cellist). **9.0**, Weather Conditions and Forecast followed by Late News and Announcements and Time Signal. **9.15**, Dance Music Programme. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1648.3 metres**); 40 kW.—**7.55 a.m.**, Church Chimes relayed from Potsdam Garrison Church. **8.0 a.m.**, Morning Festival of Vocal and Instrumental Music from **Voxhaus**, followed by Chimes from Berlin Cathedral. **12.45 to 1.15**, Experimental Picture Transmission. **1.30 to 2.30**, Three Agricultural Talks. **2.30**, Reading of Fairy Tales. **3.0**, Talk or Reading. **3.30**, Musical Programme. **5.0**, Two Topical Talks. **6.0**, Talk. **7.0** (approx.), Musical or Dramatic Programme followed by Late News and Announcements. **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 Musical Festival and Address followed by Chimes from the Cathedral. **12.15**, Talk on Modern Chess Playing by E. Nebermann. **1.30**, Practical Hints and Announcements for Farmers. **1.45**, Weekly Survey of Market Conditions and Weather Forecast. **1.55**, Talk on an Agricultural Subject. **2.30**, Reading of Fairy Tales. **3.0**, Talk. **3.30**, Concert Programme. **5.0**, Talk. **5.30**, Talk. **6.0**, Talk. **7.0** (approx.), Musical or Dramatic Programme followed by Meteorological Report and Late News and Announcements, Time Signal and Sports Notes. **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**, Concert of Orchestral Music. **2.30**, Popular Concert by the Kursaal Orchestra. **6.29**, Time Signal. Weather Report and Forecast and Football Intelligence. **6.30**, Reading or Talk. **7.0**, "La guive"—Opera (Halévy). Followed by Sports Notes, General News Bulletin and Meteorological Report. **9.0** (approx.), Concert. **9.40** (approx.), Close Down.

BEZIERS (**211.3 metres**); 0.6 kW.—**12.0 Noon**, Religious Address and Sacred Concert organised by Lovers of Religious Music. **6.0**, Programme arranged by "La Radio Agricole Française." **8.30**, Sports Intelligence. **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**, Relay of Musical Programme by the Armenonville Tea Room Orchestra. **6.0**, Programme for Children. **6.30**, Concert by the Station Trio. **7.30**, "Journal Parlé de Radio-Belgique." **8.15**, Musical or Dramatic Programme. **10.15**, News and Announcements from the Evening Papers. **11.0** (approx.), Close Down.

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. **7.5 a.m.**, Instruction in German Shorthand by Hans Molitor. **7.25 a.m. to 7.55 a.m.**, Lesson in Esperanto and Review in Esperanto of Programmes of the Week, by Alfred Dormanns. **8.5 a.m. to 9.0 a.m.**, Evangelical Morning Festival, with Sermon and Vocal and Instrumental Items. **12.0 Noon**, Concert of Popular Music. **1.30**, Talk. **1.50**, Talk. **6.25**, Talk for Workers by Heinz Thelen: The English Labour Movement. **6.20** (approx.), Talk. **7.0**, Musical or Dramatic Programme, followed by General News Bulletin, Sports Intelligence and Late Concert. **11.0** (approx.), Close Down.

CORK, Call 6CK (**222 metres**); 1.5 kW.—**8.30 to 11.0**, Concert of Vocal and Instrumental Music. **9.30**, Selections rendered by the Choral Society of Cork Municipal School of Music, conducted by Padraig O Conchubhair. **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.**, Divine Service, relayed from a 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.**, Relay of Concert from the Philharmonic Hall, **Warsaw**. **1.0 and 1.20**, Agricultural Talks. **1.40**, "La Chronique Agricole." **2.0**, Meteorological Bulletin. **2.15**, Concert by the Philharmonic Orchestra, relayed from **Warsaw**. **4.30**, Talk: Silesia and its Neighbouring Countries at the Time of the Appearance of the First Metals—the Bronze and Iron Ages. **4.55**, Lesson in Italian, by Dr. Nelly Nucci. **5.20**, Concert, relayed from **Warsaw**. **6.0**, Miscellaneous Items. **6.20**, Talk. **6.56**, Relay of Time Signal from the Astronomical Observatory. **7.0**, Fanfare from the Church of Notre Dame. **7.15**, Sports Intelligence. **7.30**, Musical Programme. **9.0 to 9.30**, Programme relayed from **Warsaw**. **9.0**, Report on Aviation Routes and Meteorological Bulletin. **9.5**, News and Announcements from the Polish Telegraph Agency. **9.20**, Police Announcements and Sports Notes. **9.30**, Programme from **Warsaw**: Orchestral Music relayed from a Restaurant. **10.30** (approx.), Close Down.

DUBLIN, Call 2RN (**411 metres**); 1.5 kW.—**8.30 to 11.0**, Programme relayed from **Cork**: Concert with Vocal and Instrumental Numbers; Soprano Solos rendered by Miss Elizabeth Mellor. **11.0**, National Anthem and Weather Conditions and Forecast. **11.15** (approx.), Close Down.

GENOA, 1GE (**386.9 metres**); 1.2 kW.—**4.0**, Musical Selections. **7.0**, Opening Signal; "Il Radiogiornale," consisting of News and Announcements from the Agency Stefani and Sports Intelligence. **7.20**, Official Wireless Announcements. **7.25** (approx.), Talk by Leandro Vaccari: Sporting Events of the Day. **7.40**, Concert of Popular Music by the Station Orchestra, conducted by Fortunato Russo; Orchestral Selection: From the Neapolitan Suite (De Nardis), (a) Canto Napoletano, (b) Pulcinella.

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.**, Ice Report, Weather Conditions and Forecast and News and Announcements. **7.40 a.m.**, Talk: Contemporary Problems of Economics. **8.0 a.m.**, Talk on a Legal Subject. **10.0 a.m.**, Talk. **11.55 a.m.**, Time Signal from **Nauen**. **12.5**, Orchestral Concert. **12.5** (for **Hanover**), Gramophone Selections. **12.5** (for **Bremen**), Programme by the Station Orchestra. **1.0**, Programme by Funkheinzelmann. **2.0**, Concert or Reading. **6.40**, Sports Results. **6.55**, Weather Report and Forecast. **7.0**, Musical or Dramatic Programme followed by Inland Weather Conditions and Forecast and News and Announcements. **9.40**, Concert. **10.50** (for **Bremen, Flensburg, Hamburg** and **Kiel**), Meteorological Report for North Sea and Baltic. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**); 5 kW.—**11.40 a.m.**, Talk: How to Play Bridge. **12.10**, Concert of Popular Music. **1.40**, Critique of the Drama. **2.10**, Concert of Orchestral Music by the **Amsterdam** Concert Hall Orchestra, conducted by Willem Mengelberg. **3.40**, Musical Selections with Sports Intelligence in the intervals. **7.40**, Time Signal. **7.55**, Relay of an Oratorio interpreted by the Augmented Wireless Orchestra, conducted by Nico Treep. **11.10** (approx.), Close Down.

HUIZEN (**336.3 metres**); 4 kW.—Transmits from 5.40 on 1,852 metres. **8.5 a.m.**, Church Service and Sermon. **9.30 a.m.**, Morning Service Relay. **12.10**, Musical Selections by the Station Trio. **1.10**, Talk. **1.40**, Talk. **5.30**, Evening Service with Sermon, relayed from **Zaanden**. **7.10**, Talk. **7.50**, Orchestral Concert. **9.10**, Late News and Announcements from the Press. **10.25**, Relay of Epilogue by a 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 Conditions and Forecast from the Meteorological Institute at **Copenhagen**. **12.0 Noon**, Lesson in German. **12.30**, Lesson in French. **2.30**, Concert of Instrumental Music. **5.20**, Talk. **5.50** (**Kalundborg** only), Weather Report and Forecast from the **Copenhagen** Meteorological Institute. **6.0**, General News Bulletin from the Press. **6.15**, Time Signal. **6.16**, Sports Notes. **6.25**, Talk. **7.0**, Relay of "La Tosca"—Opera in Three Acts (G. Puccini), produced by Egisto Tango. Followed by Selections of Dance Music 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.**, Church Service Relay. **10.56 a.m.**, Time Signal, followed by Meteorological Report. **11.10 a.m.**, Concert of Orchestral Music. **1.0**, Talk: "The Silesian Gardener." **1.20 and 1.40**, Talks for Agriculturists. **2.0**, Weather Report and Forecast. **6.0**, Various Announcements. **6.56**, Time Signal. **7.0**, Humorous Interlude by Professor St. Ligo. **7.30**, Concert relayed from **Warsaw**. **9.0**, Meteorological Report, Late News and Announcements and Sports Intelligence. **9.30**, Dance Music Programme. **10.30** (approx.), Close Down.

KÖNIGSBERG (**280.4 metres**); 4 kW.—Programme relayed by **Danzig** (456 metres).—**8.0 a.m.**, Religious Festival with Sermon and Musical Numbers. **9.56, a.m.** (**Danzig** only), Meteorological Report. **10.0 a.m.** (**Königsberg** only), Weather Report and Forecast. **1.0**, Talk for Chess Players by P. S. Leonhardt. **3.0**, Musical Programme. **6.0** Transmission of "Mudder Mews"—a Low-German Drama in Five Acts by Fritz Stavenhaven, produced by Doctor Karl Bink under the Auspices of the Low-Prussian Section of the Union of Friends of the Low-German Dialect. **7.10** (approx.), Orchestral Concert. **9.0** (approx.), Late News and Announcements and Sports Intelligence.

LAHTI (**1,504 metres**); 35 kW.—Programme also for **Helsingfors** (374 metres).—**8.0 a.m.**, Church Service Relay of the Finnish Language. **9.50 a.m.**, Press News and Announcements. **10.5 a.m.**, Concert of Instrumental Music. **10.25 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 the Swedish Language. **3.0**, Concert by the Wireless Orchestra. Conductor: Erkki Linko. **4.0**, Talk. **4.25**, Musical Recital. **4.57**, Time Signal and Meteorological Report. **5.15**, Talk. **5.45**, Musical Programme. **6.25**, Musical Recital. **6.45**, Concert by the Wireless Orchestra, conducted by Heikki Klemetti. Selections from "La belle Hélène"—Opera (Offenbach). **7.45**, General News and Announcements in Finnish and 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.**, Lesson in Self Defence. **7.5 a.m.**, German Shorthand Lesson by Hans Molitor. **7.25 a.m.**, Esperanto Lesson. **7.45 a.m.**, Survey in Esperanto of Forthcoming Programmes. **8.5 a.m. to 9.0 a.m.**, Protestant Morning Recital including Sermon and Vocal and Instrumental Numbers. **12.0 Noon**, Musical Programme. **1.30**, Talk. **1.50**, Talk. **6.20** (approx.), Talk. **7.0**, Musical or Dramatic Programme. **8.0**, Relay of "Widow Grapin": Operetta in One Act (Friedrich von Flotow). Followed by Late News and Announcements, Sports Notes and Late Concert. **11.0** (approx.), Close Down.

LEIPZIG (**361.9 metres**); 4 kW.—Programme relayed by **Dresden** (276 metres).—**7.30 a.m.**, Organ Recital relayed from a Church in Leipzig. **8.0 a.m.**, Morning Concert of Vocal and Instrumental Music. **12.0 Noon and 12.30**, Two Agricultural Talks. **4.0**, Musical Selections. **6.0**, Talk. **7.30**, Students' Evening rendered by a Choir of Students, Hermann Munk (Songs to the Lute) and the Station Orchestra conducted by Hilmar Weber. **9.0** (approx.), Late News and Announcements, Sports Results and Dance Music Programme. **11.30** (approx.), Close Down.

LYONS (Radio Lyon) (**291 metres**); 1.5 kW.—**3.30**, Concert of Vocal and Instrumental Music. **7.30**, "Le Journal Parlé" consisting of News and Announcements and Review of Press, Theatre Notes and Communications. **8.0**, Concert of Instrumental Music by the Wireless Orchestra. **10.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**427 metres**); 3 kW.—**2.0**, Relay of Chimes from the Gobernacion and Time Signal. **2.5**, Concert of Light Music by the Station Orchestra. **3.30 to 7.0**, No Transmission. **7.0**, Chimes Relay followed by Dance Music Programme. **8.0**, Talk about Famous Journeys. **8.30 to 10.0**, No Transmission. **10.0**, Relay of Chimes followed by Time Signal. **10.5**, Concert by the Station Sextet: Overture to "Cleopatra"—Opera (Mancinelli). **10.30**, Selections of Band Music relayed from the Hotel National. **12.0 Midnight**, Chimes. **12.5 a.m.** (Monday), Concert continued. **12.30 a.m.** (approx.), Close Down.

Programmes from Abroad.—

MILAN, 1MI (504.2 metres); 7 kW.—**9.0 a.m.,** Opening Signal followed by Lesson in English. **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,** Comedy relayed from the Teatro Arcimboldi. Concert of Popular Music by the Station Quintet. Quintet Selection: Negro Dance (Pennati). **4.40,** Entertainment for Children. "Work and Beauty," Music by C. Pedron. **7.30,** Time Signal followed by Official Announcements from the Station. **7.40,** Historical Talk. **8.0,** Opera relayed from the Scala Theatre. At the end of Act One: Song Recital. At the end of Act Two: Talk, "Town and Country," by Ulderico Tegani. At the end of Act Three: Sports Bulletin and General News Bulletin from the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (1,265 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.,** Church Service relayed from **Stockholm. 4.55,** Relay of Chimes from the Town Hall, **Stockholm. 6.30,** Dramatic Programme. **8.15,** Late News and Announcements and Meteorological Report. **8.45,** Musical Programme. **10.30** (approx.), Close Down.

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (273 metres) and **Nuremberg** (240 metres).—**9.0 a.m.,** Sacred Morning Festival. **10.0 a.m.,** Relay of Chimes from Munich Town Hall. **10.10 a.m.,** Transmission of the Weather Chart for Bavaria. **12.5,** Time, Weather Report and Forecast and Programme Review. **5.0,** Talk. **5.35,** Musical Recital. **7.0,** Popular Sunday Concert arranged by the Munich Musical Union relayed from the Tonhalle. News in the interval. **10.0,** Late News Bulletin. **10.15** (approx.), Close Down.

NAPLES, Call 1NA (333 metres); 1.5 kW.—**8.30 a.m.,** Lesson in French by Professor Etienne Verdier. **9.0 a.m.,** Concert of Religious Music. **3.45,** Children's Corner. **4.0,** Popular Concert, Vocal and Instrumental Items. **4.30,** Time Signal. **7.30,** Il Radiogiornale. **7.50,** Communications by the Naples Harbour Authorities. **8.0,** Time Signal. **8.2,** Concert of Light Music: Vocal and Instrumental Items; in the Interval, Recitations by E. Murolo; Selections from "O munasterio" (Di Giacomo). **9.0,** Sports Notes. **9.55,** Calendar and Review of Forthcoming Programmes. **10.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (458 metres); 0.5 kW.—Programme relayed at intervals by the following Stations: **Bordeaux,** PTT (275 metres). **Eiffel Tower** (1,485 metres), **Grenoble** (416 metres), **Lille** (269 metres), **Limoges** (285 metres), **Lyons,** PTT (475.2 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse,** PTT (260 metres).—**8.0 a.m.,** General News and Announcements and Time Signal. **9.25 a.m.,** International Time Signal and Weather Conditions and Forecast. **1.30,** Concert of Orchestral Music, arranged by the General Association of French Wireless Listeners: Sérénade (B. Godard). **2.30,** Symphony Concert, relayed from the Assembly Hall of the Paris "Le Journal." **4.0,** Pasdeloup Concert of Symphony Music, relayed from the Théâtre des Champs Elysées, conducted by M. Rhené Bâton. **6.30,** "Le Radio Journal de France." **8.15,** Talk, under the auspices of the Union of French Associations. **8.45,** Orchestral Concert, followed by General News Bulletin, Time and Weather Report and Dance Music Programme from the Coliseum de Paris. **12.0 Midnight,** Close Down.

PARIS (Eiffel Tower), Call FL (1,485 metres); 5 kW.—**7.56 a.m.,** Time Signal on 32.5 metres. **7.10,** Weather Conditions and Forecast. **7.20.** "Le Journal Parlé," consisting of Police Memoirs, Sports Bulletin, News and Announcements and Racing Results supplied by "Paris Sport." **7.58,** Time Signal on 32.5 metres. **8.0 to 9.0,** Theatrical Evening: "Le Pont Neuf en 1620."

PARIS (Petit Parisien) (336 metres); 0.5 kW.—**8.45,** New Gramophone Records. **8.50,** Talk. **8.55,** News and Announcements. **9.0,** Concert with the collaboration of Artistes of the Opéra and the Opéra-comique. **9.25,** General News Bulletin. **9.30,** Concert of Symphony Music, under the Direction of M. Estyle, of the Paris Conservatoire. **10.0,** Late News Bulletin. **10.10,** Orchestral Concert. Légende pastorale (Godard) for Oboe and Orchestra; Solo part rendered by M. Gobert, of La Société des concerts du conservatoire. **11.0** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (1,769 metres); 15 kW.—**8.0 a.m.,** News and Announcements and Press Review. **8.30 a.m.,** Daily Lesson in Physical Culture, arranged by Dr. Difire. **12.0 Noon,** Address by Father Lhande, followed by Concert of Religious Music. **12.30,** News and Announcements. **12.45,** Musical Selections by the Albert Locatelli Orchestra: Selections from Monsieur Beaucaire, Operetta (Messager, arr. Salabert); in the Interval, Humorous Programme by Bilboquet. **3.30,** Gramophone Selections supplied by "L'Industrie Musicale"; General News Bulletin in the Intervals. **5.0,** Lenten Sermon, pronounced by Father Pinard de la Boulaye, relayed from Notre Dame de Paris. **6.30,** Agricultural Reports. **6.45,** Pathé Programme of Gramophone Records. **7.45,** Radio Paris Guignol. **8.30,** Radio Paris Café Concert; Late News Bulletin and Communications in the Intervals. **10.30** (approx.), Close Down.

Sunday, March 17th.

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

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—**4.0,** Sessions Clock Chimes. **4.1,** Church Service Relay. **6.29,** Time. **6.30,** Allegheny Memorial Park Programme. **7.0,** The Roxy's Concert of Symphony Music. **8.0,** Symphony Music by the Mu-Sol-Dent Orchestra. **9.0,** Selections for Organ, played by Dr. Charles Heinroth. **9.30,** McKinney Manufacturing Co. Programme, relayed from **New York. 9.45,** Evening Service and Address, relayed from the Shadyside Presbyterian Church: Pastor, Hugh Thomson Kerr. **11.0,** Time. **11.1,** Programme by the William Penn Hotel Orchestra. **11.30,** Whittall Anglo-Persians Programme from **New York. 12.0 Midnight,** Sessions Clock Chimes. **12.1 a.m.** (Monday), Relay of Evening Service from the Calvary Protestant Episcopal Church: Pastor, 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.,** "Days of St. Patrick" relayed from **New York. 3.15 a.m.,** Longines Time, relayed from **New York. 3.16 a.m.** (approx.), Close Down.

POSEN (336.3 metres); 1.5 kW.—**9.15 a.m. to 10.45 a.m.,** Relay of Sacred 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. **6.0,** Bulletin of the Catholic League of Polish Youth. **6.20,** Talk, relayed from **Warsaw. 7.5,** Miscellaneous Items. **7.30,** Concert of Choral Music and Soprano Solos, rendered by a Mixed Choir, conducted by B. Dembinsky and Mme. Sophie Fedyczkowska (Soprano): Polish Songs for Mixed Choir (Jakubowicz). **8.0,** Literary Interlude, relayed from **Warsaw. 8.15,** Concert (continued). **9.0,** Time Signal, followed by Sports Intelligence. **9.20,** Concert of Light Music. **11.20** (approx.), Close Down.

RABAT. Call PTT (414 metres); 2 kW.—**12.30 to 2.0,** Concert by the Wireless Orchestra. **4.0 to 5.0,** Musical Programme. **8.0,** "Le Journal Parlé," consisting of Miscellaneous Notes and News and Announcements. **8.15** (approx.), Concert of Light Music by the Wireless Orchestra. **9.30** (approx.), Sports Talk and Results by M. Barrier. **10.30** (approx.), Dance Music Programme from La Chaumière de Rabat, or Relay of European Stations. **11.0** (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.,** Sacred Recital with Vocal and Instrumental Music. **10.0 a.m.,** Transmission from the Casa di Dante, Talk on Il Purgatorio (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,** General News Bulletin and Agricultural Talk. **7.15,** Sports Intelligence and Various Announcements. **7.29,** Time Signal. **7.45,** Transmission of "Le Maschere"—Lyrical Comedy in Three Acts (Mascagni), rendered by the Wireless Orchestra and Choir; After Act I, Reading of a Short Story; after Act II, Fashion Talk. **9.50,** Late News and Announcements. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (19.56 metres); 30 kW.—**6.30,** Programme by the Peerless Reproducers relayed from **New York. 7.0,** Biblical Drama relayed from **New York. 8.30,** Organ Music Recital by Elmer A. Tidmarsh, relayed from the Union College Memorial Chapel, Schenectady, N.Y. **9.0,** Address for Men by Doctor S. Parkes Cadman, relayed from **New York. 10.30.** Dayton Westminster Choir with Talk by Walter Damrosch relayed from **New York. 11.0,** Stetson Parade and the American Legion Band relayed from **Boston, Mass. 12.0 Midnight,** Old Company's Programme from **New York. 12.30 a.m.** (Monday), Programme relayed from the Capitol Theatre, **New York. 2.0 a.m.,** Talk by the Editor of "The United States Daily," relayed from **Washington D.C. 2.15 a.m.,** The Atwater Kent Hour, relayed from **New York. 3.15 a.m.** Studebaker Programme relayed from **New York. 4.15 a.m.** (approx.), Close Down.

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

TOULOUSE (Radiophonie du Midi) (383 metres); 8 kW.—**12.45.** Variety Concert. **1.0.** Time Signal. **1.5,** Concert (continued). **1.45,** News and Announcements from "Le Télégramme," "L'Express" and "Le Midi Socialiste." **8.0,** Parisian Stock Exchange Quotations and Market Prices and News and Announcements from the Parisian Press. **8.30,** Musical Programme. **9.0,** Time Signal. **9.1,** Concert of Operatic Music, arranged by L'Association des Commerçants radio-électriciens du Midi, including Vocal and Orchestral Items: Selections from "Le Jongleur de Notre Dame"—Opera (Massenet), (a) Air du prieur, (b) Il pleure. **10.15,** North African News, followed by General 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.,** Selections by a Boys' Choir, directed by Prof. H. Müller. **10.0 a.m.,** Musical Selections. **2.30,** Experimental Picture Transmission. **8.15,** "Die Wette"—Comedy in Three Acts by Carl Sloboda (died Feb. 25th, 1929), and produced by Doctor Hans Nuchtern, followed by Concert of Popular Music and Experimental Television Transmission. **10.30** (approx.), Close Down.

VILNA (426.7 metres); 1.5 kW.—**9.15 a.m. to 10.50 a.m.,** Divine Service relayed from a Cathedral. **10.56 a.m. to 4.30,** Programme relayed from **Warsaw. 10.56 a.m.,** Time Signal, followed by News and Announcements. **11.10 a.m.,** Concert relayed from **Warsaw. 1.0 to 2.0,** Three Talks for Agriculturists. **2.15,** Concert by the Philharmonic Orchestra relayed from **Warsaw. 4.30** (approx.), Children's Corner. **4.55,** Talk on History relayed from **Warsaw. 6.20,** Talk relayed from **Warsaw. 6.45,** Time Signal and General News and Announcements relayed from **Warsaw. 7.0.** Talk. **7.30** (approx.), Musical Programme. **9.0.** Aviation Route Conditions and Meteorological Report relayed from **Warsaw. 9.20,** Police Announcements and Sports News 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 Relay 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 Agricultural Talks. **2.0,** Weather Report and Forecast. **2.15,** Concert of Symphony Music relayed from the Philharmonic Hall. **4.30,** Talk. **4.55,** Talk. **6.0,** Miscellaneous Items. **6.20,** Talk: "In the Land of the Crescent, the Sphinx and the Pyramids." **6.45,** News and Announcement. **6.56,** Time Signal. **7.0 to 7.20,** Talk: "Intellectual Amusements," by Lieut. Jablonovsky. **8.20,** Popular Concert. **9.0,** (approx.), Aviation Route Conditions and Weather Report. **9.5,** Late News and Announcements. **9.20,** Police Notes and Sports Intelligence. **9.30,** Dance Music Programme from the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (308.3 metres); 0.7 kW.—**10.30 a.m.,** Morning Concert of Instrumental Music. **4.0,** Programme of Dance Music relayed from the Club Cabaret. **6.45,** Information and Announcements of a Social and Cultural Nature. **7.0.** Relay of an Opera from the Zagreb National Theatre. In the Interval at **8.50** (approx.), News and Announcements and Weather Conditions and Forecast. **10.0** (approx.), Close Down.

ZÜRICH (489 metres); 1 kW.—**10.0 a.m.,** Musical Recital by the Station Orchestra. **11.29 a.m.,** Time Signal, followed by Weather Conditions and Forecast. **11.30 a.m.,** Selections of Gramophone Music. **3.0,** Programme by the Carletti Orchestra, relayed from the Carlton Elite Hotel. **6.30.** Time Signal. **6.33,** Relay of Protestant Sermon.

Radio-Gramophone Combination

Assembly, Wiring and Operation.

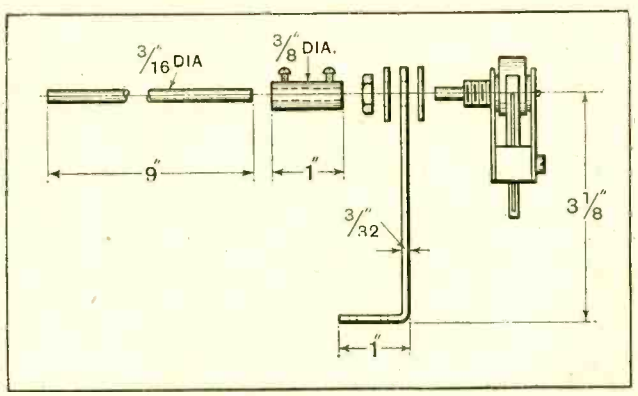
Concluded from page 244 of previous issue.

By H. B. DENT.

THE apparatus comprising a radio-gramophone combination, which includes the motor, turntable, and other accessories, cannot be accommodated in an orthodox wireless cabinet, and, therefore, a special gramophone cabinet is needed. The dimensions on the drawings should be followed, unless for some particular reason it is desired to make use of another style of cabinet, or utilise a discarded gramophone cabinet. A re-arrangement of the layout may be undertaken by those sufficiently experienced to correct any difficulties that should arise due to this cause; otherwise, very careful consideration must be given to the effect of altering the position of the components.

The cabinet shown in the illustrations can be purchased ready made. Dimensional drawings are given for the benefit of those having the facilities for constructing this at home. It is not necessary to describe the assembly of the motor and other accessories, as this is a straightforward job and does not call for detailed particulars. It would be well to mention in passing, however, that the turntable stop is stood off from the sub-deck by a ¼in. washer cut from hard wood to raise it to the level of the turntable. The makers of the motor supply a special fitment for both this and the speed regulator, but it was not thought necessary to include this refinement in the original model. An electrical gramophone pick-up and arm of any good make may be used, and the drilling of the hole for the leads should be left until the actual fitment is available, as the make decided on may require fixing in a different position from the one shown in the illustrations.

When the last screw has been driven home the tools can be laid aside and a practical test made before the baseboard is placed in the cabinet. Every part will be easily accessible should it be found necessary to correct any errors in wiring. The writer is an advocate of the safety first policy, and strongly advises a careful check of all the wiring before the valves are inserted in their holders. The theoretical diagram is generally the easier to follow for this purpose, although many still prefer the practical plan. If theory diagrams can be read without any effort, the wiring can be checked in a few minutes. If everything appears to be correct, the batteries (both H.T. and L.T.) may be connected up, but without the valves in position, and with a voltmeter take a reading of the voltage across the filament sockets in each valve holder. This may be the means of preventing one or more valves burning out due to a wrong connection. Do not be satisfied with a test on one valve holder only; try each in turn. If all is well, the valves can be inserted, with the assurance that no regrettable accident will take place. It is assumed, of course, that a decision has already been made as to the class of valves, whether 2-, 4-, or 6-volt, that are to be used.



Details of the switch showing extension rod and bracket.

A table showing the type of valve most suitable for each position has been prepared (see page 293), and although only a few of the many makes available have been singled out, these should be regarded more in the nature of a guide to the A.C. resistance and amplification factor than as definite recommendations, and, provided suitable types of other reliable make are available, there is no reason why they should not be employed.

Choice of Valves.

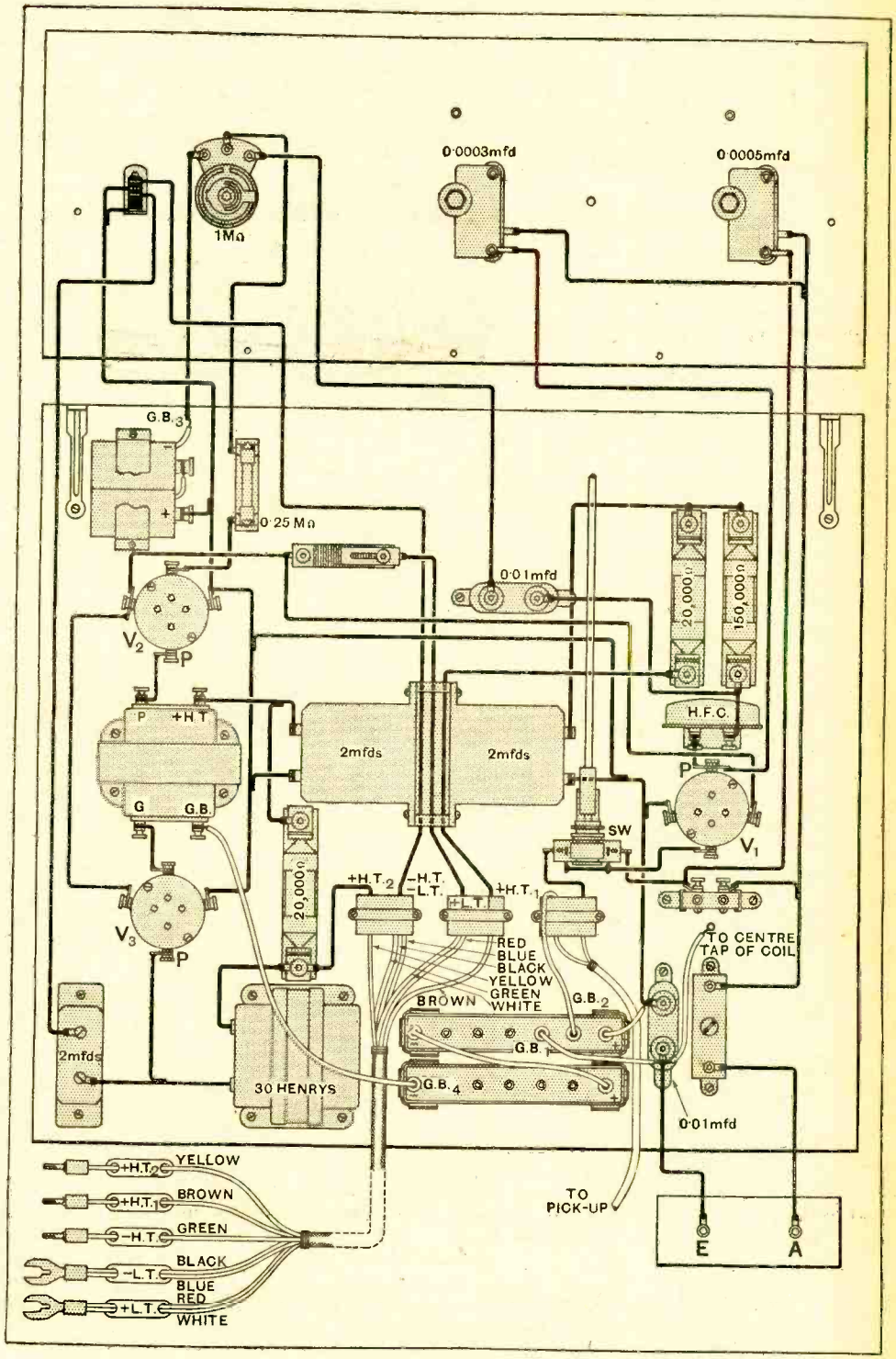
A word regarding the interpretation of the table will not be out of place. G.B.1, in the third column from the left, is the approximate amount of negative bias required for anode bend rectification, and G.B.2 is the value of the bias necessary for amplification purposes when the first valve is used in conjunction with the gramophone pick-up. G.B.2 is the lead coming from

Radio-Gramophone Combination.

the porcelain connector to which is attached the pick-up leads. The grid bias necessary for the second valve is derived from two small Ever-Ready "O" type cells housed just below, and slightly to the right of, the volume control. If valves are used requiring more, or less, than −3 volts, then these cells must be added to, or removed, according to requirements. The same applies to the two 9-volt grid batteries at the back of the baseboard, and there is ample space for an extra unit should one be found necessary.

Operation.

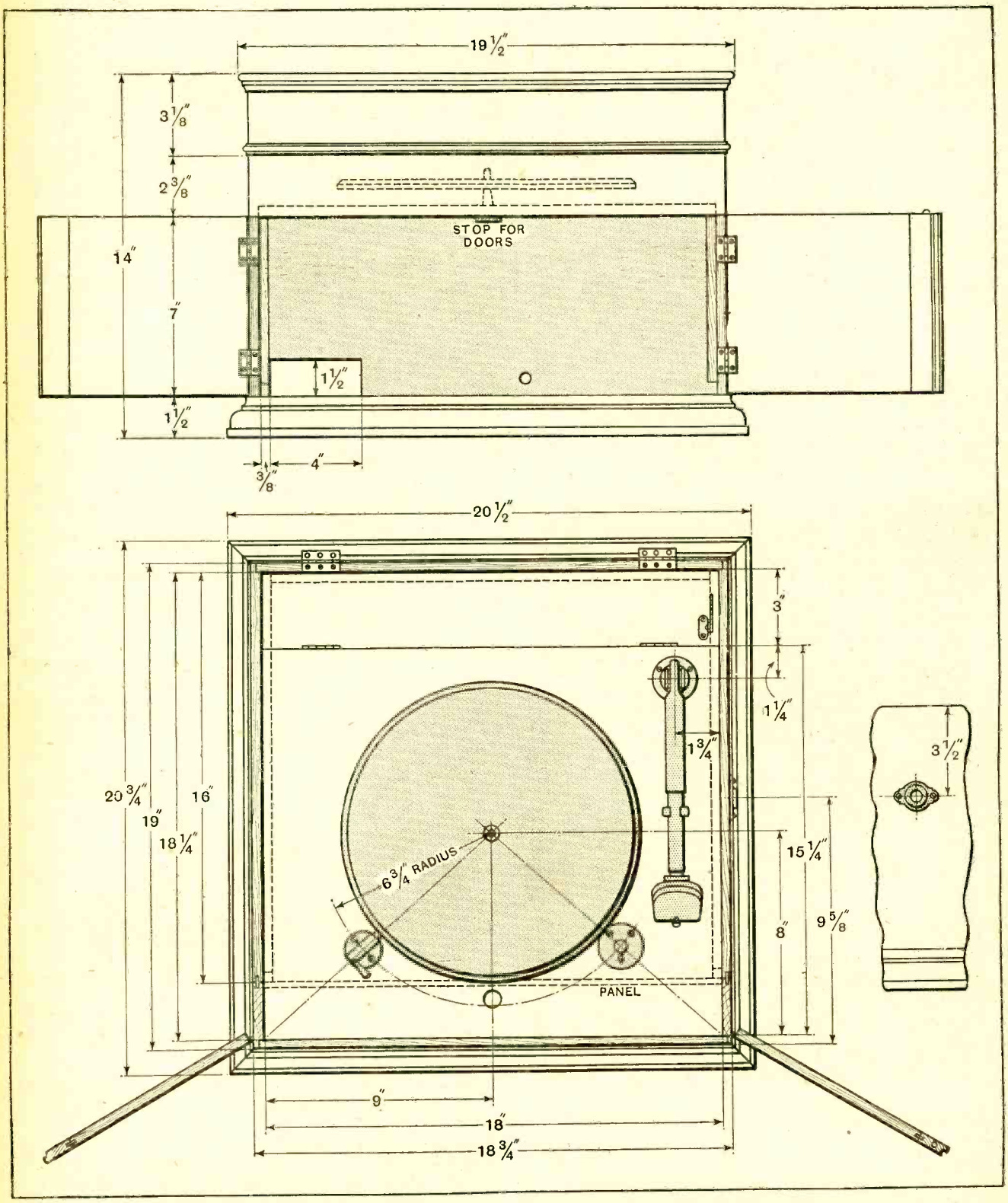
The method of operating the set does not call for lengthy comment, but a few notes may be helpful to the beginner. As far as wireless reception is concerned, the control is delightfully simple. After attaching the aerial and earth and having set the change-over switch so that the grid of the valve is connected to the tuning circuit, when fixing the knob on the extension handle the small pip should be pointing upward when the switch is in the neutral position. For broadcast the pip would then be pointing to the left (or 9 o'clock with reference to a clock face), and to the right (3 o'clock) for gramophone playing. It should be an easy matter to tune in the local station by rotating the dial on the left-hand condenser. The right-hand condenser controls reaction, and in the first stages of test should be set to the minimum position.



The practical wiring plan.

If signals are unduly weak having regard to the location of the set, the small knob on the aerial series condenser (Formo-densor) should be given a few turns in a clockwise direction. This increases the amount of series capacity and will naturally affect the tuning. Selectivity will be highest with least series capacity, but volume will be greatest with the maximum capacity available, i.e., the knob screwed down as far as it will go. Remember there is a lock-nut on the spindle, so this should be loosened. Do not forget the volume control; many hours have been spent in looking for faults that do not exist by forgetting to set this in the position for maximum intensity.

Although emphasis has been placed on the limitation

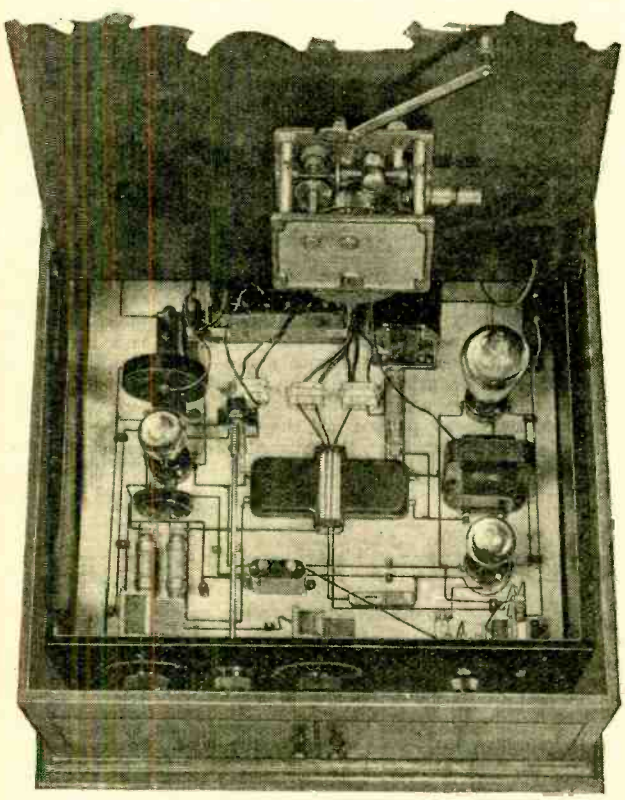


Dimensional drawing of the cabinet showing the position of the turntable and sub-deck fixtures.

TYPES OF VALVES SUITABLE FOR EACH POSITION IN THE AMPLIFIER.

Make.	First Stage.			Second Stage.		Third Stage.		H.T.
	Type.	G.B.1.	G.B.2.	Type.	G.B.3.	Type.	G.B.4.	
Marconi Osram	H.L.210	−6	−3	H.L.210	−3	D.E.P.240	−24	150
	D.E.L.410	−7½	−4½	D.E.L.410	−4½	P.425	−16½	150
	H.L.610	−4½	−1½	H.L.610	−1½	P.625	−24	150
Mullard	P.M.1H.F.	−6	−4½	P.M.2D.X.	−6	P.M.252	−15	150
	P.M.3	−7½	−6	P.M.4D.X.	−4½	P.M.254	−22½	150
	P.M.5X.	−6	−4½	P.M.6D.	−4½	P.M.256	−22½	150
Mazda (B.T.H.)	H.F.210	−3	−1½	G.P.210	−3	P.227	−15	150
	H.F.407	−3	−1½	G.P.407	−3	P.415	−12	150
	H.F.607	−3	−1½	G.P.607	−3	P.X.650	−40	150
Cossor	210 H.F.	−4½	−3	210 H.F.	−3	230 X.P.	−15	150
	410 H.F.	−4½	−3	410 H.F.	−3	415 X.P.	−15	150
	610 H.F.	−4½	−3	610 H.F.	−3	610 X.P.	−13½	150

of the set in regard to broadcast reception, it should not be inferred that the local station only is all that the set will bring in. Actually it has a much wider range than this; tested about 1¾ miles from 2LO, no difficulty was experienced in receiving 5GB.



The arrangement of the receiver-amplifier components and wiring can be seen in the above photograph taken with the turntable platform raised.

Beyond moving the switch to the appropriate position and making the necessary initial adjustment to the volume control, the reproduction of gramophone records by this means is identical with that normally adopted. One outstanding advantage of the electrical method is that the intensity can be adjusted scientifically and without spoiling the reproduction, whereas with an ordinary gramophone the usual method is to close the doors in front of the horn, with the result that a muffled effect is produced, or employ different types of needle, but the flexibility obtained by electrical control is far beyond what can be attained with the mechanical gramophone.

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WIRELESS PICTURE TRANSMISSIONS.

The following is the current schedule of "Fultograph" broadcasts from British and Continental stations:—

MONDAY.

Daventry 5XX and London 2LO	12 midnight to 12.15 a.m
Berlin, 1,649 metres	12.45 p.m. to 1.15 p.m.
Vienna, 518 metres	2.15 p.m. to 2.45 p.m. and 2 pictures after evening programme.*

TUESDAY.

Daventry 5XX	2.0 p.m. to 2.25 p.m.
Berlin	9.45 p.m. to 10.15 p.m.
Vienna	2.15 p.m. to 2.45 p.m.

WEDNESDAY.

Daventry 5GB	11.15 p.m. to 11.45 p.m.
Berlin	12.45 p.m. to 1.15 p.m.
Vienna	2.15 p.m. to 2.45 p.m.

THURSDAY.

Daventry 5XX	2.0 p.m. to 2.25 p.m.
Berlin	12.45 p.m. to 1.15 p.m.
Vienna	2.15 p.m. to 2.45 p.m.

FRIDAY.

Daventry 5XX and London 2LO	12 midnight to 12.15 a.m.
Berlin	9.45 p.m. to 10.15 p.m.
Vienna	2.15 p.m. to 2.45 p.m.

SATURDAY.

Daventry 5GB	11.15 p.m. to 11.45 p.m.
Berlin	12.45 p.m. to 1.15 p.m.
Vienna	2.15 p.m. to 2.45 p.m.

SUNDAY.

Berlin	12.45 p.m. to 1.30 p.m.
Vienna	2.15 p.m. to 2.45 p.m.

* This is a nightly feature.

Transmissions from "Radio Paris" will commence shortly, but times are not yet available. Other Continental stations will be starting in the near future.

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.

LOUD-SPEAKER HISTORY.

Sir,—With reference to the subject of "The Cone Loud Speaker" in your issue of the 20th ult., and particularly with regard to the use of the term "Loud Speaker" and the reference to the use of large diaphragms.

Mr. Swinburne, F.R.S., is reported to have said that the term "Loud Speaker" only came into use after the introduction of the valve amplifier. Now I have in my possession a volume of the *Electrical Review*, No. 44, year 1899, in which there is a paper read by Sir Oliver Lodge, then Dr. Lodge, entitled "Improvements in Magnetic Phase Telegraphy." In these papers the term "Loud Speaker" is used, viz., on page 141, January 27th, 1899, will be found a reference to a diaphragm as follows: "III is the final telephone of the series, viz., an ordinary Western Electric loud speaker (2 ohms) in series with the transmitter M2." This proves the use of the term "Loud Speaker" to have been in use at least thirty years ago.

W. G. LEE.

Barnet, Herts.

5SW.

Sir,—As numbers of articles and comments have from time to time appeared in *The Wireless World* regarding the subject of 5SW, I do not propose to go to any great length in this letter propounding suggestions on this almost exhausted topic; but if these few words happen to catch the eye of a B.B.C. official, they might help him to realise the conditions under which residents overseas obtain reception of the station at Chelmsford.

The dinner-time programme is received here between 6 and 7 p.m., and, as daylight conditions are prevailing at the time, signals are not very strong, but exceptionally clear and distinct.

The programme broadcast in the evening is received between 1 a.m. and 5.30 a.m., when Big Ben strikes midnight, and one has to be very enthusiastic to wait up all night even if the prize is a really British concert.

Unfortunately, if the times of transmission were altered to enable the longer programme to be received in the evening in India and Australia, listeners in Canada would be receiving during the working hours of the morning, when the majority of people are at business.

The only remedy, which, of course, is highly improbable, would be to have a more or less continuous broadcast from 1 a.m. to 8 p.m. This would enable listeners in all parts of the world to receive a programme between the sensible hours of 6 p.m. and midnight.

After darkness has fallen 5SW comes in at a wonderful strength and clearness, and therefore it would be very gratifying if this station could become a permanent institution.

We are all well aware of the fact that gratitude will not pay for the transmitting plant, but when considering the total expenditure of the B.B.C., surely the cost of maintaining 5SW will not be so great?

C. EDMUNDSON.

Royal Air Force, Quetta, India.

STATION IDENTIFICATION.

Sir,—In spite of a few opinions to the contrary, some scheme for identification of European stations would be welcomed by a great many listeners.

To be effective a scheme must:—

(1) Follow some definite plan.

(2) Be intelligible to all nationalities.

(3) Be frequently repeated during the programme.

(4) Be simple.

The growing use of the metronome by Continental stations as an internal signal suggests a solution which is at once simple and of universal application. The beats of the metronome need only bear a definite relation to the wavelength or frequency of the station to enable anyone with a list of official wavelengths to determine the origin of the transmission.

I suggest that each station transmits during every interval in the programme a metronome, the beat of which is set to tick out in five minutes its official frequency in Kilohertz.

The choice of the Kilocycle or Kilohertz and the period of five minutes is, of course, quite arbitrary, but chosen for the following reasons:—

(1) The Brussels plan is based on frequency separation.

(2) The Broadcasting range covers roughly from 150-1,500 Kh. These figures when spread over five minutes give 30-300 per minute—beats which can be counted easily. (The faster beat fortunately coinciding with a greater frequency separation of the shorter wave stations.)

(3) Given the metronome signal for quite a small interval, say 15 seconds, the frequency of the transmission can be readily ascertained.

(4) The metronome tick is the least irritating interruption in an evening's programme; it would give some indication that the station was in operation during a long interval; the signal is independent of all language differences.

A. F. FERGUS.

Mitcham, Surrey.

STANDARD FREQUENCY.

Sir,—Referring to the correspondence in your columns with regard to standard frequency notes, it seems to me that those of your correspondents who advocate a gramophone record and pick-up are overlooking the fact that it is extremely improbable that the ordinary commercial pick-up has a constant response to all frequencies; so that, as the input could not be definitely said to be constant, I do not think any results obtained *via* amplifiers, etc., would be of very great use.

If, however, the B.B.C. were to transmit standard frequencies surely they have sufficient technical and financial resources to assure that the carrier would be modulated to the same extent at all their standards.

L. A. LAFONE (G6ZA).

Cobham, Surrey.

Sir,—I do not consider that your correspondents "S.S." and F. D. Harris, writing in your issue of February 27th, have realised sufficiently the fact that standard frequency records have little value in comparison with broadcasts as a means of obtaining an idea of the response curve of an amplifier and loud speaker. The gramophone would only be of value as a generator of low-frequency oscillations if the pick-up itself had a response curve as perfect as the studio microphone; and admittedly this is far from the case at present, even with the best obtainable.

R. W. GRIGSON.

S.W.11.

WHO'S WHO IN THE ETHER.

Answers to Queries.

G. K. (Pompey).—Yes, this was the Eiffel Tower. This station regularly relays the mid-day transmission from PTT Paris. **Wotwozit (Dover).**—Radio Toulouse, which, after working for some time on about 540 metres, is again working on its old wavelength of 382 metres. Interval signal: strokes on a bell. **H. W. (Crewe).**—Apparently Nauen (Germany) on 25 metres. Tests in long-distance telephony are carried out by this station. **P. A. H. (Finchley, N.).**—Are you sure of the date? We cannot trace any reference to the relay of the opera *Carmen* in any European programme on February 26. Your condenser reading would point to a wavelength below the broadcasting band. Could you send further details? **F. R. O. (Harwich).**—Yes, your identification of the language was correct, but this was *not* Motala, but *Lahti*. On Fridays only this station broadcasts a Swedish programme, and gives the call and announcements in that language, the former being: *Giv akt! Giv akt! Finlands Rundradio Lahti Helsinfors*; on others days the Finnish language is used, the call being: *Huomio! Huomio! Suomen Yleis-Radio Lahti Helsinki*. **There** is no special interval signal. **H. F. (Wimbledon).**—On Saturdays and Mondays *Radio Belgique* temporarily brings into operation its new high-power transmitter, hence the reason for your more powerful reception. **Interested (Plymouth).**—You give no estimate of WL, but this was definitely the Madrid (EAJ7) programme, received direct, or through a Spanish relay (not Cadiz, as you suggest, as this station has been closed down for the last six months).

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Television on Trial.—Line Disturbance on Atlantic Relays.—Keston's Move.

Intercepting Television Tests.

Although no details are vouchsafed as to the times of the experimental television transmissions by B.B.C. stations, listeners are reporting the reception of musical items and the associated sounds of picture analysis.

The Oxford Street and Marconi House transmitters are used simultaneously, the former working on its normal wavelength of 358 metres and providing the picture signals. Marconi House transmits the speech and music on 300 metres.

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No Secrecy.

The rhythm of the sounds conveying the pictures gives an audio-frequency note of about 40 cycles. Observations by the announcer indicate that these transmissions are addressed to all listeners, and less precaution is shown in revealing the nature of the tests than is adopted with the Fultograph transmissions, notwithstanding the fact that the latter are received by the hundreds of listeners possessing picture receiving sets.

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The Receiving End.

At least two Televisors are being used for receiving the tests. One is erected at the General Post Office, where several important personages, including more than one Cabinet Minister, are understood to have witnessed demonstrations. The other instrument is at Savoy Hill.

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The Hoover Relay.

Home-made "atmospherics," it seems, were partly responsible for the poor results obtained with the Presidential ceremony relay from America last week. Mr. Partridge, the "O.C." of the B.B.C.'s receiving station at Keston, tells me that he heard every word of the transmission. No listener to 2LO could say the same, which is rather surprising when we consider that Keston is linked to 2LO by private land line.

On the much longer Post Office line from London to Daventry there is practically no disturbance.

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Chelmsford and Keston.

I hear that the spaced-aerial system at Chelmsford was also used in an attempt to provide a suitable relay, but on this occasion Keston gave better signals.

A New Site.

By the way, the Keston station is to be moved to "more commodious premises." A higher site has been found in the same neighbourhood, and thither the B.B.C. folk will silently steal away in the course of the next few weeks. Whether this move portends big business in Transatlantic reception is doubtful. Its main object is to increase the sensitivity of the station for European reception.

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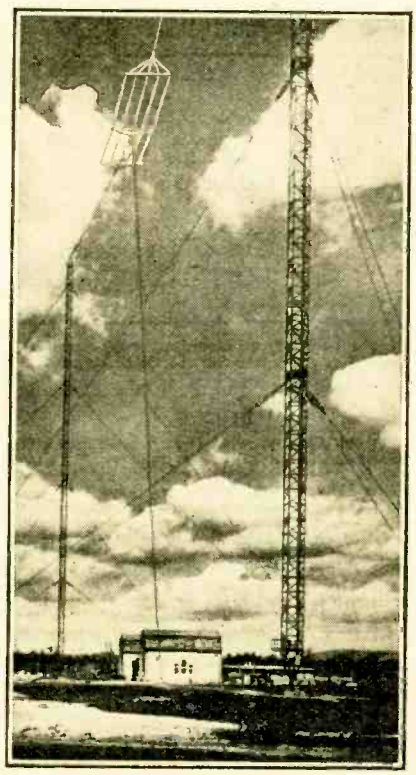
The Brussels Scheme Reviewed.

Apropos the Brussels wavelength scheme, the opinion at Keston after two months of constant checking is that the European ether is certainly more settled than before January 13th. However, the scheme is not accepted as a solution of the wavelength problem, and there is a growing feeling that some entirely new anti-interference method must be evolved.

The possibilities of single wavelength working by low-power stations sending the same programme are rousing special interest at the moment in view of the success obtained by Bournemouth and three of the relays.



"HALLO! HALL IT BUDA-PEST." The well-known Hungarian station, which is now working on 554.6 metres. The power is 20 kilowatts.

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More Picture Transmissions.

This week sees an extension in the time devoted to Fultograph transmissions from B.B.C. stations. The new time-table, which appears on another page, came into operation on Monday, March 11th.

The importance of the arrangement lies in the fact that reception facilities are now available at night as well as in the afternoon. The earlier arrangement was quite unsuited to many enthusiasts, who can afford to jilt the seductive pillow but not their means of livelihood.

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"Dance Plugging."

The B.B.C. has acted in a drastic manner in refusing to allow the titles of dances to be broadcast. It is difficult, however, to see what other means could have been adopted to check an evil which has been steadily growing for more than a year. Cases are known in which dance band conductors have been making £100 a week in "fees" received from parties interested in the boosting of new numbers.

The action of the B.B.C. has naturally aroused a good deal of opposition from certain quarters, but I gather that Savoy Hill intends to stick to its guns.

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Talks in America.

Listeners who still sigh for a reduction in the number of talks can take heart from the reflection that American "fans" are not exempt from the spoken word. In a programme survey just conducted by the National Broadcasting Company of America it is shown that out of 510 broadcasts from New York during January 212 consisted of lectures. In addition there were twenty-eight plays and sketches, and ninety-three news announcements.

READERS' PROBLEMS ANSWERED

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

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

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

Frame Aerial Dimensions.

In order to obtain maximum selectivity I propose to use a frame aerial, and to concentrate my efforts on the long wavelengths — medium waves are seldom well received here on account of interference. Will you tell me the best dimensions for the frame?
S. T. W.

Broadly speaking, a frame aerial, particularly for the long wavelengths, can hardly be too large, as the efficiency of this form of collector is proportional to its area. This is a matter for compromise, and you should use the largest frame that you can comfortably accommodate.

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The Old Problem.

In the interests of better quality reproduction I am thinking of changing my second L.F. coupling from transformer to resistance. The transformer is an old one, hence the change. Do you think that it is likely to result in any very serious falling-off in volume? W. R. T.

As a general rule it may be stated definitely that resistance coupling gives much less magnification than the other method; unless your transformer is a very indifferent one there will be an audible falling-off in volume if you make the conversion. You yourself are in the best position to know whether this can be tolerated.

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Grid Bias from the Mains.

I am thinking of modifying my existing set so that it may be fed entirely from the A.C. supply, which has recently been installed here. Do you recommend me to attempt to obtain grid-bias from the same source? It seems that this method is not very popular. J. M.

Except in comparatively rare cases, where an output valve requiring a very large bias voltage is used, we do not generally recommend that an attempt should be made to obtain grid voltages from an eliminator. The advantages likely to accrue from this arrangement are hardly sufficient to offset the fact that its inclusion is likely to increase risk of trouble, and is certain to add to the total cost. Grid-bias batteries are cheap and have a long life, due to the fact that current is not normally taken from them.

Pick-up Connections.

I have fitted a pick-up to my "A.C.3" in the manner shown in the attached circuit diagram, from which you will see that it is inserted in the grid circuit of the detector valve. Unfortunately results are very poor; gramophone reproduction is both weak and distorted. Are the connections correct? C. S. A.

No; the pick-up is, in effect, connected across the large by-pass condenser C_4, and is in series with the grid decoupling resistance. Your circuit diagram is reproduced in Fig. 1; the correct position for the pick-up is marked X.

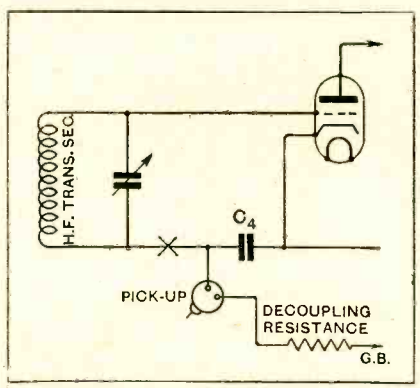

Fig. 1. — A short-circuited pick-up: it should be moved to the position marked X.

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.

High-resistance Connections.

(Referring to a reply to a previous query). . . . *You suggest that my trouble may be due to leakage or to a high-resistance joint in one of the grid circuits; I know how to test for faulty insulation with a pair of phones and a dry cell, but am vague as to the procedure to be adopted in locating faulty joints. Is there a simple method?* A. M.

Without measuring apparatus it is rather difficult to locate high-resistance joints (of a few ohms); we fancy you will find it easier to examine all those in the circuits concerned, re-soldering or cleaning those not above suspicion. Should you prefer a definite test, we suggest that you should obtain an ammeter reading up to 1 or 2 amps. (an inexpensive instrument will do); this should be connected in series with an L.T. accumulator battery of 4 or 6 volts and a rheostat of 5 or 6 ohms, which should be adjusted so that the meter shows a convenient round figure—say, 1 amp. Now break the circuit and complete it through the joint under suspicion; if the current reading is not appreciably decreased you may safely assume that the resistance under test is negligible.

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New Empire Receiver.

The reaction adjustment of my "New Empire Receiver," built exactly to the instructions published in your issue of December 26th, 1928, is giving me a good deal of trouble. In an ordinary receiver sensitivity increases as the interleaving of the control condenser vanes is increased; with this set reaction seems to be at maximum when the condenser vanes are "all out." Does this mean that my coils are incorrectly wound? T. A.

No; this set makes use of the so-called "throttle control" reaction system, in which the impedance of the anode circuit —and consequently the amount of energy passed back to the grid through the feed condenser—is increased as the reaction condenser capacity is decreased. Consequently the usual method of operation is reversed, and, to increase sensitivity, the reaction control knob is rotated in an anti-clockwise direction. When you realise this we think your difficulties will disappear.

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CONTENTS OF THIS ISSUE.

SUPPRESSING PERSONALITY.

ACCORDING to recent reports the B.B.C. has decided that in all future dramatic performances before the microphone the names of the actors are to be suppressed, being omitted both from the microphone announcements and also from the published details of the programmes. An explanation given for introducing this change in policy is that it is to ensure that the performance itself shall count with the audience and not the personality of individual performers.

There is much that is commendable in adopting this policy, and on a previous occasion we expressed our approval of the attitude of the B.B.C. when it was decided to suppress the identity of announcers, and uncles and aunts of the Children's Hour. But to deprive the individual of the advantages of personal publicity is an action which only the B.B.C. monopolistic position makes possible. It at once kills the advertising advantage to performers which the microphone has hitherto given, and we believe that many performers have been ready to offer their services to the B.B.C. at a purely nominal fee because they recognised the publicity value to themselves of microphone performances.

The decision of the B.B.C. is a very bold one indeed, and if the policy is to be maintained it seems to us that either the B.B.C. must be prepared to pay very much higher fees to performers than in the past, or else be satisfied to employ talent of a standard which will regard the present scales of remuneration as sufficiently generous.

Another Explanation.

There may be, in the action of the B.B.C., intentions a little more subtle than those which are disclosed as the reasons for the step that has been taken. We foresee that so long as the B.B.C. is continually seeking new talent for microphone performances, they may find that, having discovered an artist of outstanding ability, the publicity which the association of his name with his microphone performances would give him might quickly result in the B.B.C. losing him to a higher bidder in some other section of the entertainment industry. Having found exceptional talent, the B.B.C. would naturally like to retain it for their own performances, and one of the surest means of doing so is to withhold the identity of the performer.

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THE NEW MERGER.

THE recent announcement that His Master's Voice Gramophone Company has acquired the Marconiphone Company is an item of news of considerable interest to the world of wireless.

This association marks a very definite step in the progress of the fusion of interests of wireless and the gramophone. It may be recollected that when broadcasting started there was a very general impression created that the development of listening-in would mean disaster to the interests of the gramophone, but as time went on it became apparent that, instead of being rivals, the one was complementary to the other, and that as the interest in broadcasting grew and provided the means of widening the interests in music, so the demand for gramophone reproduction was extended.

Now that the electrical gramophone is setting a standard of reproduction so that it is likely to supersede the mechanical instrument generally, there is another bond between the two industries. Nor should we overlook that electrical methods are now employed universally for gramophone recording, all the problems of which are closely allied to the everyday problems met with by the radio engineer.

Choosing a POWER VALVE for the REED DRIVEN LOUD SPEAKER

An Analysis of Impedance Relationship.

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

THE power valve to be used in conjunction with a loud speaker sometimes introduces difficulties to the experimenter. One always has a subconscious feeling that the power valve and speaker impedance should be matched, so that the condition for maximum power is secured. This condition can only be satisfied at one particular frequency, since the impedance of the loud speaker increases with the frequency, i.e., it is inconstant. The real issue is to get the best possible result from the loud speaker, i.e., the response of the loud speaker at any point in the room should be as constant as possible over the required audio frequency range, as shown in Fig. 1. Of course, an accurate definition of " response " is a highly complicated issue, owing to the idiosyncrasies of the situation. First of all there is the focusing of the higher frequencies due to the wavelength of sound being small compared with the dimensions of the diaphragm.[1] This is further complicated by the fact that the diaphragm does not move as a whole. Then there is an added complication due to the *velocity of propagation of energy down the diaphragm being less than that of sound in air*. Lastly, we have the standing wave effect of the room or enclosure where the loud speaker is operated. (See " Loud Speakers," Chap. VII.)

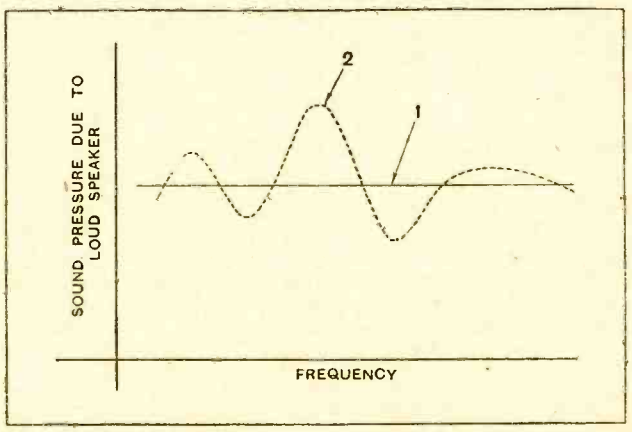

Fig. 1.—Hypothetical diagram showing response curves of ideal loud speaker; (1) in a perfectly damped room, (2) in an ordinary room where standing waves occur.

By aid of these conditions there occurs in the space surrounding the loud speaker a complex interference pattern corresponding to, say, 1,000 cycles, i.e., the intensity varies according to one's position in the room. Each frequency will have its own pattern. Suppose a microphone were situated on the axis of an ideal loud speaker at a distance of 5 metres, the response or air pressure due to the sound at various frequencies would in all probability be a curve with hills and hollows as indicated by the dotted line of Fig. 1. This is due to interference caused by reflection of the sound from the walls of the room. Owing to the additional complications already cited, the curve for an actual loud speaker would be more complex. It is for this reason that response curves must be interpreted with great caution. One might imagine that a sudden rise in the curve would indicate a resonance, whereas in reality it might be due to an interference effect. Moreover, in what follows we shall assume for the purpose of discussion that the response curve is a mean curve taken when the calibration apparatus is situated at different points in an average room at a distance of 5 metres from the diaphragm.

To secure satisfactory results under the preceding condition with a moving coil loud speaker, the current must be approximately constant over the audio frequency range. In a *reed-driven* loud speaker the electrical and acoustic conditions are quite different. It can be shown in connection with the new Amplion reed-driven loud speaker that as the resonance frequency of the reed is approached the sensitivity of the reed is offset by the breaking up of the diaphragm which results in a reduction in the effective area. But this in itself is insufficient to give a good response characteristic. To approximate to the desired result it is imperative that *the current at the lower frequencies shall be appreciably greater than that at the higher frequencies*. This object can be achieved by means of a power valve of suitable internal resistance.

The first step is to show the variation in the impedance of the speaker with the frequency. By bridge measurements it is possible to obtain the reactance and

[1] *The Wireless World*, March 23rd and September 21st, 1927.

Choosing a Power Valve for the Reed Driven Loud Speaker.—the effective resistance of the loud speaker at various frequencies. Curves showing these quantities for the reed-driven loud speaker already mentioned are given in Figs. 2 and 3. The reactance and effective resistance both increase with the frequency. The reactance is $2\pi fL$, where f is the frequency and L is the inductance at the frequency in question. The value of L when the speaker is in action varies with the frequency in a manner we need not discuss here. The general tendency is for the inductance to decrease with rise in frequency due to the effect of eddy currents in reducing the effective permeability of the iron. Some idea of the magnitude of the inductance variation can be gained from the data of Table I. The effective resistance increases with frequency due to hysteresis and eddy current losses, which always occur when the magnetic circuit contains iron. The resistance due to the iron alone is indicated in Fig. 3, where the D.C. resistance of the winding has been subtracted from the total resistance of the speaker. Having set forth the reactance and resistance of the loud speaker at various frequencies, we are now in a position to ascertain the total circuital impedance when a valve is included with the speaker. In Fig. 4 is given a diagram by aid of which the total circuital impedance can be computed. BC is the effective resistance of the speaker, CD is the internal alternating current resistance of the valve, whilst AB is the reactance which is drawn at 90° to the resistance. The total impedance to scale is the length AD. The latter can be found either by drawing or by calculation. Its value, at various frequencies, for power valves having resistances of 3,000, 5,000, and 40,000 ohms, is given in Fig. 5.

TABLE I.

Frequency. Cycles per sec.	Inductance. Henrys.
250	0.67
500	0.63
1000	0.58
2000	0.52
2500	0.5

Table showing inductance of Amplion Lion reed-driven loud speaker at various frequencies with diaphragm in action.

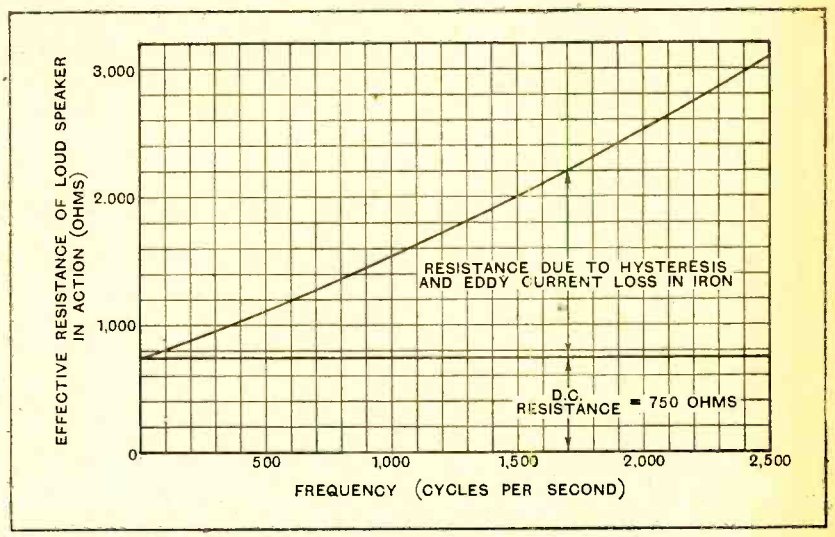

Fig. 3.—Curve showing effective resistance of the Lion loud speaker at various frequencies.

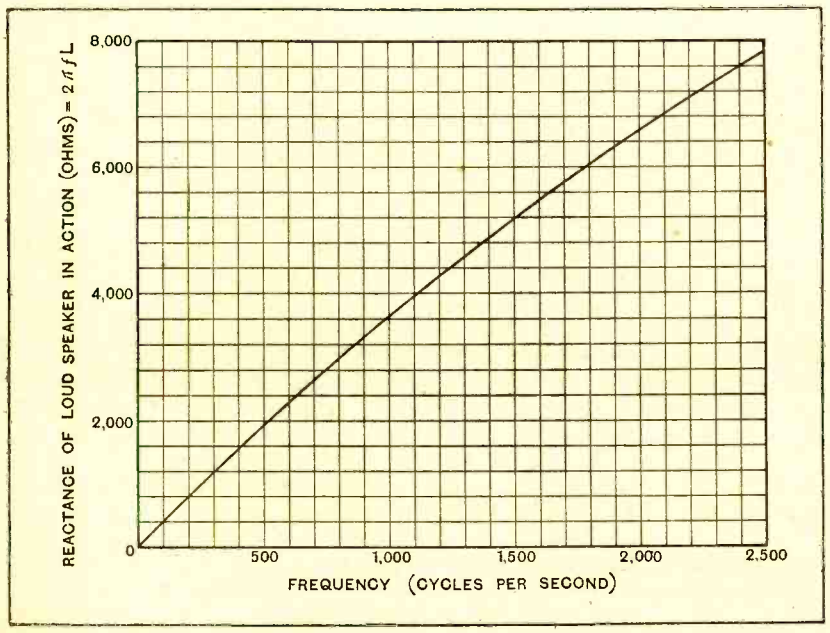

Fig. 2.—Curve showing reactance ($2\pi fL$) of Lion loud speaker at various frequencies.

The Current through the Loud Speaker.

In Fig. 7 we have the familiar equivalent circuit of the power valve, including the loud speaker. The current through the complete circuit, including the loud speaker, is found from the formula, root mean square Current = Voltage/Impedance, or $I = \frac{mVg}{Z}$

In this case Vg is the root mean square voltage variation at the grid of the power valve of magnification factor m, whilst Z is the impedance as shown in Fig. 5. Taking Vg = 10 volts (r.m.s.) and assuming for simplicity that $m = 1$ for all three valves, we get I r.m.s. $= \frac{10}{Z}$.

If, therefore, we divide 10 by the values of Z from Fig. 5, we obtain the current through the loud speaker when used with each of the three valves. In Fig. 6, for the sake of comparison, the currents at 3,000 cycles have been made equal to that with the 3,000 ohms valve, so that the variation in current

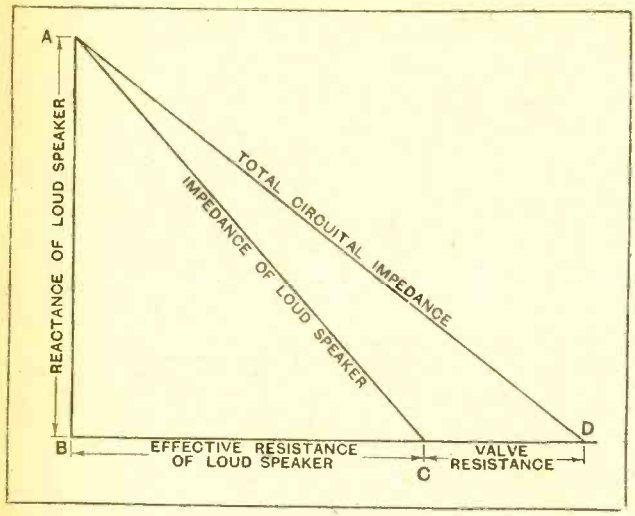

Fig. 4.—Vector diagram illustrating method of obtaining total circuital impedance of valve and loud speaker.

at low frequencies can be visualised more readily. It will be understood that these data are merely comparative for the sake of illustration.

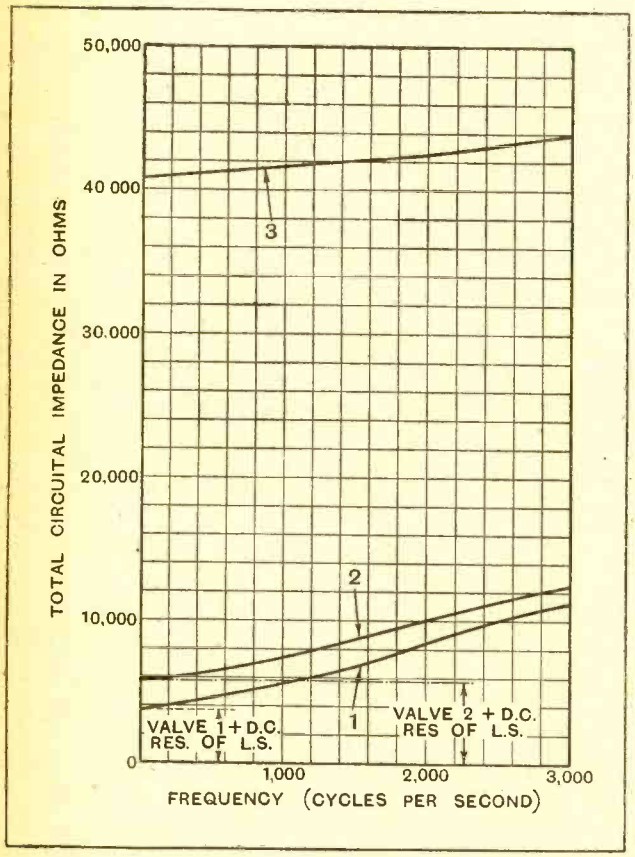

Fig. 5.—Curves showing total circuital impedance of valve and loud speaker. Curve (1) is for a valve whose internal resistance is 3,000 ohms. In curve (2) the valve resistance is 5,000 ohms, whilst in curve (3) the valve resistance is 40,000 ohms. By aid of the data in this diagram it is possible to calculate the current in the loud speaker at various frequencies.

It will be obvious from Fig. 6 that the lower th e-sistance of the power valve the greater the curre at low frequencies. Moreover for a reed-driven sp ker the internal A.C. resistance of the valve shou not exceed about 3,000 ohms in order that the lc fre-quency register from 250 cycles downwards sh not be appreciably attenuated. By putting two 3,c ohm valves in parallel the low frequencies can be i eased still more. From Fig. 6 it can be deduced at the sound energy radiated at 150 cycles with a 3 ohm

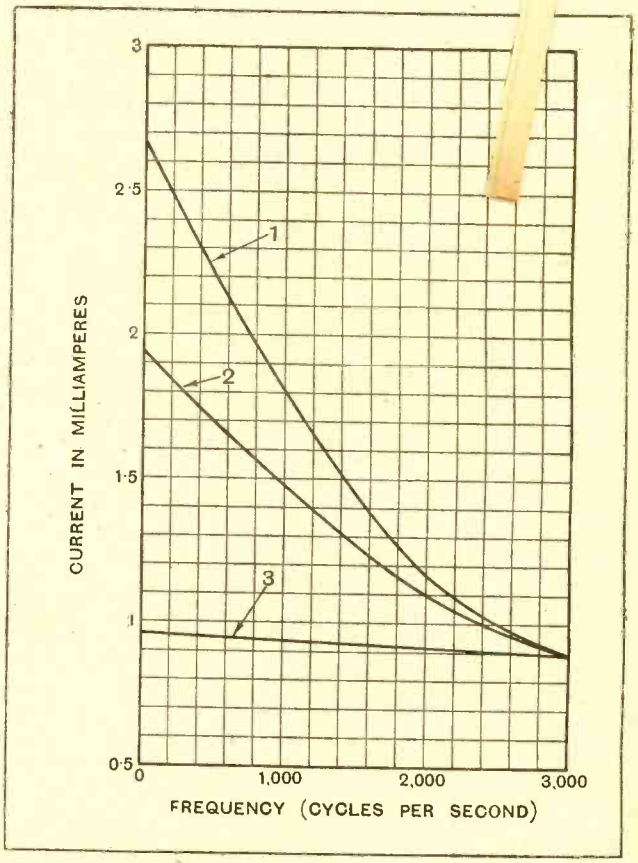

Fig. 6.—Curves showing current in the Lion loud speaker at various frequencies. Curve 1 = internal valve resistance = 3,000 ohms. Curve 2 = internal valve resistance = 5,000 ohms. Curve 3 = internal valve resistance = 40,000 ohms. It should be observed that there is practically no variation in current with the pentode (curve 3).

valve is 1.8 times that with a 5,000 ohm valve, and 7 times that with a 40,000 ohm valve (when the currents are equal at 3,000 cycles).

The Output Valve and the *Megavox* Receiver.

Finally, it is of interest to indicate a modification to the *Megavox* receiver when *using a reed-driven speaker*. The pentode should not be used as a pentode—this must be clear from what precedes.[2] The P.M.254, or the Marconi or Osram P.425, are suitable valves, which should be used in place of the pentode. The grid bias on the power valve must be increased from −9 to

[2] See also *The Wireless World*, October 31st, 1928.

Choosing a Power Valve for the Reed Driven Loud Speaker.—about −15 or −18, according to the H.T. voltage used. Personally, in the last stage of the *Megavox* I have two valve holders in parallel so that two valves can be used to lower the resistance if desired. I find, however, that one P.M.254 is quite suitable for moderate intensities. In *The Wireless World*, July 11th, 1928, I gave the characteristic curves of the pentode used as a triode, when the screen grid and anode are connected together. The internal resistance of the valve was then about $\frac{1}{10}$th its value as a pentode. This artifice can be adopted by those who have no P.M.254 or other suitable triode. The valve resistance of the average pentode used as a triode is just on the high side, but the results with a reed-drive loud speaker are a vast improvement on those obtained from it in the orthodox way.

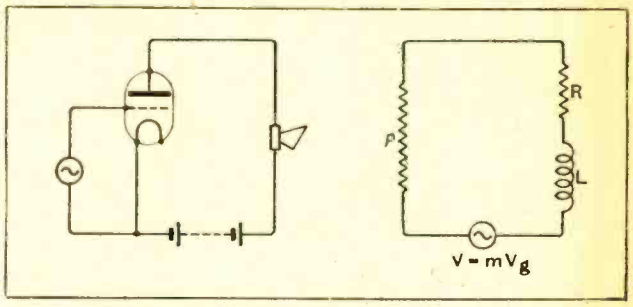

Fig. 7.—Diagram showing equivalent circuit of valve and loud speaker. V is the voltage of the fictitious alternator; ρ the internal A.C. valve resistance; R the effective resistance of loud speaker and L the effective inductance of the loud speaker.

SWINGS AND ROUNDABOUTS.

Insensitive Loud Speakers and False Economy.

IN designing the output stage of a receiver it is primarily necessary to make provision for whatever volume of undistorted signals may be required. Usually the output stage is designed without reference to the particular type of loud speaker that is to be used with it; it is the purpose of this note to draw attention to the very close relationship between the two, in particular in the matter of expense.

The point that it is desired to make is concerned with the very different degrees of sensitivity that are exhibited by different types and makes of loud speakers. Generally speaking, instruments of the horn type are more sensitive than those which employ cones, and therefore require for their adequate operation a less ambitious output stage in the set. But even if we restrict ourselves to speakers of one general type, we shall find that some give very much more sound in return for a given electrical input than do others; and, as might be expected, it is usually found that the more expensive models are the more efficient. In consequence, if we elect to economise over the purchase of a loud speaker, it is almost certain that we shall be compelled to spend more, both in first cost and in upkeep, upon the valve and anode-current supply for the output stage of the receiver than if we had expended a greater sum upon the loud speaker in the first place, and by so doing had acquired a more efficient instrument.

Poor Loud Speakers may Require Heavy Anode Current.

The writer has in mind, as a glaring example of this, a comparison that he once had occasion to make between two horn speakers. One was a five-guinea instrument by a famous firm, the other a gramophone attachment marketed at less than fifteen shillings. For test, both bases were used in succession on the same horn. The expensive instrument gave as great a volume of sound as could be required when operated by an ordinary "super-power" valve with 120 volts high tension; with a similar input the cheap attachment gave only a whisper. To bring the volume up to the original standard, an L.S.5A valve, with 300 volts high tension, had to be used with it. In this case the attempt to save four pounds ten shillings made it necessary to spend about an extra ten pounds or so on the output stage, and to face, in addition, very largely increased running costs.

If the user had been prepared to accept a smaller standard of volume than is here implied, the difference between the costs of the output stages for the two speakers would naturally have been less. For example, the cheap instrument would have required a "super-power" valve and 120 volts high tension to produce the volume that could have been given by the expensive instrument when operated by a small-power valve on 60 volts, but in any case the purchase of the cheap speaker would amount, in reality, to an extravagance rather than an economy.

The particular case instanced here is perhaps an extreme one, but it may serve as a reminder of the fact that it is more expensive to use high-power valves and high anode voltages in the receiver than to equip oneself with a sensitive speaker that will operate on a smaller input. In terms of moving-coil loud speakers, it is not necessarily most economical to choose the model that uses the smallest field current; it *may* need an extra hundred volts on the H.T. supply! We are, in fact, up against a case where we may expect to lose on the swings what we gain on the roundabouts. A. L. M. S.

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WHO'S WHO IN THE ETHER.

Answers to Queries.

F. M. (Hammersmith).—FTT Marseilles relaying dance music from the Coliseum at Paris. This transmission is taken by most FTT stations every Sunday, Wednesday, and Saturday. **S. R. (Brighton).**—Moscow Komintern (RDW). Special news bulletin given at midnight (10 p.m. G.M.T.); it is read slowly in order to allow of transcription. **H. E. P. (Muswell Hill).**—Prague, news bulletin followed by a relay of orchestral concert from the Hotel Rosenbreier at Brunn. The native name of the former city is *Praha*, hence the call "Radiopraha." **Wireless Mad (Chiswick).**—There are so many stations on the short waves that it is very difficult to tell; quite possibly 3LO (Melbourne), which works from 7-8 p.m. G.M.T. on Sundays, but cannot confirm as your estimate of WL is too indefinite. **R. H. M. (Poole, Dorset).**—No, not an amateur; this was 7LO Nairobi, Kenya Colony, which works daily from 4 to 7 p.m. G.M.T. on 31 and 400 metres. **BM/MB5P (Fallowfield, Manchester).**—Posen, relaying a concert of light music from the Café Wielko Polanka. This is the only station on a wavelength between London and Gleiwitz with which programme your details would tally. **N. R. B. (Kingston).**—(1) Kalundborg relaying Daventry 5GB. This station frequently relays foreign stations at the end of the evening programme, but this is not always advertised. (2) The same station; physical exercises daily (except Sundays) at 6.30 p.m. G.M.T. **T. E. B. (Walsall).**—Cologne. Gramophone records are given every morning at 9.15 a.m. G.M.T.

BROADCAST RECEIVERS

A Short-wave Receiver with Screened-grid H.F. Amplification.

THE Empire Screened Four has been developed in response to numerous enquiries from overseas, and is really a special edition of the Burndept Screened Four, which was designed for European reception and includes coils for long-wave as well as medium-wave broadcasting. Outside Europe, however, the long waves are of little interest as the majority of broadcast stations overseas are confined to the 200-500-metre band. In the " Empire " receiver, the long-wave coils are omitted, and their place is taken by ultra-short-wave coils covering a wave-band of 20-48 metres. The Colonial listener will therefore be able to keep in touch with the home country through 5SW, and will also be able to receive his local station on the 200-500-metre band should the latter exist. Conversely, the listener in this country will be able to pick up Australian, South African, and American broadcasting, in addition to the B.B.C. programmes. True, he will have to forgo 5XX, but the sensitivity of the set on the 200-500 band is sufficient to give several alternative programmes.

Interesting Circuit Arrangement.

On examining the set for the first time, one cannot fail to be impressed by the robust simplicity of the design. The controls are well placed, and while being simple to operate give a wide range of adjustments so that the performance of the set can be modified to extract the most from any given set of receiving conditions. Accessibility has been carefully considered; the valves, grid bias battery, and filament resistors can all be exchanged without the necessity of opening up the interior of the set. The screened grid valve is situated in a well at the top of the set, where it is readily accessible, and at the same time is in an ideal position in relation to the screening compartments inside the set.

The circuit consists essentially of a screened grid H.F. stage followed by a leaky grid detector with reaction and two L.F. stages, the first being resistance-capacity coupled and the second transformer-coupled. The circuit includes many interesting refinements, and it is worth while to examine it in some detail, working through from the aerial to the loud speaker.

The aerial circuit is built as a self-contained unit, and has for its base a rotary selector switch giving three degrees of selectivity on each wavelength range. When the switch is moved over from the group of contacts on the right controlling the medium waves to those on the left, a cam on the switch spindle closes an additional pair of contacts which short-circuit the medium-wave coil, leaving only the short-wave coil in circuit. On short waves perfect electrical contact is essential to selectivity, and for this reason a special system of contacts has been developed. The switch arm consists of a clip which securely grips both sides of the contact pegs, the pegs being mounted radially on the flanged base. On the 220-560-metre band the switch varies the aerial tapping point on the tuned grid coil, the minimum selectivity and maximum signal strength being obtained when the whole of the coil is included in the aerial circuit. On short waves not more than a quarter of the grid circuit turns are included in the aerial circuit, even in the position for maximum signal strength, and in order to improve selectivity the remaining contacts are used to introduce small capacities in series with the aerial. The contact giving maximum selectivity is entirely isolated, and the minute capacity to the adjacent contact is the only medium through which signals are transferred from the aerial to the tuning circuit. This capacity does not amount to more than one or two micro-microfarads, yet it is sufficient to pass the ultra-high frequencies covered by the 20-48-metre band. The knob operating the selector switch is on the extreme left of the sloping front panel.

The aerial coils are mounted on the switch base with their axes at right angles, and their position is clearly shown in one of the photographs. The short-wave coil

Broadcast Receivers.—

is interesting on account of its small diameter, which gives a good ratio of winding length to diameter and also tends to keep the field associated with the coil within small dimensions. Tinned copper wire is used, and the turns are located in a thread cut in the ebonite former.

The dimensions of the tuned anode coils are essentially the same, but in this case the windings are centre-tapped, the +H.T. feed being connected to the centre of each coil. The top of each coil is connected through the reaction condenser with the anode of the detector valve, the bottom of the coil going, of course, to the anode of the screened grid H.F. valve. A change-over switch, the knob of which is on the extreme right of the panel, connects in circuit the appropriate coil for long or short waves and at the same time disconnects the coil not in use. The same switch carries contacts for L.T., and both H.T. leads, which are disconnected when the switch is in the intermediate position.

The Method of Controlling Volume.

It is interesting to note that the screened grid is supplied with the requisite potential through a series resistance from the H.T. battery. This method is quite satisfactory where it is required to drop a comparatively small voltage, and in the Burndept set a separate H.T. tapping of lower voltage is provided for the first three valves. The potential of the screen will, however, depend on the screen current, which may vary with different valves. It will also depend on the anode current, which is closely linked up with the screen current. A filament resistance for the screened grid valve is used as a volume control, and this will affect the anode current so that the volume control is really a combination of the effect of the reduced emission from the filament and the change in screened grid volts.

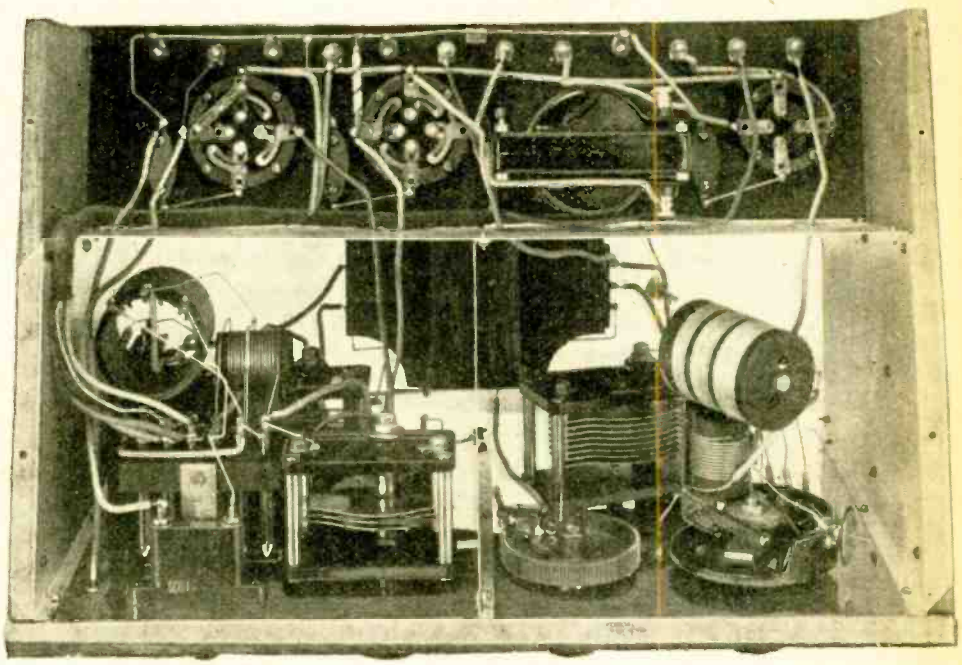
The aerial and tuned anode circuits are segregated into separate screening boxes as shown in the view of the underside of the set. The screened grid valve, which is of the double-ended variety, is bridged across the two compartments, the dividing partition coinciding with the screened grid.

The low-frequency portion of the circuit follows conventional practice. The detector, which operates on the leaky grid principle and therefore draws an appreciable anode current, is coupled to the first L.F. valve through the medium of a heavy duty, wire-wound anode resistance, and a Ferranti A.F.3 transformer is used to couple the L.F. valve to the output valve. The loud speaker terminals are connected directly in the anode circuit of the last valve, so that if one of the new super-power valves is used it may be desirable to connect a transformer or filter circuit externally to divert the steady anode current from the loud speaker windings.

The arrangements for providing grid bias are interesting. A separate grid battery, housed in a special compartment at the back of the set, is provided for the power output valve, the remaining valves derive their bias from the filament circuit through the fall in potential across fixed resistors in series with the filament of each valve. These resistors are of the well-known Burndept screw-in type, and are interchangeable.

In spite of the fact that there are three tuning controls (including reaction) the set is no more difficult to tune on short waves than a conventional reacting detector circuit. The right-hand tuning dial is calibrated directly in metres, and this was found to be an invaluable aid in searching for any given station. A compensating condenser is fitted in the well at the top of the set near the screened valve for the purpose of adjusting the tuning condenser to the scale, but it is unnecessary to touch this unless the set has been dismantled for any reason, as each set is properly adjusted at the works before dispatch.

One of the secrets of effective tuning on short waves is to work with the absolute minimum of reaction when searching for a station so that the set oscillates only over a very narrow band of wavelengths when the two circuits are brought into resonance. If too much reaction is used it is difficult, if not impossible, to tell when the two circuits are in tune. Having found the carrier wave of the station with the set oscillating



Interior view with base removed, showing screening compartments and tuner units.

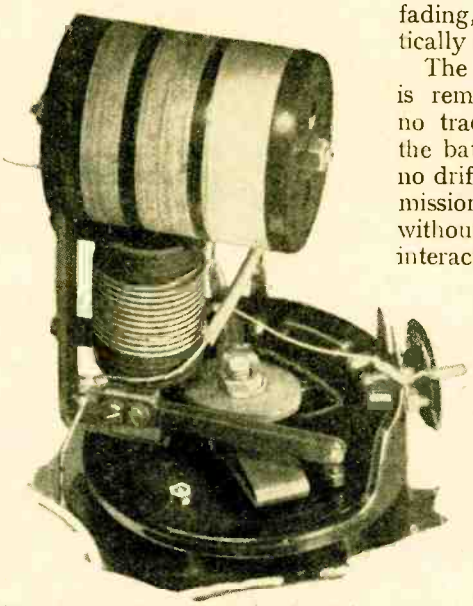
Broadcast Receivers.—

(radiation is negligible as the H.F. valve acts as an effective buffer between the detector and the aerial) the reaction should be backed off until oscillation just ceases. As the reaction knob is small this is a somewhat delicate operation, and in our opinion a graduated dial would be a useful adjunct to the reaction control.

A very fruitful source of annoyance in short-wave sets is the prevalence of "blind spots" in the tuning range—places where more than the normal degree of reaction has to be used to bring the set up to the oscillation point. In the Burndept set there is absolutely no trace of this trouble, and the set behaves just as logically on short waves as on the medium band.

The performance on the normal broadcast wavelengths is good. Position 2 on the selector switch is best for general reception, and gives adequate selectivity for all normal purposes. When the set is installed near to a powerful transmitter it may be necessary to use the No. 3 position, but this considerably reduces signal strength, and the maximum permissible reaction must be used to maintain range. However, at $1\frac{3}{4}$ miles from 2LO the No. 2 position was found to be satisfactory, and good signals were received from several Continental stations in addition to 5GB.

On short waves, also, the No. 2 position was found to be best both from the point of view of signal strength and ease of control. On March 3rd, Melbourne (Australia) was received at good loud speaker strength. Short-period fading was present for part of the time, but some pianoforte solos came through clearly, and the announcer's "Melbourne Station now closing down. Good morning everybody," and the chimes of 6 a.m. (Australian time) were easily distinguished. On March 5th Schenectady (2XAF) was received during the reading of market prices. The signals were not quite as loud as those from Melbourne, but there was no fading, and the sound level remained practically constant.



Close-up view of aerial tuner and selector switch.

The stability of the set on short waves is remarkably good. There is absolutely no trace of hand capacity, and provided the batteries are in good condition there is no drift in the tuning; the Melbourne transmission was held for over half an hour without touching the controls. There is no interaction between the aerial and the loud speaker leads; it so happens that the "Aerial" and "L.S." terminals are adjacent on the terminal panel, an arrangement which would immediately show up the presence of H.F. in the loud speaker leads.

The set as a whole reflects great credit on the development department of the Burndept works. The disposition of the parts has been well thought out, the workmanship is clean, and the wiring extremely neat.

In conclusion a word of praise is due to the instruction booklet, which not only gives full details of the circuit and many useful hints on tuning, but also contains a special section at the end for the information of service engineers abroad.

The price of the Empire Screened Four is £25, exclusive of royalty, valves and batteries. The valves and additional equipment for "super-power" operation cost about £17 10s., but a cheaper equipment is available for those who do not require superlative loud speaker reproduction.

Club News.

Classes for Beginners.

The path of the wireless tyro is a smooth one nowadays, elementary instructions being obtainable from books specially written to suit his needs. Many students, however, find that work in class is the surest means of attaining knowledge. Wireless classes for beginners are now being held each Friday at 7.30 p.m. at the John Woolman Institute, 28, Duncan Terrace, Islington, N., and at the same time on Wednesdays at the Putney Secondary School, corner of West Hill and Upper Richmond Road, Putney, S.W.18. The membership fee for each of these classes up to June 30th next is 4s., and application should be made at the addresses given.

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A.B.C. of the "S.G."

An illustrated lecture on the Screened-grid Valve was recently given before the Bec (Streatham) Radio Society by Messrs. Youle and Godfrey, of the Marconiphone Co., Ltd. The function of the screened-grid valve was clearly explained by means of lantern slides in which the various circuits were distinguished by different colouring. The evening concluded with a striking demonstration of the Marconiphone Moving-coil Loud Speaker and the Marconiphone 44 receiver, which includes two stages of screened-grid H.F.

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

Gramophone Reproduction Demonstrated.

A special selection of gramophone records, each one presenting a particular problem in electrical reproduction, was demonstrated by Mr. R. A. Simmonds at a recent meeting of the South Croydon and District Radio Society. The enthusiasm aroused among members showed to what extent the electrical reproduction of gramophone records is interesting the wireless amateur.

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

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Public Fultograph Demonstration.

Daily demonstrations, extending over a week, of the reception of Fultograph pictures were recently given by the Northampton and District Amateur Radio Society, and it is estimated that more than 600 visitors witnessed picture reception for the first time. The receiver used was a B.T.H. Screened Valve Five, which also operated a moving-coil loud speaker. The demonstrations were carried out by Messrs. Turner Bros., of 6, Kingsley Park Terrace, Northampton.

All Mains Receivers.

Members of the Wimbledon Radio and Gramophone Society recently profited by a demonstration given by Mr. Richardson, of Messrs. Philips Lamps, Ltd., of the Company's new two- and three-valve "all mains" receivers. Excellent results were obtained both on broadcasting and, by means of the Philips electrical pick-up, on gramophone records. Much interest was shown in the lecturer's description of the constructional difficulties encountered in compressing such efficient receivers into so small a compass.

The Society's programme for the next few weeks is highly attractive. New members are cordially invited, and full particulars may be obtained from the Hon. Secretary, Mr. P. G. West, 11, Montana Road, S.W.20.

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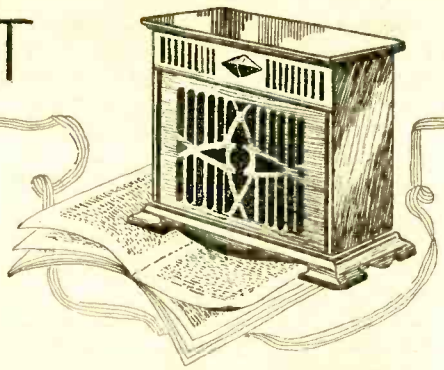
Oil Companies' Radio Society.

A wireless club for the benefit of employees of the Shell Group of oil companies has recently been formed under the title of the Lensbury Radio Society. The president is Lt.-Gen. Sir George M. W. Macdonogh, G.B.E. Through the generosity of the directors, a room at headquarters has been placed at the disposal of the members, and this has been fitted up as an experimental workshop and clubroom with tools, testing apparatus and a library.

Hon Secretary, Mr. D. Wilkes, Norman House, Strand, W.C.2.

CURRENT TOPICS



Notes of the Week

PICTURES FROM PARIS.

On Wednesday last *Radio Paris* took delivery of a "Fultograph" transmitter, and the first picture tests are expected in a few days' time. The number of picture receivers in the hands of the French public is at present very small. The instruments are to be known on the French market as *Spherographs*.

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AIR MINISTRY TESTS THE "FULTOGRAPH."

An important development in wireless picture transmission is foreshadowed by news that experiments with Fultograph instruments are now being conducted at the Air Ministry's station at Cardington, Norfolk. In an interview, an official of Wireless Pictures, Ltd. stated that the transmissions consist of weather maps, and that these have been successfully received at a number of places in the south of England.

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WIRELESS AT CRAIGWEIL HOUSE.

During his convalescence at Bognor the King has become an enthusiastic listener. His Majesty uses a four-valve set, which is necessarily very selective in order to cut out Morse interference from the Channel and jamming from the Paris broadcasting stations. The set is generally tuned to 5XX.

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A FULTOGRAPH FILM.

The whole procedure of picture transmission and reception by the Fultograph process has been filmed by First National Pathé, Ltd., and we understand that the picture can be seen this week at many cinemas incorporated in the Pathé Pictorial.

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A BROADCASTING PATRIARCH.

Mr. David Sarnoff, vice-president of the Radio Corporation of America, who has just paid a visit to this country, claims to be the "father" of broadcasting. He conceived the idea of a central telephony station disseminating news and entertainment in 1914, embodying his proposals in a memorandum to his company. The war postponed practical developments until 1921.

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BROADCAST ADVERTISEMENTS IN INDIA.

Faced with the necessity of obtaining funds to improve the programmes, the Indian Broadcasting Company has decided to sell "time on the air" to advertisers. "Commercial announcements" now feature in the programmes from Calcutta and Bombay. A listener states that the advertisements are short and pithy and do not bore.

IMPORTANT SUGGESTION.

A correspondent in a Manchester paper writes: "May I suggest that for the coming election the B.B.C. permit politicians to have free use of the microphones all over the country between the hours of 12.30 a.m. and 6 a.m.?"

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EVEN THE BEAM WILL TURN.

The Beam wireless service is at present unable to carry single-handed the traffic between England and Australia, according to Rear-Admiral W. R. Napier, of the Australian Naval Board, in giving evidence at the Senate enquiry as to whether charges should be reduced.

In the House of Commons last week the Assistant Postmaster-General (Viscount Wolmer) stated that no general reduction for beam wireless telegrams was contemplated at present.

EASTER HOLIDAYS.

Owing to the Easter Holidays the latest date upon which small advertisements can be accepted for *The Wireless World* of April 3rd, is Tuesday, March 26th.

A PRIVATE YACHT STATION. The wireless room on board the motor yacht "Crusader" which has just been built by a Southampton firm for an American oil magnate.

in Brief Review.

MORE MONEY FOR B.B.C.

The Post Office grant to the British Broadcasting Corporation for 1929 is to be £925,000, compared with £880,000 in 1928.

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COMMERCIAL CANDOUR.

"Our special 3-valve long- and short wave receiver . . . seldom gets out of order."—Calcutta advertisement.

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BETTER THAN THE TREADMILL.

Two "study groups" in connection with the B.B.C. Adult Education Scheme have been formed in Wakefield Prison.

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HOME CINEMATOGRAPHY.

The many wireless enthusiasts who are also attracted by cinematography will find abundant interest in "Motion Pictures with the Baby Ciné," an illustrated handbook issued by our sister journal, *The Amateur Photographer*. The book is obtainable from our publishers, price 2s. 6d., or post free 2s. 8d.

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BATTLE FOR NEW ZEALAND WIRELESS MARKET.

British, American, Australian, and German wireless manufacturers are all contending for premier place in the New Zealand market. Hitherto American sets have held the field, but a good proportion of trade is now in the hands of British firms. On December 31st the number of licensed receiving sets in New Zealand amounted to 42,801.

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2LO IN THE ARCTIC.

How British broadcasting is received within the Arctic Circle is revealed in a report issued from the Canadian police station at Bernard Harbour, North-west Territories, and published in the *Yorkshire Post*. The receiving station is on Coronation Gulf, 150 miles north of the Arctic Circle. During the past year London was heard 67 times, and Bournemouth and 5GB 43 times each. Newcastle, Aberdeen, and Glasgow were also picked up at less frequent intervals. The Tokio station, JOAK, and Brisbane (9,000 miles distant) were also heard.

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TELEPHONES ON GERMAN TRAINS.

Germany now has in operation a regular public service of wireless telephony available to passengers on the main line between Berlin and Hamburg, by which two-way communication can be established between the train and any telephone subscriber in either of these cities. A number of trains are now to be equipped with receiving apparatus on the Berlin-Beuthen (Silesia) main line in order that broadcast concerts and news bulletins may be heard during the journey.

KIT CONSTRUCTORS' NOTES

The Mullard Master 3

Quick Waveband Changing without Complications.

IT is in the nature of things that a detector-L.F. set should be easier both to build and operate than a combination of the same number of valves which includes a stage of tuned H.F. amplification. In addition, the simpler receiver will generally be slightly cheaper, and, when dealing with signals of medium strength, will as a rule give more volume: consequently, it is likely to appeal to that large body of listeners to whom extreme selectivity is not essential.

Most of the "kit" sets are easy to make, but the designers of the Mullard "Master Three Star" have taken advantage of the inherent simplicity of their circuit to avoid the necessity for working in awkward and inaccessible corners, with the result that the operations of assembly and wiring call for something less than even the average degree of manual dexterity. The avoidance of crowding means that overall dimensions are slightly greater than that of the average set of the same type (the panel measures 18in. by 7in., and the baseboard is approximately 10in. deep).

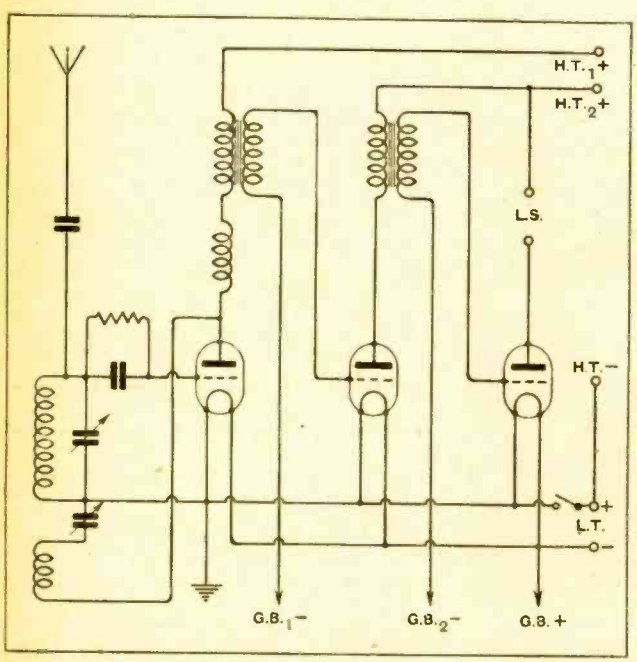

Fig. 1.—The circuit diagram, simplified by omission of waveband switching.

Reference to the simplified theoretical diagram given in Fig. 1 shows that the circuit arrangement comprises a grid detector with capacity-controlled reaction, followed by two transformer-coupled L.F. magnifying stages. The aerial is directly coupled to the grid end of its tuning coil through a fixed condenser which normally has a value of 0.0001 mfd.

Two-range Coil and Waveband Switching.

In order that the essential circuit may easily be traced, the waveband switching system is omitted from the diagram. Actually, however, this is an important feature of the set; the easy and simple change-over is made possible by the use of a special Colvern dual-range coil, consisting of two concentric windings mounted on a moulded base which contains a special switch operated through a rod projecting through the panel. This switch has the effect of placing the windings in parallel and with their magnetic fields in opposition for medium-wave reception, while for long waves they are in series and the fields are assisting, with the result that inductance is at maximum. A reaction coil, common to both wave ranges, is wound in a slot immediately below the grid coils. A compact coil assembly of this kind has inevitably a fairly high H.F. resistance, but its value is by no means excessive for insertion in the average aerial circuit; on test, selectivity and signal strength were found to be well up to the average. The reaction adjustment was found to be effective over both wavebands, and to have very little effect on tuning: the use of a control condenser of comparatively large capacity is responsible in part for good detection efficiency.

Tests were made with the Mullard valves customarily recommended to those users who must perforce exercise economy in the matter of anode current consumption; up to the permissible maximum input to a P.M.4 in the output position, reproduction was pleasing. Overall magnification is distinctly high, due to the use of two

Kit Constructors' Notes.—

transformer-coupled stages, and so care should be taken to avoid the inclusion of resistance in that part of the H.T. source common to the several anode circuits; an aged dry battery might be responsible for L.F. reaction, and, with an eliminator, it would be desirable to provide separate feeds for the detector and first L.F.

In view of the obvious simplicity of the set it is not surprising that the usual search for points likely to be responsible for difficulties, particularly to the beginner, failed in this case; provided battery voltages are properly maintained, there seems little reason why the receiver should give trouble, and any faults that may develop will probably be of the type that are easily traced. The layout and method of wiring facilitates a systematic stage-by-stage test.

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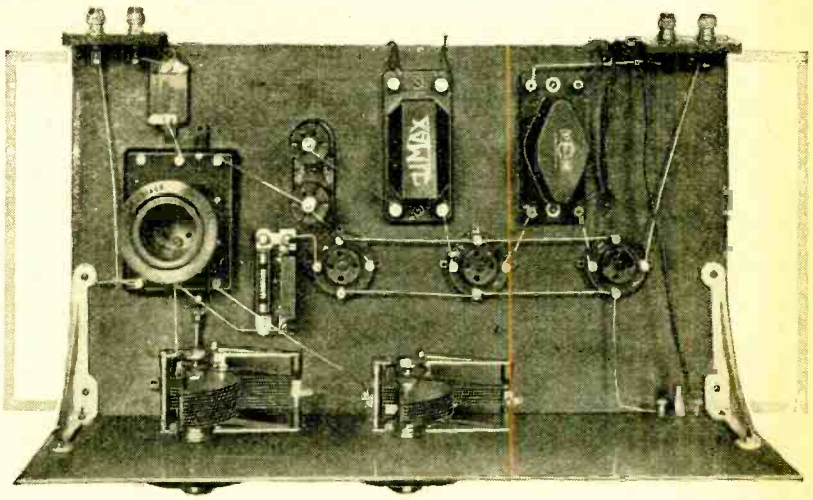
KIT CONSTRUCTORS' PROBLEMS.

The Information Department Service has been extended to deal with problems encountered by builders of "kit" sets discussed in these pages. Receivers already dealt with are the "New Cossor Melody Maker," G.E.C. "Music Magnet," and the Mullard "Master Three Star." The service is subject to the rules printed in the "Readers' Problems" section.



Plan view of the receiver, showing wide spacing of components and simplicity of wiring.

The Series Aerial Condenser.

I am not quite sure whether I have properly wired the fixed aerial condenser in my "Music Magnet"; there are two wires joined to this component, but it seems to me that only one of them is to be connected up. Is this right? S. C. S.

We think that this matter will be clear to you if you understand the construction of the condenser. One "plate" consists of a brass rod; over this is a thin layer of mica, which insulates the brass from a single-layer winding of tinned wire, adjacent turns being soldered together. This form of construction enables the user to reduce capacity at will by removing some of the turns, but as the two ends of wire are part of the same winding, it is quite immaterial as to which is joined to the external circuit—in the case of the receiver in question to the terminal A. The free end of the wire should be cut off close to the end of the winding.

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Stability by Grid Damping?

I have read with interest your recent article on the "Cossor Melody Maker," but find no mention of my own particular trouble. Briefly, this takes the form of serious distortion when the two dials are accurately tuned to a transmission; this cannot be cured by the usual methods, and alteration of grid bias seems to have little effect. Accidentally, however, I have found out that, by reversing the L.T. negative and positive leads, reproduction is improved very noticeably, although volume is somewhat reduced. Does this suggest to you what is wrong? N. B. R.

We think that the effect you describe indicates that the set is normally on the verge of oscillation. By reversing the low tension leads, you are, in effect, applying a positive bias to the grid of the H.F. valve; this will have the effect of increased stability, but, as you have noticed, will decrease signal strength. We recommend you to try the effect of earthing the case in the manner discussed in the article referred to.

On the East Coast.

As you will see from my address, I live in one of the worst districts in the country, from the wireless point of view. Do you consider that the "Music Magnet" reviewed in the issue of February 20th would be capable of giving consistently good signals from at least one home station? Foreign reception is a secondary consideration. G. C. M.

In your part of the country most listeners depend largely on long-wave transmissions; in our review of the set in question it was stated that its performance was particularly good as far as these were concerned, and therefore we think that it should be suitable. You will realise that, without an intimate knowledge of conditions, it is impossible to be definite in these matters.

Pick-up and Pentode.

I am thinking of fitting a pentode output valve to my G.E.C. "Music Magnet," and at the same time adding a gramophone pick-up. As this special valve gives so much magnification, will it be best to insert the pick-up in its grid circuit and to cut out the detector? A. G.

This method of connection will not be satisfactory; in spite of the high amplification of the pentode, it will not be adequately loaded by the output of the pick-up, which should accordingly be inserted in the grid circuit of the detector, arrangements being made to disconnect the grid condenser and to apply a small negative bias. A volume control resistance will be practically essential.

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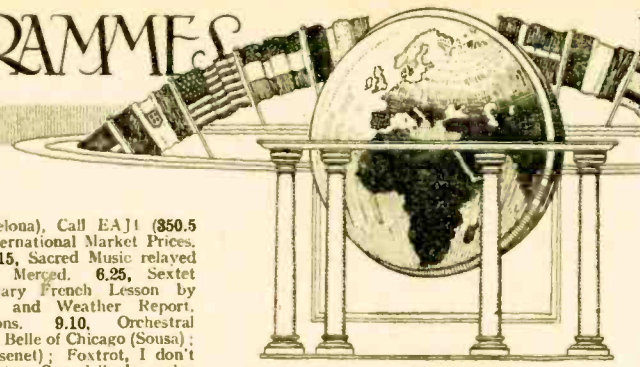
Power Circuit Interference.

I am working my "Cossor Melody Maker" on an indoor aerial, running diagonally across the ceiling, the earth connection being taken to a water pipe. My trouble is interference from the electrical machinery at a near-by mill, which works on three nights of the week, and almost spoils reception. Can you suggest a remedy? N. D. S.

Were it not for the fact that you live in a district remote from broadcasting stations, we would recommend frame aerial reception, but in your locality it is doubtful if, with a single stage of H.F., you would get sufficiently loud signals without using an unduly large frame. It is impossible to suggest a certain remedy for interference from power circuits, which is best cured at the source. We suggest, however, that you should try the use of a counterpoise instead of an earth; or, alternatively, that you should try the effect of making your earth connection to a buried metal plate instead of to the water pipe system as at present.

If the electrical machinery responsible for the trouble derives its power from the same supply as your house-lighting mains, it is quite possible that the trouble may be mitigated by moving the aerial.

PROGRAMMES FROM ABROAD



SATURDAY, MARCH 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 Selections. 6.15, Sacred Music relayed from the Basilica de la Merced. 6.25, Sextet Selections. 8.30, Elementary French Lesson by Mr. Martin. 9.0, Chimes and Weather Report. 9.5, Exchange Quotations. 9.10, Orchestral Selections: March from The Belle of Chicago (Sousa); Selection from Manon (Massenet); Foxtrot, I don't care (Dowell-Potter); One-step, Quand il n'y a plus d'amour (Rosary); Célèbre Minuet (Lully); Waltz, El Valenciano (Cotó). 10.5, News and Announcements, followed by Programme relayed from Madrid, EAJ7.

BERGEN (365.9 metres); 1.5 kW.—6.0, Programme for Girls. 6.30, Programme relayed from Oslo. 7.0, Orchestral Concert. 7.50, Topical Talk. 8.0, Recitation by an Actor. 8.30, Concertina Recital. 9.0, Weather Report, News and Time Signal. 9.15, Programme of Dance Music. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,649 metres); 40 kW.—3.30, Programme relayed from Hamburg. 4.30, Herr H. Kunze, Talk: Women in Official Life. 5.0, Herr R. Waclawick, Talk: The Worker and Books. 5.30, Elementary Spanish Lesson. 5.55, Dr. Eilers, Talk: The Ethics of Hunting. 6.20, Dr. P. Zucker, Talk: In Memory of Alfred Messel. 7.0, Country Programme: Paraphrase on Abt's, Frühmorgens wenn die Hähne krähen (Nehl): Two Selections for String Quartet (Razek); Die Post kommt (Eilenberg); Waltz, Bei uns z'haus (Strauss); Prof. Mielke, Talk: Hearth and Kitchen, the Heart of the Peasant's Home; German Peasant Dance (Neumann); Kinderliederwalzer (Becker); A Peasant Wedding (Södermann). 8.0, Talk with Vocal and Pianoforte Illustrations on Schubert and his Work, followed by News and Dance Music relayed 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 a.m., Programme of Gramophone Records. In the Interval—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, Talk by Leopold Lehmann. 3.0, Dr. Kurt Zielenziger, Talk: Captains of Modern Industry—Ford and Morgan. 3.30, Orchestral Concert: Selection from La Fauvette du Temple (Messager); Ballet Music from Isoline (Messager); Waltz, Wiener Kinder (Jos. Strauss); Selection from Tiefland (d'Albert); Selections (Rich. Strauss), (a) Freundliche Vision, (b) Winterweihe, (c) Schlechtes Wetter; Minuet, The Three Fates (May); Scènes napolitaines, Suite (Massenet); Tibetan Dance (Frühauf); Tango, Was mir dein Mund heiss verspricht (Ailbout); Selection from Eva (Lehár), followed by Advertising Notes. 5.10, Prof. J. M. Verweyen, Talk: The Symbol of Light. 5.35, Dr. Hans Erdmann, Talk: German Musical Culture. Music in the Cinema. 6.0, Herr Alber Grzesinsky, Talk The Organisation and Tasks of the Police. 6.30, Introductory Talk to the following Transmission. 7.0, "Der Hofnarr": Operetta in Three Acts (Müller), followed by Time Signal, Weather Report, News, Sports Notes and Dance Music from the Hotel Adlon. 11.30 (approx.), Close Down.

BERN (406 metres); 1.5 kW.—6.30, Prof. Hans Zickendraht, Talk: The Work of the International Wireless Union relayed from Basle (1,010 metres). 7.0, Choral and Orchestral Concert. 8.45, News and Weather Report. 9.0, The Kursaal Orchestra. 9.40, Dance Music. 11.0, (approx.), Close Down.

BRESLAU (321.2 metres); 4 kW.—4.45, Film Review of the Week by Dr. Heinz Hamburger and Herr M. Lippmann. 5.25, Hans Joachim Plehn, Talk in Esperanto: Silesian Plant-Life. 5.35, Talk on Hygiene by Dr. R. Kayser. 6.0, Herr Sperling, Talk: Lower Silesian Frontiers. 6.25, Weather Report. 6.30 (approx.), Dr. Schmidt, Talk: Upper Silesian Frontiers, relayed from Gleiwitz (326.4 metres). 6.50, Topical Discussion. 7.15, Concert of Light Music: Radetzky March (Joh. Strauss); Morning Noon and Night Overture (Suppé); Waltz, Acceleration (Jos. Strauss); Bauernpolka; Waltz, Bürgersinn. Lieder-quadrille (Joh. Strauss); March, Hoch Österreich (Joh. Strauss); Overture to Der Dorfbarbier (Schenk); Polka Mazurka, Frauenherz (Jos. Strauss); French Polka (Fahrbach); Waltz, Seid umschlungen Millionen (Joh. Strauss); March, Freiwillige vor (Joh. Strauss). 9.0, News and Announcements. 9.30, Dance Music relayed from Voxhaus. 11.0 (approx.), Close Down.

BRÜNN (432.3 metres); 2.5 kW.—4.30, Talk: Wine-growing in Czecho-Slovakia. 4.45, German Transmission—News and Musical Selections: Variation and Fugue (Reger); Three Compositions for Pianoforte (Wettner). 5.15, Weekly Report for Journalists by Dr. Jerábek. 6.0, Programme relayed from Prague. 9.20, Programme Announcements. 9.25, Programme relayed from Prague.

BRUSSELS (511.9 metres); 1.5 kW.—After 7.30 p.m. 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, Violin and 'Cello Recital. 7.0 Columbia Gramophone Records. 7.30, "La Radio-Chronique." 8.0, Concert from the Royal Conservatoire at Liége, under the direction of M. François Rasse. La croisade des enfants, for Solo, Choir and Orchestra (Pierné). In the Interval—Topical Talk. 10.15, News, Announcements in Esperanto and Close Down.

BUDAPEST (545 metres); 20 kW.—6.0, Talk: The Modern Technique of the Stage. 6.30, Song Recital. 7.40, Orchestral Concert of Light Music: Overture to Casanova (Lincke); Waltz, The Blue Danube (Strauss); Potpourri, The Rose of Stamboul (Fall); Behüt dich Gott from Der Trompeter von Säkkingen (Nessler); Rococo Serenade (Mayer-Helmond); Oriental March (Blon); Overture to The Palace of Marble (Tittel); Abschiedswalzer (Oscar Straus); March, Kwang-Hsu (Lincke); followed by Tzigane Concert from the Hotel Britannia.

CRACOW (314.1 metres); 1.5 kW.—6.10, Talk: The Rational Game. 6.56, Time Signal from the Astronomical Observatory. 7.0, Chimes from the Church of Notre Dame. 7.5, Dr. J. Regula, Talk: Review of the Foreign Politics of the Past Week. 7.30, Programme relayed from Warsaw. 9.30, Concert from a Restaurant. 10.30 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—1.30, Weather Report and Concert of Gramophone Selections. 7.20, News. 7.30, Talk by C. Ni Dubhghaill. 7.45, Irish Lesson by Seamus O'Duirinne. 8.0, Variety Programme by the Leinster School of Music. 8.30, Vocal Selections by Joan Burke (Contralto) and Kitty Fagan (Soprano). 8.50, Request Music by the Station Orchestra. 9.0, Baritone Solos by Clemence Bradley. 9.15, Vocal Selections by Rosalind Cohen. 9.30, Selections by the Station Orchestra. 9.40, The Top Knots Concert Party. 10.20, Light Music by the Station Orchestra. 10.30, News, Weather Report and Close Down.

FRANKFURT (421.3 metres); 4 kW.—3.35, Orchestral Concert of French Music. In the Interval News and Announcements. 5.10, Reading by O. W. Studtmann, from The Lives of the Casars (Suetonius). 5.30, Answers to Correspondents. 5.40, Lesson in Esperanto by Herr W. Wischhoff. 5.55, Otto Schwerin Talk: Smugglers' Secrets Revealed. 6.15, Alfred Auerbach, Talk: Artists and National Education. 6.35, Frau Apel, Talk: Foster Children. 6.55, Dr. Helene Turnau, Talk: A Busy Life and the World of Books. 7.15, Claire Waldoff Programme, assisted by the Station Orchestra. 8.0, "The Stolen Microphone"—Sketch (Impekoven), followed by Dance Music relayed 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 18th Century, relayed from Kiel (250 metres). 3.30, Concert: Overture to Undine (Lortzing); Air from Czar and Carpenter (Lortzing); Overture to The Barber of Bagdad (Cornelius); Duet from Tristan and Iseult (Wagner); Monologue from Die Meistersinger (Wagner); Prelude to Die Gezelchneten (Schrecker); Ballade from Der ferne Klang (Schrecker). 4.30, Orchestral Concert of Request Items. 5.30, Dr. K. Würzburger, Talk: What does the Modern Man think of the Modern Woman. 6.0, Talk: Old Instruments in the Music Room of the Hamburg Museum. 6.55, Weather Report. 7.0, "The Lincke Revue." 9.30, Talks outside the Programme, followed by News, Weather Report, Sports Notes. 10.0, Café Wallhof Concert. 10.50, North Sea and Baltic Weather Report.

HILVERSUM (1,071 metres); 5 kW.—9.40 a.m., Time Signal and Daily Service. 11.40 a.m., Police Announcements. 11.55 a.m., Concert of Trio Music. 1.40, Musical Programme 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, Trio Concert. 6.25, German Lesson by Mr. Edgar Grün. 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.—11.10 a.m., Sacred Music Recital. 11.55 a.m., Concert of Trio Music. 12.55, Gramophone Records. 2.40, Programme for Children. 5.10, Gramophone Records. 6.10, Talk by M. Dubois. 6.30, Catholic Bulletin. 6.40, Elementary English Lesson. 7.10, Lesson in Dressmaking. 7.40, Talk. 8.0, "Judas": Passion Play in Five Acts (Verschaeve). 9.10, 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. 12.15, Educational Talk. 2.0, Programme for Children. 2.30, Instrumental Concert: Turkish March (Mozart); Overture to The Black Domino (Auber); Waltz from Polenblut (Nedbal); Persian Dance (Svendsen); Dance of the Insects (Svendsen); Selection from The Daughter of the Regiment (Donizetti); Czardas from Die Fledermaus (Joh. Strauss); Reading by Carl Schiönning. March from The Gipsy Baron (Joh. Strauss) Ave maris stella (Grieg); Arab Dance from Peer Gynt (Grieg); Fantasia on Danish Soldier Songs (Nielsen); Crépuscule (Friml); En badinant (d'Ambrosio); Waltz from The Merry Widow (Lehár); Persian March (Joh. Strauss). 4.40, Exchange Quotations and News. 5.20, Talk by Mr. S. M. Sorensen. 5.50, Weather Report. 6.0, News. 6.15, Time Signal. 6.30, Emil Frimodt, Talk: Modern Foreign Authors: Robert Hugh Benson. 7.0, Chimes from the Town Hall. 7.2, Sonata Recital: Andante and Allegro from the Sonata for Violin and Piano in G. Major (Haydn); Three Movements from the Sonata for Violin and Piano in G Minor (Debussy). 7.30, Popular Concert from the Works of Danish Composers. 8.30, Readings by Emil Frimodt from a Novel by Robert Hugh Benson, followed by News. 9.15, Orchestral Concert; Overture to Bandittenstreiche (Suppé); Waltz, Doctrinen (E. Strauss); On the Bosphorus (Lincke); Waltz, Hesperus (Lumbye); Fantasia on Danish Student Songs; Es war ein Traum (Eilenberg);

Programmes from Abroad.—

Gallop (Jensen). **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.—**3.0,** Gramophone Records. **4.0,** Music Lesson by Prof. F. Sachse. **4.25,** Children's Letter Box by H. Reutt. **4.55,** Programme for Children. **5.50,** Announcements. **6.10,** Talk. **6.56,** Time Signal. **7.0,** Talk. **7.30,** Programme relayed from **Warsaw.** **9.0,** Weather Report and News. **9.30,** Programme of Dance Music.

LAHTI: (1,522.8 metres) ; 35 kW.—**4.57,** Time Signal and Weather Report. **5.10,** Recital from the Johannes Church. **6.15,** Sports Talk. **6.30,** Song Selections by Minna Tallvik-Rikala. **6.50,** Talk. **7.10,** Orchestral Selections : An den Mond (Schubert) ; Andante (Kuhlau) ; Symphony in B Minor (Schubert). **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** (267.8 metres).—**12.5,** Orchestral Concert : March, Entry of Spring (Blon) ; Waltz, Indra (Lincke) ; Overture to Zehn Mädchen u. kein Mann (Suppé) ; Fantasia on the Works of Liszt (Urbach) ; Exotic Dance No. 1 (Zeh) ; Selection from Hamlet (Thomas) ; Serenade (Graener) ; Selection from The Mikado (Sullivan). **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,** Reading by Norbert Jacques from New Brazilian Travels. **3.30,** Karola Simson, Talk : Gardening for Children in the Spring. **3.55,** Dr. Bienstock, Economic Talk : Problems of the International Coal Industry. **4.15,** English Lesson by Prof. Hase. **4.45,** Orchestral Concert : Entry March from The Queen of Sheba (Goldmark) ; Selection for 'Cello with Orchestral accompaniemnt, Kol Nidrei (Bruch) ; Italian Caprice (Tchaikovsky) ; Hungarian Rhapsody No. 2 (Liszt). In an Interval at **5.15,** Programme Announcements. **5.30,** Prof. Tietze, Talk : Vienna. **5.50,** Lesson in Morse **6.15,** Talk for Workers by Herr Albert Fuchs. **6.40,** Dr. Lips, Talk : The Development of Culture. **7.0,** Variety Programme, followed by News, Sports Notes, Commercial Announcements and Concert. **11.0,** Gramophone Selections of 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.** **5.55,** Labour Market Report. **6.0,** Dr. Hermann Boessneck, Talk : English Philosophy. **6.30,** Dr. Neubert, Talk : A Tour through the Sports Exhibition in Leipzig. **7.0,** Variety Programme : Orchestral Selections from the Rhineland Suite (Lüling) ; Recitation ; Orchestral Selection, Rheinischer Sang (Hannemann) ; Two Songs; Orchestral Selection, Vom Rhein zur Donau (Max Rhode) ; Anecdotes of Rhineland Humour ; Orchestral Selection ; So singt man am Rhein (Haseloff) ; Two Songs ; Orchestral Selection, Beim Rheinwein sollst du mein fein (May) ; Anecdotes ; Orchestral Selection, Mainzer Narrhalia-Marsch (Zulehner) ; Two Songs ; Orchestral Selection. **9.0,** Time Signal, Snow Report. Weather, News, Sunday Programme Announcements and Sports Notes, followed by Dance Music relayed from **Voxhaus.** **11.30** (approx.), Close Down.

MADRID (Union Radio), Call EAJ 7 **(426.7 metres)** ; 3 kW.—**7.0,** Chimes, Exchange Quotations and Programme of Dance Music. **8.0,** Talk : Inventions and Inventors. **8.25,** News and Announcements. **9.45,** Weekly Agricultural Report. **10.0,** Chimes, Time Signal and Musical Comedy Selections, (a) " Las Musas latinas (Penella), (b) " El principe casto " (Valverde). In the Interval at **12.0 Midnight** (approx.), News. **12.30 a.m.** (approx.) (Sunday), Close Down.

MOTALA (1,351 metres) ; 30 kW.—Programme also for **Stockholm** (438 metres), **Böden** (1,200 metres), **Göteborg** (346.8 metres). **Hörby** (260.9 metres), **Oster sund** (720 metres), and **Sundsvall** (545.5 metres).—**3.30,** Reading by Carl Johan Fahlcrantz. **4.0,** Programme for Children, relayed from **Jönköping** (201.3 metres). **4.55,** Chimes from the Town Hall. **5.0,** Evensong from St. Peter's Methodist Church. **6.10,** Choral Concert relayed from the Cathedral, **Karlstadt** : Varstorm (Jader) ; Esthonian Folk Melody ; Swedish Folk Melody ; Solvet (Lammers) ; Landkjending (Grieg) ; Coronach (Schubert) ; Maria Wiegenlied (Max Reger) ; Virgo glorioso (Södermann) ; Stjärnöga (Stenhammar) ; Dröm (Sjögren) ; Panis Angelicus (César Franck) ; Rosa rorans bonitatem (Norman) ; Morning Song from Elverskud. **7.15,** Concert by the Band of the Svea Life Guards : Coronation March from The Prophet (Meyerbeer) ; Waltz, Roses of the South (Joh. Strauss) ; Overture to The Thieving Magpie (Rossini) ; Zigeunerständchen (Mehl) ; Selection from Samson and Delilah (Saint-Saëns) ; Rhapsody on Swedish Folk Melodies, From far and near (Löfgren). Military March (Grundström). **8.15,** News and

Saturday, March 23rd.

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Weather Report. **8.45,** Talk by Nils Hasselskog, relayed from **Göteborg.** **9.15,** Old Dance Music, relayed from **Göteborg.** **10.0,** Dance Music from the Sphinx **11.0** (approx.) Close Down.

MUNICH (536.7 metres) ; 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (272.7 metres), and **Nuremberg** (240 metres).—**3.0,** Trio Concert. **4.30,** Talk for Radio Amateurs by Rudolf Wittwer. **5.0,** Zither Concert : March, Da Capo (Hintermeyer) ; Juninacht (Reigenberg) ; Was Mädchen träumen (Seidl) ; Intermezzo, Scherzende Schmetterlinge (Hintermeyer) ; Abendläuten am Traunsee (Messner) ; Im Gnomenreich (Hintermeyer). **5.35,** Labour Market Report. **6.0,** The Letter Box. **6.30,** Pianoforte Recital by Hilarius Hautz : Fantasia in C Minor (Bach) ; Sonata in F Minor Op. 57 (Appassionata), (Beethoven) ; Polonaise in A Flat Major (Chopin). **7.5,** German Folk Stories. **7.25,** Gramophone Concert of Light Music. **8.0,** Musical Tattoo. **9.20,** News and Announcements. **9.45,** Concert relayed from the Café Reichsadler, **Munich.** **11.0** (approx.), Close Down.

NAPLES, Call 1NA **(333 metres)** ; 1.5 kW.—**7.30** Time Signal, Wireless Talk. Announcements, News and Harbour Notes. **7.45,** Relay of an Opera from the San Carlo Royal Theatre. **9.50,** News. **9.55,** Calendar and Programme Announcements. **10.0** (approx.), Close Down.

OSLO (496.7 metres) ; 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (554 metres). **Notodden** (297 metres), **Porsgrund** (456 metres), and **Rjukan** (242 metres).—**6.15,** Weather Report and News. **6.30,** Talk on Ancient Babylon. **7.0,** Time Signal, followed by Irish Programme. Talk on Ireland. Orchestral Concert of Irish Melodies. Readings from Irish Poetry. Irish Song Selections. **8.30,** Weather Report and News. **8.45,** Topical Talk. **9.0,** Light Song Recital. **9.30,** Programme of Dance Music. **11.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT **(458 metres)** ; 0.5 kW.—**6.30,** Radio Journal de France. **8.0,** Talk by M. Lassalle. **8.15,** Talk : Social Hygiene. **8.30.** Concert, followed by News, Time Signal and Weather Report. **10.30,** Running Commentory of the Six Days' Race, followed by Dance Music. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL **(1,485 metres)** ; 5 kW. —**4.0,** 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) M. René Casalis : Sunday Sports (d) Mlle. Jacqueline Bertillon : Social Works ; and Talks by other contributors.

PARIS (Petit Parisien), **(336.3 metres)** ; 0.5 kW.— **8.45,** Gramophone Selections, Talk and News. **9.0.** Concert : Overture to The Drum-major's Daughter (Offenbach) ; Selection from Les Cloches de Corneville (Planquette) ; Prelude and Variations (Franck) ; Chant élégiaque for 'Cello and Orchestra (Schmitt) ; Selection from Fortunio (Messager) ; Selection from Guernica (Vidal) ; Bourrée from La plus forte (Leroux). In the Intervals at 9.25 and **10.0,** News.

PARIS (Radio Paris), Call CFR **(1,744 metres)** ; 15 kW.—**12.30,** Programme of Dance Music. In the Interval—Exchange Quotations and News. **2.0,** Market Prices Report. **3.30,** Exchange Quotations. **3.45,** Programme of Dance Music. **4.0** (in the Interval), Mr. Denis d'Ines, Talk : The Art of Elocution. **4.45,** Exchange Quotations and News. **5.25,** Sacred Address by Pastor Marc Boegner. **6.30,** New York Exchange Rates and Agricultural Report. **6.45,** Gramophone Selections. **7.30,** Pianoforte Lesson. **7.45,** Metal Prices and News. **8.0,** Talk arranged by the Union des Grandes Associations. **8.15,** Concert : Overture to Iphigenia in Aulis (Glück) ; Ballet Music from Dardanus (Rameau) ; Marche héroique (Saint-Saëns) ; Overture to Euryanthe (Weber) ; Caucasian Sketches (Ippolitoff-Ivanoff) ; March from Tannhäuser (Wagner). **9.0,** Programme of Dance Music. In the Intervals—News.

PITTSBURGH, Call KDKA **(63 and 27 metres)** ; 25 kW.—**10.25,** KDKA Theatrical Calendar. **10.30,** New York Exchange Quotations by Moore, Leonard and Lynch. **10.45,** News casting. **10.55,** Talk on Dentistry. **11.0,** Telechron Time Signal. **11.1,** Orchestral Programme from the Fort Pitt Hotel **11.30,** The Gold Spot Pals, relayed from **New York. 12.0 Midnight,** Sessions Clock Chimes. **12.1 a.m.** (Sunday), Address from the University of Pittsburgh. **12.15 a.m.,** The Home Radio Club. **12.30 a.m.,** Gems of American Literature by E. R. Moses. **12.45 to 3.1 a.m.,** Programme relayed from **New York. 12.45 a.m.,** A Week of the World's Business by Dr. Julius Klein. **1.0 a.m.,** The Purol Band. **1.30 a.m.,** Interwoven Entertainers. **2.0 a.m.,** Pan Americana. **2.30 a.m.,** Programme by the Seven-Elevens Dance Orchestra. **3.0 a.m.,** Longines Time Signal. **3.1 a.m.,** Orchestral Programme from the Fort Pitt Hotel. **3.30 a.m.,** Champion Weather Reports. **3.35 a.m.,** Orchestral Programme from the William Penn Hotel.

PRAGUE (343.2 metres) ; 5 kW.—**6.0,** Chimes and News. **6.5,** Wireless Notes of the week. **6.15,** Concert from the Works of Ot. Zich. **7.0,** Concert by the Moravian Teachers' Choral Society. **9.0,** Time Signal, News, Sports Notes and Theatre Review. **9.25,** Programme of Popular Music, from the Hotel Sramota. **10.0,** Relay of Chimes.

ROME, Call 1RO **(443.8 metres)** ; 3 kW.—**7.30,** Giornale parlato, followed by Press Review. **7.45** Concert by the Band of the Reali Carabinieri, with Scenes from " La Furia dormente " (Salvatori) and " La Gioconda " (d'Annunzio). In an Interval, Talk : The World of Literature and Art. **9.50,** Giornale parlato and News. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAF **(31.48 metres)** ; 30 kW. **11.29,** Telechron Time Signal. **11.30,** The 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. 1.0 a.m.,** Basket-ball Game, relayed from Glens Falls, N.Y. **2.0 a.m.,** General Electric Hour, relayed from **New York. 3.0 a.m., Lucky Strike** Programme relayed from **New York. 4.0 a.m.,** Dance Music from the Hotel Ten Eyck, **Albany. 5.0 a.m.** (approx.), Close Down.

STUTTGART (374.1 metres) ; 4 kW.—**2.0,** Orchestral Concert. **3.30,** Thé-Dansant relayed from the Pavillon Excelsior. **5.0,** Time Signal and Weather Report. **5.15,** Prof. Aly, Talk : To what kind of Secondary School shall I send my son ? relayed from **Freiburg** (577 metres). **5.45,** Lesson in Book-keeping by Dr. Wolff. **6.15,** Time Signal and Sports Notes. **6.30,** Concert by the Liederlust Men's Choral Society : Ahoi (Lendvai) ; Soprano Solos (Trunk), (a) Den Andern, (b) Stilles Lied 1 and 2 ; Male Voice Chora Selections, (a) Eine Wiese weisser Margueriten (Heuser), (b) Daheim (Reither) ; String Quartet in E Minor Op. 27 (Hasse) ; Male Voice Choral Selections, (a) Schmied Schmerz (Zöllner), (b) Liebesgedanken (Trunk) ; Soprano Solos (Haas), (a) Das Glück, (b) Warte, wenn wieder das Veilchen blüht, (c) Du bist die Macht ; Two Horn Quartets, (a) Liebeslied, (b) Auf der Jagd (Keyssner) ; Male Voice Choir with Soprano Solo, String Quartet and Three Horns, Die Königskinder (Othegraven). **8.0,** Programme relayed from **Frankfurt.** In the interval at **9.45** (approx.), News. **11.30** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) **(389.6 metres)** ; 8 kW.—**12.45,** Concert. **8.0,** Exchange Quotations and News. **8.30,** Concert : Songs from the Operas, (a) Sigurd (Reyer), (b) Le Caïd (Thomas), (c) Lohengrin (Wagner), (d) La favorita (Donizetti), (e) La Traviata (Verdi) ; Selections from Romeo and Juliet (Gounod) ; Selection from Maritana (Wallace) ; Prelude to Lohengrin (Wagner) ; Potpourri, Die geschiedene Frau (Fall) ; Funeral March (Chopin) ; Souvenir (Drdla) ; Overture, Preciosa (Weber) ; Selections of Dance Music. **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (519.9 metres) ; 15 kW.—**4.20,** Chamber Music. Quintet for Pianoforte in E Flat Major Op. 44 (Schumann). Pianoforte Solos, (a) Variations on a Hungarian Song Op. 21 No. 2 (Brahms) ; Allegro de Concert Op. 46 (Chopin) ; Songs (Schumann), (a) Stille Tränen, (b) Der Nussbaum ; Songs (Brahms), (a) Vor dem Fenster, (b) Alte Liebe. **5.30,** Josef Zilker, Sports Talk—Cycles and Motor Cycles. **6.0,** Readings from his own Works by Karl Schlossleithner **6.30,** Topical Talk. **7.0,** Time Signal and Weather Report. **7.5,** " Die heilige Ente " : Opera in Three Acts (Gál), followed by Phototelegraphy Transmission.

WARSAW (1385.7 metres) ; 10 kW.—**6.56,** Time Signal. **7.0,** Prof. Niewiadomsky, Talk : Polish Music. **7.30,** " The Betrothal by Lantern Light "—Operetta (Offenbach). **9.0** (approx.), Aviation and Weather Reports, News, Police Announcements and Sports Notes. **9.30,** Dance Music from the Hotel Bristol. **10.30** (approx.), Close Down.

ZÜRICH (489.4 metres) ; 1 kW.—**6.17,** Programme from Glarus. **7.15** (approx.), Programme from **Bern,** followed by Quartet and Orchestral Selections. **9.0,** Weather Report and News. **9.10,** Gramophone Dance Music.

Programmes from Abroad.—

BARCELONA (Radio Barcelona), Call EAJ1 (**350.5 metres**) ; 1.5 kW.—**11.0 a.m.**, Relay of Chimes from Barcelona Cathedral. **11.5 a.m.**, Weather Conditions and Forecast for Europe and North East Spain and Aerial Route Notes for Aviators. **1.30**, Concert by the Iberia Trio. **2.45 to 6.0**, No Transmission. **6.30**, Recital of Soprano Songs rendered by Conception Llorens. Not conciXia (J. Borrás de Palau). **8.20**, Concert of Light Music by the Station Orchestra **8.40**, Sports Chronicle. **9.0** (approx.), Close Down.

BERGEN (**365.9 metres**) ; 1.5 kW.—**9.30 a.m.**, Morning Service with Sermon. **11.30 a.m.**, Weather Report and Forecast and General News Bulletin. **7.0**, Orchestral Concert. **7.50**, Topical Talk. **8.0**, Programme of Recitations rendered by Lars Hansen, the Author. **9.0**, Weather Report and Forecast followed by General News Bulletin and Time Signal. **9.15**, Programme of Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (**1649 metres**) ; 40 kW.—**7.55 a.m.**, Relay of Church Chimes from the Garrison Church at Potsdam. **8.0 a.m.**, Morning Festival with Choral and Instrumental Numbers and Sermon from **Voxhaus**, followed by Chimes relayed from Berlin Cathedral. **10.30 a.m.**, Orchestral Concert relayed from the Grosse Schauspielhaus. **12.15**, Talk by E. Nebermann : "Modern Chess Games." **12.45 to 1.15**, Experimental Transmission of Pictures. **1.30 to 2.30**, Three Talks for Agriculturalists. **2.30**, Reading of Fairy Stories. **5.0**, Two Talks for and against a motion on a Topical Subject. **7.0** (approx.), Concert or Play followed by General News Bulletin and Dance Music Programme. **11.30** (approx.), Close Down.

BERLIN (Voxhaus) (**475.4 metres**) ; 4 kW.—**7.55 a.m.**, Relay of Chimes from Potsdam Garrison Church. **8.0 a.m.**, Morning Recital of Sacred Music and Sermon followed by Relay of Chimes from the Cathedral. **10.30 a.m.**, Orchestral Concert relayed from the Grosse Schauspielhaus. **12.15**, Talk : "The Modern Chess Game," by E. Nebermann. **1.30**, Notices and Practical Hints for Agriculturalists. **1.45**, Weekly Review of Market Prices and Weather Report and Forecast. **1.55**, Talk on an Agricultural Topic. **2.30**, Programme of Fairy Tales. **5.0 and 5.30**, Topical Talks. **6.0**, Advertising Talk. **6.30**, Talk. **7.0** (approx.), Concert or Play followed by Weather Report and Forecast and Late News Bulletin, Time Signal and Sports Notes and Programme of Dance Music. **11.30** (approx.), Close Down.

BERN (**406 metres**) ; 1.5 kW.—**9.30 a.m. to 10.30 a.m.**, Catholic Address. **12.0 Noon**, Time Signal and Weather Conditions and Forecast. **12.5**, Popular Concert. **2.30**, Afternoon Concert by the **Bern** Kursaal Orchestra. **6.29**, Time Signal, Meteorological Report and Football Results. **6.30**, Reading or Talk. **7.0**, Palm Sunday Concert relayed from **Zürich** Cathedral with the collaboration of Soloists and the Station Orchestra conducted by Hermann Hofmann. **8.45** (approx.), Sports Chronicle, Late News and Announcements, Weather Report and Forecast and Concert. **9.40** (approx.), Close Down.

BEZIERS (**211.3 metres**) ; 0.6 kW.—**12.0 Noon**, Festival of Sacred Music with Sermon rendered by the Orchestra and Choir of "The Friends of Religious Music" conducted by M. Panmier. Panis Angelicus (César Franck). **6.0**, Programme of "La Radio Agricole Française." **8.30**, Sports Notes. **8.45**, Gala Concert of Pathé and Pathé-Art Gramophone Records by La Maison Relin-Missoles. **10.30** (approx.), Close Down.

BRUSSELS (**511.9 metres**) ; 1.5 kW.—**5.0**, Relay of Concert by the Armenonville Tea Room Orchestra. **6.0**, Programme for Children arranged by the Children's Theatre. **6.30**, Selections by the Station Trio. **7.30**, Radio-Chronique. **8.15**, Concert by the Station Orchestra with the collaboration of Mlle. Saucin and M. Emilio Perea of La Scala, Milan. Tenor Aria from "André Chenier"—Opera (Giordano) rendered by Emilio Perea. **10.15**, General News Bulletin from the Evening Papers. **11.0** (approx.), Close Down.

COLOGNE (**263.2 metres**) ; 4 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Langenberg** (462.2 metres) and **Münster** (267.8 metres).—**6.45 a.m.**, Lesson in Self-Defence. **7.5 a.m.**, German Shorthand Lesson by Hans Molitor. **7.25 a.m. to 7.55 a.m.**, Esperanto Lesson and Survey in Esperanto of Forthcoming Programmes. **8.5 a.m. to 9.0 a.m.**, Catholic Morning Recital of Vocal and Instrumental Music, with Address. **12.0 Noon**, Concert of Light Music, conducted by Eysoldt. **1.30**, Talk. **1.50**, Talk. **2.10**, Talk or Reading. **5.0**, Talk. **7.0**, Choral Selections by the Choir of Aix-la-Chapelle Cathedral relayed from the Aix-la-Chapelle Municipal Concert Hall. Organ Selection : Prelude in B Minor (J. S. Bach). **9.30** (approx.), News and Announcements, Sports Results and Orchestral Concert. **11.0** (approx.), Close Down.

Wireless World

SUNDAY, MARCH 24th.

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

CORK, Call 6CK (**222 metres**) ; 1.5 kW.—**8.30 to 11.0**, Concert with Vocal and Instrumental Items. **8.50**, Contralto Solos, rendered by Jean Roper. **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 Morning Service from a Cathedral. **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.**, Orchestral Concert from the Philharmonic Hall, **Warsaw**. **1.0 and 1.20**, Talks for Agriculturalists. **1.40**, Agricultural Chronicle. **2.0**, Weather Report and Forecast. **2.15**, Relay of Concert by the **Warsaw** Philharmonic Orchestra. **4.30**, Talk. **4.55**, Italian Lesson by Dr. Nelly Nucci. **5.20**, Programme from **Warsaw**. **6.0**, Various Items. **6.20**, Talk. **6.56**, Time Signal, relayed from the Astronomical Observatory. **7.0**, Fanfare, relayed from the Church of Notre Dame. **7.15**, Sports Announcements. **7.30**, Concert of Religious Music : Stabat Mater (G. B. Pergolese), rendered by Mesdames Helena Zboinska-Ruszkovska (Soprano), Sophie Jenkovska (Mezzo-Soprano) and a School Choir. **9.0 to 9.30**, Programme from **Warsaw**. **9.0**, Notes on Aerial Routes and Weather Conditions and Forecast. **9.5**, General News Bulletin from the Polish Telegraph Agency. **9.20**, Police Communications and Sports Intelligence. **9.30** (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 ; Trio No. 4 in C Major (Mozart), rendered by Mr. Brady's Trio. **11.0**, National Anthem and Meteorological Report. **11.15** (approx.), Close Down.

GENOA, 1GE (**386.9 metres**) ; 1.2 kW.—**4.0**, Musical Programme. **7.0**, Opening Signal ; "Il Radiogiornale" with News and Announcements supplied by the Stefani Agency and Sports Results. **7.20**, Official Wireless Communications. **7.25** (approx.), Talk : "The Day's Events in the World of Sport," by Leandro Vaccari. **7.40**, Variety Concert by the Station Orchestra, under the direction of Fortunato Russo : Tenor Solo, O Tu che in seno agli Angeli, from The Force of Destiny (Verdi), rendered by Luigi Angelo Cuneo. **9.45** (approx.), Late Press News, communicated by the "Giornale di Genova," and 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. **7.20 a.m.**, Ice Notes, Weather Report and Forecast and General News Bulletin. **7.40 a.m.**, Talk : Economic Problems of To-day. **8.0 a.m.**, Weekly Legal Talk. **8.15 a.m.**, Morning Festival. **9.55 a.m.** (for **Kiel** and **Flensburg**), Relay of Morning Service from the University Church, **Kiel**. **11.55 a.m.**, **Nauen** Time Signal. **12.5**, Concert of Orchestral Music. **12.5** (for **Hanover**), Concert of Gramophone Records. **12.5** (for **Bremen**), Concert by the Station Orchestra. **1.0**, Programme for Children, by Funkheinzelmann. **2.0**, Orchestral Concert. **6.0**, Talk : The Experiences of a Foreign Correspondent by Philipp Berg. **6.30**, Talk. **6.40**, Sports Notes. **6.55**, Weather Conditions and Forecast. **7.0**, Musical or Dramatic Programme, followed by Weather Report and Forecast and General News Bulletin. **9.40**, Orchestral Concert. **10.50** (for **Bremen**, **Flensburg**, **Hamburg** and **Kiel**), Weather Report and Forecast for North Sea and Baltic. **11.0** (approx.), Close Down.

HILVERSUM (**1,071 metres**) ; 5 kW.—**11.40 a.m.**, Talk : How to play Bridge. **12.10**, Concert of Light Music. **1.40**, Running Commentary on the International Football Match between Belgium and Holland. **3.40**, Sports Intelligence and Musical Selections. **7.40**, Time Signal, and News Announcements. **7.55** (approx.), Musical Programme. **11.10** (approx.) Close Down.

HUIZEN (**336.3 metres**) ; 4 kW.—Transmits from 5.40 p.m. on 1,852 metres.—**8.5 a.m.**, Morning Service with Address. **9.30 a.m.**, Morning Service relayed from the Vrediskerk at **Utrecht**. Sermon by Doctor G. P. Marang. **12.10**, Concert by the Station Trio. **1.10**, Talk. **1.40**, Talk. **5.30**, Evening Service and Sermon. **7.10**, Talk. **7.50**, Concert Programme. **9.10**, Press News and Announcements. **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.**, Relay of Church Service from **Copenhagen**. **10.30 a.m. to 10.40 a.m.** (Kalundborg only), Weather Report and Forecast from the Meteorological Institute at **Copenhagen**. **11.0 a.m.**, Times and Chimes. **11.5 a.m.**, News and Announcements. **12.0 Noon** German Language Lesson. **12.30**, French Language Lesson. **5.50** (Kalundborg only) Weather Conditions and Forecast from the Meteorological Institute at **Copenhagen**. **6.0**, Press News and Announcements. **6.15**, Time Signal. **6.16**, Sports Intelligence. **6.25**, Talk. **7.0**, "Som i ungdommens Vaar"—Vaudeville Operetta in Four Tableaux by Rudolf Bernauer and Rudolf Schanzer, relayed from the Casino. Music by Walter Kollo and Willy Bueschneider. Followed by Dance Music Programme by the Palace Hotel Orchestra, **Copenhagen**, conducted by Teddy Petersen. In the interval at **11.0**, Chimes relayed from **Copenhagen** Town Hall. **11.30** (approx.), Close Down.

KÖNIGSBERG (**280.4 metres**) : 4 kW.—Programme relayed by **Danzig** (455.1 metres).—**8.0 a.m.**, Recital of Sacred Music with Address. **9.56 a.m.** (Danzig only), Weather Report and Forecast. **10.0 a.m.** (Königsberg only), Weather Conditions and Forecast. **10.30 a.m.**, Concert of Military Music by the first Prussian Pioneer Battalion Band : Vom Fels zum Meer—March (Jessel). **1.0**, Hints for Chess Players by P. S. Leonhardt. **5.0**, Relay from Berlin of Two Contradictory Talks on a Topical Subject. **7.10** (approx.), Concert. **9.5** (approx), General News Bulletin and Sports Results.

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. **11.10 a.m.**, Orchestral Concert from **Warsaw**. **1.0**, Talk : The Silesian Gardener. **1.20 and 1.40**, Two Agricultural Talks. **2.0**, Meteorological Report. **3.0**, Concert of Popular Music. **4.30 to 5.15**, No Transmission. **6.0**, Miscellaneous Announcements. **6.56**, Time Signal. **7.0**, Half an Hour of Humour by Professor St. Ligo. **7.30**, Concert of Vocal and Instrumental Music relayed from **Warsaw** ; Orchestral Selection, Air from the Suite, Grandmother's Album (L. Rogovsky). **9.0**, Weather Report and Forecast Late News Bulletin and Sports Notes. **9.30**, Programme of Dance Music. **10.30** (approx.), Close Down.

LAHTI (**1,522.8 metres**) ; 35 kW.—Programme also for **Helsingfors** (375 metres).—**8.0 a.m.**, Relay of Divine Service in Finnish. **9.50 a.m.**, General News Bulletin from the Press. **10.5 a.m.**, Musical Programme of Instrumental Items. **10.25 a.m.**, Musical Selections. **10.50 a.m.**, Meteorological Report and Time Signal. **11.0 a.m.**, Divine Service Relay (in Swedish). **3.0**, Variety Concert by the Station Orchestra, conducted by Erkki Linko. **4.0**, Talk. **4.25**, Musical Items. **4.57**, Time Signal and Weather Report and Forecast. **5.15**, Talk. **5.45**, Musical Selections. **7.0**, Concert by the Station Orchestra, with Recitations. Le roi l'a dit—Overture (Léo Delibes). **7.45**, Late News Bulletin in the Finnish and Swedish Languages. **8.15** (approx.), Close Down.

LANGENBERG (**462.2 metres**) ; 20 kW.—Programme also for **Aix-la-Chapelle** (455.9 metres), **Cologne** (263.2 metres) and **Munster** (267.8 metres).—**6.45 a.m.**, Self Defence Lesson by Dr. Ludwig Bach. **7.5 a.m.**, Lesson in German Shorthand. **7.25 a.m.**, Lesson in Esperanto by Alfred Dormanns. **7.45 a.m.**, Esperanto Review of Coming Programmes. **8.5 a.m. to 9.0 a.m.**, Catholic Morning Festival with Address and Choral and Solo Items. **12.0 Noon**, Concert of Popular Music. Conductor : Eysoldt. **1.30**, Talk. **1.50**, Talk. **2.10**, Talk or Reading. **3.30**, Orchestral Concert by the Wireless Orchestra conducted by Busschkötter. Overture to "The Bartered Bride"—Opera (Smetana). **5.0**, Talk. **9.30** (approx.), General News Bulletin, Sports Intelligence and Orchestral Concert. **11.0** (approx.), Close Down.

LEIPZIG (**361.9 metres**) ; 4 kW.—Programme relayed by **Dresden** (317 metres).—**7.30 a.m.**, Relay of an Organ Recital from one of the Leipzig Churches. **8.0 a.m.**, Morning Festival with Vocal and Instrumental Selections. **12.0 Noon and 12.30**, Two Talks for Agriculturalists. **4.0**, Musical Programme. **6.0**, "Rienzi"—Tragic Opera in Five Acts (Richard Wagner), relayed from the New Theatre, Leipzig, followed by Time Signal, News from the Press, Sports Intelligence and Dance Music Selections. **11.30** (approx.), Close Down.

LYONS (Radio Lyon) (**291 metres**) ; 1.5 kW.—**8.30**, Vocal and Instrumental Concert. **7.30**, "Le Journal Parlé" including General News Bulletin and Press Review, Theatre Programmes and Official Announcements. **8.0**, Coucert of Orchestral, Vocal and In-

Programmes from Abroad.—

strumental Music: Accordion Selection, Martelette (Péguri). **10.0** (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (**426.7 metres**); 3 kW.—**2.0**, Chimes relayed from the Gobernacion and Time Signal. **2.5**, Concert of Popular Music by the Wireless Orchestra. **3.30 to 7.0**, No Transmission. **7.0**, Relay of Chimes followed by Dance Music Programme. **8.0**, Talk: "Celebrated Journeys." **8.30 to 10.0**, No Transmission. **10.0**, Chimes Relay followed by Time Signal. **10.5** Concert by the Station Orchestra. Prelude to "Lohengrin": Opera (Wagner). **10.30**, Concert of Band Music relayed from the Hotel National. **12.0 Midnight**, Relay of Chimes. **12.5 a.m.** (Monday), Concert continued. **12.30 a.m.** (approx.), Close Down.

MILAN, 1MI (**504.2 metres**); 7 kW.—**9.0 a.m.**, Opening Signal followed by English Language Lesson. **11.30 a.m.**, Time Signal. **11.32 a.m.**, Concert of Selections by the Station Quartet. **12.30 to 3.0**, No Transmission. **3.0**, Opening Signal. **3.2**, Relay of a Comedy from the Arcimboldi Theatre, followed by Musical Selections by the Station Quintet. Quintet Selection: Prelude and Sicilienne from "Cavalleria Rusticana" (Mascagni). **7.30**, Time Signal, followed by Official Wireless Information. **7.40**, Talk on a Historical Subject. **8.0**, Relay of an Opera from the Scala Theatre; in the Intervals, Talk by Ulderico Tegani: "Town and Country" and Sports Intelligence and General News Items supplied by the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (**1,351 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.**, Divine Service relayed from **Stockholm**. **4.55**, Chimes relayed from the **Stockholm** Town Hall. **6.15**, "Easter": Play (August Strindberg). **8.15**, General News Bulletin and Weather Report and Forecast. **8.45**, Concert Programme. **10.0** (approx.), Close Down.

MUNICH (**536.7 metres**); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (272.7 metres) and **Nuremberg** (240 metres).—**9.0 a.m.**, Sacred Morning Recital. **10.0 a.m.**, Chimes relayed from Munich Town Hall. **10.10 a.m.**, Transmission of the Bavarian Weather Chart. **12.5**, Time, Weather Conditions and Forecast and Review of Forthcoming Programmes. **2.0**, Musical Programme. **5.0**, Talk. **7.0**, Concert by the Wireless Orchestra with the collaboration of Heinrich Knoti (Vocalist). **9.20** (approx.), News and Announcements. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (**333 metres**); 1.5 kW.—**8.30 a.m.**, Lesson in the French Language given by Professor Etienne Verdier. **9.0 a.m.**, Programme of Sacred Music. **3.45**, Programme for Children. **4.0**, Variety Programme of Vocal and Orchestral Selections. **4.30**, Time Signal. **7.30**, Il Radiogiornale. **7.50**, Report issued by the Naples Harbour Authorities. **8.0**, Time Signal. **8.02**, Popular Concert of Vocal and Instrumental Selections: Tenor Solo, "La donna è mobile," with Orchestral accompaniment, from "Rigoletto" (Verdi); In the interval, Selection from his Repertoire by E. Murolo. **9.0**, Sports Intelligence. **9.55**, Calendar and Survey of Programmes of the Week. **10.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (**458 metres**); 0.5 kW.—Programme relayed at intervals by the following stations: **Bordeaux PTT** (275 metres), **Eiffel Tower** (1,485 metres), **Grenoble** (416 metres), **Lille** (267 metres), **Limoges** (285 metres), **Lyons PTT** (478.2 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse PTT** (260 metres).—**8.0 a.m.**, General News Bulletin and Time Signal. **9.25 a.m.**, International Time Signal and Weather Report and Forecast. **1.30**, Orchestral Concert arranged by the General Association of French Wireless Listeners. **2.30**, Concert of Symphony Music relayed from the Assembly Hall of "Le Journal." **4.0**, Pasdeloup Symphony Concert relayed from the Théatre des Champs Elysées conducted by M. Rhené Bâton. **6.30**, "Le Radio Journal de France." **8.15**, Talk arranged by the Union of French Associations. **8.30**, Orchestral Concert followed by Late News and Announcements, Time and Meteorological Report. **10.20**, Finish of the Six Days' Race relayed from Le Velodrome d'Hiver followed by Dance Music from the Colisemn de Paris. **12.0 Midnight**, Close Down.

PARIS (Eiffel Tower), Call FL (**1,485 metres**); 5 kW.—**7.56 a.m.**, Time Signal on 32.5 metres. **9.26 a.m.**, Time Signal on 2,650 metres. **7.10**, Weather Report and Forecast. **7.20**, "Le Journal Parlé," including Police History, Sports Chronicle, General News Bulletin and Racing Results, supplied by "Paris Sport." **7.56**, Time Signal on 32.5 metres. **8.0** to

Sunday, March 24th.

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

9.0, "La jalousie de Barbouillé"—Farce (Molière). **10.26**, Time Signal on 2,650 metres.

PARIS (Petit Parisien) (**336.3 metres**); 0.5 kW.—**8.45**, Gramophone Selections. **8.50**, Talk. **8.55**, General News Bulletin. **9.0**, Orchestral Concert, with the collaboration of Artistes of the Opéra and the Opéra-comique. **9.25**, News and Announcements. **9.30**, Programme of Symphony Music, under the direction of Prof. Estyle of the Paris Conservatoire: Conzertstück (Pfeiffer) for Harp and Orchestra; M. Vuillermoz, Soloist of La Société des Concerts du Conservatoire at the Harp. **10.0**, Late News and Announcements. **10.10**, Concert of Orchestral Music. **11.0** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (**1,744 metres**); 15 kW.—**8.0 a.m.**, General News Bulletin and Review of Press. **8.30 a.m.**, Daily Physical Culture Lesson, directed by Dr. Diffre. **12.0 Noon**, Sermon by Father Lhande, followed by Concert of Sacred Music. **12.30**, General News Bulletin. **12.45**, Concert by the Albert Locatelli Orchestra: Intermezzo (M. Delnas-Chapelier). In the Interval, Humorous Interlude by Bilboquet. **3.30**, Concert of Gramophone Records, supplied by "L'Industrie Musicale"; News from the Press in the Intervals. **5.0**, Lenten Address, pronounced by Father Pinard de la Boulaye, relayed from Notre Dame de Paris. **6.30**, Agricultural Chronicle. **6.45**, Concert of Gramophone Selections. **7.45**, Radio Paris Circus. **8.30**, Concert by the Wireless Orchestra; Late News and Announcements in the Intervals. **10.30** (approx.), Close Down.

PITTSBURGH, Call KDKA (**63 and 27 metres**); 25 kW.—**4.0**, Sessions Clock Chimes. **4.1**, Relay of Divine Service. **6.29**, Time. **6.30**, Allegheny County Memorial Park Programme. **7.0**, The Roxy's Symphony Concert, relayed from **New York**. **8.0**, Symphony Music by Mu-Sol-Dent Orchestra. **9.0**, Organ Recital by Dr. Charles Heinroth. **9.30**, Relay of McKinney Manufacturing Co. Programme, from **New York**. **9.45**, Evensong relayed from the Shadyside Presbyterian Church: Sermon by the Pastor, Hugh Thomson Kerr. **11.0**, Time. **11.1**, Orchestral Concert relayed from the William Penn Hotel. **11.30**, Whittall Anglo-Persians Programme, from **New York**. **12.0 Midnight**, Sessions Clock Chimes. **12.1 a.m.** (Monday), Divine Service, relayed from the Calvary Protestant Episcopal Church: 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, relayed from **New York**. **2.15 a.m.**, Utica Jubilee Singers, relayed from **New York**. **2.45 a.m.**, El Tango Romantico, relayed from **New York**. **3.15 a.m.**, Longines Time, relayed from **New York**. **3.16 a.m.**, Champion Weather Report. **3.20** (approx.), Close Down.

POSEN (**336.3 metres**); 1.5 kW.—**9.15 a.m.** to **10.45 a.m.**, Morning Service Relay. **11.10 a.m.**, Time Signal. **11.15 a.m.** and **11.35 a.m.**, Talks for Agriculturalists. **11.55 a.m.**, Address for Peasant Women. **5.20**, Vocal Recital by M. Jean Romanovsky (Baritone) with M. Mieczyslav Mierzejevsky at the Piano: Aria from Verbum nobile, Opera (Moniuszko). **6.0**, Report of the Catholic League of Polish Youth. **6.20**, Talk, relayed from **Warsaw**. **6.45**, Talk: Silva rerum, by B. Busiakiewicz. **7.5**, Various Items. **7.30**, Evening Concert; in the Interval, Literary Talk, relayed from **Warsaw**; Theatre and Cinema Notes and News and Announcements. **9.0**, Time Signal, followed by Sports Results. **9.20**, Concert of Light Music. **11.0** (approx.), Close Down.

ROME, Call 1RO (**443.8 metres**); 3 kW.—**8.30 a.m.**, Opening Signal. **8.32 a.m.**, Lesson in the German Language. **9.0 a.m. to 9.45 a.m.**, Vocal and Instrumental Programme of Religious Music. **10.0 a.m.**, Talk on Dante's "Purgatorio," relayed from the Casa di Dante. **12.0 Noon**, Opening Signal. **12.5 to 1.0**, Concert of Trio Selections. **1.0 to 4.0**, No Transmission. **4.0**, Opening Signal. **4.5 to 5.30**, Popular Concert of Variety Music. **6.50**, News and Announcements and Agricultural Information. **7.15**, Review of Sporting Events and Miscellaneous Announcements. **7.29**, Time Signal. **7.45**, Transmission of "Un Signore senza pace" Operetta in Three Acts (Music by Dino Rulli); after the First Act, Short Story Reading; after the Second Act, Review of Fashions for Women. **9.50**, Latest News from the Press. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (**19.56 metres**); 30 kW.—**12.0 Midnight**, Old Company's Programme relayed from **New York**. **12.30 a.m.** (Monday), Capitol Theatre Programme relayed from **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 Atwater Kent Hour from **New York**. **3.15 a.m.**, Relay of Studebaker Programme from **New York**. **4.15 a.m.** (approx.), Close Down.

SEVILLE (Union Radio), Call EAJ5 (**369.9 metres**); 2 kW.—**2.0**, Concert by the Wireless Orchestra, followed by New Gramophone Records and Selections of Spanish Music. **3.0 to 9.30**, No Transmission. **9.30**, Popular Concert by the Wireless Orchestra, followed by Flamenco Songs: El Trust de los Tenorios—Jota (Serrano), rendered by Sr. Arévalo (Baritone). **11.30** (approx.), Close Down.

TOULOUSE (Radiophonie du Midi) (**389.6 metres**); 8 kW.—**12.45**, Popular Concert. **1.0**, Time Signal. **1.5**, Concert (continued). **1.45**, General News Bulletin communicated by Le Télégramme, L'Express and Le Midi Socialiste. **8.0**, Stock Exchange Quotations from Paris, Cereal Prices from the Fournier Agency and News of the Day supplied by the Parisian Press. **8.30**, Musical Selections. **9.0**, Time Signal. **9.1**, Concert of Modern Dance Music arranged by the Music Publishers, Smith and Lawrence Wright, including "I can't give you anything but love": Foxtrot. **10.15**, News from North Africa, followed by Late News and Announcements. **10.30** (approx.), Close Down.

VIENNA (**519.9 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 Organ Music. **10.0 a.m.**, Musical Programme. **2.30**, Experimental Transmission of Pictures. **5.35**, Concert of Chamber Music: String Quartet in E Minor, Op. 59, No. 2 (Beethoven); followed by Concert of Light Music and Experimental Television Transmission. **10.30** (approx.), Close Down.

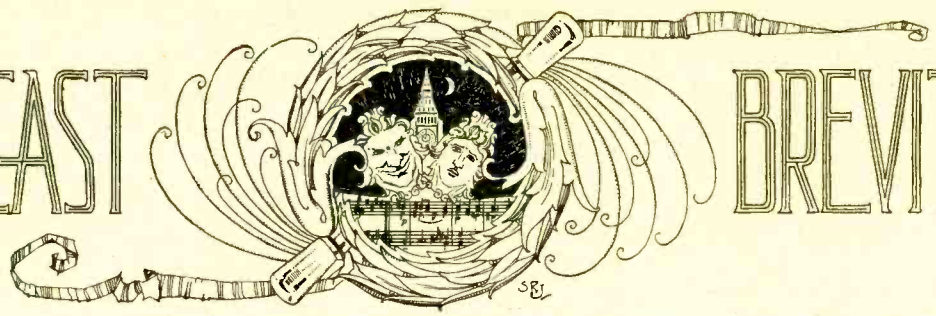
VILNA (**456 metres**); 1.5 kW.—**9.15 a.m. to 10.50 a.m.**, Relay of Morning Service from a Cathedral. **10.56 a.m. to 4.30**, Programme from **Warsaw**. **10.56 a.m.**, Time Signal, followed by General News Bulletin. **11.10 a.m.**, Relay of Orchestral Concert: Selections from "Parsifal": Opera (Wagner) rendered by the **Warsaw** Philharmonic Orchestra, conducted by J. Oziminsky. **1.0 to 2.0**, Three Agricultural Talks. **2.15**, Relay of Concert by the **Warsaw** Philharmonic Orchestra. **4.55**, Historical Talk relayed from **Warsaw**. **6.56**, Time Signal relayed from **Warsaw**. **7.0**, Talk. **7.30** (approx.), Musical Selections. **9.0**, Aerial Route Conditions and Weather Report and Forecast relayed from **Warsaw**. **9.20**, Police Communications and Sports Notes relayed from **Warsaw**. **9.30**, Concert of Dance Music from the "Oaza" Restaurant, **Warsaw**. **10.30** (approx.), Close Down.

WARSAW (**1385.7 metres**); 10 kW.—**9.15 a.m.**, Relay of Morning Service from a Cathedral. **10.56 a.m.**, Time Signal and Fanfare relayed from the Church of Notre Dame at **Cracow**, followed by Aerial Route Conditions and Weather Report and Forecast. **11.10 a.m.**, Concert by the Philharmonic Orchestra. **1.0 to 2.0**, Three Talks for Agriculturalists. **2.0**, Meterological Report. **2.15**, Symphony Concert relayed from the Philharmonic Hall. **4.20** (approx.), Talk. **4.55**, Talk. **6.0**, Various Items. **6.20**, Natural History Talk: "The Melancholy Story of the Bison and his Fellows," by Doctor St. Guminsky. **6.45**, General News Bulletin. **6.56**, Time Signal. **7.0 to 7.20**, Talk: "Intellectual diversions" by Lieut. Jablonovsky. **8.30**, Evening Concert. **9.0** (approx.), Aerial Route Conditions and Weather Report and Forecast. **9.5**, Late News Bulletin. **9.20**, Police Communications and Sports Notes. **9.30**, Programme of Dance Music from the "Oaza" Restaurant. **10.30** (approx.), Close Down.

ZAGREB (**308.3 metres**); 0.7 kW.—**10.30 a.m.**, Concert of Popular Music. **4.0**, Dance Music Programme. **6.45**, Communications and Notes from Educational and Cultural Societies. **7.0**, An Opera relayed from the Zagreb National Theatre In the interval, at **8.50** (approx.), Press News and Announcements and Weather Report and Forecast. **10.0** (approx.), Close Down.

ZÜRICH (**489.4 metres**); 1 kW.—**10.0 a.m.**, Concert by the Station Orchestra. **11.29 a.m.**, Weather Report and Forecast. **11.30 a.m.**, Concert of Gramophone Records. **3.0**, Relay of Concert by the Carletti Orchestra from the Carlton Elite Hotel. **6.30**, Time Signal. **6.33**, Protestant Sermon. **7.0**, Musical Programme relayed from the Grossmünster, with the collaboration of Alice Frey-Knecht (Vocalist), Viktor Schlatter (Organist), Julius Bächi ('Cellist) and Hermann Hofmann (Conductor). **9.0**, General News Bulletin and Information supplied by the Neue Züricher Zeitung.

BROADCAST BREVITIES



By Our Special Correspondent.

Seeking an Acoustic Paradise.—Better Hospital Sets.—New Broadcasting Game.—Disembodying the B.B.C.

Captain West's Organ.

Captain West, the B.B.C. research chief, is seated these days at the organ. Far from being weary and ill at ease, however, he is filled with the hope that usually precedes experimental enterprise. He tells me that the organ is nearing completion.

It has not been necessary to guard this instrument from the jealous eyes of the Programme Department. Its entertainment value is about nil. It consists of a row of flue pipes fixed in a frame, the whole contrivance being easily portable.

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Seeking Another "Eastbourne."

Captain West's plan is to tour the country in search of the ideal "O.B." point. With the use of the organ the acoustic characteristics of any hall can be readily determined, pronounced resonances on any particular frequency being immediately apparent. If they could be overcome as easily as they can be detected the job would be easy. Unfortunately, in eliminating one resonance it is often found that new and worse ones are introduced.

However, if Captain West can find another Eastbourne we shall take off our hats to him.

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Standardised Sets for Hospitals?

Last year *The Wireless World* drew attention to the poor condition into which many hospital sets had fallen. Some had become obsolete, while others were suffering from neglect.

The B.B.C. splendidly responded by sending engineers to each hospital in turn. I hear that the tour is now nearly completed and that the engineers have learnt a great deal from their experiences.

A standard specification for hospital sets is being drawn up and will shortly be published. As there are all kinds of buildings to be considered, from cottage hospitals to large general hospitals, the specification will be based on the unit system.

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"S.R." or Simultaneous Reception.

Just as a man thrown to the vipers begins in his madness to fondle the creatures, so people on the South Coast are throwing kisses to Continental broadcasting stations and the Brussels scheme. Abandoning all ideas of selectivity, there are persons, I am told, who now concentrate on collectivity, enlarging their aerials and broadening their tuning with the sole object of beating their neighbours at the game of simultaneous reception. Apparently the man who can hear eight stations at once to his neighbour's seven wins the halfpenny. N.B.—Spark stations don't count.

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The Ceaseless Combat.

The constant struggle between *Radio Toulouse* and its neighbour, the Posts and Telegraphs station, pursues two parallel courses. On the one hand there is the conflict over programmes; all France was entertained recently by the skirmish over the officially forbidden broadcasts from the Capitol Theatre and the subterfuge of *Radio Toulouse* in installing a short-wave transmitter in the theatre. On the other hand there is the perpetual battle of wavelengths, summarised in a diary just published in the French journal *Fantasio*. The record reveals the P.T.T. station in the *rôle* of a bloodhound never more than a few metres from luckless *Radio Toulouse*. If the latter drops to 425 metres the former is on its heels in the region of 420. A further flight to 270 brings the Post Office down to 260. *Radio Toulouse* has just moved to 382.2 metres, but so far P.T.T. has failed to respond, and *Radio Toulouse* is wondering what the snag may be.

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The Urge for Power.

More kilowatts will be cast upon the European ether at the end of this month when the new 60 kW. Telefunken station at Oslo begins testing. The Continent is becoming rapidly covered with high-power stations double the strength of 5XX.

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The Craze for Anonimity.

It is hardly surprising that the B.B.C. has had to make apologetic explanations to the Press regarding the astounding decision of Mr. Val Gielgud to withhold the names of broadcast actors. It is now stated that the decision only applies to plays written specially for broadcasting.

Rumour has it that the next step will be the appointment of an anonymous Board of Governors with a disembodied spirit in the *rôle* of Director-General.

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The Boat Race.

The commentary on the Boat Race on Saturday next will be broadcast by Mr. G. Wansbrough, assisted by Mr. J. C. Squire, who will give a "word-picture" of the towpath scenes, and possibly administer verbal bromide for listeners who might otherwise swoon with excitement.

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Four Hours of G.B.S.

"Saint Joan," the first of Shaw's full-length plays to be broadcast, will be given from 2LO in two parts on April 25th and 26th. The first night's performance on April 25th will take the play as far as the end of the scene before Orleans, and on April 26th the second part will open with the "Tent" scene between the Earl of Warwick and the Bishop of Beauvais.

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This Year's "Proms."

Although he will take a leading part in the formation of the National Symphony Orchestra, Sir Thomas Beecham will not monopolise the conductor's rostrum. Many leading conductors have been asked to co-operate, including Sir Henry Wood, who, however, has decided to restrict his broadcasting activities to the conductorship of this year's "Proms."

FUTURE FEATURES.

London and Daventry.

MARCH 27TH.—"Ivanhoe," an opera by Arthur Sullivan.

MARCH 28TH.—"Good Friday," a play by John Masefield.

MARCH 30TH.—"Samson and Delilah," played by the British National Opera Company.

Daventry Exp. (5GB).

MARCH 26TH.—An Hour of Requests.

MARCH 28TH.—"St. Matthew Passion" (Bach), relayed from the Town Hall, Birmingham.

Cardiff.

MARCH 29TH.—Cardiff Musical Society Concert.

Manchester.

MARCH 28TH.—A Programme of Marches and Waltzes.

Newcastle.

MARCH 26TH.—"The Last Man In," a play by W. B. Maxwell.

Glasgow.

MARCH 28TH.—A Shakespearean Programme.

Aberdeen.

MARCH 29TH.—A Good Friday Concert.

Belfast.

MARCH 29TH.—"The Kingdom," an oratorio by Sir Edward Elgar.

WORLD-WIDE TELEPHONY

Successful Short-wave Service Between Holland and Java.

By A. DE HAAS,
Eng. P.T.T. Dep., Java.

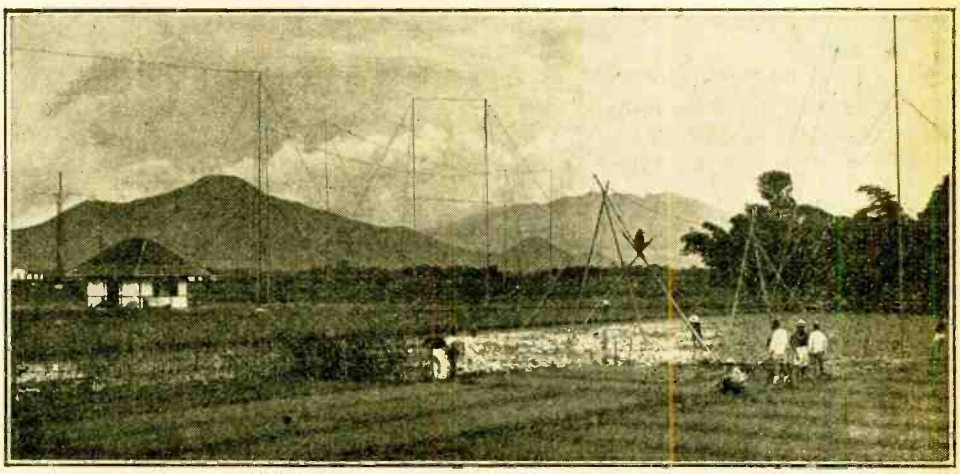
SHORT-WAVE listeners will undoubtedly have observed the regular wireless telephone conversations between Holland and Java, which for more than a year and a half preceded the opening of the first public service on January 7th, 1929. Soon after the beginning of these tests it was realised that in establishing a regular service the problem of reliable reception had to be considered as the most difficult part. Short-wave long-distance reception is interfered with particularly by fading, which at times makes speech reception quite impossible, and in addition, especially on the Java side of the circuit, trouble is experienced by heavy atmospheric disturbances which sometimes rise to a very high level, even on the shortest waves employed. Another phenomenon which had to be considered is the presence of the so-called atmospheric "mush," a continuous hissing, the level of which rises and falls with the incoming carrier strength of the station to be received.

At the start of preliminary tests in June, 1927, the main difficulty seemed to be the severe fading to which the signals are liable, and the author commenced his observations on this subject at that time, at the central receiving station Rantja-Ekek, a native town near Bandoeng, Java. Different receiving sets were tried, some of them using different antenna, located some hundred feet apart. It was found experimentally in course of these tests that fading did not occur simultaneously on sets using separate antennas. For instance, if two receiving sets, tuned to the same transmitter and using antennas which are separated by, say, one wavelength, are connected to two loud speakers, it is quite easy to observe that the respective volume from these loud speakers varies continuously. These results gave rise to the establishing of the so-called anti-fading receiving equipment at the Rantja-Ekek station for the purpose of definitely testing out this phenomenon.

The Experimental Tests.

In neighbouring cottages, located some three or four hundred yards from the central point, receiving sets were installed, the low-frequency outputs of which were conducted by cable to the central point where a combining or mixing amplifier was installed. This instrument may be described as having a number of different and separate inputs and a combined output. After completion the instrument proved to be highly successful as a means of preventing fading to any serious degree. By combining four separate receivers at the low-frequency end, it has been possible to ensure reception without troublesome fading, even when fading on the separate receivers made speech almost unintelligible.

The system was, however, rather delicate to maintain in operation over long periods as the receivers were of the simplest type, consisting of detector and three stages of low-frequency amplification. In readjusting one of



Aerials for the Rantja-Ekek receiving station near Bandoeng, Java, being erected by native labour.

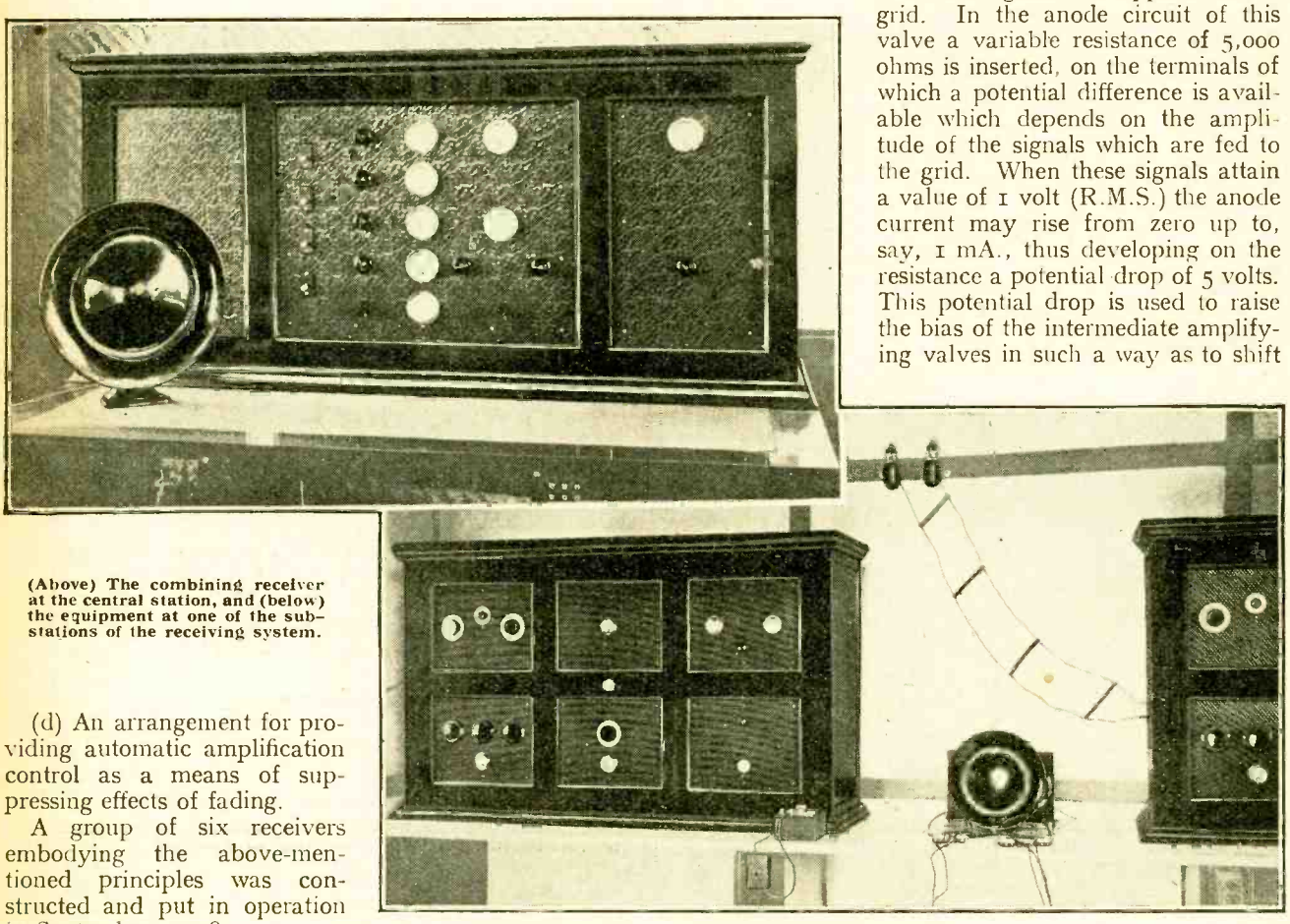
World-wide Telephony.—

the receivers, it might happen that it would start to oscillate and so jam the three other sets. It will be understood that trouble from atmospheric disturbances and "mush" was not removed by this arrangement. It is beyond the scope of this article to give a description of the many experiments which were carried out in an attempt to find a solution to these problems. As a result of these experiments it was realised that receiving sets had to be constructed incorporating the following features:—

(a) No radiation in the aerial circuit.

(b) Frequency changing of the carrier *plus* sidebands to an intermediate frequency in order to obtain the desired high-frequency amplification and for the filtering process.

(c) Very high but stable and easily variable degree of overall amplification to secure adequate volume even with weakest signals.



(Above) The combining receiver at the central station, and (below) the equipment at one of the sub-stations of the receiving system.

(d) An arrangement for providing automatic amplification control as a means of suppressing effects of fading.

A group of six receivers embodying the above-mentioned principles was constructed and put in operation in September, 1928.

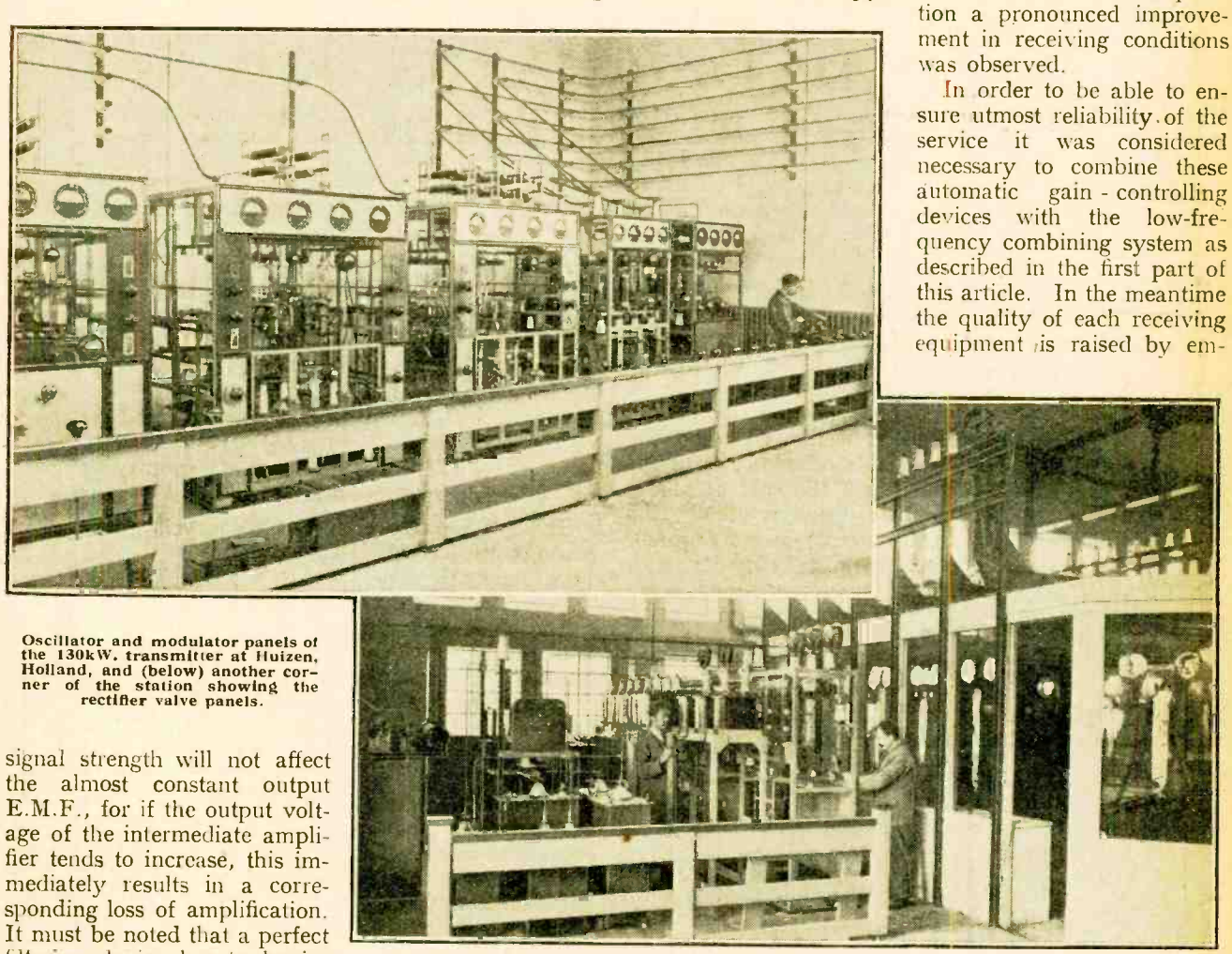
The first detector or modulator valve is preceded by one stage of high-frequency amplification, which serves mainly to prevent direct coupling between the aerial and oscillating circuit. High-frequency amplification is obtained with screened-grid valves, and the aerial circuit is perfectly free from radiation. The incoming carrier is now modulated by the (oscillating) first detector, the beat frequency occurring at about 50 kC. By means of tuned intermediate circuits the transferred carrier *plus* sidebands is subject to a band filtering process before reaching the intermediate frequency amplifier. After proper amplification band filtering is applied once more, and thence the signal is fed to the grid of the rectifying valve, which is of the anode-bend type.

Details of the Receivers.

The automatic gain-controlling device may be considered as a separate unit attached to the intermediate frequency part of the apparatus. The voltages which are applied to the rectifying valve are at the same time fed to the first grid of a two-stage amplifier, after which the signal reaches an E.M.F. of the order of 1 volt (R.M.S.), and this is applied to the grid of another anode-bend rectifying valve which has a negative grid bias so set as to keep the anode current at exactly zero when no signals are applied to the grid. In the anode circuit of this valve a variable resistance of 5,000 ohms is inserted, on the terminals of which a potential difference is available which depends on the amplitude of the signals which are fed to the grid. When these signals attain a value of 1 volt (R.M.S.) the anode current may rise from zero up to, say, 1 mA., thus developing on the resistance a potential drop of 5 volts. This potential drop is used to raise the bias of the intermediate amplifying valves in such a way as to shift their working point to the left of their characteristic curve, resulting in a decrease in sensitivity of the amplifier, which in turn lowers the amplitude of the outgoing current. The apparatus is now adjusted in such way that the lowering of amplification only comes into operation after the signal has reached a strength corresponding to adequate output volume at the end

World-wide Telephony.—

of the two-stage low-frequency amplifier which follows the second detector. As soon as the signal amplitude on the input side of the intermediate amplifier rises above this level, the potential developed on the anode resistance of the gain-controlling device reaches a value sufficient to reduce the amplification of the intermediate amplifier so that the outgoing amplitude of this unit remains practically constant. Any rise in incoming signal strength will not affect the almost constant output E.M.F., for if the output voltage of the intermediate amplifier tends to increase, this immediately results in a corresponding loss of amplification. It must be noted that a perfect filtering device has to be inserted between the point from which the potential drop of the gain-controller is fed and the grids of the intermediate amplifier, since the rectified current is built up by intermediate frequency pulsations. An elaborate low-pass filter is essential for this purpose, as otherwise self-oscillation would be set up.



Oscillator and modulator panels of the 130kW. transmitter at Huizen, Holland, and (below) another corner of the station showing the rectifier valve panels.

Combining the Outputs.

The gain-controlling action can be adjusted by altering the value of the anode resistance upon which the potential drop develops. The device therefore can be considered as a limiter, but it should be kept in mind that the noise level rises and falls inversely as the action of the gain-controller proceeds; during the period of greatest incoming signal amplitude the amplification is brought down to its lowest value, so the noise level will then be very low too. On the other hand, during the moments that the signal fades out, the gain-controller is out of action, and extraneous noises, static and mush are at maximum strength. It will be clear that for this reason this device can only be used up to a certain point, beyond which only an intolerable increase of the noise level during the signal minima would result. After the receivers of the type described had come into operation a pronounced improvement in receiving conditions was observed.

In order to be able to ensure utmost reliability of the service it was considered necessary to combine these automatic gain-controlling devices with the low-frequency combining system as described in the first part of this article. In the meantime the quality of each receiving equipment is raised by employing a directive aerial system of sufficient dimensions. It is a well-known fact that the use of directive receiving aerials is relatively of greater importance on the receiving side than on the transmitting side of a circuit. The use of a beam aerial on the receiving side *increases* the signal amplitude and at the same time *lowers* the noise level, so that the overall effect is considerable.

The telephony receiving plant as now completed at Rantja-Ekek receiving central comprises one central point and two sub-stations. Each sub-station contains a number of receiving sets of the type described, and for the principal wavelength to be received, viz., PCLL (Huizen) on 18.4 and 38.8 metres, complete directive aerials are constructed at two points. For the

World-wide Telephony.—circuits of minor importance, such as 2ME (Sydney), with which station only an experimental service is conducted, PCJJ (Philips Works), 5SW (Chelmsford), and others, directive aerials of considerably less elaborate design are adopted.

British readers may be interested to know that Chelmsford is received with excellent strength and quality. It is, however, regrettable that this station closes down between 1.30 p.m. and 7 p.m. G.M.T., this period being best suitable for reception in the Far East. Reception of PCLL, the corresponding station at Huizen, Holland, with an intelligibility sufficient for public telephone service, is possible from 11 a.m. till 5 p.m. G.M.T. on a wavelength of 18.4 metres, and from 3 p.m. till 1 a.m. G.M.T. on a wavelength of 38.8 metres, so that fourteen hours are available for a public telephony service.

USEFUL DATA CHARTS. (No. 23.)

Equivalent Resistance of a Tuned Plate Circuit.

WHEN an e.m.f. is applied to a tuned circuit so that the total current is divided between the coil and the condenser (see Fig. 1) the currents can be drawn as in Fig. 2; the capacity current is 90° ahead of the e.m.f.; the coil current lags by the phase angle, which is represented in Fig. 4, the slope being coil reactance/coil resistance. In a well-designed coil the phase angle is nearly 90°, and the coil and condenser currents are nearly 180° out of phase, so that their resultant (the total current) is very small. Though large currents may surge *round* the circuit, very little passes *through* it.

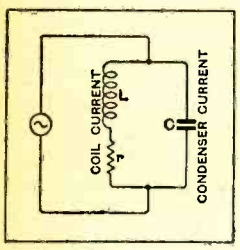


Fig. 1.—An alternator supplies current to a parallel tuned circuit; part of the total current passes through the coil and part through the condenser.

The coil current may be resolved into a horizontal and a vertical component (Fig. 3), and by varying the condenser the condenser current may be made equal to this vertical component, so that the vertical currents add up to zero and only the horizontal current is left.

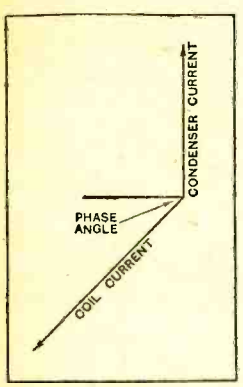


Fig. 2.—The condenser current leads the e.m.f. by 90° while the coil current lags by the phase angle.

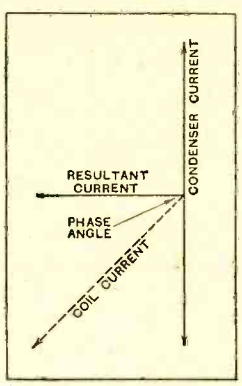


Fig. 3.—The coil current (dotted line) can be resolved into a horizontal and a vertical component.

Comparison of Figs. 3 and 4 shows that

resultant current/coil current = coil resistance/coil impedance,

so that the circuit behaves as if the condenser were abolished and the coil impedance multiplied by the ratio coil impedance/coil resistance.

Fig. 5 shows this equivalent circuit, which is a pure resistance, since the resultant current is in phase with the e.m.f.

At H.F. the coil resistance is negligible compared with its reactance, thus:

equivalent resistance = square of coil reactance/coil resistance,

or $[L \times 2\pi f]^2/r$,

or [henrys × 2π × cycles]²/ohms,

or [microhenrys × 2π × megacycles]²/ohms.

Thus, if L = 200 mics, f = 1 megacycle (300 metres), r = 12 ohms, the equivalent resistance is

$[200 \times 2\pi \times 1]^2/12$ = 131,000 ohms.

The chart finds the equivalent resistance when the reactance and resistance of the coil are known. The reactance can be found by Chart 6, and the resistance by Chart 20 or 21.

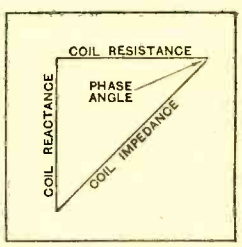


Fig. 4.—In a well-designed coil the phase angle is nearly 90° and the coil and condenser currents are nearly 180° out of phase. The slope in this diagram represents coil reactance/coil resistance.

The following table is useful as indicating the maximum equivalent loads which can be built up with ordinary coils and condensers at various frequencies; these figures can, however, be considerably exceeded by using stranded wire coils of large diameter.

Kilocycles.	Metres.	Ohms.
100	3,000	500,000
1,000	300	130,000
10,000	30	10,000

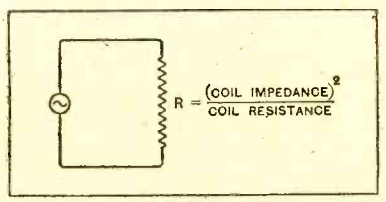
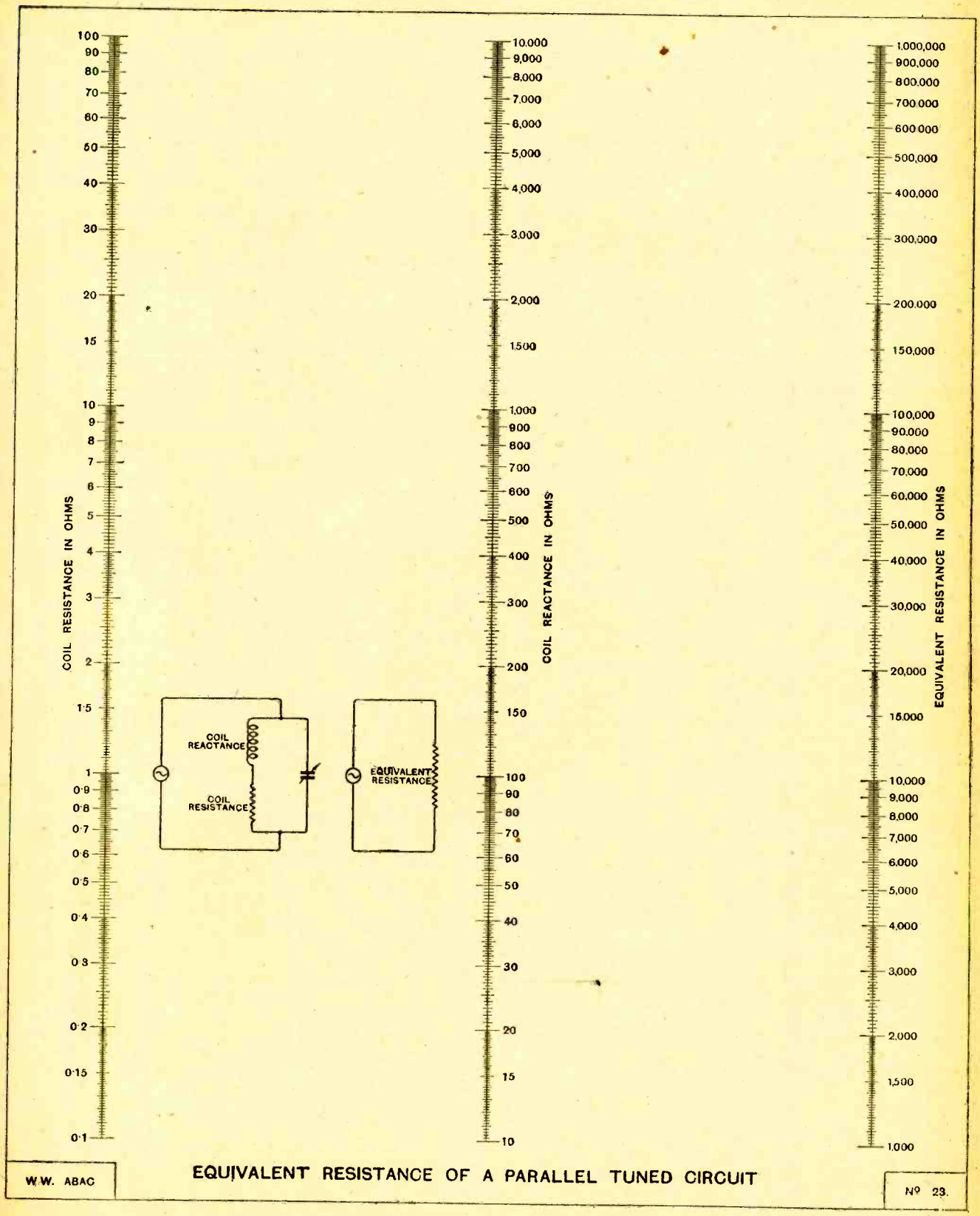


Fig. 5.—The equivalent of Fig. 1 when the circuit is tuned to the incoming frequency.

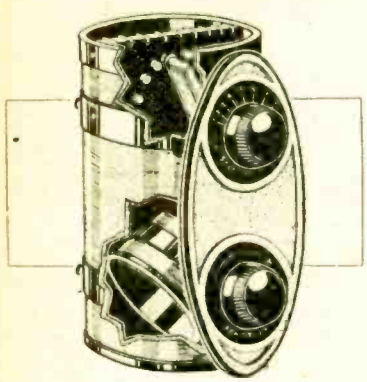


A Review of Manufacturers' Recent Products.

TAPPED AERIAL TUNING UNIT.

The tuner under review is a product of the British General Manufacturing Co., Ltd., Brockley Works, Brockley, London, S.E.4, and although this is not a new accessory it incorporates a number of novel features well worthy of mention. The general arrangement is a tapped single-layer coil wound on a 3in. diameter former with an internal cylindrical reaction coil at one end. At the other end is a totally enclosed 10-point switch. The control spindles for the reaction coil and switch extend beyond an oval-shaped front plate cleanly moulded from bakelite and terminating in moulded knobs 1¼in. in diameter. Both sides of the front plate carry embossed markings arranged so that the tuner can be mounted either horizontally or vertically. Four terminals are provided, one each for aerial and earth and two for the reaction coil.

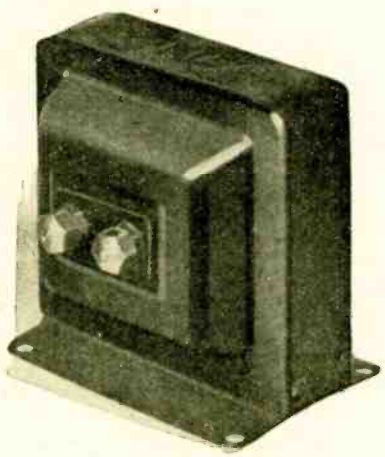
Full instructions for fixing are given on a leaflet enclosed in the carton, and to facilitate marking off the correct distance between the two fixing holes a drilling template has been printed on one side of the box. The unit tunes from 250 to 2,[illegible] metres with a 0.0005 mfd. variable condenser in parallel and connected to a standard P.M.G. receiving aerial. The price is 18s. 6d.



British General aerial tuner with reaction coil and built-in switch.

"STAL" L.F. TRANSFORMERS.

These transformers, which are of French origin, are obtainable through Messrs. Lester and Co., Ltd., 45, Fore Street, Moorgate, London, E.C.2. They are obtainable in three ratios—3 : 1, 4 : 1, and 5 : 1, the price in each case being 6s. 11d.



"Stal" intervalve transformer, a low priced component available in three ratios.

Two specimens having ratios of 3 : 1 and 5 : 1 were submitted for test, and a measurement of the primary inductance indicated that the size of the primary is standardised for all ratios. The 3 : 1 transformer had a primary inductance of 2.0 henrys and the 5 : 1 an inductance of 1.96 henrys. These values are rather low, and, as might be expected, the reproduction of low notes, when using ordinary L.F. amplifying valves of medium impedance, was noticeably weak. In order to bring out the low notes a valve having an A.C. resistance of 2,000 or 3,000 ohms should be used. Such a valve would have a low amplification factor, and it would, therefore, be advisable to employ the 5 : 1 transformer.

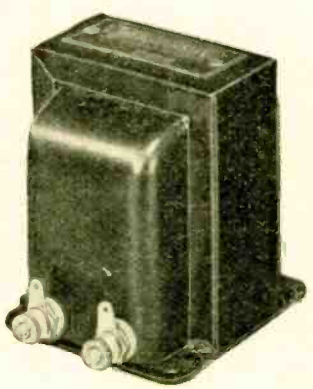
Another point to bear in mind is that a 3,000 ohm valve generally takes a fairly high steady anode current, and this will have the effect of reducing the inductance of the primary. An examination of the interior of the transformer reveals, however, that the iron core is of generous cross-section and the inductance is likely to be only slightly affected by the D.C. load. The use of a low impedance valve with the 5 : 1 ratio transformer should, therefore, give satisfactory results in the matter of low note reproduction. At frequencies above 1,000 cycles the reproduction is up to standard, even with the valves of comparatively high impedance.

The core and windings are shrouded in a steel case with an attractive dull black finish, and substantial hexagonal shaped terminals are provided for the primary and secondary connections.

o o o o

THORDARSON CHOKE.

This component is of American origin, and is obtainable in this country through the Rothermel Corporation, Ltd., 24 and 26, Maddox Street, London, W.1, the price being 12s. It is intended for use as a filter or output choke, and has a rated inductance of 30 henrys. A substantial iron core of ample cross-section is provided, and the current-carrying capacity is given as 80 mA.

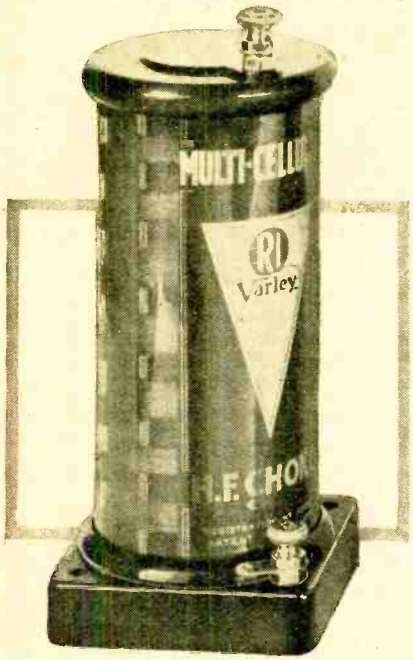


Thordarson type R-196 choke.

The inductance of the specimen submitted was measured at 920 cycles and was found to be 18.5 henrys without D.C. flowing through the winding. The D.C. resistance is 360 ohms.

R.I.-VARLEY MULTI-CELLULAR H.F. CHOKE.

In the construction of the R.I.-Varley H.F. choke considerable care has been taken to minimise self-capacity. The turns are wound on the "multi-cellular" principle, which involves not only



R.I.-Varley Multi-Cellular H.F. choke; D.C. resistance, 360 ohms.

the splitting up of the winding into sections, but also the spacing of individual layers in each section. The turns in each layer are also spaced by means of a thread wound simultaneously with the wire. A skeleton former with a minimum of supporting material is used, and the windings are protected from moisture by a celluloid cover.

The impedance curve of the choke is free from subsidiary resonances, and reaches a maximum at about 2,500 metres. The following table gives the impedance at representative broadcast wavelengths :—

Wavelength. (Metres.)	Impedance. (Ohms.)
200	11,000
500	23,000
1,600	212,000

The D.C. resistance is 360 ohms, which is a normal value for components of this type.

The overall height is 4⅜in., and the base, which measures 1⅞in. × 1⅞in., is drilled for horizontal or vertical mounting. The price is 9s. 6d.

o o o o

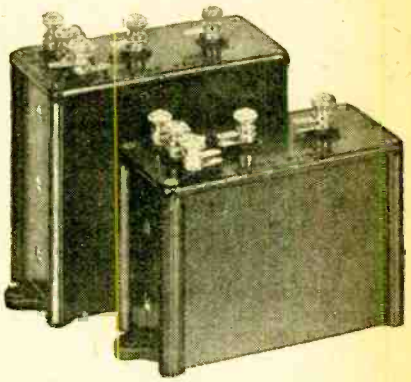
"WEARITE" FILTER UNITS.

It is now generally recognised that anode feed, or de-coupling, resistances are a necessary part of the make-up of a modern receiver, and unless the set follows a very simple design these safety devices are rarely omitted. Usually the additional components required are purchased separately, but Messrs. Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17, have now put int oproduction anode filter units consisting of the essential parts in a neat bakelite moulding.

These are available in two forms, one for the L.F. side of the set, and the other for use in H.F. circuits. These units must not be confused with the resistance-capacity intervalve coupling units, as they do not replace these, and it is essential to include a coupling device whether of the R.C. type or a transformer—in regard to L.F. circuits—in the usual manner.

Each unit is provided with five terminals for connecting in the circuit; these are marked E, P, H.T.1, 2 and 3. The by-pass condenser is connected between terminals P and E, one of 2 mfds. capacity being fitted in the L.F. filter, and a 0.01 mfd. condenser in the H.F. unit.

The de-coupling resistance is situated between terminals P and H.T.1, 2 and 3, and allows the choice of three different values, viz., 15,000, 30,000 or 50,000 ohms



"Wearite" anode filter units. The larger size is for use in L.F. circuits.

for the L.F. unit, and 10,000, 20,000, or 30,000 ohms for the H.F. unit.

The price of the L.F. filter is 9s. 6d., and the H.F. unit is offered at 8s. 6d.

o o o o

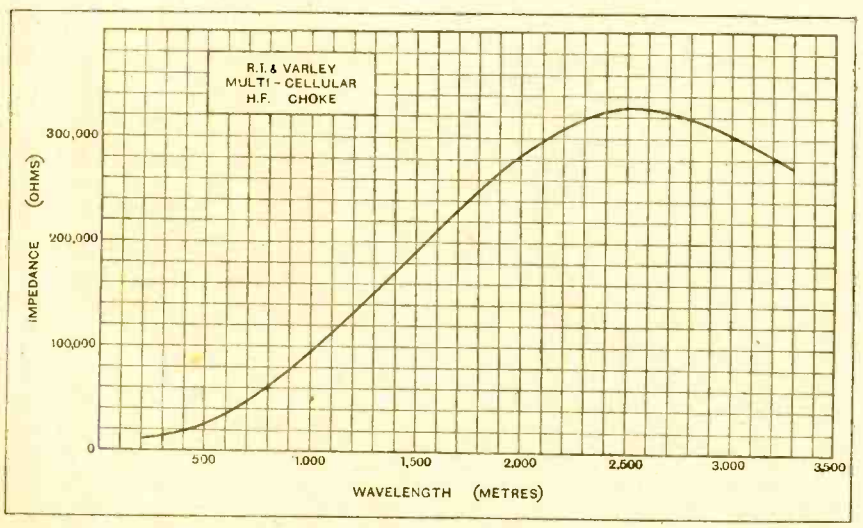
SIEMENS NEW GRID CELL.

It is rather surprising that so little attention has been given in the past to the perplexing problem of fixing a single grid cell satisfactorily to the baseboard, more especially as fixing devices have always received considerable attention in respect of most other components. The fact that fixing clips can be purchased separately only goes to prove that, so far as this component is concerned, this important point has been ignored.

Siemens new grid cell, size G.T., fitted with fixing tabs and two terminals.

Messrs. Siemens Bros. & Co., Ltd., of Woolwich, London, S.E.18, have made the first step towards a solution of this problem by putting into production a grid cell fitted with two stout cardboard tabs on the base, pierced with holes to facilitate fixing to a baseboard. This is to be known as the size G.T.; the dimensions being 1⅜in. × 1⅜in. × 2⅞in. over terminals, and the price is 9d.

In addition to the fixing tabs, a further modification that will be readily appreciated is the substitution of a small terminal for the short length of wire hitherto fitted as the negative connector



Impedance curve of the R.I.-Varley Multi-Cellular H.F. choke; external capacity 8 micro-mfd.

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.

Screening Boxes.

Is there any objection to using zinc in the construction of a screening case for a set with two H.F. stages? B. T. T.

This material will be found to be quite satisfactory, although it is more usual to use copper in cases where soldered joints are necessary.

○○○○

The "Two-Circuit Two."

My detector-L.F. receiver uses a modified "Reinartz" method of reaction control. I have modelled the coils on information that has appeared in your journal, and the reaction arrangement works well, being both smooth and reasonably constant over the wave-band covered. Unfortunately, however, selectivity is not so good as I could wish, and I have come to the conclusion that the best way of improving matters is to substitute a tuned aerial circuit for the present "aperiodic" system. Would the auto-transformer arrangement of the "Two-Circuit Two," described in the issue of February 6th, be applicable to my own set, or is it only suitable for a throttle-controlled "Hartley" set? F. W.

This method of coupling a tuned aerial circuit is not restricted to any particular arrangement, and it should work perfectly satisfactorily with your own set, but you must be prepared to experiment in choosing the best tapping point on the coil; the number of coupling turns suggested in the article to which you refer may not necessarily hold good in your own particular case.

○○○○

Control of Grid Voltage.

I understand that under certain conditions it is possible to improve the performance of a 2-volt screen-grid H.F. valve by applying a grid bias of slightly less than the voltage of a single dry cell. Is there any easy way of doing this? I am familiar with the usual potentiometer method, but should like something more compact.—L. D.

We know of no simpler way of obtaining critical control of grid bias, and think you will find it necessary to use a potentiometer; there is no need for this addition to occupy much space if you use a semi-adjustable component of the type sold for detector bias regulation. This would be connected as shown in Fig. 1. By joining the positive side of the bias cell (1½ volts) to the tapping point which includes one-third of the total resistance of the winding, an opposing voltage equal to one-third of your L.T. voltage is applied, and grid bias will amount to approximately 0.8 volt. If connection is made to the centre point the effective bias will be 0.5 volt. The addition of a large by-pass condenser (marked C) is to be recommended.

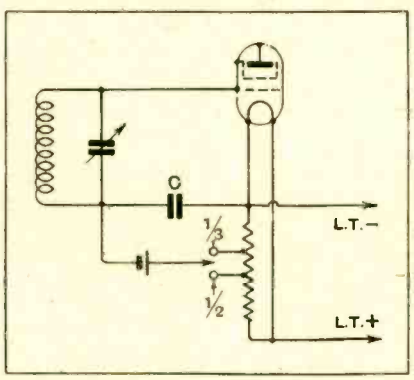


Fig. 1.—Use of tapped potentiometer for regulating grid voltage.

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A Simple Conversion.

Will you tell me how an existing set, normally operated with an outside aerial, may be modified for reception with a frame? E. M. N.

As a rule this modification does not present any difficulty; all you have to do is to replace the present grid coil of the first valve by the frame winding.

In sets without H.F. amplification matters may be complicated by the need for providing a reaction winding. Such receivers are hardly suitable for frame reception, except at comparatively short ranges; but, when it is desired to modify them, it is generally easiest to adopt the "Hartley" circuit, or a similar arrangement, with a centre-tapped frame.

We should add a word of warning; a set with H.F. amplification and a limited amount of screening may lack stability if the frame is mounted sufficiently close to allow magnetic interaction between it and the H.F. coupling coil.

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L.F. Choke Inductance.

I have an L.F. choke stated to have an inductance of 20 henrys when carrying 25 milliamps. I now propose to use it in a circuit where the current will be very much less than this (only 1 or 2 milliamps). Can it be assumed that its inductance will be very greatly increased when it is used in this way? M. D. P.

There is certain to be some increase of inductance under the new working conditions, but it is impossible to be definite as to its extent, as a good deal depends on the design of the iron circuit. We think you would be well advised to get in touch with the makers, who very probably have full information on this subject.

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The Best "Earth."

In an attempt to improve reception I am thinking of changing my present water-pipe connection, and substituting a buried earth plate. Is this likely to be worth while? F. F.

Provided your present connection is reasonably direct, and is made to a "rising" supply pipe, we doubt very much if the buried earth will afford improved reception. It is only likely to do so if the surface area of the buried metal is large—at least several square feet.

○○○○

A Frame Aerial.

Will you please give me full instructions for making an efficient frame aerial suitable for working on medium- and long-wave broadcasting wavelengths? L. S. M.

We fear that it would be beyond the scope of the Information Department to supply full details, and we think our best course is to refer you to a published description which appeared in our issue of July 27th, 1927. If you have not got a copy of this back number, we suggest that you apply to our publishing office.

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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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CONTENTS OF THIS ISSUE.

BROADCASTING RELATIONS OVERSEAS.

SO long ago as 1899 Sir Ambrose Fleming, F.R.S., then Dr. Fleming, of University College, referred to the earliest achievements in wireless transmission and reception in the following words:—

"No familiarity with the subject removes the feeling of vague wonder with which one sees a telegraphic instrument, merely connected with a length of 150 feet of copper wire run up the side of a flagstaff, begin to draw its message out of space and print down in dot and dash on the paper tape the intelligence ferried across 30 miles of water by the mysterious ether"

This statement was made, of course, in reference only to wireless telegraphy, the possibility of wireless telephony never having been even considered at that date. But what is true of wireless telegraphy is equally true of a telephony transmission; the great wonder to the layman is the fact that communication becomes possible without any intervening link between the transmitter and the receiving station, and in broadcasting we have the added interest that transmissions being distributed irrespective of direction are receivable over a wide area by a multitude of listeners.

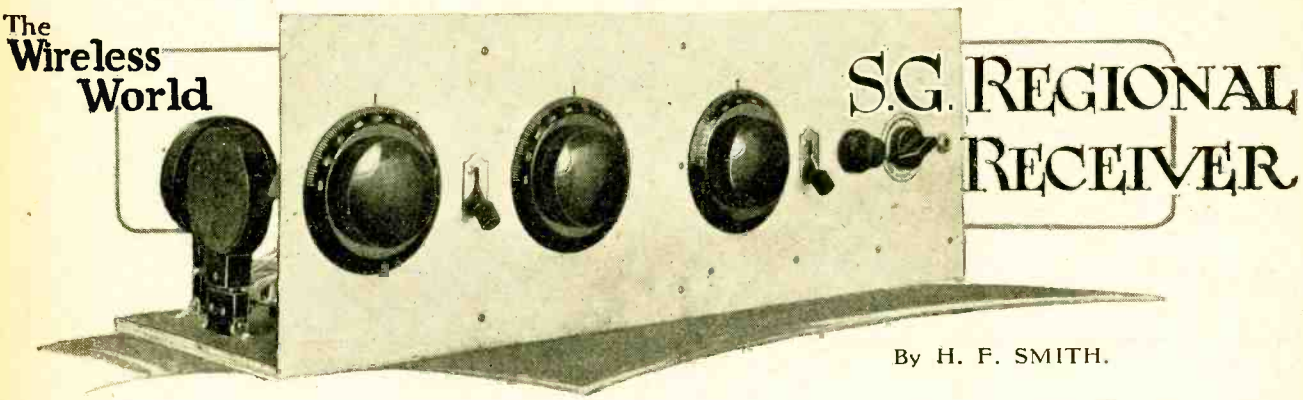
The broadcasting organisation in this country is developing schemes whereby it is hoped to provide an efficient broadcast service to every portion of these islands, but little or no progress is being made in any attempt at communication farther afield.

The whole policy of the B.B.C. seems to be directed towards restricting the range of their own transmitters so that they shall not extend overseas, and at the same time discouraging any interest in reception by the listener of stations abroad. Over a period of some weeks of careful listening to stations abroad we have had reports which confirm our own experience that Continental stations, even in the face of the somewhat chaotic condition which has resulted from the adoption (or perhaps the failure to adopt) the Brussels plan, are well worth listening to, and that the programmes are, in fact, often far more attractive than any alternative from our own local programme which can be obtained in this country.

Widening the Interest in Listening.

We believe that the popularity of broadcast listening throughout Europe would grow enormously if some of the present obstacles in the way of satisfactory reception of stations abroad could be overcome, even though it might mean a substantial reduction in the total number of stations at present working. Such a reduction would not necessarily mean that the listener would have fewer programmes to receive—in fact, quite the contrary effect would probably be produced, for the reason that every station eliminated from the ether in Europe would probably make the reception possible of at least two more stations, hitherto inaudible on account of mutual interference. The listener requires variety in programmes, and so long as the ether is congested as at present, the variety is hardly available even to those with powerful and extremely selective receivers.

A substantial reduction in the number of stations with permission to increase the power of those which remain is, we believe, the right direction in which to look for a solution of the present difficulties. The attraction of broadcasting is that it is capable of bringing you into instant touch with events as they are actually happening, and this is the great advantage which broadcasting has over the gramophone. The gramophone is, we are afraid, tending to usurp the place which wireless should retain for itself, because the programmes are not sufficiently diverse, nor have they adequate entertainment value, with the consequence that the listener is driven to depend instead upon his own choice, utilising the gramophone as his means of obtaining it.



The Wireless World S.G. REGIONAL RECEIVER

By H. F. SMITH.

A Selective General-Purpose Set.

AS long ago as August, 1927, the present writer, in a mood of inexcusable optimism, described a receiver[1] to which the title of "Regional" was given. Even now, after some eighteen months, the new scheme of transmissions has not come into being, but fortunately no harm has been done by thus anticipating events, and an apology is unnecessary; the selective type of three-valve H.F.-det.-L.F. set has proved itself as being capable of satisfying the needs of a large number—perhaps a majority—of wireless users. It is not a difficult matter to devise a simple circuit of this type that is practically immune from L.F. reaction, which is such a prevalent source of trouble with sets having two L.F. stages. Provided that its H.F. stage is a good one, the "1-v-1" set will consistently provide some two or three programmes under average conditions. In favourable circumstances, it will afford loud-speaker reproduction of distant transmissions, but for purely long-distance work, it is safer to say that a fourth valve (which may be either an H.F. or an L.F. amplifier) is desirable, if not necessary.

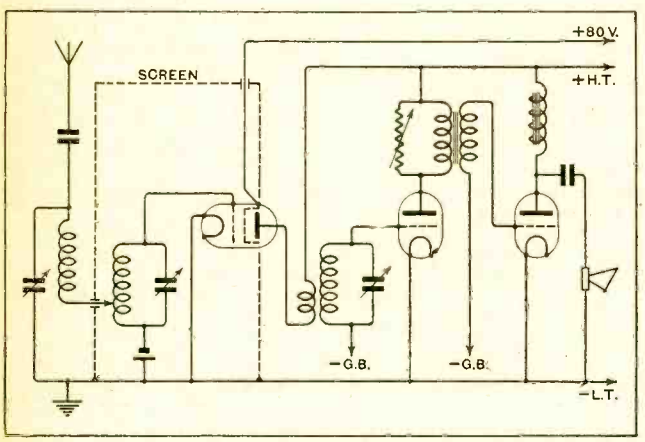


Fig. 1.—Simplified circuit diagram, without switching and decoupling devices.

Compared with its prototype, the receiver forming the subject of this article includes the same basic circuit arrangement, drastically modified to take advantage of modern developments and improved valves. Waveband switching, now regarded as almost essential for a general-purpose set, is included; this addition tends to complicate the circuit diagram, so it is reproduced in simplified form in Fig. 1. It will be seen that the coupled and separately tuned aerial circuit is retained, but in the improved form of an auto-transformer arrangement in which a few turns of the secondary coil are common to the aerial circuit.

A screen grid valve acts as an H.F. amplifier, and in order to attain high magnification it becomes necessary to provide fairly complete metallic shielding between its grid and plate circuits. Although the expedient adopted of totally enclosing the grid coil and its associated apparatus is theoretically inferior to the alternative plan of screening the plate circuit components, it affords perfect stability over the whole of both wavebands, and makes for easier construction and a more compact receiver.

Increased Overall Amplification.

A double-wound H.F. transformer is used in place of the alternative tuned-anode coupling, largely because it prevents any L.F. feed-back to the detector grid: this is an important advantage when the set is fed from an H.T. eliminator. The detector operates on the anode bend principle, and is linked to the L.F. amplifier by a step-up transformer, the primary of which is shunted with a variable resistance for volume control purposes. As the subject of these methods of detection and amplification in conjunction has recently[2] been dealt with at considerable length, it is unnecessary to dilate on the advantage of the scheme, beyond pointing out that a greatly enhanced amplification is obtainable as compared with the resistance-capacity coupling of the original set. This is mainly due to the voltage step-up of the transformer. It now becomes possible fully to load an L.F. valve of large power output without running any risk of overloading the detector.

In order to understand the operation of the waveband switching scheme, it is recommended that the

[1] *The Wireless World*, August 17th and 24th, 1927.

[2] "The Valve as an Anode Bend Detector," by W. I. G. Page, *The Wireless World*, March 13th (concluded in this issue).

S.G. Regional Receiver—

complete circuit diagram, Fig. 2, should be considered in conjunction with Fig. 1. Appropriate aerial loading coils (L_1, L_2) are thrown into circuit by action of the two left-hand blades of switch S_1. The next pole is

Decoupling resistances and by-pass condensers are provided for screening grid and anode circuits of the H.F. valve, and also for the grid circuit of the detector valve; an H.F. stopping resistance is also inserted in series with the L.F. amplifier grid.

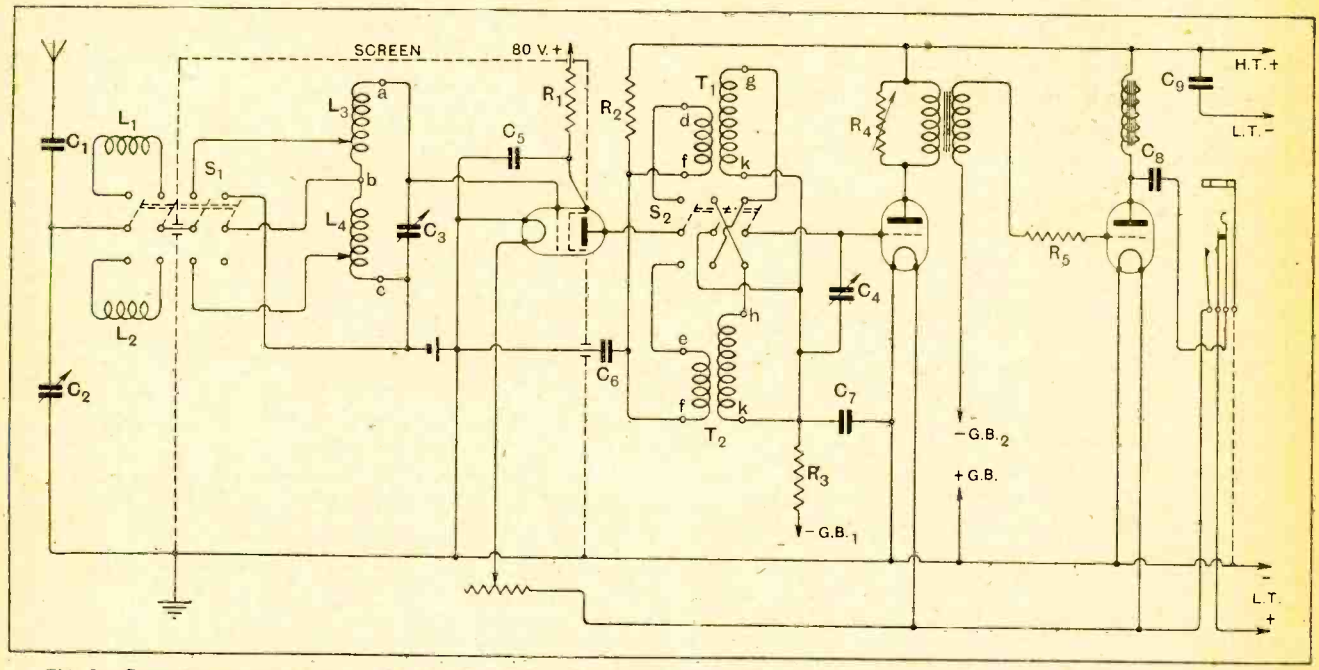


Fig. 2.—Complete circuit diagram. C_1, 0.00025 mfd.; C_2, 0.0005 mfd.; C_3, C_4, 0.0003 mfd.; C_5, C_6, C_8, C_9, 2 mfds.; C_7, 1 mfd. L_1, L_2, aerial loading coils: L_3, short-wave grid coil; L_4, long-wave grid coil. T_1, short-wave H.F. transformer; T_2, long-wave H.F. transformer. R_1, R_2, decoupling resistances, 600 ohms; R_3, 20,000 ohms; R_4, volume control resistance; R_5, 100,000 ohms.

arranged to transfer the "loaded" aerial connection to tapping points on the long- or medium-wave grid coils L_3, L_4; the latter winding is short-circuited by the remaining arm when it is in the medium-wave position (blades "up").

Switching of the intervalve H.F. transformers is carried out by S_2 on a somewhat different plan. Low-potential ends (from the "H.F." point of view) of primaries and secondaries are joined together, and, respectively, to H.T. positive and negative filament (the latter connection through the by-pass condenser C_7). The H.F. valve anode is joined to the centre left-hand contact, and thus may be connected at will to either primary winding; similarly, the detector grid is changed over to either secondary winding by the right-hand blade. Whichever secondary is out of use is automatically short-circuited by the remaining centre arm.

A jack, of the type known commercially as the "single open, filament control" pattern, is used both for switching on the L.T. battery and for joining the loud speaker; its frame is in contact with the earthed metal panel, and so the "return" connection required for a choke-filter output is automatically provided.

Where extensive screening is included in the design of a receiver, it is always more economical to use a panel of metal rather than of insulating material, the greater part of which will be wasted. In the present case, both panel and sub-base are of frosted sheet aluminium, No. 18 gauge, a single sheet of metal being bent at right angles to the shape shown in Fig. 3. Dimensions are given in this diagram and in Fig. 5, which shows the metal sheet before bending, and gives

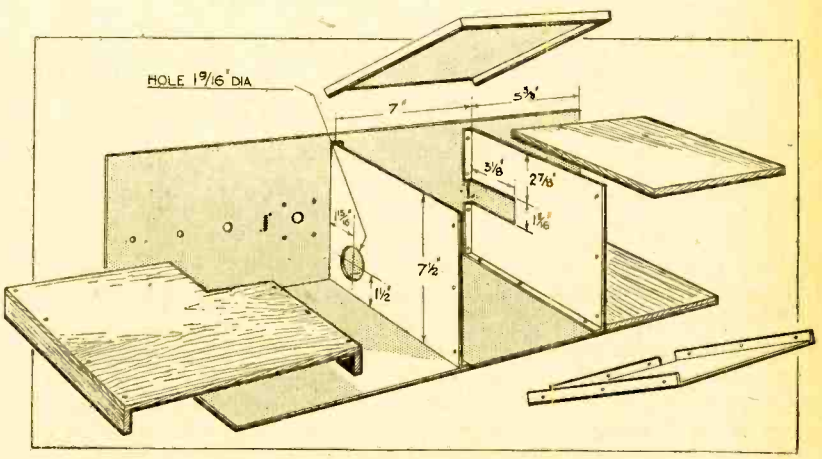


Fig. 3.—Construction of metal screens and baseboards.

S.G. Regional Receiver—

the positions of the various holes, etc. A screening box, of which both position and construction are shown in Fig. 3, is built on to the framework thus formed; it is made of aluminium of the same gauge, and is fitted with a removable lid and a back-piece so arranged that it may be secured in position by means of small screws and nuts after assembly and wiring is complete.

Each of the three "compartments" is fitted with a baseboard; those for the "aerial" and "H.F. grid" sections are simple strips of wood about $\frac{3}{8}$in. thick, but the platform for the left-hand compartment is raised on battens of 1in. in depth, in order that certain components may be mounted on its under-side. To provide room for the H.F. valve, which is mounted horizontally and projects through the screen, it is necessary to cut away one corner of this platform, the measurements of this aperture being $3\frac{1}{8}$in. by $2\frac{7}{8}$in. (the latter dimension is from back to front). A slot for the wave-changing switch S_1 and a hole for the valve must be cut in the sides of the screening box in the positions shown.

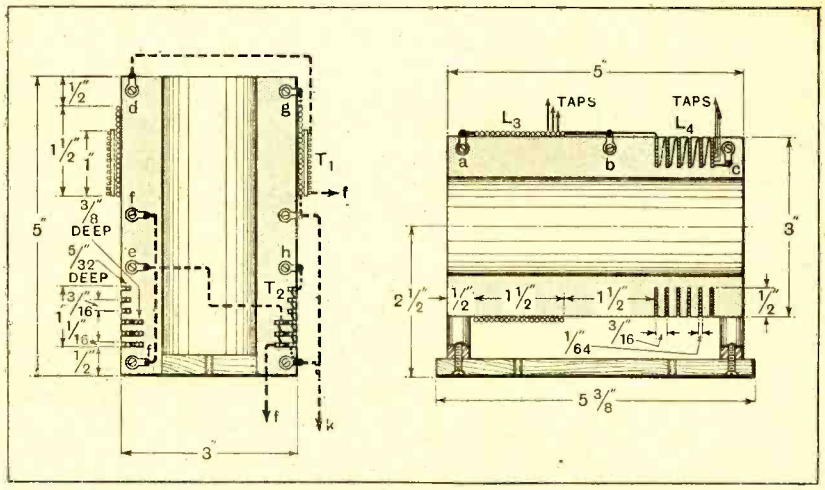


Fig. 4.—Sectional drawings showing construction of H.F. transformers and (right) long- and short-wave grid coils.

In order that the completed set may be inserted in a cabinet of conventional design, it is desirable that the under side of the metal base should be smooth; conse-

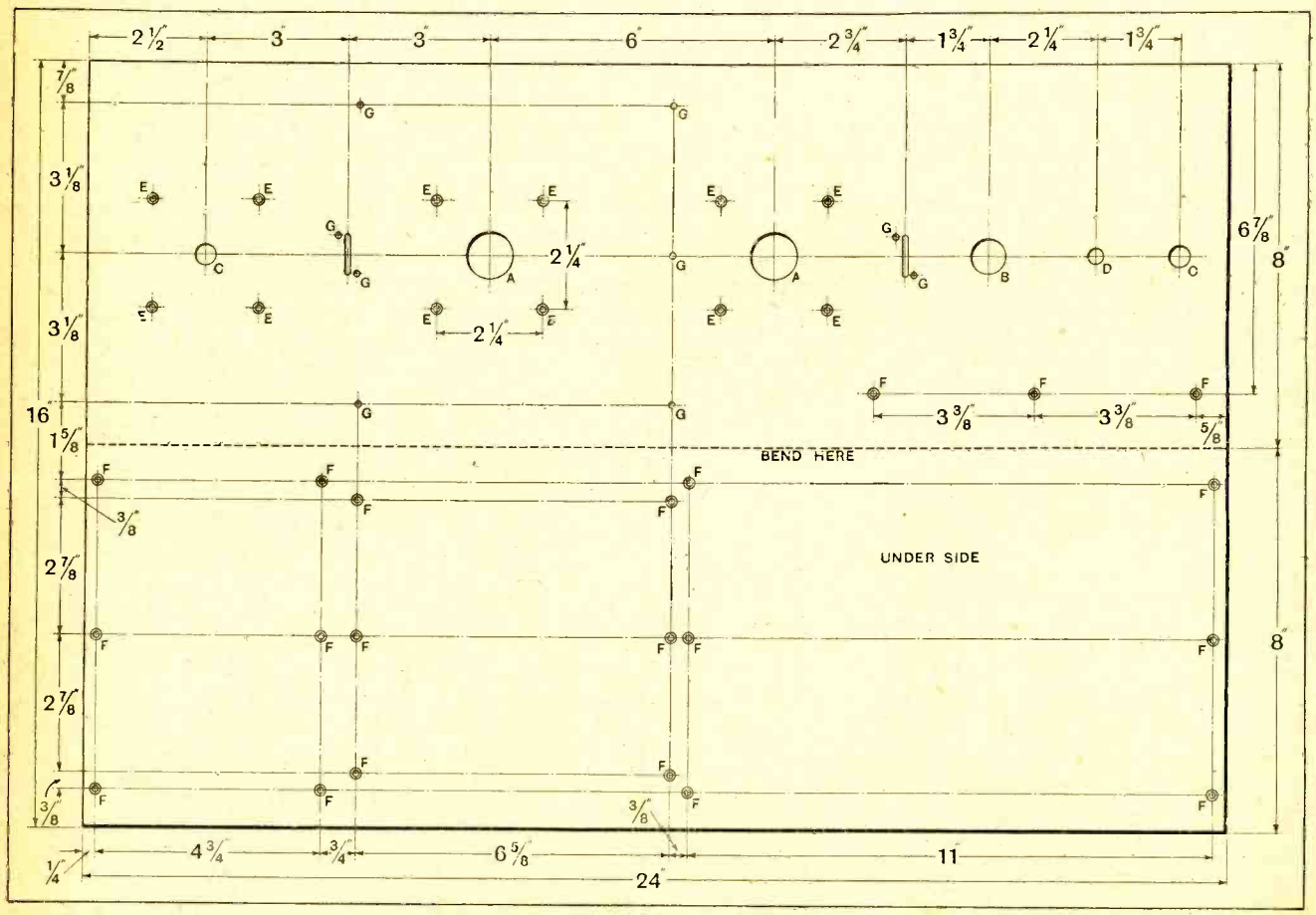


Fig. 5.—Drilling details of combined panel and base. A, 1in. dia.; B, 3/4in. dia.; C, 7/16in. dia.; D, 5/16in. dia.; E, 1/8in. dia., countersunk; F, 1/8in. dia., countersunk; G, 1/8 in. dia.

LIST OF PARTS.

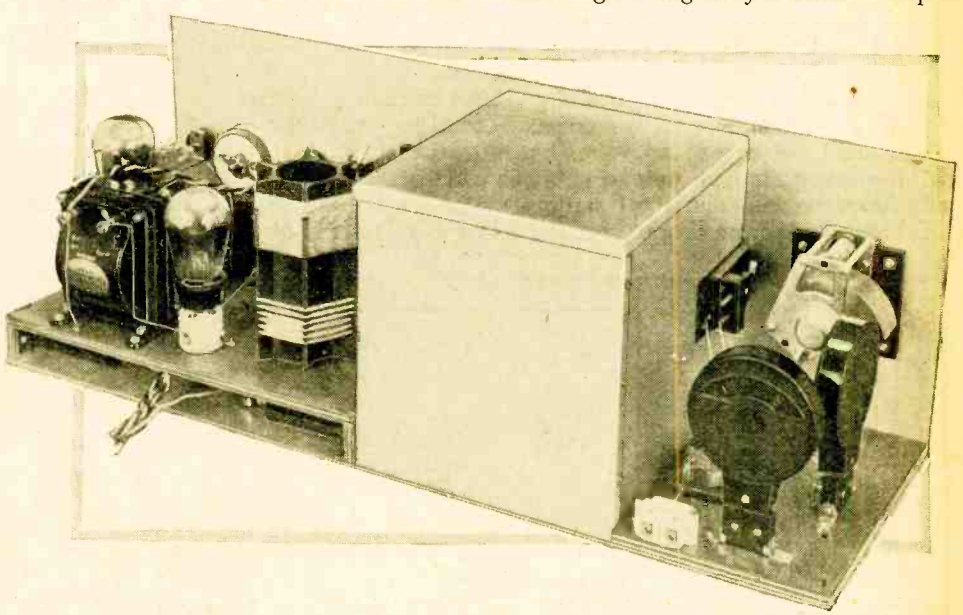
2 Variable condensers, 0.0003 mfd. (Polar "Ideal").
1 Variable condenser, 0.0005 mfd. (Polar "Ideal").
3 Fixed condensers, 2 mfd. (Ferranti; C2).
1 Fixed condenser, 1 mfd. (T.C.C.).
1 Fixed condenser, 0.00025 mfd. (Ormond R/144; air dielectric).
1 L.F. transformer (Ferranti; A.F.5).
1 L.F. choke, 32 henrys (Pye).
1 Variable resistance (Standard Clarostat: Claude Lyons, Ltd.).
1 Switch, 4-pole, change-over (Wearite; special type).
1 Switch, 3-pole, change-over (Wearite; special type).
2 Single coil holders (Lotus).
1 Terminal block, 2-way porcelain (Athol).
1 Dry cell (Ever-Ready; "O" size).
1 Valve holder, horizontal type (Aermonic, Type E).
2 Valve holders (Athol; porcelain).
2 Ribbed coil formers, 3in. dia., 5in. long (Redfern; deep rib type).
1 Jack, single open filament control (Edison Bell; R/166).
1 Rheostat, 30 ohms (Igranic-Pacent; porcelain).
1 Resistance, 100,000 ohms (Ediswan).
1 Resistance, 20,000 ohms (Ediswan).
2 Grid leak holders (Bulgin; porcelain).
2 Decoupling resistances, 600 ohms (Wearite).
Sheet aluminium for panel and screening box.
Wood for baseboard, ebonite, wire, screws, etc.

Approximate cost, without cabinet, £7 : 15 : 0.

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.

quently screws used for fixing the screening box and platform should be countersunk on this side. As a result the securing nuts of the screws will project above the upper surface, and so it will be necessary to cut holes in the baseboard to provide a clearance; if preferred, the boards may be reduced in size to occupy the spaces between the flanges. Possibly it will be found easiest to follow the method of construction adopted in the receiver illustrated; instead of using small bolts and nuts wood screws were passed through the metal base and the flanges of the vertical screens into the boards.

The making of this metal "chassis" and screens may seem to be a difficult task; actually, it is much easier than would appear, and is quite within the capabilities of the average handyman, provided that the metal sheet does not need flattening; that used for the receiver illustrated was obtained in a single flat sheet from the British Aluminium Co. Those who prefer not to undertake its construction will doubtless be able to buy a ready-made panel-screening box assembly from one of the firms that specialise in apparatus described in these pages.

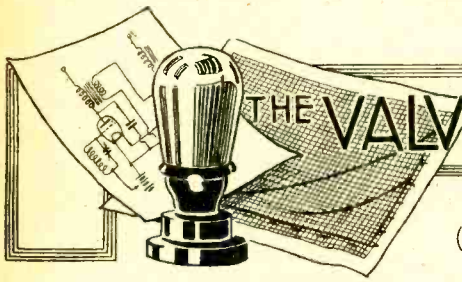


Rear view of the receiver. Note mounting of aerial-grid wave-change switch.

Coils and H.F. transformers are of vital importance in a receiver which, in the absence of reaction and a multi-stage L.F. amplifier, must perforce depend mainly for sensitivity on the effectiveness of its high-frequency amplifier. In the case of the present receiver, the aim has been to devise reasonably simple coils capable of providing as much amplification and selectivity as possible without introducing instability or serious high-note loss. At the same time, it has been necessary to keep dimensions within reasonable limits. These inductances, shown in section in Fig. 4, are wound on Redfern's deep-rib ebonite formers of 3in. diameter and 5in. in length in two separate assemblies. The first comprises the medium- and long-wave grid coils L_3 and L_4, and the second the complementary pair of H.F. transformers, T_1, T_2. This latter assembly is mounted vertically by the simple expedient of fitting a wooden plug into the lower end of the former and passing a screw through it into the baseboard of the set. The grid coil former is mounted on two short ebonite legs, bridged by a narrow strip of plywood; the height of the legs is arranged so that the windings are raised a clear 1¼in. above the baseboard.

Three soldering tags, marked *a*, *b*, *c*, are screwed to one of the upper ribs of the grid coil former in the positions indicated in Fig. 4. Eight tags are mounted on adjacent ribs of the H.F. transformer, and not on diametrically opposite ribs as suggested in the above-mentioned drawing, which is made out in this way to avoid confusion; their actual positions will be made clear in a diagram to be included in the second instalment of this article.

(To be concluded.)



THE VALVE AS AN ANODE BEND DETECTOR

(Concluded from page 283 of the issue dated March 13th.)

The Importance of Pre- and Post-Detector Volume Controls. The Question of the Loading of the Input Discussed.

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

IT was shown in the first instalment of this article that, with the deep average modulation which is now a standard practice of the B.B.C., for anode bend detection a valve should be chosen having a long, straight portion to its characteristic. By making use of practically all the curve available to the "left" of that point where grid current starts to flow—that is, by avoiding both underloading and overloading—it was stated that the detector would be worked under conditions of minimum distortion. If the working impedance of the valve is sufficiently low, a large stage amplification, together with reproduction of excellent quality, can be obtained by following the detector with a transformer having a primary of high inductance.

The maximum peak amplitude of an H.F. oscillation to be impressed on the grid of a detector biased to $-10\frac{1}{2}$ volts should not exceed 10 volts, but with the aid of high-frequency amplification an effort should be made, with transmissions from local stations, to prevent the signal amplitude from dropping much below this figure. It is a foregone conclusion that the few millivolts obtained from distant weak transmissions will be applied to the wrong part of the curve (see TU in Fig. 4), and all sorts of unwanted harmonics will be produced, but when the mush-to-signal ratio is large, does this matter?

The Value of the Detector Milliammeter.

In Fig. 8 the essential circuit details for a single H.F. stage containing a screen-grid valve followed by an anode bend detector are given. The milliammeter reading from 0 to 2 mA. is a very desirable component to be permanently incorporated in a receiver with anode bend detection, for by its diligent use not only can optimum rectification efficiency be assured, but also the effect of slight adjustment of any pre-detector circuit can be seen at once. It is, in fact, an uncalibrated valve voltmeter costing about £2, and, in the writer's opinion, is a better asset in a receiver when only one meter can be afforded than a higher-range milliammeter in the plate circuit of the last valve, for it can reveal many things that the ear cannot readily detect. Output-valve overloading is generally sufficiently distressing not to require visible indication of its presence. The reader will be surprised at the increase in average rectified current which may result from a slight alteration of grid bias for the screen-grid valve. Perhaps the earth connection can be improved or maybe the aerial insulation requires attention or the screen volts of the H.F. valve are too high.

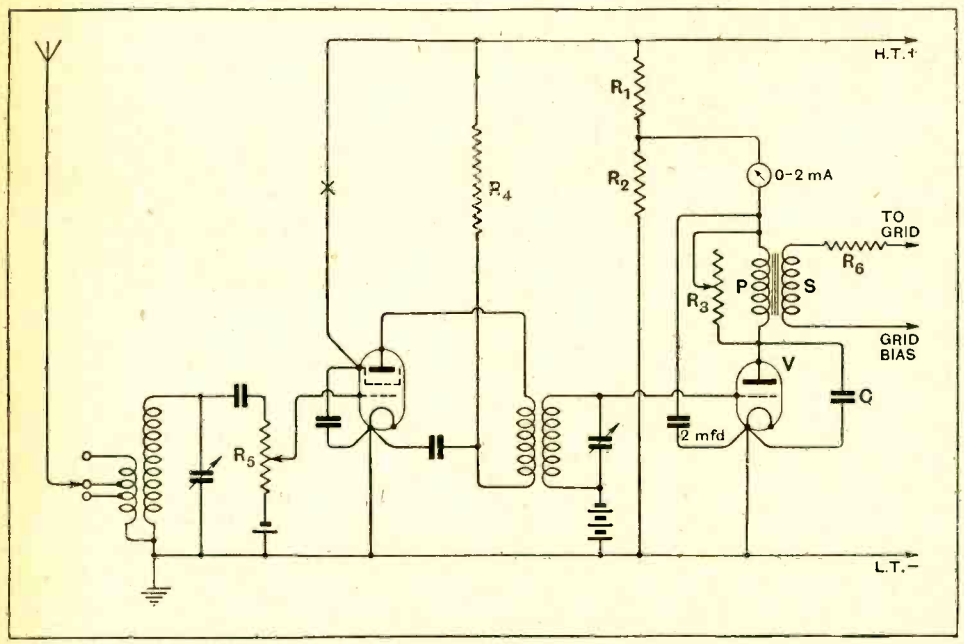


Fig. 8.—A suggested circuit containing a screen-grid valve followed by an anode bend detector. For local station reception pre- and post-detector volume controls (R_5 and R_3) are advised.

These points and many others which hitherto were the subject of speculation are now dealt with on a scientific basis, and very valuable alterations can be made, the combined effect of which may be greatly improved performance. When adjusting the

The Valve as an Anode Bend Detector.—detector, which we will assume is of the P.M.D. or D.E.L. class coupled to an efficient transformer (employing 150 volts H.T.), it is best to start by over-biasing to, say, 15 volts negative and gradually reducing the grid potential until the standing feed (with the aerial disconnected) is from 0.02 to 0.1 mA. The standing current must be small, for it produces a portion of unsuppressed negative half-cycle (see AO in Fig. 3), with the result that the plate pulsations in the detector will not be wholly uni-directional but will contain an alternating component. We will suppose that a standing current of 0.05 mA. flows when the bias is $10\frac{1}{2}$ volts; on connecting the aerial and tuning in a local transmission, the average anode current will rise to a maximum at resonance, and, provided the modulation peaks (see Fig. 4) do not cause grid current to flow, we must try to obtain as large a rise in anode current as possible. By inserting a microammeter in the grid circuit, as in Fig. 9, and taking an average for a number of valves of the type already mentioned (with 150 volts H.T. and $10\frac{1}{2}$ volts bias), it was found that grid current was *just* avoided when the anode meter read 1.2 mA. For this reason a meter reading from 0 to 1.5 mA. is ideal, but this range does not appear to be standardised commercially, and is therefore expensive.

When handling large signals, the bias within small limits is not so critical as it was in the days when square law anode bend detection was popular. It matters rather that the modulated fringe of the carrier should be impressed on the straight part of the characteristic and that the latter should be as steep as possible. The sharpness of bend is not of such paramount importance as the mutual conductance and the suppression of the negative half-cycle. It is a fact that 2-volt valves having short filaments with a minimum of potential difference across their ends have the best defined lower bends, but in the 6-volt counterpart this is counteracted by better mutual conductance. Valves with indirectly heated cathodes have no potential difference across the ends of the cathode, and having high mutual conductances are probably the best anode bend detectors on the market to-day. The emission of a valve under anode bend conditions is small, so that maximum H.T. voltages of, say, $33\frac{1}{3}$ per cent. greater than those given by the makers can be used to get longer curves and greater signal-handling capacity if necessary.

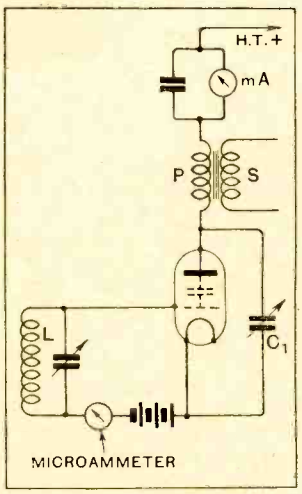


Fig. 9.—An experimental circuit to show the presence of an input load due to the interelectrode capacity of an anode bend detector.

The Need for a Radio-frequency Volume Control.

With a three-valve receiver, the first two valves of which were arranged as in Fig. 8, the transmissions of 5XX at a distance of 120 miles were able to produce more than 1.2 mA. rectified current, meaning that the H.F. peak voltage was over $10\frac{1}{2}$, and that grid current was flowing. By detuning the aerial and H.F. coupling condensers in opposite directions away from resonance the rectified current could be brought within the safe limits of 1.2 mA.; at the same time quality was maintained. For those living quite near to a powerful broadcasting station, the process of detuning is not practicable, and a radio-frequency volume control is needed. It can take the form of a rheostat in the filament circuit of the H.F. valve, a variable loose coupling scheme, a control of screen volts, or a variable resistance in the aerial-earth circuit. Another method that, no doubt, will appeal to readers is that evolved by Dr. McLachlan for the *Megavox-Three* receiver. It consists of a 500,000-ohm potentiometer shunted across the tuned input, and has the advantage of not affecting selectivity. It is shown in Fig. 8 as R_2. Having discussed how to maintain a constant safe input with powerful signals by means of a pre-detector volume control and a low-reading detector anode milliammeter, we must now turn our attention to the output of the secondary of the transformer which follows the detector.

Post-detector Volume Control.

When a 10-volt H.F. peak, such as KL in Fig. 4 containing a modulated envelope (ML) of about 7 volts, was applied to the grid of a P.M.6D. valve biased to $10\frac{1}{2}$ volts (H.T. = 150 volts), the volts applied to the grid of the single L.F. valve were measured as approximately 110 (total swing). This necessitates choosing an L.F. valve, which will handle that grid swing when biased to 55 volts. Suitable meters interposed in the grid and anode circuits of a P.X.650 valve[1] with 200 volts H.T. and 40 volts bias showed, as was to be expected, a flow of grid current simultaneously with lower bend rectification. The detector stage amplification, including a $3\frac{1}{2}$ to 1 transformer step-up, is thus about $\frac{110}{7} = 16$, and with the large input advised, the single L.F. valve would have to be of the L.S.5A. class to accept the signal voltage. An alternative is the use of two L.F. valves of less ambitious characteristics in push-pull, or preferably the employment of a post-detector volume control to throw away the excess of signal volts from near-by stations.

If a variable resistance is shunted across the primary of a transformer, the frequency response characteristic is not impaired; in fact, a slight rise at the high-frequency end of the curve is noticed; this is an advantage after highly selective tuned circuits. The post-detector volume control advocated is shown in Fig. 8 at R_3, and the actual component tested is known as the "Electrad-Royalty," having a resistance range from 1,500 to 100,000 ohms. It is not advisable to short-circuit the primary winding of the transformer, and the minimum resistance of 1,500 ohms shunts away sufficient energy for all ordinary purposes. When weak signals are being received, the residual 100,000 ohms

[1] See *The Wireless World*, "Valve Data Sheet," February 13th, 1929.

The Valve as an Anode Bend Detector.—shunted across the primary has no aural effect in reducing loud speaker strength; the use of a potentiometer volume control across the secondary of a transformer is to be deprecated. It should be pointed out that at the last Olympia Exhibition Messrs. Ferranti were showing a modern receiver with an anode bend meter and post-detector volume control; a photograph of this receiver accompanies the text. Elsewhere in this issue will be found constructional details of a three-valve set in which the volts, which would overload the third valve under local reception conditions, are shunted to earth by a variable resistance or volume control across the primary of the L.F. transformer. Perhaps one of the greatest advantages resulting from large amplification before detection is that for ordinary domestic purposes one L.F. stage gives ample loud speaker strength, and thus low-frequency oscillation is not likely to be encountered with cheap eliminators, especially if a ripple path to the detector grid is avoided by using a high-frequency transformer in place of ordinary tuned anode coupling (see Fig. 8).

How the Anode-bend Detector Loads the Input.

It should be noted that the circuit of Fig. 8 has been well decoupled. The screen feed can have a small resistance of, say, 600 ohms at X if a tapping at about 80 volts on an H.T. battery can be arranged; if a large voltage (e.g., from mains) has to be dropped, a potentiometer should be included between X and L.T.−. The plate current of a screen-grid valve is generally about 2 mA., so that a series decoupling resistance R_1 is satisfactory. We have already appreciated that the current in the anode circuit of the detector according to signal strength may vary between about 0.05 and 1.2 mA.; therefore, any decoupling scheme in which a large voltage has to be dropped must consist of a potentiometer (shown as R_1, R_2) to prevent a fluctuation of applied H.T. voltage under working conditions. The condenser C is not necessary when the transformer is already provided with a shunted capacity across its primary, but with other makes C should be made as large as possible without causing a noticeable loss of high audio-frequencies. The H.F. stopping resistance R_6 helps to prevent H.F. impulses from being amplified by the L.F. valve; in this connection it should be noted that if the time constant of the leaky condenser (see Figs. 1 and 2) is correct there is not likely to be more than 15 per cent. of the H.F. input voltage found in the detector output.

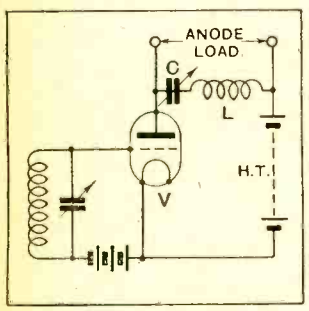
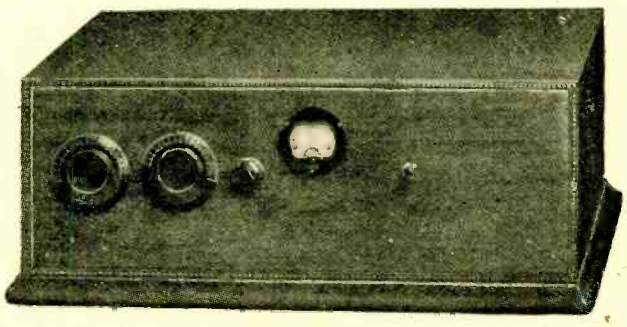


Fig. 10.—If the series resonance circuit CL across the primary of the transformer is tuned to the radio-frequency, the load on the input is released. Incidentally, CL short-circuits the H.F. component and prevents H.F. impulses from being amplified by the L.F. valve.

If the detector circuit of Fig. 9 is assembled and C_1 made 0.001 mfd. (variable), when a loud signal causes the milliammeter to give the predetermined safe reading which just fails to cause any current to flow through the microammeter in the grid circuit, increase of C_1 to its maximum capacity may nearly double the reading of the milliammeter and at the same time the microammeter will show a considerable flow of grid current. It is fairly easy to understand why the large capacity of C_1 increases rectification efficiency, for it is a better storage for the uni-directional impulses, and the saw-tooth effect as shown in Fig. 2 at AB is reduced, and a large *average* output is got. It is perhaps not so easy to see why when nothing is changed on the input side an alteration of the capacity across the output load is accompanied by an increased signal on the grid.



A receiver which was exhibited by Messrs. Ferranti at the last Olympia Exhibition. An anode bend meter and a post-detector volume control are incorporated.

The cause of this somewhat abstruse effect is to be found in the anode-grid capacity (shown in dotted lines), which is present to the extent of about 7 or 8 micro-microfarads in modern triodes. Before the neutrodyne circuit was invented and before screen-grid valves were manufactured, it was common for a high-frequency valve with tuned anode coupling to burst into oscillation long before any appreciable stage magnification was obtained. Because the anode load was inductive, the feed-back of H.F. energy through the interelectrode capacity was in phase with the input. In an anode bend detector the anode load to H.F. is capacitative, and the feed-back of the H.F. energy *via* the plate-grid capacity is out of phase with the input, and causes an appreciable drop in the input volts and also tends to flatten the tuning. When the capacity of C_1 (Fig. 9) is increased, the H.F. potential variation of the plate is decreased, and so the load on the input is released and the volts on the grid rise, the tuning is sharper, and much louder signals result; in fact, on local stations, the pre-detector volume control must be used to prevent grid current, but on distant stations louder signals and greater efficiency are possible.

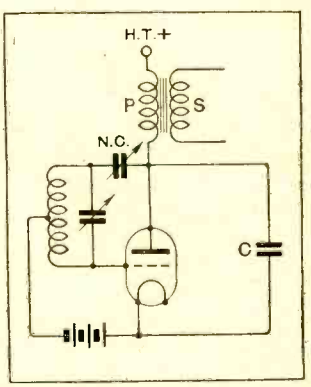


Fig. 11.—A neutralised anode bend detector. Input loading is prevented.

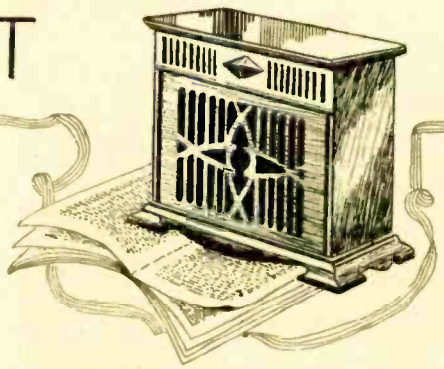
By releasing the load on the input, using a large

The Valve as an Anode Bend Detector.—

by-pass condenser, there is the disadvantage of high-note loss, but the foregoing experiment brings home the necessity of paying serious attention to reverse reaction or anti-phase feed-back. A great deal of work has been done by W. B. Medlam and U. A. Oschwald[2] on this subject, and it is hoped that the results of some of their experiments may be available shortly. Suffice it to say that with a pentode the feed-back is negligible, for although there is considerable capacity between successive electrodes the earthed grid reduces the capacity between the anode and control grid to a very small figure. It is possible that in the pentode lies the anode bend detector of the future. The screen-grid valve with its normal constants will not handle the input as advised in this article, and the requirements of negligible feed-back, together with the characteristics of the P.M.D. or D.E.L. type of valve, would be met by a pentode having an impedance of under 10,000 ohms. To release the load on the input when using a triode detector a series resonance circuit CL shunted across the transformer primary as shown in Fig. 10 can be used. The circuit is tuned to the carrier by means of C, which should be a small balancing condenser; the H.F. component is short-circuited, and, incidentally, the arrangement provides an excellent means of keeping H.F. out of the L.F. In Fig. 11 a neutralised detector is shown, and although only half the input volts of the grid inductance are applied to the valve by virtue of the centre-tapping, *there may actually be a net gain in signal strength* due to the elimination of feed-back, which in certain circumstances can cause a drop of over 50 per cent. of the input volts developed under orthodox conditions. The opportunity is taken here of correcting a small error which crept into the first instalment of this article; the last sentence on page 282 should contain the words—for this valve—and not—for this, a value.

[2] *Journal I.W.T.*, Vol. 1, No. 4, and *Experimental Wireless*, October, 1928.

CURRENT TOPICS



News of the Week

THE KING AS RADIO-GRAMOPHILE.

We learn that His Majesty's electrically reproducing gramophone has been taken from Buckingham Palace to Craigweil House. The King also uses a four-valve set for reception from 5XX.

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DUTCH TELEVISION TESTS.

PCGS, The Hague, is to be equipped with new plant for the purpose of experimenting in television transmissions. The system to be adopted, writes a correspondent, is new, and will be tried for the first time in Holland. A permit has been obtained from the Dutch post and telegraph authorities, and it is hoped to carry out the first tests in May next.

oooo

WIRELESS PICTURES ON SHORT WAVES.

Picture transmission is being carried out almost nightly from 10 p.m. G.M.T. by the Nauen (Germany) wireless telegraphy and telephony station which, at that time, is in two way communication with Buenos Aires. In the intervals, conversations may be heard from both transmitters, Nauen working on 26.22 metres and the Argentine transmitter on 29 metres.

oooo

THE INTELLIGENT PUBLIC.

Increased technical knowledge of the listening public is partly responsible for the B.B.C. decision to dispense with pianoforte solos during intervals in the programmes. In earlier days it was felt that unless listeners were given a continuous indication that the transmitter was working they would suspect their receivers and begin oscillating.

PALESTINE RADIO SHOW.

Wireless apparatus will be included in the exhibits at the Fourth Palestine and Near East Exhibition, to be held in April at Tel-Aviv, says *The Wireless Trader*.

oooo

NAVAL EXPRESSIONS AMPLIFIED.

The bosun's whistle is dispensed with on H.M.S. London, the new 10,000-ton cruiser which has recently been open for public inspection at Gravesend. Orders are broadcast all over the ship through loud speakers.

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EVERYBODY TALKS TO AMERICA.

At Podebrady, where Czecho-Slovakia's main wireless receiving station is located, says *The Central European Observer*, the Post Office is installing a short-wave transmitter for communication with America.

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THOSE INVISIBLE WIRES.

Bird lovers are opening another campaign to induce wireless users to "cork" their aerials. Fortunately for the birds the number of outside aerials is diminishing owing to the vogue of the portable and the frame aerial.

oooo

5-METRE AEROPLANE TRANSMISSIONS.

Tests on ultra-short waves between aeroplane and ground stations are to be conducted by the German telegraph authorities. Two ground stations have been installed at Berlin-Adlershof with the call-signs D4ADQ and D4AGA. Four aeroplanes will be used with the call-signs D4AFX, D4AFY, D4AFZ, and D4AGA. We learn that the wavelengths employed will be 5-5.35, 10-10.7, 20.8-21.4, and 41-42.8 metres, and that the tests may be expected after broadcasting hours.

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BERLIN-STOCKHOLM PICTURE TESTS.

An agreement has now been made between the German and Swedish postal and telegraph authorities for an exchange of wireless picture transmissions between Berlin and Stockholm. It is stated that the service will begin in May next.

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FOR DUBLIN ENTHUSIASTS.

A new demonstration lounge will shortly be opened by Marconi (Ireland), Ltd., at 20, Duke Street, Dublin.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 27th.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Lecture: "Inductance," by Mr. Wm. Watson, M.A., B.Sc.

North Middlesex Radio Society.—At 8 p.m. At St. Paul's Institute, Winchmore Hill. Annual General Meeting.

THURSDAY, MARCH 28th.

Stretford and District Radio Society.—At 8 p.m. At 6A, Derbyshire Lane. New apparatus demonstrated by Messrs. Philips Lamps, Ltd.

TUESDAY, APRIL 2nd.

The Bee Radio Society.—At 7.30 p.m. At Bee School, Beechcroft Road, Streatham, S.W.17. Demonstration by Messrs. Ferranti, Ltd.

INTERNATIONAL SHOW IN SWITZERLAND.

An international wireless and gramophone exhibition is to be held at Fribourg, Switzerland, in September next.

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MORE TRANSATLANTIC TALKS.

Calls on the Transatlantic telephone service have increased in number by nearly 400 per cent. during the past year, according to an official at the General Post Office. Two circuits are at present in use and a third will be opened in June or July. A fourth is under consideration.

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RADIO AND FIRE INSURANCE.

A red-hot controversy is reported to be raging in the American radio industry over the question of fire insurance. It appears that certain insurance companies are raising their premiums in respect of wireless gear on the grounds that this material is more subject to damage by fire and water than other electrical products, such as curling irons, dish washers, and refrigerators.

The Federated Radio Trades' Association disputes the point, and is carrying out an investigation, apparently with the idea of proving that a wireless set will function at a higher temperature than a refrigerator.

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NEW BRANCH OF R.C.A.

The Radio Corporation of America announces the formation of a subsidiary company called "The Radio Corporation of America Communications, Incorporated." The new company will take over the communications business of the R.C.A. with the exception of the ship-to-shore service.

THE NORWEGIAN RELAY.

The B.B.C. engineers deserve congratulation on the success of their efforts to relay the Norwegian Royal Wedding celebration on Thursday last. The clarity of the speech and much of the music was the more remarkable in view of the fact that the transmission was a relay of a relay, the Keston receiving station picking up the signals from Kalundborg, which was relaying Oslo.

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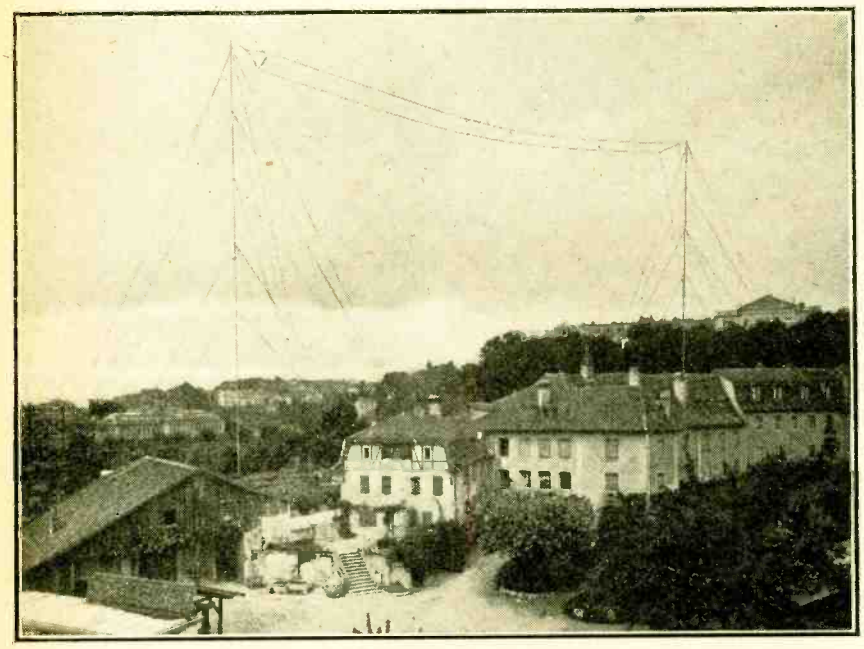
BRIGHTENING THE POLAR NIGHT.

More than 3,000 personal messages from Great Britain, Canada, Germany, and South Africa have been transmitted to the North and South Polar regions during the past winter in the series of "Arctic-Antarctic" broadcasts staged by the Canadian Westinghouse Company, says a Montreal message. The stations participating were KDKA, Pittsburgh; KFKX, Chicago; WBZ, Springfield, and WBZA, Boston, Mass. The addressees included members of the Canadian Mounted Police, Commander Byrd's Antarctic Expedition, trappers, traders, and missionaries.



BROADCASTING FROM THE HEART OF EUROPE. The Lausanne station HB2, which is well known to the many students who have visited the town to learn French. The station is less familiar to listeners in England as its power is only 0.6 kW.

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SAFETY OF LIFE AT SEA.

All U.S. naval stations broadcasting weather forecasts, hydrographic information, and Press reports, have been ordered to cease transmission for three minutes at half-hourly intervals to listen for distress signals.

WHO'S WHO IN THE ETHER.

Answers to Queries.

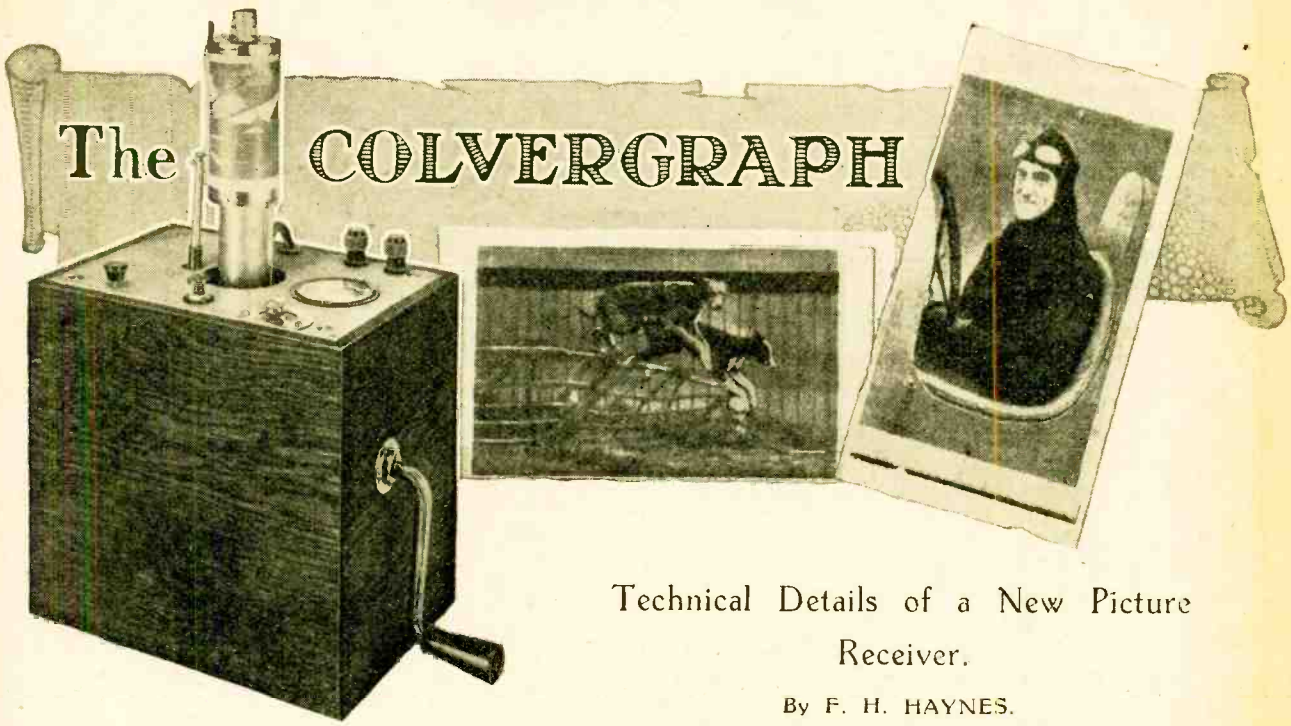
J. P. F. (Croydon): Many thanks for the information, but we have since ascertained that this station was Turin (Italy) on 276m. An altered programme. **E. M. T. (Bickley):** Scheveningen-Haven (Holland); Stock Exchange quotations, market reports, etc., only. **C.B. (Huddersfield):** Yes, Lille; the call you heard was: Radio Flandres. This station transmits on 430m. daily from 7 to 7.30 p.m. **P. A. H. (Finchley, N.):** Yes, this was Turin (Italy), which, although not advertised, broadcast the opera "Carmen" (Bizet) on that date. The call is: EIA (pronounced ay-ee-ah) Radio Torino. **R. H. (W.1):** (1) An amateur transmission of gramophone records, but it is impossible to trace without the call sign; (2) this was a German station, as the National Anthem of that country is played to the melody of the old Austrian Hymn (Haydn), but we cannot say which, as you give no estimate of wavelength.

JAY COOTE.

ALTERATIONS IN WAVELENGTHS.

STATION.	METRES.	KC.
GREAT BRITAIN.		
Belfast	302.6	991.1
Daventry 5XX	1566.6	191.5
Glasgow	401	748.3
London	358.9	838
Stoke-on-Trent	293.8	1021
Swansea	293.8	1021
Leeds	258.6	1160
BELGIUM.		
Brussels	511.9	586
Liege (Radio Wallonie)	280	1070
CZECHO-SLOVAKIA.		
Bratislava	276	1035.7
FINLAND.		
Lahti	1504	199
FRANCE.		
Lyons (PTT)	472.3	635.1
Radio (Paris)	1750	171.3
Radio Vitus (Paris)	310	968
Bordeaux - Radio - Sud - Ouest	238	1261
Lille (PTT)	306	978
Marseilles (PTT)	310	968
Strasbourg	268	1120
Toulouse (PTT)	211.3	1419.6
Toulouse (Radio)	382.2	985
GERMANY.		
Dresden	387	775
Munich	537	559
GRAND DUCHY OF LUXEMBURG.		
Radio (Luxemborg)	1280	234.2
HOLLAND.		
Hilversum	1074.8	279.1
HUNGARY.		
Buda-Pest	545	551
ITALY.		
Naples	332	904
NORWAY.		
Bergen	365	820
Frederiksstad	384	780
Porsgrund	455.9	660
PORTUGAL.		
Lisbon, CTIAA (Wed. and Sat. 10.0 Midnight, G.M.T.)	314	955
RUSSIA.		
Moscow Komintern	1443	207.9
Kharkov Narkompotschtel	1690	177.4
SPAIN.		
Madrid (EAJ7)	426.7	703
Radio Espana	400	750
Salamanca (EAJ22)	456	658
San Sebastian (EAJ8)	404	744
SWEDEN.		
Motala	1345	223
TURKEY.		
Angora	1840	163

The COLVERGRAPH



Technical Details of a New Picture Receiver.

By F. H. HAYNES.

LAST autumn saw the start of picture broadcasting. Since then the number of picture transmissions has been steadily increasing. More time is now taken up by the transmissions, and many stations are being given over to the sending of pictures. Listeners will have noticed that during the past fortnight a picture transmitting service has been commenced by both 2LO and 5GB in addition to the transmissions from 5XX, so that the length of time devoted to the sending of pictures from British stations has been almost doubled. Arrangements have been made with many Continental stations for installing picture transmitting equipments.

On the manufacturing side this increase in interest has brought a new picture receiver into the market—the Colvergraph—a product of Collinson's Precision Screw Company, Ltd. That the new machine should be evolved by a firm engaged in screw manufacture is not surprising, as the problems of high speed automatic machine design are not unassociated with the difficulties encountered in picture receiver construction. Careful examination of this new machine brings to light many underlying considerations to which attention has not previously been drawn.

In order to conform to the conditions now laid down for the broadcasting of pictures the Colvergraph is fitted with "stop-start" synchronising, and adopts the specified ratio of speed of rotation to rate of traverse. "Stop-start" synchronising ensures that the picture-carrying cylinders of transmitter and receiver shall rotate precisely together, and implies the use of a slightly smaller cylinder at the receiver so that it may be briefly held once each revolution and released by a synchronising dot signal. The greatest problem of picture receiver design is that of devising a form of drive between the clockwork motor and the cylinder by which stopping of the cylinder leaves the motor unchecked, while starting shall be spontaneous and regular in its action. Friction drives may partly achieve this effect, but it is obvious that the load on the motor would increase when the cylinder is held so that the start up would be irregular until the motor gathers speed. The possibilities of slip, moreover, are sufficiently serious to rule out the use of friction.

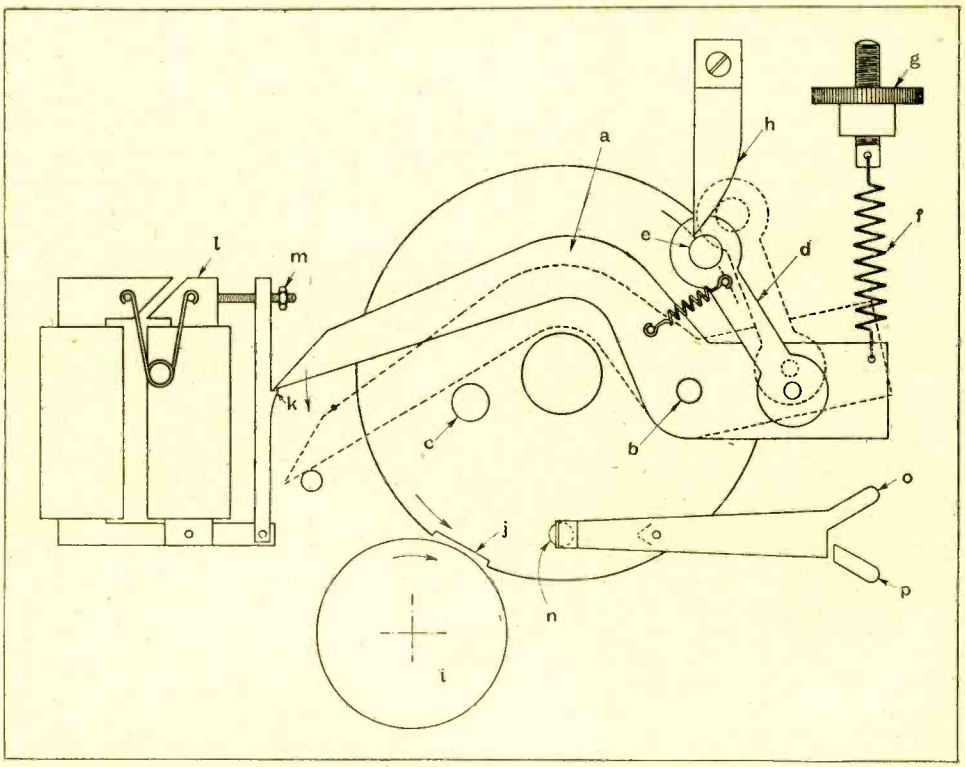
An untouched picture received from Konigswusterhausen. Note the definition around the eyes. The mottled effect has arisen in the process of making printing blocks.

The mechanism used in the Colvergraph is shown in the accompanying explanatory diagram. Here the large centre wheel is concentric with the picture-carrying cylinder. It is driven by the smaller pinion (*i*) which is secured to the shaft of the clockwork motor. These two wheels bed together and give a positive drive until the gap (*j*) is encountered when the driv-

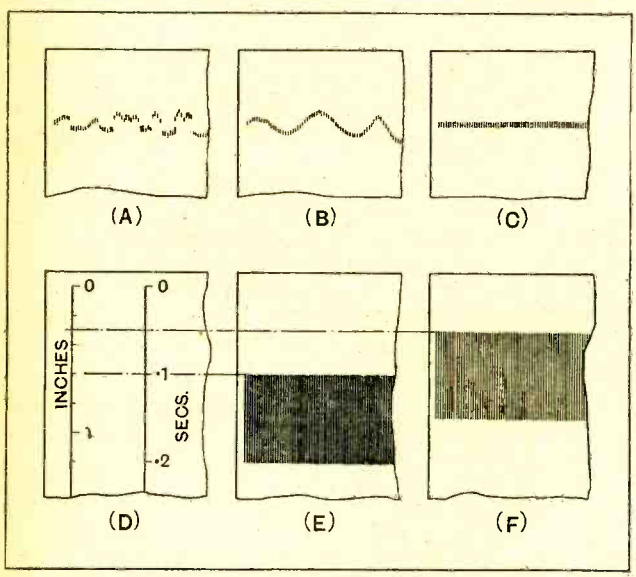
The Colvergraph.—

ing pinion (*i*) is left running entirely free and unloaded, its speed being maintained constant by the governor of the motor. To precisely locate the position of rest of the cylinder the peg on the end of the arm (*d*) drops into the recess (*e*), and is held by the tensioning spring. Now during rotation the vertical peg (*c*) has moved across the face of the arm (*a*), and in slowly lifting it back the spring (*f*) has become tensioned, and the end of the arm cocked against the stop (*k*). The arm (*a*) is actually set up on the baseplate beneath the larger wheel, and pivots on a vertical bearing (*b*).

On the release of (*k*) by the action of the synchronising signal the spring (*f*) causes the arm (*a*) to jump forward so that the peg engaging at (*e*) imparts a rapid motion to the wheel. It is a simple matter, with the aid of the adjusting screw (§), to cause the wheel to move forward at such a speed that when the pinion (*i*) engages the faces of the two wheels are running at the same speed. To remove the driving pin from action a stationary cam (*h*) is provided by which the peg is lifted from the slot (*e*).



The starting mechanism. When the cylinder is stopped the driving motor is entirely relieved of load. A trigger action causes both wheels to be running at the same speed when engaging, so that the motor is not retarded by providing the starting load.



Picture receivers are tested by the transmission of a series of dot signals from an accurately revolving disc fitted with the necessary contacts. These dots are brought together on each successive revolution to form a straight line. (A) Erratic results due to friction. (B) Wavy effect due to imposing a starting load on a small motor. (C) The dots will only fall in line when the starting drive is absolutely regular in its action. (D) The running speed of the paper. (E) Image recorded with a signal of 2 mA. (F) Possible displacement of 0.05 sec. when the signal strength falls so that only 1 mA is available.

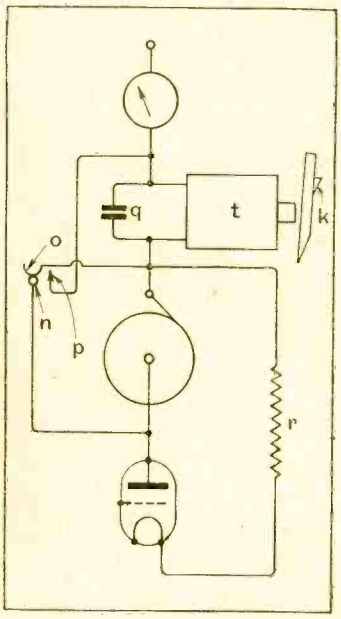
For this method of accelerated start it is claimed that fluctuation of starting speed is entirely avoided, for the motor is relieved of the starting load while the meshing of pinions which are running at the same speed is considered a good feature. It is obvious, also, that a starting load results in the taking up of backlash in the train of pinions in the motor and may, therefore, be slightly variable at the actual time of starting unless assisted by friction. In brief, the spring (*f*) stores up power during rotation and releases it so as to supply the starting load. When the pinions have engaged a positive drive results, and if the cylinder is held the motor is, in fact, stopped.

Test transmissions by way of recording a series of lines across the paper demonstrate the results to be obtained by this form of accelerated start. Three specimens are reproduced in which A shows how dots which should fall together to form a straight line become displaced in an erratic fashion when the start is produced by friction and the motor is called upon to furnish the starting load. In B a more positive start is provided, though a wavy line results by a difference in the meshing of the pinions when subjected to the starting load. The result claimed for the Colvergraph is shown at C, where the starting effect is constant for each successive revolution, being, as it is, dependent upon the accelerating effect of the starting spring acting directly on the cylinder rather than the main spring

The Colvergraph.—

of the motor applied through a train of pinions and subjected to the starting load. It is appreciated that each of the dots falling together to form the line are made during successive revolutions.

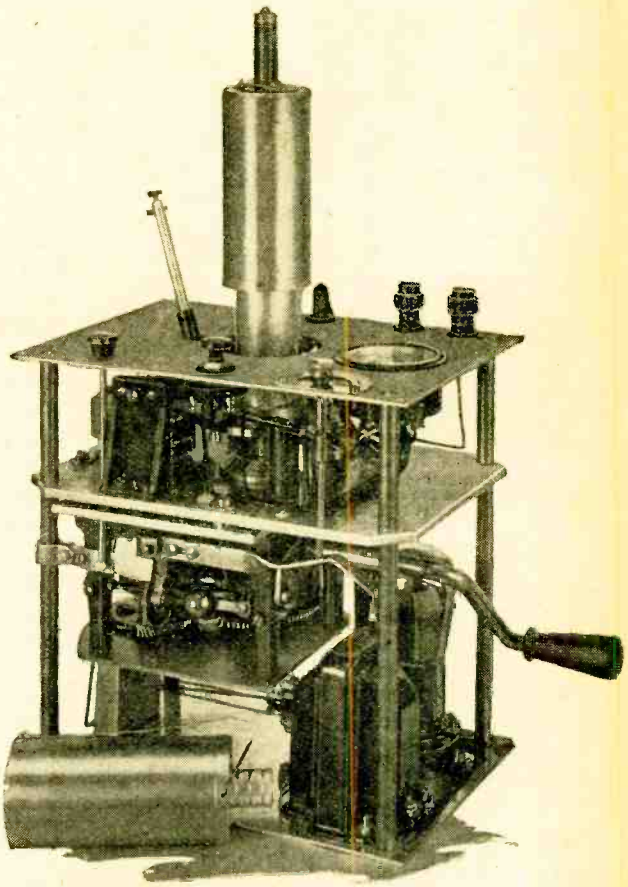
Another device has been incorporated to ensure uniformity of starting, which is the important consideration upon which the quality of a picture depends. As the diameter of the cylinder is about 2in., and the running speed just over fifty revolutions a minute, it is obvious that the paper runs under the stylus at the rate of about 6in. a second. In addition to the dangers of an uncertain start, a variation in the strength of the signal responsible for setting free the cylinder results in a lack of uniformity. This is shown at E and F, where, in the first instance E, the release current is 2 mA., and, in the second F, 1 mA. The reason for the change in time of starting, with variations in the magnitude of the signal currents, is both electrical and mechanical. The smaller available current takes a longer time to build up the required flux in a magnet winding, the time interval depending upon the inductance, capacity, and resistance of the winding. When the release action is operated through a relay there may also be a mechanical time lag, while the variation in the resistance of its contacts with changes of energising current may further modify the relationship between actual time of release and the value of the signal current.



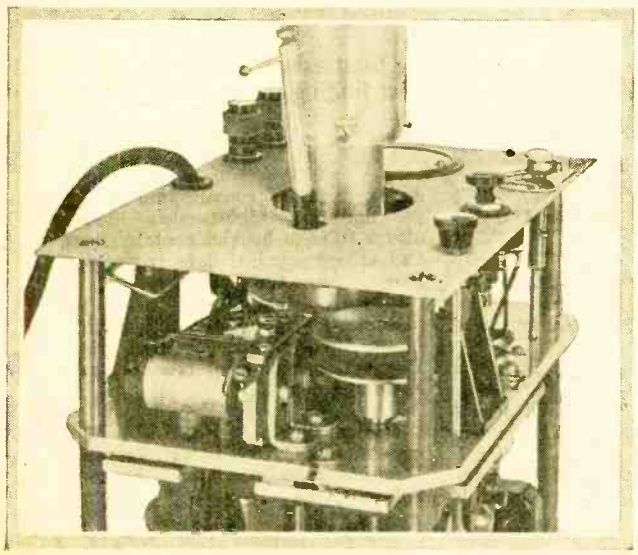
Anode circuit of the Colvergraph. The resistance provides the current for the threshold trigger adjustment. The use of a relay is abandoned. Only a single switch-over contact is needed.

Steps have been taken in the machine under description to ensure that the time of release shall be as far as possible independent of the value of the signal current. First, a relay as a means of actuating the trigger has been dispensed with while the trigger is not entirely energised by the signal current. A local current is passed to the release magnet winding so that the signal current merely produces a slight change in the value of this current. From the circuit it will be seen that current from the H.T. battery passes through the magnet winding by way of the high resistance which connects to the filament circuit. This current is insufficient to actuate the release.

The synchronising signal causes a rise in anode current producing just sufficient added pull to let go the trigger. For such an arrangement a constancy of starting is claimed, in spite of variation in signal strength such as occurs by fading when receiving from a distant station, while the threshold condition renders the arrangement



Case removed showing the sub-panel assembly. During reception a spare cylinder is loaded ready for dropping into position so as to avoid delay between successive pictures. Here the cylinder is removed exposing the inner driving drum.

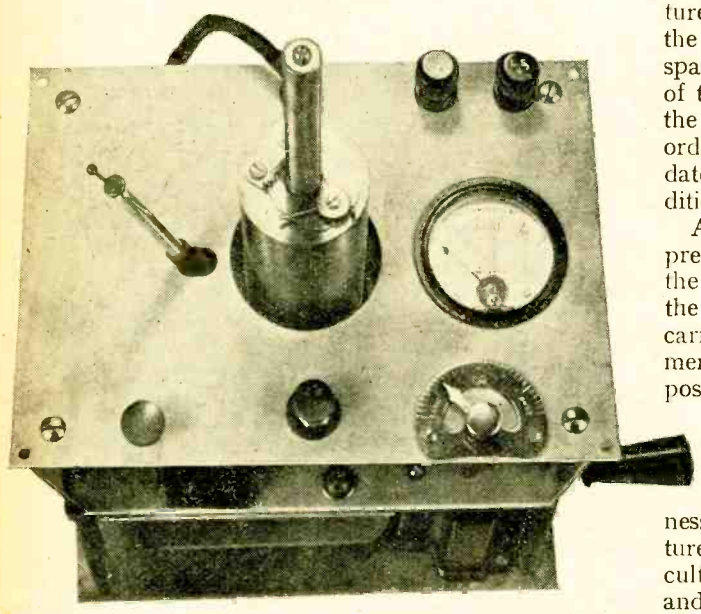


Close-up view showing the trigger release and driving pinion. One pole of the release magnet is hinged between centres.

The Colvergraph.—

sensitive. The valve is a P.M.6.D, and the shunt current as revealed by the meter is about 0.75 mA., while a signal grid swing of less than 2 volts R.M.S. trips the release. As soon as the trigger has pulled over and rotation has been restored, a short circuit is applied to the magnet winding, so that the local energising current is removed and the armature readily falls back.

Assembly is carried out on three plates, one above the other. The lower one supports the input transformer,



Plan view with paper-carrying cylinder withdrawn. Space is left on the top panel for accommodating other forms of recording gear than the electrolytic stylus. The stylus is stationary.

valve, and anode resistance, the centre one, which is more substantial, the motor and trigger release mechanism, while the top one is a cover plate carrying the necessary controls and through which the receiving cylinder protrudes.

Several new features are to be noted. The cylinder, while rotating, lifts vertically against gravity around a centre spindle carrying a buttress thread. The stylus does not travel and is so mounted that side-play is in the direction of rotation and not transverse to the image forming line as it is recorded. Incidentally, its bearing points are widely spaced. As a stationary stylus is used, it can readily be replaced by an attachment for the light controlled form of photographic recording, while a paint-spray method making use of a signal controlled aperture is referred to by the makers. Clear space is left on the top of the panel adjoining the stylus position in order to accommodate the necessary additional apparatus.

This picture (Sir Henry Wood), as well as those shown in the title illustration, was recently received from Daventry with the Colvergraph machine.

A point much appreciated when using the machine is that the cylinder which carries the paper is merely dropped into position over a central drum. A spare cylinder is provided which is loaded in readiness for the next picture so that the difficulties of both loading and rewinding between successive pictures is avoided. A double-claw device drops the central drum from the top of the column to the starting position. An extension lever renders it impossible to replace a new cylinder until the driving drum has been reset ready for starting. Either purple-brown or blue images are recorded by the use of starch-iodide or ferricyanide treated paper, the latter being a little less sensitive, though giving a permanent picture.

The machine, being built as a single unit, is provided with a battery cable for linking to the batteries common to the radio receiver.

CATALOGUES RECEIVED

The Edison Swan Electric Co., Ltd., 123-125, Queen Victoria Street, London, E.C.4. Illustrated catalogue with curves of transmitting and rectifying valves.

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A. F. A. Accumulators, Ltd., 120, Tottenham Court Road, London, W.1. Illustrated leaflets of "Pertrix" dry batteries and "Varta" accumulators.

o o o o

Henry Joseph, 96, Victoria Street, London, S.W.1. Illustrated brochure of cone loud speakers, gramophone pick-up devices and loud speaker units.

o o o o

C. S. Dunham, Elm Works, Brixton Hill, London, S.W.2. Illustrated catalogue of receivers and particulars of the Dunham home constructor's two-valve set.

Messrs. Priestly and Ford, 3-11, Carr's Lane, Birmingham. Illustrated leaflet of "The Peeanef" 3-valve receiver.

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The Rothermel Corporation, Ltd., 24 and 26, Maddox Street, Regent Street, London, W.1. Three new publications as follows: (1) 1929 Radio Catalogue. (2) Second edition of "Great Voice" booklet, dealing with "Magnavox" loud speakers and accessories. (3) Centralab circuit booklet.

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Messrs. Ferranti, Ltd., Hollinwood, Lancashire. Descriptive leaflet of measuring instruments, H.T. supply units and a series of construction broadsheets for building high-tension eliminators, also a 22-page booklet containing circuits and other technical data regarding H.T. current from the mains.

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Empress Radio and Electrical Co., Manor Works, Stonehouse, Plymouth. Descriptive leaflets of receivers and self-contained sets.

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Messrs. Read Radio, Ltd., 32, Newman Street, Oxford Street, London, W.1. Descriptive leaflet of the "Reaco" portable receiver.

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Messrs. Wilkins and Wright, Ltd., Utility Works, Holyhead Road, Birmingham. Illustrated leaflet of the Utility "Mite" condenser.

A Review of Manufacturers' Recent Products.

LEWCOS "SUPER" SIX-PIN COILS.

As a general rule the multi-contact type of coil former supporting two or more coils has a limited application, and it is usual to find some reference in the maker's literature regarding the particular valve and circuit constants for which the coils were designed. The Lewcos "Super" six-pin coils would appear to be adaptable to many diverse circuit arrangements, the only stipulation made by the designers being that the aerial circuit should follow one of many variations of the Reinartz principle, particularly as regards applying reaction, should this be required on the aerial circuit.

In cases where H.F. amplification is employed, it is advisable, in the interests of neighbouring listeners, to react on to the secondary of the H.F. transformer, and to facilitate this each of the "Super" six-pin H.F. transformers are provided with a special reaction winding.

The C.A.C.5—the medium-wave aerial-grid coil—covers a waveband of 250 to 550 metres when tuned by a 0.0005 mfd. variable condenser, and, in addition to the aerial tappings previously mentioned, is provided with pins on the side of the case for attachment of a reaction coil if required. In the C.A.C.20—the Daventry waveband coil—a separate aerial coil tapped in three places is used in preference to the auto-transformer arrangement of the C.A.C.5, and this is provided also with pins for attaching a reaction coil. The waveband covered by the C.A.C.20, when tuned by a 0.0005 mfd. condenser, is 1,000 to 2,000 metres.

Each of the H.F. transformers, C.S.P.5 and C.S.P.20, cover wavebands corresponding to the aerial coils numbered similarly when the secondaries are tuned by a 0.0005 mfd. condenser. They consist of a fixed secondary and reaction windings, with pins on the side of the case for attaching one of the various primary coils included in the range. The primaries are centre-tapped, so that the transformers can be used either in neutralised H.F. circuits or following screen-grid valves. In the last case the centre tapping is ignored, the whole of the primary being included in the anode circuit.

The interchangeability of the primaries enables the most suitable coil to be chosen by trial without dismantling the H.F. transformer and rewinding the primary.

Lewcos "Super" six-pin aerial coils and H.F. transformers. The interchangeable primaries are shown in the foreground.

Tests under working conditions led to the conclusion that reaction applied to the secondary of the transformer improved the selectivity, and it is recommended in cases where high selectivity is required. Incidentally, the sensitivity is improved also. Used in a neutralised H.F. amplifier with a 20,000-ohm A.C. resistance valve, the amplifier remained stable over the whole range of the condenser when the correct neutralising capacity had been found. It was necessary, however, to screen the two coils to prevent magnetic coupling, a simple vertical screen being sufficient.

The medium waveband aerial coil, C.A.C.5, and H.F. transformer, C.S.P.5, each cost 10s. 6d., the price of the long-wave coils being 12s. 6d. each. Interchangeable primaries, also used for reaction coils on the C.A.C.5, cost 3s. each for the sizes P.4 to P.14, and 4s. each for P.16 to P.22 sizes.

Each carton contains a descriptive folder giving full instructions regarding the use of the coils. Some diagrams of typical circuits are included also. A table gives the most suitable primary coil to use under various receiving conditions, and this should prove very helpful. Some interesting resonance curves showing the selectivity and amplification obtained with the various primaries are supplied and fully explained.

The makers are the London Electric Wire Company and Smith's, Ltd., Church Road, Leyton, London, E.10.

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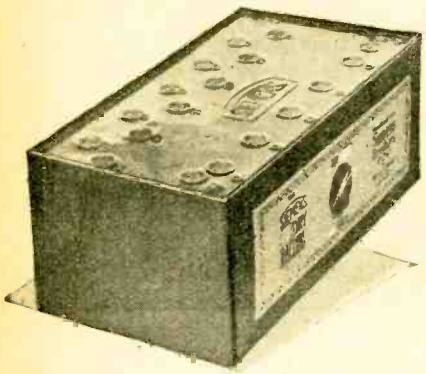
SIEMENS PORTABLE SET H.T. BATTERIES.

The restricted space in a portable set prohibits the accommodation of large-capacity H.T. batteries of the size generally regarded as necessary when a rela-

tively heavy discharge is required. Messrs. Siemens Bros. and Co., Ltd, Woolwich, London, S.E.18, appreciating this difficulty, have put into production two special batteries of the large-capacity type, but reasonably small in size and not unduly weighty. The larger of these, No. 1.075, has a nominal voltage of 126, measures 9⅞in × 5⅞in. × 4in. high, and weighs 12½ lb.



Siemens portable set H.T. battery Type No. 1,077, nominal voltage 108.

The No. 1,077 has a nominal voltage of 108, and measures 10in. × 5in. × 4in. high, the weight being 11 lb. only. It is to the smaller size that the following test relates.

As the battery will be required to do heavy work, the discharge was set to give an initial current of 13 mA., the terminal voltage at the commencement being 124, or a fraction over 1.7 volts per cell. After the first rapid drop the current was well maintained for 180 hours, when the voltage per cell had dropped to 1.1. During the following eighty hours a steeper fall is recorded, and at the end of this period the volts per cell were down to 0.75. As this can be regarded as the cut-off point, the useful life of the battery tested was 260 hours.

As there is, however, no sign of a natural "cut-off," the battery need not be discarded, as it will give many hours of useful service if used in conjunction with a "boosting" battery to bring up the voltage. However, its useful life, as far as portable work is concerned, will doubtlessly end when the voltage has dropped to 0.75 per cell.

The price of the larger size is 30s., and that of the 108-volt model 25s.

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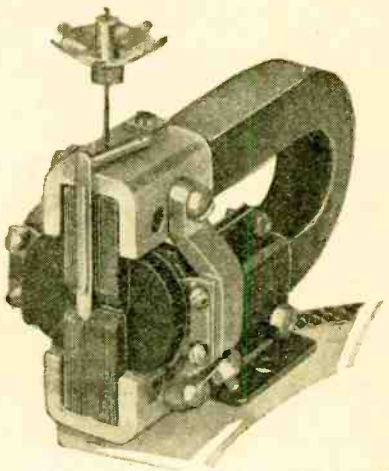
"HEGRA" CABINET LOUD SPEAKER AND BALANCED-ARMATURE UNIT.

There is nothing cheap or shoddy in the external appearance of this loud speaker, the cabinet work and finish being of a very high order and well worthy to rank with the best of its class made in this country

The driving mechanism consists of a differential or balanced-armature movement working into a cone constructed from specially prepared material. The semi-free edge method of mounting is favoured, the cone being glued to a surround of resilient material, somewhat resembling rubber, which is attached to a small baffle-board rigidly fixed to the sides of the cabinet.

"Hegra" Cabinet cone loud speaker.

The loud speaker does not lack sensitivity, and on the whole the quality of reproduction is good, although there is a tendency to over-stress the lower frequencies, which may be due in part to cabinet resonance. The same type of unit driving a cone attached to a large baffle-board and not boxed did not show this tendency to the same extent.



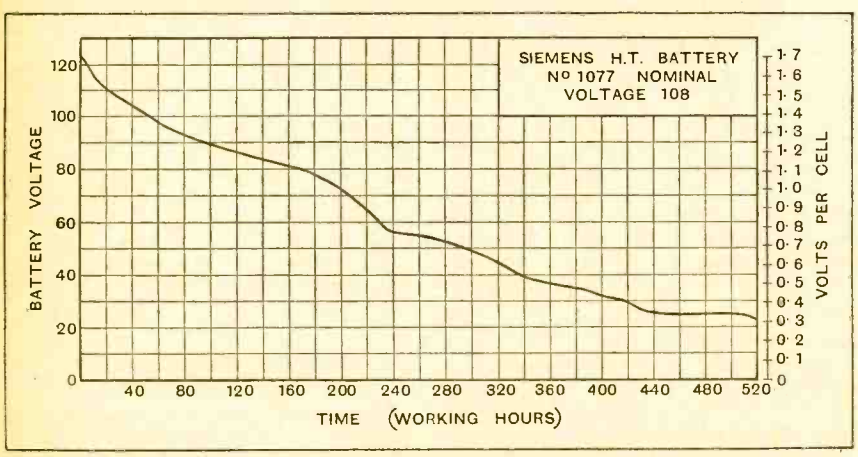
"Hegra" balanced-armature unit.

We were able to examine the driving mechanism in detail as a separate unit accompanied the loud speaker. The body of the unit consists of a large horse-shoe magnet provided with two laminated pole-pieces shaped to concentrate the flux at each end of the armature. As in all compensated movements, the reed or armature is fixed at its centre, and is polarised by the change in current circulating through the coils arranged round the reed at either side of the fulcrum. The driving spindle is attached to a small stiff reed rigidly fixed at one end but linked to one end of the armature at the other.

Although the unit will drive a cone at good volume, it shows signs of slight distress on deeply modulated passages or when the cone is being driven hard. This may be due to the thinness of the driving spindle, which is only No. 22 gauge, and may tend to whip if the cone is attached rather near the free end. The effect will be much less marked if the diaphragm is set well down on the spindle, leaving the shortest length possible to take the drive.

The price of the loud speaker is £4 10s. in a polished mahogany cabinet, and £3 15s. in oak, the unit with cone washers and fixing attachment costing 21s.

The sole agency for the British Isles has been acquired by Messrs. Geo. Becker, Ltd., 203-205, Edgware Road, London, W.2.

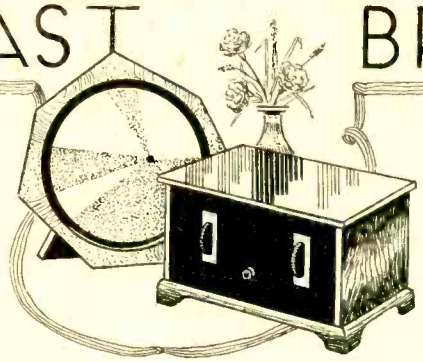


Discharge curve of the Siemens dry-cell H.T. battery Type No. 1,077.

TRADE NOTE.

Messrs Ripaults, Ltd., 1, King's Road, St. Pancras, London, N.W.1, announce that in future all their batteries will be provided with a special label, which, in case of any battery failing to give satisfaction, should be filled in and posted to them. The matter will then receive more prompt attention than would be the case if the complaint had to pass through the hands of an intermediary.

BROADCAST BREVITIES



By Our Special Correspondent.

A New Star.

Events move swiftly in the television and picture transmission field. While the world waits in more or less breathless silence for the P.M.G.'s pronouncement concerning Baird television a rival to Mr. Baird appears on the scene in the person of Denes von Mihaly.

This Hungarian research worker, whose experiments were described in *The Wireless World* five years ago, is coming to this country at the invitation of Wireless Pictures, Ltd.

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Mihaly's Hopes.

As readers are aware, Mihaly tackles television in a manner different from Baird's. He believes that the future of television is linked up with the principles of the film, and his "Telehor" is nothing more nor less than a wireless film transmitter. But he has no intention of stopping at that.

The successful transmission of a film cannot be regarded as genuine television, but it is a step in the right direction, and if it were possible to "shoot" a scene and retransmit the film a fraction of a second later then television would have arrived.

Mihaly pins his faith on the fact that in film transmission he is dealing with images that are stationary, even if the period of stoppage is only $\frac{1}{5}$th of a second.

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P.M.G. and Television.

In the meantime, Baird television experiences a hold-up while the P.M.G. ruminates upon the "secret" demonstration. The matter being *sub judice*, so to speak, no one at Savoy Hill or at the Baird headquarters dares to utter a word of prophecy.

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Is Scotland Neglected?

Caledonia is growing sterner and wilder in consequence of the Brussels scheme and other annoyances; in fact, conscientious Scots are beginning to realise that they are not getting value for money.

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The Grounds for Complaint.

The complaints which are now reaching the B.B.C. fall under five heads. In the first place it is contended that certain parts of Scotland, including the Orkneys and the Shetlands, are out of reach of a Scottish programme; secondly, that the only programme available in many areas is London's *via* 5XX, a station which frequently fades and is often interfered with by the German station Zeesen.

The third complaint—perhaps the most serious—is that the quality of the transmissions of the Glasgow and Edinburgh stations is very often poor, due to the extensive use of "S.B." by means of land-line or (before 6.15 p.m.) the wireless link.

Fourthly, it is contended that 5GB is a farce as far as Scotland is concerned.

Finally, Scotsmen declare that the installation of the first regional transmitter in the London district is an injustice, in view of the fact that London and the Home Counties are now better served that the greater part of Scotland.

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Savoy Hill Replies.

To each complaint the B.B.C. furnishes a reply. It is admitted that many parts of Scotland are outside the service areas of the existing stations, but little hope is held out of improvement before the regional transmitter comes into operation. A suggestion that the present stations should increase their power by 5kW is vetoed on the grounds that such a step would involve entirely new plant and, moreover, would not ameliorate conditions to any appreciable extent. *No medium frequency broadcasting station, however powerful,* says the B.B.C., *can give a regular service much beyond* 80 *to* 100 *miles after dark.*

The B.B.C. also bows its head to the second complaint, viz., that 5XX frequently fades and suffers interference.

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The Need for "S.B."

With regard to the contention that Edinburgh and Glasgow transmissions are poor in quality, the B.B.C. admits that land-line transmission is by no means ideal, but explains that constant effort is being made to improve matters.

As to the use of the wireless link, it is stated that P.O. land lines from London cannot be used before 6 p.m. except in very special circumstances. The retort that "S.B." from London is not essential is anticipated, for the B.B.C. hastens to add that "S.B." provides obvious enlargement of the programme material facilities and also that it is only by this means that the single wavelength working scheme is rendered possible.

The fourth complaint is dismissed with the legitimate remark that 5GB was never intended to serve Scotland.

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A Question of Population.

And how does the B.B.C. meet the charge of injustice? The first regional transmitter is being erected in the London area, says Savoy Hill, because the broadcasting service must be developed in terms of the claims of majorities. Excluding the urban areas of Glasgow, Edinburgh, Dundee and Aberdeen, a study of the population map shows that there is, in relation to other parts of the British Isles, a smaller number of persons who will be benefited by the erection of a high-power station in Scotland.

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An Official Admission.

Summing up the present position, my informant admitted that the service from British stations is inferior to that which was given three years ago. Two reasons were adduced. First, the growth of broadcasting in Europe, and secondly, the fact that permission to go ahead with schemes put up by the Corporation experts three years ago was not forthcoming.

Meanwhile, many Scots listeners are still labouring under a sense of injustice. Some first-hand opinions from Scotland would make interesting reading.

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Valve Tax for French Listeners?

France seems to be waking up at last to the fact that precious time is being wasted by the delay in regularising broadcasting. After a thorough investigation, the Paris Chamber of Commerce has put forward some interesting proposals for the conduct of broadcasting, the principal recommendation being that the controlling board should give equal representation to the Government, the wireless trade and the listener.

The Chamber of Commerce also suggests that income should be derived from broadcast advertisements and from two taxes—one to be levied annually on listeners and the other on the retail price of valves.

Taxing valves is not a new idea, nor is it a very sound one in view of continual changes in receiver design and the further reduction in the number of valves which future sets are likely to require.

FUTURE FEATURES.

London and Daventry.

MARCH 31ST.—Easter Sunday Service from York Minster, S.B. from Leeds.

APRIL 4TH.—Popular Orchestral Concert, relayed from the People's Palace.

Daventry Experimental (5GB).

APRIL 4TH.—"Ultimatum," a radio play adapted from Victor MacClure's novel, by Cecil Lewis.

APRIL 6TH.—Two Plays of the Road.

Cardiff.

APRIL 3RD.—Act 1 of "Outward Bound," by Sutton Vane.

Glasgow.

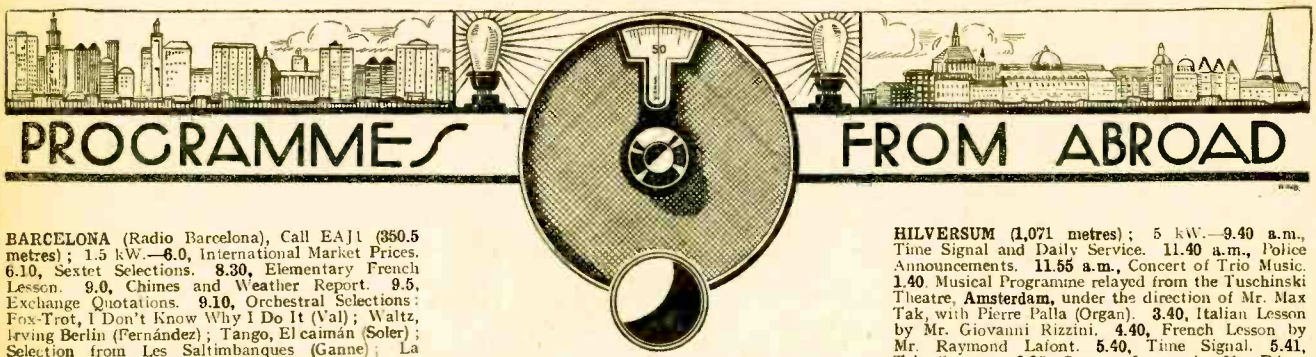
APRIL 6TH.—Running Commentary on Scottish Cup Final.

Aberdeen.

APRIL 2ND.—Reminiscences of Opera.

Belfast.

APRIL 2ND.—"The Chaplet," by William Boyce.



PROGRAMMES FROM ABROAD

SATURDAY, MARCH 30th.

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. **8.30,** Elementary French Lesson. **9.0,** Chimes and Weather Report. **9.5,** Exchange Quotations. **9.10,** Orchestral Selections: Fox-Trot, I Don't Know Why I Do It (Val); Waltz, Irving Berlin (Fernández); Tango, El caimán (Soler); Selection from Les Saltimbanques (Ganne); La Euterpense (Manent); Galician Rhapsody, Festa n'a tolda (Freire). **10.0** News, followed by Relay of the Traditional Meeting of the Choral Groups known as the Easter Caramellas.

BERGEN (365.9 metres); 1.5 kW.—**7.0,** Orchestral Selections. **7.20,** Boris Borisdoff, Talk: Russian Legends. **7.50,** Topical Talk. **8.0,** Orchestral Concert. **8.30,** Balalaika Concert. **9.0,** Weather Report, News and Time Signal. **9.15,** Dance Music. **11.0** (approx.), Close Down.

BERLIN (Königswusterhausen) (1,649 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,** Educational Talk. **3.30,** Programme relayed from **Hamburg.** **4.30,** Talk by A. Rausch. **5.0,** W. Maschke, Talk: Literature and Working Youth. **5.30,** Elementary Spanish Lesson. **5.55,** Easter Recital: Selections from Marienlieder (Zilcher); Osterspaziergang from Faust; Symphony in B Flat Major (Schubert). **7.0,** "Rural" Programme: Quartet Music, (a) Osterlied (arr. Sitt), (b) The Heavens are telling (Beethoven), (c) Schöne Ahnung ist erglommen (Weber), (d) Der Lenz ist angekommen (Dürrner); Talk by Prof. Heinrich Sohnrey: Easter Fire; Quartet Music, (a) Wenn der Frühling auf die Berge steigt (Wilhelm), (b) Die Sonn' erwacht (Weber), (c) Hell ins Fenster scheint die Sonne (Kremser), (d) Wem Gott will rechte Gunst erweisen (Mendelssohn-Bartholdy) **8.0,** Programme relayed from **Voxhaus.**

BERLIN (Voxhaus) (475.4 metres); 4 kW.—**9.10 a.m.,** Market Prices. **9.15 a.m.,** Time, Weather Report and News. **10.0 a.m.,** Programme of Gramophone Records. In the Interval: Exchange Quotations. **11.55 a.m.** Time Signal. **12.30,** Time, Weather Report and News. **1.0,** Programme of Gramophone Records. **2.0,** Exchange Quotations. **2.10,** Agricultural Report and Time. **2.30,** Prof. Oscar Wappenschmitt, Talk: The Music of Bach and Beethoven. **3.0,** Kurt Lubinsky. Talk: Easter at the Court of the Empress Zauditu of Abyssinia. **3.30** "Jockele, the Leveret," Easter Play (Tatjana Petschnikoff). **4.0,** Organ Recital relayed from the Bach Saal: Fantasia and Fugue in G Minor (Bach); Prelude and Chorale, (a) O Mensch, bewein' dein' Sünden gross, (b) O Haupt voll Blut und Wunden (Bach); Variations on O Gott, du frommer Gott (Bach); Prelude and Chorale, (a) Herzliebster Jesu, was hast du verbrochen, (b) Schmücke dich, o liebe Seele (Brahms); Sonata in E Flat (Drwenski); followed by Advertising Notes and Report of the Central Berlin Labour Bureau. **5.10,** Dr. J. E. Poritzky, Talk: The Renaissance of Idealism in Germany. **5.35,** Herr H. Fritsch, Talk: The Student in the Large Town. **6.0,** Oswald Riedel, Talk: German Industry. **6.30,** Dr. Richard Stein, Talk: The Riddle of the World of Sound, with Pianoforte Illustrations. **7.0,** Orchestral Concert: Overture to Der Waffenschmied (Lortzing); Largo and Rondo from the Concerto, No. 11, in D Major (Rode); Selection from The Evangelist (Kienzl); Symphonic Poem; Von der Wiege bis zum Grabe (Liszt). **8.0,** Scenes from Faust, followed by Time, Weather Report, News and Sports Notes.

BRESLAU (321.2 metres); 4 kW.—**4.45,** Weekly Film Review. **5.25,** Hans Joachim Plehn, Talk in Esperanto: Silesian Plant Life. **5.35,** Talk on Silesian Frontier Questions, by Herr Boer. **6.20,** Shorthand for Beginners. **6.50,** Georg Lichey, Talk: The United States. **7.15,** Orchestral Concert: Concerto grosso in B Flat Major (Händel); Rheinische Nachtmusik for Strings and Horns, Op. 35 (Niemann); Anakreon, Op. 50 (Niemann); Nacht und Morgen, for Two Pianofortes, Strings and Kettle-drums, Op. 24 (Zilcher); Aus Holberg's Zeit, Suite in Old Style for Strings, Op. 40 (Grieg). **9.0,** News, Announcements and Close Down.

BRUSSELS (511.9 metres); 1.5 kW.—After **7.30,** Experimental Transmission on a High Power.—**5.0,** Orchestral Concert from the Palace Hotel Tea-room. **6.0,** Elementary English Lesson. **6.15,** Intermediate English Lesson. **6.45,** Pianoforte Selections. **7.0,** Gramophone Records of Dance Music. **7.30,** "La Radio-Chronique." **8.15,** Orchestral Concert, followed by Topical Talk. **10.10,** News, followed by Announcements in Esperanto. **10.15,** Orchestral Concert from the Palace Hotel Tea-room. **11.0** (approx.), Close Down.

BUDAPEST (545 metres); 20 kW.—**3.45,** Time Signal, Weather and Tide Reports and News. **5.40,** Dr. László Ravasz, Religious Address: Easter. **6.30,** Orchestral and Choral Selections of Easter Music. **8.15,** Time Signal, Weather Report, News, and Sports Notes, followed by Concert by the Tzigane Orchestra from the Grand Hotel Britannia.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—**7.20,** News. **7.30,** M. J. Lennon, Talk: Spain. **7.45,** Irish Lesson by Seamus O'Duirinne. **8.0,** Random Rhymes by Blanche Mercer. **8.15,** "The Daughter of the Regiment"—Opera (Donizetti), by the Station Orchestra, Station Opera Chorus and Soloists. **10.30** (approx.), 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: Overture to The Messiah (Händel); Ave verum corpus (Mozart); Six Songs to Text by Rilke (von Westermann); The Seven Words on the Cross for String Orchestra, Op. 51 (Haydn); In the Interval—News and Announcements. **5.0,** Motet Concert relayed from St. Peter's Church. **6.0,** Answers to Correspondents. **6.20,** Lesson in Esperanto by Herr W. Wischhoff. **6.35,** Reading of Stories by Fritz Gross, with Pianoforte Improvisations by Eugen Bodart, relayed from **Cassel** (250 metres). **6.55,** Dr. Doris Dauber, Talk: Wolfram von Eschenbach's "Parsifal" and Wagner's Re-casting of it. **7.15,** "The Life and Death of Our Saviour Jesus Christ"—Passion Play (Anton Kröllhesel), followed by Concert relayed from **Stuttgart.**

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 Intervals, Time Signal, Tide Reports, News and Snow Report. **1.40** Exchange Quotations. **2.30,** Review of Books. **3.0,** Heinz Liepmann, Talk: Indiscretions of a Reporter. **3.30** Concert of Modern Chamber Music: Sonata in G Major (Rapheel); Sonata in E Flat Major (Hindemith); Suite for Pianoforte and Violin (Stravinsky). **4.30.** Concert of Request Items by the Station Orchestra. **5.30,** Prof. Otto Lauffer, Talk on Folk Lore: Easter Fire, Easter Hares and Easter Eggs. **6.0,** Herr Strohkirch, Talk: Woodcarving, relayed from **Bremen** (273 metres). **6.30,** Hermann Quistorf, Talk: Twenty Years of Technical Schools for the Book Trade. **6.55,** Weather Report. **7.0,** "Great News"—Wireless Play (Manfred Georg). **8.30,** Easter-Eve Concert by the Scarpa Orchestra. In the Interval, at **9.30,** Talks extraneous to the Programme, Topical Discussions, News, Weather Report, Sports Notes, and Police Announcements. In the Interval, at **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,** 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,** Trio Concert. **6.25,** German Lesson by Mr. Edgar Grün. **7.25,** Police Announcements. **7.40,** 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.—**2.40,** Programme for Children. **5.10,** Gramophone Records. **6.40.** Two Talks. **7.40,** Religious Address. **8.0,** Concert: Overture to Il Seraglio (Mozart); Suite No. 1 from L'Arlésienne (Bizet); Recitations with Pianoforte accompaniment; Overture to Martha (Flotow); Ballet égyptien (Luigini); Recitations; Vocal and Orchestral Selections from Cavalleria Rusticana (Mascagni); Vocal and Orchestral Selections from I Pagliacci (Leoncavallo). **9.10,** News and Close Down.

KALUNDBORG (1,153 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,** Vocal and Orchestral Concert: Overture to Tancred (Rossini); Waltz, Mein Lebenslauf ist Lieb und Lust (Jos. Strauss); Selection from Romeo and Juliet (Gounod); Minuet and Divertissement in D Major (Mozart); Gavotte for String Instruments from Armida (Glück); Spanish Dance, Andaluza. (Granados); Polonaise from Les Millions d'Arlequin (Drigo); Songs, (a) Ved vintertid (Lynghye), (b) Paa Vossevangen, der vil jeg bo (Hillebrandt), (c) Til Myklegaard og Spanieland (Rung), (d) Natten er saa stille (Weyse), (e) Takt, takt (Nutzhorn), (f) Der er en gammel Rönne (Carl Nielsen), (g) Höje Nord, Friheds Hjem (Glasser); Selection from Paganini (Lehár); Waltz from The Little Dutch Girl (Kálmán); Gondola d'amore (Mercuri); Moorish Fantasia from Bobadil (Moszkovsky); Selection from Gretna Green (Guiraud); Russian March (Tchaikovsky). **5.20,** Talk in Swedish by Thyra Freding. **5.50,** Weather Report. **6.0,** News. **6.15,** Time Signal. **6.16,** Nic. Blaedel, Talk: Politics in March. **6.45,** Talk: Modern Foreign Authors: Jack London. **7.15,** Programme of Old Dance Music: Neapolitan March (Gastaldon); Offenbach-Valse (Fetrás); Polka, Tric-Trac (Waldteufel); Mazurka, Suzanne (Möller); Quadrille from A Waltz Dream (Oscar Straus); Pas de quatre (Oscar Straus); Fantasi-Vals (Coote); Mazurka, Labra coralline (Becucci); Vera-Galop (Michaëlis), followed by News. **8.30.** Readings by Per Knutzen from The Daughter of the Snows (Jack London—Translated by Aslaug Mikkelsen). **9.0,** "To uden Kuffert"—Wireless Sketch with Songs and Dance Music (Flemming Geill). **10.0,** Dance Music from the Industri Restaurant. **11.0,** Chimes from the Town Hall. **11.15** (approx.), Close Down.

KÖNIGSBERG (280.4 metres); 4 kW.—**4.0,** Concert: Selection from Loreley (Bruch); Selection from Manon (Massenet); The Death of Aase (Grieg); Solveig's Song (Grieg); Spring's Awakening (Bach); Träumerei (Schumann); Abendlied (Schumann); Adagio from the Sonate pathétique (Beethoven). **5.10,** Ice Report. **5.20,** International Market Report. **5.35,** Legal Talk. **6.0,** Programme Announcements in Esperanto. **6.5,** Talk: Economic Problems of China To-day and in the Past. **6.30,** Topical Talk. **7.0,** "Aïda"—Opera (Verdi), followed by Weather Report, News and Sports Notes.

LAHTI (1,522.8 metres); 35 kW.—**6.0,** Concert of Chamber Music. **6.30,** Recitation by Ebba Jacobsen-Lilius, from "The Vikings"—Play (Ibsen). **6.55.** Concert: Overture to Lohengrin (Wagner); Legenda Zorahayda (Svendsen); Songs; Adagio from The Pilgrims' Chorus from Tannhäuser (Wagner). **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** (267.8 metres).—**12.5,** Orchestral Concert. **1.30,** Hints for the Housewife. **2.0,** Programme for Children by Els Vordemberge. **2.30** Industrial Report. **3.0,** Thea Bicker, Talk: Easter in the Family. **3.30** Choral Concert: Sacred Songs,

Programmes from Abroad.—

(a) O bone Jesu (Bai), (b) Ave Maria (Arcadelt), (c) Tenebrae factæ sunt (Perez); Madrigals, (a) Zug der Juden nach Babylon (Vecchi), (b) Innsbruck, ich muss dich lassen (Isaac), (c) Jungfrau, dein' schön' Gestalt (Hasler), (d) Hans und Grete (Eccard); Sweet Love (Dowland), Madrigal (Bennet); Dancing Song (Morley); Scaldava il sol (Marenzio); Pastorella (Vecchi); Languir me fais (Claudin); Au joli jeu (Jannequin); Quand mon mari (di Lasso); Vilanella alla Napolitana (Donati); Bonzorno, madonna (Scandelli). **5.0,** Humour in World Literature, with Introductory Talk. **5.20,** English Lesson by Prof. Hase. **5.50,** Lesson in Morse. **6.15,** Talk for Workers by Albert Fuchs. **6.40,** Talk on Culture by Dr. Lips. **7.0,** Easter-Eve Concert from the Messehalle, **Cologne** (263.2 metres): Passion Choral, Christus, der uns selig macht (Bruhns); Prelude in E Minor (Bruhns); Psalm, Da Jesus an dem Kreuze stund (Scheidt); Prelude and Triple Fugue in E Minor (Buxtehude); Organ Chorale, Da Jesus an dem Kreuze stund (Bach); Organ Chorale, Christ lag in Todesbanden (Bach); Prelude and Fugue in C Minor (Bach); Sonata in A Major for 'Cello (Boccherini); Trio in E Flat Major Op. 3 (Prince Louis Ferdinand); Violin Solo; Choral Fantasia, Wie schön leuchtt uns der Morgenstern (Reger); Passacaglia in A (Haas), followed by News, Sports Notes and Commercial Announcements.

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. **5.30,** See **Königswusterhausen. 5.55,** Labour Market Report. **6.0,** Dr. Arno Schirokauer, Talk: The Beginnings of German Satirical Literature. **6.30,** Talk by Ernst Krohn. **7.0,** Concert: Overture to The Marriage of Figaro (Mozart); Five Minuets and Six Trios for Strings (Schubert); Rezia's Air from Oberon (Weber); Wotan's Farewell and Fire Magic from The Valkyrie (Wagner); Elizabeth's Air from Tannhäuser (Wagner); Ave Maria from Das Feuerkreuz (Bruch); Three Songs with Orchestral Accompaniment (R. Strauss), (a) Morgen, (b) Ständchen, (c) Cäcilie. **9.0,** Time Signal, Snow Report, Weather Report, News, Programme Announcements and Sports Notes.

MADRID (Union Radio), Call EAJ7 (**426.7 metres**): 3 kW.—**7.0,** Chimes, Exchange Quotations and Dance Music. **8.0,** Talk: Science. **8.25,** News. **9.45,** Weekly Agricultural Report and Market Prices. **10.0,** Chimes, followed by Programme from **Barcelona. 12.0 Midnight,** Chimes, News and Orchestral Music from the Alkazar. **12.30 a.m.** (approx.). (Sunday), Close Down.

MOTALA (1,351 metres); 30 kW.—Programme also for **Stockholm** (438 metres), **Böden** (1,200 metres). **Göteborg** (346.8 metres), **Hörby** (260.9 metres), **Ostersund** (720 metres), and **Sundsvall** (515.5 metres).—**4.0,** Concert of Light Music: Overture to The Thieving Magpie (Rossini); Entr'acte from L'Amico Fritz (Mascagni); Ballet égyptien (Luigini); Romance in F Major (Sibelius); Selection from Madame Butterfly (Puccini); Blumenlied (Meyer-Helmund); Aquarallen: Waltz (J. Strauss). **5.0,** Programme for Children. **5.30,** Cabaret Programme. **5.45,** Talk: American History. **6.5,** Vocal Quartet Recital. **6.30,** Talk: Professions and Professional Men. **6.45,** Sonata for Violin and Pianoforte in B Flat Major No. 10 (Mozart). **7.0,** Popular Concert. **8.0,** Talk: Current Events. **8.15,** News and Weather Report. **8.45,** Dance Music. **12.0 Midnight** (approx.), Close Down.

MÜNICH (536.7 metres): 4 kW.—Programme relayed by **Angsburg** (566 metres), **Kaiserslautern** (272.7 metres), and **Nuremberg** (240 metres).—**3.30,** Concert: Four Sacred Songs (Courvoisier); Reading from the Novel, Jerusalem (Selma Lagerlöf); Quintet in F Major for Two Violins, Two Violas and 'Cello (Bruckner) **5.35,** Labour Market Report. **6.0,** The Letter-Box. **6.30,** Programme in Celebration of the Fifth Anniversary of the Munich Wireless Station, 1924–1929. **9.20,** (approx.), News. **9.45,** Gramophone Concert: Good Friday Incantation from Parsifal (Wagner); Erbarme dich, from The St. Matthew Passion (Bach); The St. Matthew Passion (Bach); Largo (Händel); Toccata and Fugue for Organ (Bach); Selection from Missa solemnis (Beethoven). **11.0** (approx.), Close Down.

NAPLES, Call INA (**333 metres**); 1.5 kW.—**4.0,** Concert: Orchestral Selections, (a) Intermezzo, Cavallino a dondolo (Piovano), (b) Intermezzo, Luna e laguna (Sagaria); Soprano Solo, Rosa (Tosti); Orchestral Selection, Meditazione (Ranzato); Soprano Solo, Il libro santo (Pinsuti); Orchestral Selection from La Bayadère (Kálmán); Soprano Solo, Fammi morir conte (Cosentino); Orchestral Selection, Intermezzo, Minuet in C (Mazzone); Soprano Solo, Giulia (Denza); Orchestral Selections, (a) Intermezzo, Tramonto (Longo), (b) Danza settecentesca (Longo). **4.30,** Time Signal. **7.30,** Time Signal, Announcements, Wireless Talk, News and Harbour Notes. **7.45,** Relay of an Opera from the San Carlo Royal Theatre. **9.50,** News. **9.55,** Calendar and Programme Announcements. **10.0** (approx.), Close Down.

Saturday, March 30th.

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

OSLO (**496.7 metres**); 1.5 kW.—Programme relayed by **Fredriksstad** (387 metres), **Hamar** (577 metres), **Notodden** (297 metres), **Porsgrund** (455 metres) and **Rjukan** (448 metres).—**4.45,** Programme for Children. **6.15,** Weather Report and News. **6.30,** Talk. **7.0,** Time Signal and Orchestral Concert: Overture to St. Paul (Mendelssohn); Fantasia on the Works of Bach (Urbach); Selection from The Magic Flute (Mozart); Andante funèbre (Svendsen); Au Couvent (Borodine); La blessure du cœur (Borodine); An den Frühling (Grieg); Fantasia on the Works of Händel (Urbach); Prelude Op. 28 No. 20 (Chopin). **8.30,** Weather Report and News. **8.45,** Topical Talk. **9.0** (approx.). Close Down.

PARIS (Ecole Supérieure), Call FPTT (**458 metres**); 0.5 kW.—**6.30,** Radio Journal de France. **8.0,** Talk by M. Geville. **8.15,** Legal Talk. **8.30,** Concert, followed by News, Time Signal, Weather Report and Dance Music. **12.0 Midnight** (approx.), Close Down.

PARIS (Eiffel Tower), Call FL (**1,485 metres**): 5 kW.—**4.0,** 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) M. René Casalis, Sunday Sport, (d) Mlle. Jacqueline Bertillon, Social Works; and Talks by other contributors.

PARIS (Petit Parisien) (**336.3 metres**); 0.5 kW.—**8.45,** Gramophone Records, Talk and News. **9.0,** Concert: Overture to Cavalleria Rusticana (Mascagni); Selection from Surcouf (Planquette); Rondo from the Quintet for Piano, Flute, Clarinet, Horn and Bassoon (Rimsky-Korsakoff); Sur la route de Poggio-Bustone from Paysages franciscains (Pierné); Fantasia on Danish Melodies (Lanzky); Patrouille enfantine (Ganne); Valse lente (Levadé); Spanish Dance No. 2 (Moszkovsky). In the Intervals at **9.25** and **10.0,** News.

PARIS (Radio Paris), Call CFR (**1,744 metres**); 15 kW.—**12.30,** "The Last Waltz": Operetta (Oscar Straus). In the Interval at **1.0,** Exchange Quotations and News. **2.0,** Market Prices Report. **3.30,** Exchange Quotations. **3.45,** Orchestral Concert from the Works of Valois. **4.45,** Exchange Quotations and News. **6.30,** New York Exchange Rates and Agricultural Report. **6.45,** Gramophone Concert: Orchestral Selection, Marche Lorraine (Ganne); Baritone Solo, from Orloff (Granichstaedten) by André Bauge; Violin and Pianoforte Selections, Simplement—par amour (Eblinger); Pianoforte Solo, Spanish Dance in D Major (Granados), by M. de Lausnay; Orchestral Selection, Waltz from Der Rosenkavalier (Strauss); Tenor Solo, The Stars were shining, from La Tosca (Puccini) by Edmond Rambaud; Zerline's Air from Don Juan (Mozart) by Ninon Vallin; 'Cello Solo, Clair de lune from Werther (Massenet), by M. R. Boulmé; Fox-trot, Speedy Boy (Klages-Greer). **7.30,** Pianoforte Lesson by M. Lucas. **7.45,** Metal Prices and News. **8.15,** Religious Programme. "The Sermon on the Mount"—according to St. Matthew. In the Intervals—News.

PITTSBURGH, Call KDKA (**63 and 27 metres**); 25 kW.—**11.0,** Telechron Time. **11.1,** Orchestral Concert from the Fort Pitt Hotel. **11.30,** The Gold Spot Pals relayed from **New York. 12.0 Midnight,** Sessions Clock Chimes. **12.1 a.m.** (Sunday), Address from the Pittsburgh University—Pittsburgh Sixteenth Anniversay of Photographic Art. **12.15 a.m.,** The Home Radio Club. **12.30 a.m.,** Gems of American Literature by Elbert R. Moses. **12.45 to 3.1 a.m.,** Programme relayed from **New York. 12.45 a.m.,** A Week of the World's Business by Dr. Julius Klein. **1.0 a.m.,** The Purol Band. **1.30 a.m.,** Interwoven Entertainers. **2.0 a.m.,** Pan Americana. **2.30 a.m.,** Programme by the Seven-Eleven Dance Orchestra. **3.0 a.m.,** Longines Time. **3.1 a.m.,** Orchestral Concert from the Fort Pitt Hotel. **3.30 a.m.,** Champion Weather Report. **3.35 a.m.,** Orchestral Concert from the William Penn Hotel.

POSEN (**336 metres**); 1.5 kW.—**5.25,** Song Recital by Mlle. Jeanne Wojciechovska: Air from The Messiah (Händel); Six Sacred Songs (Bach). **6.0** Miscellaneous Items. **6.25,** Talk for Women by Mme. Sabina Swidzinska. **6.40,** Mr. Magdzinsky, Talk: The Antiquities of Danzig. **7.0,** Easter Festival from the Posen Cathedral: Programme of Choral Selections.

PRAGUE (**348.2 metres**); 5 kW.—**4.40,** Agricultural Talk. **4.50,** Talk for Workers: The Summer Colony in Sazava. **5.0,** German Transmission: Talk on Good Books by Dr. Moucha. **6.0,** Chimes, News and Mr. Q. Vyskocil, Talk: Easter in Rome. **6.15,** Recital of Easter Poems, followed by "The Easter Scene" from Goethe's "Faust." **7.0,** "El Christo de la Luz;"—Legend (Vladimir Ambrose) relayed from **Brünn** (432.3 metres). **9.0,** Time Signal, News and Theatre Notes. **9.25,** Tzigane Music relayed from the Reduta Palace, **Bratislava** (299.8 metres). **10.0,** Chimes.

ROME, Call 1RO (**443.8 metres**); 3 kW.—**7.30,** Giornale parlato and Press Review. **7.45,** "Falstaff"—Opera in Three Acts (Verdi). In the Intervals—Lucio d'Ambra, Talk: The World of Literature and Art, Giornale parlato and Talk for Women by Mme. Pompadour. **9.50,** Giornale parlato and News. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAF (**31.48 metres**); 30 kW.—**11.29,** Telechron Time. **11.30,** The 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. 1.0 a.m.,** Orchestral Music from the Hotel Van Curler. **1.30 to 4.0 a.m., New York** Relay. **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.

STUTTGART (**374.1 metres**); 4 kW.—**1.0,** Programme for Children by Elsa Pfeiffer, Karl Köstlin and the Station Orchestra. **2.0,** Concert: Overture to Samson (Händel); Wenn alle untreu werden (Aronsson); Recitative and Air from Christ on the Mount of Olives (Beethoven); Andante from the Violin Concerto (Mendelssohn); Recitative and Air from The Messiah (Händel); Es ist vollbracht (Bach); Melody (Kwast); Recitative and Air from The Messiah (Händel); Air from The Messiah (Händel); Two Songs without words (Rudnik); Auferstehung Christi (Frank); Easter Anthem (Winterberger); Good Friday Incantation from Parsifal (Wagner). **3.35,** Programme relayed from **Frankfurt. 5.0,** Time and Weather Report. **5.15,** Prof. Degen, Talk: Employment on the Railway, relayed from **Freiburg** (577 metres). **5.45,** Ernst Franzseph, Talk: The Trial and Crucifixion of Jesus. **6.15.** Dr. Erasmus, Talk: The Craving for Immortality. **6.45,** Time and Sports Notes. **7.15,** Programme relayed from **Frankfurt,** followed by "Now Heaven is Open"—Easter Play (Ernst Duis), with Soprano, Contralto and Baritone Solos and Music by Orchestral Trio, followed by News.

TOULOUSE (Radiophonie du Midi (**389.6 metres**); 8 kW.—**12.45,** Concert. **8.0,** Exchange Quotations and News. **8.30,** Concert: Violin Concerto (Brahms); Songs from the Operas, (a) Tannhäuser (Wagner), (b) Faust (Gounod), (c) Hérodiade (Massenet), (d) The Tales of Hoffmann (Offenbach), Selection from The Queen of Sheba (Gounod); Ballet Music from Faust (Gounod); Anitra's Dance from Peer Gynt (Grieg). **9.45,** Selections of Dance Music. **10.15,** North African News. **10.30** (approx.), Close Down.

VIENNA (**519.9 metres**); 15 kW.—**2.15,** Experimental Phototelegraphy Transmission. **3.0,** Orchestral Concert: Overture to Der Freischütz (Weber); Selection from Lohengrin (Wagner); Slavonic Dances Nos. 7 and 8 (Dvorák); Serenade No. 2 in G Major (R. Strauss); Violin Solo, Romance from the Second Violin Concerto (Wieniawsky); Selection from La belle Hélène (Offenbach). **4.35,** Easter Stories and Easter Songs for the Children with Lute Illustrations **5.20,** Prof. V. O. Ludwig, Talk: Easter Customs. **5.50,** Chamber Music: String Quartet in D Minor (Hugo Wolf); Andante and Variations for Two Pianofortes (Schumann). **7.0,** Time Signal and Weather Report. **8.5,** "Das Schutzengelspiel"—Play (Max Mell), followed by Orchestral Concert: Overture to Raymond (Thomas); Waltz, Accelerationen (Joh. Strauss); Fantasia, Grieg-Erinnerungen (Urbach); Fantasia on Faust (Gounod-Sarasate); Selection from Friederike (Lehár); Intermezzo, Die alte Spieluhr (Humphries); Potpourri of Modern Viennese Folk Music (Komzák); Gallop, Petersburger Schlittenfahrt (Eilenberg), followed by Phototelegraphy Transmission.

WARSAW (**1,385.7 metres**); 10 kW.—**3.25,** Wireless Review by Dr. M. Stepovsky. **3.50,** Prof. H. Moscicki, Talk: The Life and the History of the Polish Nation. **4.15,** Programme for Children. **5.15,** Chimes relayed from **Cracow** (314.1 metres). **5.30,** Recitation, accompanied by the Chimes of Sigismond's Bell at **Cracow. 7.0,** Programme relayed from **Posen.**

SUNDAY, MARCH 31st.

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

Programmes from Abroad.—

BARCELONA (Radio Barcelona), Call EAJ1 (350.5 metres); 1.5 kW.—11.0 a.m., Chimes, relayed from Barcelona Cathedral. 11.5 a.m., Weather Report and Forecast for Europe and North-East Spain and Aviation Route Communications. 1.30, Concert of Trio Music. 2.45 to 6.0, No Transmission. 6.0, Opening Signal and Agricultural and Commercial Reports and Information. 6.10, Dance Music Programme by the Station Orchestra. 6.30, Vocal Recital. 7.0, Weekly Agricultural Lecture, arranged by the San Isidro Catalonian Agricultural Institute. 8.15, Concert of Vocal and Instrumenta Music: Selections from Tannhäuser, Opera (R. Wagner). 8.40, Sports Intelligence. 9.0 (approx.), Close Down.

BERGEN (365.9 metres); 1.5 kW.—9.30 a.m., Religious Service with Address. 11.30 a.m., Weather Conditions and Forecast and News and Announcements. 7.0, Concert of Orchestral Music. 7.50, Talk on Topical Events. 8.0, Recital of Music for the Balalaika, by Boris Borisoff. 8.40, Concert of Vocal Music. 9.0, Weather Conditions and Forecast, followed by News and Announcements and Time Signal. 9.15, Dance Music Programme. 11.0 (approx.), Close Down.

BERLIN (Königswusterhausen) (1,649 metres): 40 kW.—7.55 a.m., Church Chimes, relayed from the Garrison Church at Potsdam. 8.0 a.m., Morning Recital with Vocal and Instrumental Items and Address, from Voxhaus, followed by Chimes from Berlin Cathedral. 10.30 a.m., Concert of Orchestral Music. 12.15, Talk, by E. Nebermann on Modern Chess Playing. 12.45 to 1.15, Experimental Transmission of Pictures. 1.30 to 2.30, Three Agricultural Talks. 2.30, Reading of Fairy Tales. 5.0, Two Speeches for and against a Motion on a Subject of Current Interest. 7.0 (approx.), Musical or Dramatic Programme, followed by News and Announcements and Programme of Dance Music 11.30 (approx.), Close Down.

BERLIN (Voxhaus) (475.4 metres); 4 kW.—7.55 a.m., Chimes, relayed from the Potsdam Garrison Church. 8.0 a.m., Sacred Recital of Vocal and Instrumental Music with Address, followed by Chimes, relayed from the Cathedral. 10.30 a.m., Concert of Orchestral Music. 12.15, Talk on Modern Chess Play, by E. Nebermann. 1.30, Communications and Practical Information for Farmers. 1.45, Weekly Survey of Market Prices and Meteorological Report. 1.55 Agricultural Talk. 2.30, Reading of Fairy Stories. 5.0 and 5.30, Topical Talks. 5.50 (approx.), Advertising Notes. 6.30, Talk. 7.0 (approx.), Musical or Dramatic Programme, followed by Weather Conditions and Forecast and Late News and Announcements, Time Signal and Sports Intelligence and Dance Music Programme. 11.30 (approx.), Close Down.

BERN (406 metres): 1.5 kW.—9.30 a.m to 10.30 a.m. Protestant Sermon. 7.0, Concert of Easter Music. First Performance of "Maria Magdalina" by Alfred Fankhauser, relayed from Zürich. 9.0 (approx.), General News Bulletin, Weather Conditions and Forecast and Concert. 9.40 (approx.), Close Down.

BEZIERS (211 metres): 0.6 kW.—5.0, Programme arranged by "La Radio Agricole Française." 7.30, Sports Intelligence. 7.45, Popular Concert of Pathé and Pathé-Art Gramophone Records, supplied by La Maison Relin-Missoles. 9.30 (approx.), Close Down.

BRUSSELS (511.9 metres): 1.5 kW.—5.0, Concert, relayed from the Armenonville Tea Room Orchestra. 6.0, Programme for Children, arranged by the Children's Theatre, under the Management of Léon Leroy. 6.30, Concert by the Station Trio. 7.30, Journal parlé de Radio-Belgique. 10.15, Late News and Announcements from the Evening Press. 11.0 (approx.), Close Down.

COLOGNE (263.2 metres): 4 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Langenberg (462.2 metres) and Münster (267.8 metres).—6.45 a.m., Self-Defence Lesson by Dr. Ludwig Bach. 7.5 a.m., Lesson in German Shorthand. 7.25 a.m. to 7.55 a.m., Lesson in Esperanto and Review in Esperanto of Programmes of the Week by Alfred Dormanns. 8.5 a.m. to 9.0 a.m., Catholic Morning Festival with Vocal and Instrumental Numbers and Address. 12.0 Noon, Concert of Popular Music: Conductor, Eysoldt. 1.30, Talk. 1.50 Talk. 2.10 (approx.), Talk or Reading. 3.30, Concert of Popular Music. 5.0, Talk. 7.0, Concert of Easter Music. "Das Fatale Ei"—Musical Sketch in One Act by Walter Schütt, Followed by General News Bulletin, Sports Notes and Concert of Orchestral Music. 11.0 (approx.), Close Down.

CORK, Call 6CK (222 metres); 1.5 kW.—3.30 to 11.0, Concert of Vocal and Instrumental Music. 8.30, Selection by the Station Orchestra: Sinfonietta in D Major (Mozart, arranged for Strings only by Brown). 11.0, National Anthem, followed by Weather Conditions and Forecast, relayed from Dublin. 11.15 (approx.), Close Down.

DUBLIN, Call 2RN (411 metres); 1.5 kW.—8.30 to 11.0 Vocal and Instrumental Concert relayed from Cork. 9.15, Pianoforte Solo: Sonata in A Major (Beethoven), rendered by Geraldine Sullivan. 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., Divine Service, relayed from a Cathedral. 10.56 a.m., Relay of Fanfare from the Church of Notre Dame, followed by Time Signal. 11.5 a.m., Weather Conditions and Forecast. 11.10 a.m. to 3.30, No Transmission. 4.30, Literary Programme: A Selection "Zagloba and the Wedding," from the Novel, "By Fire and Sword," by Henry Sienkievicz, arranged for Wireless Performance and executed by the Polish Wireless Dramatic Association. 8.15 Programme from Posen. 11.0, Close Down.

GENOA, IGE (386.9 metres); 1.2 kW.—7.0, Opening Signal, followed by "Il Radiogiornale." 7.25, General News Bulletin supplied by the Stefani Agency and Sports Intelligence. 7.20, Official Wireless Announcements. 7.25 (approx.), Talk: Events of the Day in the Realm of Sport, by Leandro Vaccari. 7.40, Concert of Vocal and Instrumental Music by the Station Orchestra, conducted by Fortunato Russo Simon Mago's Aria—Ecco il tragico specchio—from Nerone—Opera (Boito), rendered by Bruno De Sanctis (Baritone). 9.45 (approx.), Late News and Announcements supplied by the "Giornale di Genova" and 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., Ice Notes. 7.25 a.m., Weather Conditions and Forecast and Press News and Announcements. 7.40 a.m., Talk: Contemporary Problems of Economics. 8.0 a.m., Legal Talk of the Week. 8.15 a.m., Morning Festival. 9.55 a.m. Divine Service Relay. 11.55 a.m., Time Signal from Nauen. 12.05 (for Hamburg, Kiel and Flensburg): Concert by the Station Orchestra. 12.05 (for Hanover), Gramophone Selections. 12.05 (for Bremen), Programme by the Station Orchestra. 1.0, Funkheinzelmann's Programme for Children. 5.0, Talk. 6.30, Talk for Athletes. 6.40, Sports Intelligence. 6.55, Weather Report and Forecast. 7.0, Transmission of The Tales of Hoffmann—Opera in Three Acts, with Prologue and Epilogue by Jacques Offenbach, Conducted by José Eibenschutz, Followed by Weather Conditions and Forecast and Late News and Announcements, Sports Notes and Orchestral Concert. 10.50 (for Bremen Flensburg, Hamburg and Kiel), Weather Conditions and Forecast for North Sea and Baltic. 11.0 (approx.) Close Down.

HILVERSUM (1,071 metres); 5 kW.—11.40 a.m. Talk by Mr. J. J. A. de Ridder: How to Play Bridge. 12.10, Concert by the Wireless Orchestra, conducted by Nico Treep. 1.40, Dramatic Criticism. 2.10, Musical Selections. 7.40, Time Signal and General News Bulletin. 7.55 (approx.), Concert by the Municipal Orchestra, conducted by Albert van Raalte, relayed from Utrecht. 11.10 (approx.), Close Down.

HUIZEN (336.3 metres): 4 kW.—Transmits from 5.40 on 1,852 metres.—8.5 a.m., Church Service with Sermon. 9.30 a.m., Relay of Morning Service. 1.10, Talk. 1.40, Talk. 5.30, Evening Service relayed from Amsterdam. Sermon: The Signification of the Resurrection of Christ," by Doctor J. G. Gerlkerken. 7.10, Talk. 7.55 (approx.), Musical Selections. 9.10, General News Bulletin from the Press. 10.25, Epilogue by the Choir, directed by Mr. Jos. Pickkers. 10.40 (approx.), Close Down.

KALUNDBORG (1,153 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 Conditions and Forecast from the Meteorological Institute at Copenhagen. 11.0 a.m., Time Signal and Chimes. 11.5 a.m., General News Bulletin. 12.0 Noon, Lesson in the German Language. 12.30, Lesson in the French Language. 5.50 (Kalundborg only), Weather Report and Forecast from the Meteorological Institute at Copenhagen. 6.0, General News Bulletin from the Press. 6.15, Time Signal. 6.16, Sports Chronicle. 6.30, Talk. 7.0, Relay of Concert of Easter Music from Copenhagen Cathedral (Choir Conductor, Ernst Hansen; Organist, N. O. Rasted): Organ Selection, Fantasia on the Chorale, Christ rose from the Dead, Opus 10 (N. O. Rasted), rendered by the Composer; followed by Dance Music Programme by the Palace Hotel Orchestra, Copenhagen, conducted by Teddy Petersen; in the Interval at 11.0, Chimes relayed from Copenhagen Town Hall. 11.30 (approx.), Close Down.

KATTOWITZ (416.1 metres): 10 kW.—9.15 a.m., Church Service Relay. 10.56 a.m., Time Signal, followed by Weather Conditions and Forecast. 4.0, Concert of Orchestral Music. 8.15, Programme from Posen: "The Day of Resurrection," by M. A. Swinarsky. 9.0, Time and Sports Intelligence. 9.20, Programme of Light Music. 11.0 (approx.), Close Down.

KÖNIGSBERG (280.4 metres); 4 kW.—Programme relayed by Danzig (455.1 metres).—8.0 a.m., Morning Festival of Sacred Music. 9.56 a.m. (Danzig only), Meteorological Report. 10.0 a.m. (Königsberg only), Weather Report and Forecast. 10.30 a.m., Concert of Popular Music. 1.0, Notes for Chess Players by P. S. Leonhardt. 3.15, Concert of Orchestral Music, conducted by Walter Kelch: Violin Solo, Passacaglia (Sammartini), rendered by Walter Kelch. 5.0, Talk. 7.0 (approx.), Popular Orchestral Concert. 9.0 (approx.), Late News and Announcements and Sports Intelligence.

LAHTI (1,522.8 metres); 35 kW.—Programme also for Helsingfors (375 metres).—7.0 a.m., Relay of Morning Service in Finnish. 9.50 a.m., Press News and Announcements. 10.5 a.m., Programme of Instrumental Music. 10.25 a.m., Musical Programme. 10.50 a.m., Weather Report and Forecast and Time Signal. 11.0 a.m., Relay of Church Service in Swedish. 3.0, Popular Concert by the Station Orchestra, conducted by Erkki Linko. 4.57, Time Signal and Meteorological Report. 7.20, Popular Concert by the Wireless Orchestra: Overture to Hamlet, Opera (Tchaikovsky). 7.45, Late News and Announcements in the Finnish and Swedish Languages. 8.15 (approx.), Close Down.

LANGENBERG (462.2 metres); 20 kW.—Programme also for Aix-la-Chapelle (455.9 metres), Cologne (263.2 metres) and Münster (267.8 metres).—6.45 a.m., Lesson in Self-Defence. 7.5 a.m., German Shorthand Lesson, by Hans Molitor. 7.25 a.m. Esperanto Lesson. 7.45 a.m., Survey in Esperanto of Forthcoming Programmes. 8.5 a.m. to 9.0 a.m., Catholic Morning Recital with Sermon and Choral and Instrumental Items. 12.0 Noon, Concert of Light Music, conducted by Eysoldt. 1.30, Talk. 1.50, Talk. 2.10 (approx.), Talk or Reading. 3.30, Concert of Instrumental Music rendered by the Musical Corps of the Second Batt. of the 18th Münster Inf. Regiment. Overture to Das Modell—Opera (Suppé). 5.0, Talk. 7.0, Musical Programme. 9.30 (approx.), News and Announcements, Sports Notes and Concert of Orchestral Music. 11.0 (approx.), Close Down.

LEIPZIG (361.9 metres); 4 kW.—Programme relayed by Dresden (317 metres).—7.30 a.m., Recital of Organ Music from one of the Leipzig Churches. 8.0 a.m., Morning Festival of Vocal and Instrumental Music. 2.0, Musical Selections. 7.30, Transmission of Part I of "Faust," Drama (Goethe), produced by Hans Peter Schmiedel: Musical Interludes by the Leipzig Station Orchestra, conducted by Wilhelm Rettich, followed by Time Signal, Late News and Announcements, Sports Chronicle and Dance Music Programme. 11.30 (approx.), Close Down.

LYONS (Radio Lyon) (291 metres); 1.5 kW.—11.0 a.m., News and Concert of Orchestral Music: Le Tombeau de Couperin (Ravel). 6.30, "Le Journal parlé," consisting of News and Announcements and Review of the Press, Theatre Programme Notes and Agricultural Bulletin. 7.0, Concert of Vocal and Orchestral Music. 9.0 (approx.), Close Down.

MADRID (Union Radio), Call EAJ7 (426.7 metres); 3 kW.—2.0, Relay of Chimes from the Gobernacion and Time Signal. 2.5, Concert of Light Music by the Wireless Orchestra. 3.30 to 7.0, No Transmission. 7.0, Chimes Relay, followed by Programme of Dance Music. 8.0, Talk: Celebrated Journeys. 8.30 to 10.0, No Transmission. 10.0, Relay of Chimes, followed by Time Signal. 10.5, Selections by the Station Orchestra, Torre bermeja (Albéniz). 10.30, Relay of Concert by a Band from the Hotel National. 12.0 Midnight, Chimes Relay. 12.5 a.m. (Monday), Concert continued. 12.30 a.m. (Monday), Close Down.

MILAN, 1MI (504.2 metres); 7 kW.—9.0 a.m. Opening Signal, followed by Lesson in English. 11.30 a.m., Time Signal. 11.32 a.m., Programme of Quartet Selections. 12.30 to 3.0, No Transmission. 3.0, Opening Signal. 3.2, Comedy, relayed from the

Sunday, March 31st.

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

Programmes from Abroad.—

Arcimboldi Theatre. **3.45**, Popular Concert, with the collaboration of the Station Quintet. L'altra notte from Mefistofele—Opera (Boito), rendered by Norma Zanni (Soprano). **7.30**, Time Signal, followed by Official Wireless Communications. **7.40**, Talk by C. A. Blanche on a Historical Subject. **8.0**, Opera relayed from the Scala Theatre. In the Intervals: Talk by Ulderico Tegani, Town and Country, and Sports Results and General News Bulletin, supplied by the Stefani Agency. **10.30** (approx.), Close Down.

MOTALA (1,351 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., Morning Service, relayed from **Stockholm. 3.30**, Programme of Readings. **4.0**, Programme for Children. **4.55**, Relay of Chimes from **Stockholm** Town Hall. **6.15**, Relay of "Everyman," Play by Hoffmansthal. **8.15**, Late News and Announcements. and Meteorological Report. **8.45**, Musical Selections. **10.0** (approx.), Close Down.

MUNICH (536.7 metres); 4 kW.—Programme relayed by **Augsburg** (566 metres), **Kaiserslautern** (272.7 metres), and **Nuremberg** (240 metres).—**9.0** a.m., Morning Recital of Religious Music and Sermon. **10.0** a.m., Relay of Chimes from Munich Town Hall. **10.10** a.m., Transmission of the Weather Chart for Bavaria. **11.0** a.m., Concert of Popular Music. **12.5**, Time, Weather Report and Forecast and Survey of Programmes of the Week. **4.0**, "The Mastersingers of Nuremberg"—Opera by Richard Wagner, relayed from the Munich National Theatre, followed by Late News and Announcements. **11.0** (approx.), Close Down.

NAPLES, Call 1NA (333 metres); 1.5 kW.—**8.30** a.m., French Language Lesson by Professor Etienne Verdier. **9.0** a.m., Programme of Religious Music. **3.45** Entertainment for Children. **4.0**, Popular Concert of Vocal and Orchestral Music. **4.30**, Time Signal. **7.30**, Il Radiogiornale. **7.50**, Communications from the Naples Harbour Authorities. **8.0**, Time Signal. **8.02**, Popular Concert of Vocal and Orchestral Operatic Music: Duet from The Pearlfishers—Opera (Bizet), rendered by G. Ferrero (Tenor) and R. Aulicino (Baritone), with Orchestral accompaniment. In the interval: Programme of Recitations by E. Murolo. **9.0**, Sports Notes. **9:55**, Calendar and Review of Forthcoming Programmes. **10.0** (approx.), Close Down.

PARIS (Ecole Supérieure), Call FPTT (458 metres); 0.5 kW.—Programme relayed at intervals by the following stations:—**Bordeaux**, PTT (275 metres), **Eiffel Tower** (1,485 metres), **Grenoble** (416 metres), **Lille** (267 metres), **Limoges** (285 metres), **Lyons**, PTT (478.2 metres), **Marseilles** (303 metres), **Rennes** (280 metres), **Toulouse**, PTT (260 metres).—**7.0** a.m., Press News and Announcements and Time Signal. **8.25** a.m., International Time Signal and Meteorological Report. **12.0 Noon**, Concert of Orchestral Music arranged by the General Association of French Wireless Listeners. **1.0** (approx.), Concert of Symphony Music relayed from the Assembly Hall of "Le Journal." **3.0**, Relay of Pasdeloup Concert of Symphony Music from the Théâtre des Champs Elysées, conducted by M. Rhené Bâton. **5.30**, "Le Radio Journal de France." **7.45**, Evening Entertainment, arranged by the General Association of Wireless Listeners, followed by Late News and Announcements. Time and Meteorological Report. **11.0**, Close Down.

PARIS (Eiffel Tower), Call FL (1,435 metres); 5 kW. **7.55** a.m., Time Signal on 32.5 metres. **9.28** a.m., Time Signal on 2,650 metres. **6.10**, Meteorological Report. **6.20**, "Le Journal parlé," including Police Memoirs, Sports Intelligence, News and Announcements and Racing Notes, supplied by "Paris Sport." **7.56**, Time Signal on 32.5 metres. **7.0 to 8.0**, Concert or Play. **10.26**, Time Signal on 2,650 metres.

PARIS (Petit Parisien) (336.3 metres); 0.5 kW.—**7.45**, Latest Gramophone Records. **7.50**, Talk. **7.55**, General News and Announcements. **8.0**, Concert of Orchestral Music, with the assistance of artistes of the Opera and the Opéra-comique. **8.25**, General News Bulletin. **8.30**, Symphony Concert, conducted by Prof. Estyle of the Paris Conservatoire. **9.0**, Late News and Communications. **9.10**, Concert of Symphony Music continued: March and Procession from "The Queen of Sheba"—Opera (Gounod). **10.0** (approx.), Close Down.

PARIS (Radio LL) (370 metres); 1 kW.—**11.30** a.m., Programme arranged by "Radio Liberté," Press News and Announcements and Concert of Instrumental Music, by the Charles Seringes Trio. **12.0 Noon**, Carillon de Fontenay. **1.30**, Programme arranged by "La Radio Agricole Française." **2.0**, Dance Music Programme, arranged by "Les Etablissements Radio L.L." **8.0**, Concert. **9.0**, Carillon de Fontenay. **9.15** (approx.), Close Down.

PARIS (Radio Paris), Call CFR (1,744 metres); 15 kW.—**7.0** a.m., News and Announcements and Press Review. **7.30** a.m., Daily Lesson in Physical Culture, arranged by Dr. Diffre. **11.0** a.m., Religious Address by Father Lhande, followed by Concert of Church Music. **11.30** a.m., Press News and Announcements. **11.45** a.m., Concert of Orchestral Music; Humorous Interlude by Bilboquet in the Interval. **2.30**, Programme of Gramophone Selections, arranged by "L'Industrie Musicale"; General News Bulletin in the Intervals. **5.30**, Agricultural Communications. **5.45**, Programme of Pathé Gramophone Records. **6.45**, Radio Paris Guignol: "Room 28," Sketch (Dartheney), played by Bilboquet, Zerca, Brinchetaye and H. Carl. **7.30**, Radio Paris Café-Concert, News and Announcements from the Evening Papers. **9.30** (approx.), Close Down.

PITTSBURGH, Call KDKA (63 and 27 metres); 25 kW.—**4.0**, Sessions Clock Chimes. **4.1**, Church Service Relay. **6.29**, Time Signal. **6.30**, Allegheny County Memorial Park Programme. **7.0**, Relay of the Roxy's Symphony Concert from **New York. 8.0**, Concert by the Mu-Sol-Dent Symphony Orchestra. **9.0**, Organ Music by Dr. Charles Heinroth, of the Carnegie Institute. **9.30**, Relay of Programme by the McKinney Musicians, from **New York. 9.45**, Evening Service, relayed from the Shadyside Presbyterian Church: Pastor, Hugh Thomson Kerr. **11.0**, Time Signal. **11.1**, Relay of Concert by the Orchestra of the William Penn Hotel. **11.30**, Whittall Anglo-Persians' Programme, relayed from **New York. 12.0 Midnight**, Sessions Clock Chimes. **12.1** a.m. (Monday), Evening Service, relayed from the Calvary Protestant Episcopal Church: Sermon by the Pastor, E. J. Van Etten. **1.0** a.m., Relay of Enna Jettick Melodies, from **New York. 1.15** a.m., Collier's Radio Hour, from **New York. 2.15** a.m., Utica Jubilee Singers' Programme, from **New York. 2.45** a.m., El Tango Romantico, relayed from **New York. 3.15** a.m., Longines Time, from **New York. 3.16** a.m., Champion Weather Reports. **3.20** (approx.), Close Down.

POSEN (333 metres); 1.5 kW.—**9.15** a.m. to **10.45** a.m., Relay of Morning Service. **11.10** a.m., Time Signal. **5.30** (approx.), Musical Selections. **7.0**, Musical Programme. **8.0**, Literary Talk, relayed from **Warsaw. 8.15**, Transmission for all Polish Stations: "The Day of Resurrection," by Mr. A. Swinarsky; Theatre and Cinema Notes and General News Bulletin in the Intervals. **9.0**, Time Signal, followed by Sports Results. **9.20**, Programme of Light Music. **11.0** (approx.), Close Down.

PRAGUE (343.2 metres); 5 kW.—**3.0** a.m., Morning Recital of Church Music. **3.30**, Concert of Orchestral Music. **4.30**, Programme for Workers. **5.0**, Transmission for German Listeners. **6.0**, Sports Chronicle. **6.30**, Musical or Dramatic Programme. **9.0**, Time Signal, Late News and Announcements and Sports Intelligence. **9.15**, Theatre Programme Notes. **9.20**, Concert of Popular Music. **10.30** (approx.), Close Down.

RABAT, Call PTT (414 metres); 2 kW.—**12.30 to 2.0**, Concert by the Radio-Maroc Orchestra. **4.0 to 5.0**, Musical Programme. **8.0**, "Le Journal parlé," consisting of Miscellaneous News and General Information and Announcements. **8.30** (approx.), Concert of Vocal and Instrumental Music by the Radio-Maroc Orchestra; Orchestral Selections: Algerian Nights (Gregh): (a) At the Moorish Café, (b) Evening Echoes, (c) Ouled Nail's Dance; in the Interval at **9.30** (approx.), Sports Talk and Results. **10.30** (approx.), Programme of Dance Music from La Chaumière de Rabat, or Relay of European Stations. **11.0** (approx.), Close Down.

ROME, Call 1RO (443.8 metres); 3 kW.—**3.30** a.m., Opening Signal. **8.32** a.m., German Language Lesson. **9.0** a.m. to **9.45** a.m., Recital of Sacred Music, with Vocal and Instrumental Items. **12.0 Noon**, Opening Signal. **12.5 to 1.0**, Concert by the Station Trio. **1.0 to 4.0**, No Transmission. **4.0**, Opening Signal. **4.5 to 5.30**, Concert of Vocal and Instrumental Music. **6.50**, General News Bulletin and Agricultural Notices. **7.15**, Sports Chronicle and Various Announcements. **7.29**, Time Signal, followed by Official Wireless Announcements. **7.45**, Performance of Katia, the Dancer, Operetta in Three Acts (Jean Gilbert), during the Intervals: Talks and Lectures. **9.50**, Press News and Announcements. **10.0** (approx.), Close Down.

SCHENECTADY, Call 2XAD (19.56 metres); 30 kW.—**7.0**, Biblical Drama relayed from **New York. 8.30**, Organ Music Recital by Elmer A. Tidmarsh, relayed from the Union College Memorial Chapel, Schenectady, N.Y. **9.0**, Relay of Address for Men, by Doctor S. Parkes Cadman, from **New York. 11.0**, Stetson Parade and the American Legion Band Programme from **Boston, Mass. 11.30**, Dictograph Programme relayed from **New York. 12.0 Midnight**, Relay of Old Company's Programme from **New York. 12.30** a.m. (Monday), Programme relayed from the Capitol Theatre, **New York. 2.0** a.m., Talk on Our Government, by the Editor of "United States Daily," relayed from **Washington D.C. 2.15** a.m., Atwater Kent Programme relayed from **New York. 3.15** a.m., Studebaker Programme relayed from **New York. 3.45** a.m., Television Transmission. **4.15** a.m. (approx.), Close Down.

SEVILLE (Union Radio), Call EA5 (339.9 metres); 2 kW.—**2.0**, Programme by the Station Orchestra, followed by Latest Gramophone Records and Concert of Spanish Music. **3.0 to 9.30**, No Transmission. **9.30**, Concert of Popular Music by the Station Orchestra, followed by Flamenco Songs: Vocal Selection: El Secreto de la Cibeles (Alonso), rendered by Señora Andrés (Soprano). **11.30** (approx.), Close Down.

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

TOULOUSE (Radiophonie du Midi) (389.6 metres); 8 kW.—**11.45** a.m., Orchestral Concert. **12.0 Noon**, Time Signal. **12.5**, Concert (continued). **12.45**, General News Bulletin, contributed by "Le Télégramme," "L'Express" and "Le Midi Socialiste." **7.0**, Parisian Stock Exchange Quotations and Grain Market Prices from the Fournier Agency and General News Bulletin from the Parisian Press. **7.30**, Concert of Operatic Music. **8.0**, Time Signal. **8.1**, Programme of Modern Dance Music: 'Shout Hallelujah 'cause I'm home again'; Russian Songs in the interval. **9.15**, News and Announcements from North Africa, followed by General News Bulletin. **9.30** (approx.), Close Down.

VIENNA (519.9 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., Selections by the Viennese Boys' Choir, conducted by Prof. H. Müller. **10.0** a.m., Musical Selections. **2.30**, Experimental Picture Transmission. **7.30**, Humour in Music—Concert Programme by the Professors of the Academy of Music, under the direction of Prof. Otto Erich Deutsch: The Children's Symphony in C Major. No. 63 (Haydn), also known as the Beechtesgaden Symphony, followed by Concert of Popular Music and Experimental Transmission of Pictures. **10.30** (approx.), Close Down.

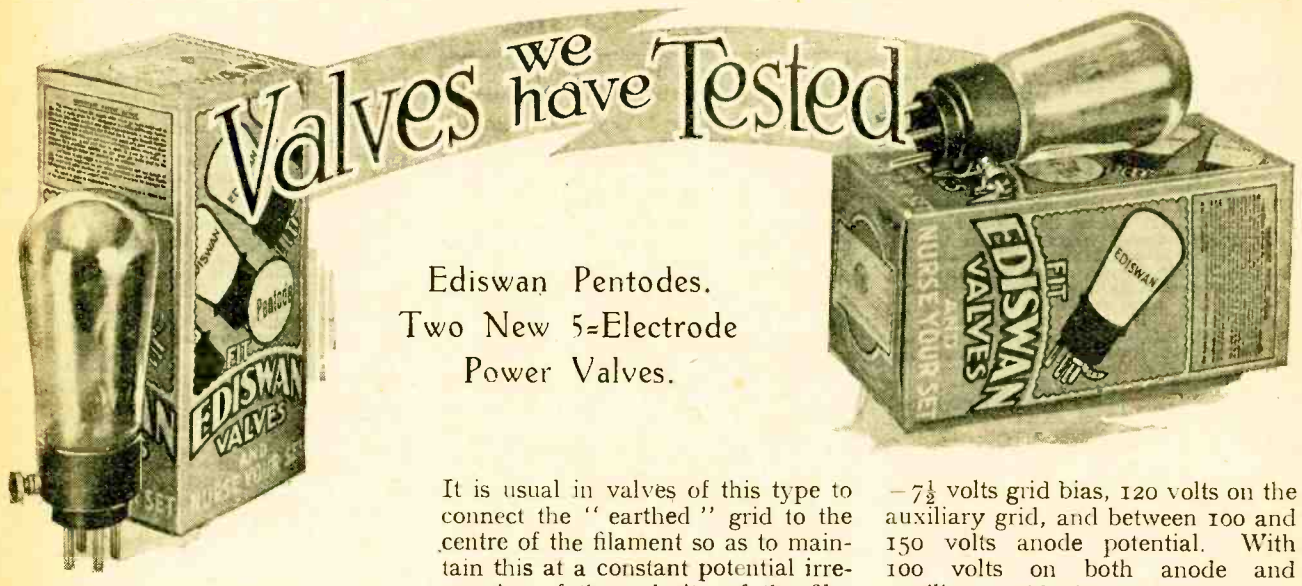
VILNA (453 metres); 1.5 kW.—**9.15** a.m. to **10.50** a.m., Morning Service relayed from a Cathedral. **10.56** a.m., Time Signal, followed by News and Announcements from **Warsaw. 6.0**, Best Greetings to the Young Ladies, by Mr. T. Bujanicky. **8.15**, Programme from **Posen. 11.0** (approx.), Close Down.

WARSAW (1,385.7 metres); 10 kW.—**9.15** a.m., Morning Service relayed from a Cathedral. **10.56** a.m., Relay of Time Signal and Fanfare from the Church of Notre-Dame at **Cracow**, followed by Notes on Route Conditions for Aviators and Weather Conditions and Forecast. **6.45**, General News Bulletin. **7.0**, Concert and Programme, The Day of the Resurrection, by Mr. Swinarsky, relayed from **Posen.** In the interval, at **8.0**, Literary Talk. During later intervals, Theatre and Cinema Programmes and Announcements. **9.0**. Time Signal. **9.5**, Sports Notes and Announcements. **9.20**, Programme of Light Music from a Restaurant. **10.30** (approx.), Close Down.

ZAGREB (308.3 metres); 0.7 kW.—**4.0**, Programme of Dance Music. **7.0**, Relay of Concert—Musical Humour, from **Vienna**, arranged by the Professors of the Viennese Academy of Music; Musical Joke in F major—The Peasant Symphony (Mozart). In the interval, at **8.50** (approx.), General News Bulletin and Weather Conditions and Forecast. **10.0** (approx.), Close Down.

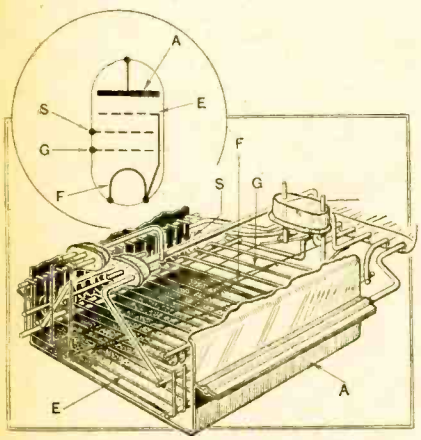
ZÜRICH (459.4 metres); 1 kW.—**10.0** a.m., Morning Concert by the Wireless Orchestra. **6.30**, Time Signal. **6.33**, Protestant Address. **7.0**, Concert of Easter Music relayed in part from **Basle** on (1,010 metres), organised jointly by the Basle and Zürich stations. Easter Songs to the Lute, rendered by Ernst **Schlott. 9.0**, Latest News and Announcements and Communications supplied by the "Neue Züricher Zeitung."

Valves we have Tested



Ediswan Pentodes. Two New 5-Electrode Power Valves.

THE Ediswan pentode is a five-electrode valve designed for use in the output stage of a receiver or amplifier. In appearance it is similar to the ordinary three-electrode valve, being fitted with a standard 4-pin base which enables it to be inserted into the usual type of valve holder without alteration to the existing wiring. The filament, control-grid, and plate are connected, therefore, to the base pins as in an ordinary triode. The additional electrodes take the form of two close-mesh grids situated between the anode and the working grid. The electrode adjacent to the anode is connected internally to one end of the filament, while the remaining grid is taken to a small terminal on the side of the base cap.



Arrangement of electrodes in the Ediswan 4-volt pentode.

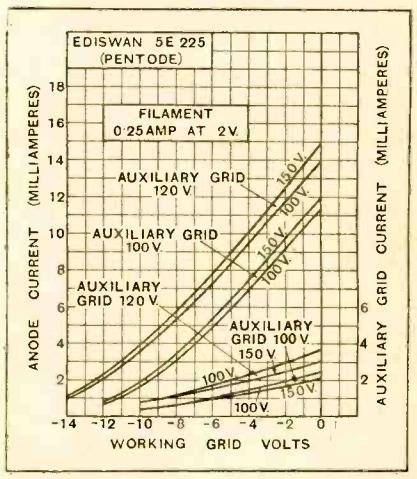
It is usual in valves of this type to connect the "earthed" grid to the centre of the filament so as to maintain this at a constant potential irrespective of the polarity of the filament. However, there does not appear to be any noticeable difference in the performance of the valve, whichever way round the filament battery is connected.

The 5E225 is fitted with a 2-volt filament, and takes 0.25 amp. if there is no other resistance than that of the wiring in the filament circuit. For a pentode this valve is remarkably economical in regard to high-tension current. Under operating conditions, with optimum grid bias and normal values of H.T. and auxiliary grid potential, the anode current was found to be about 6 mA. Of course, to this must be added the auxiliary grid current, which in the specimen tested was approximately one-fifth of the anode current. This consumption is well within the capacity of the large size dry-cell batteries, and these will provide an economical source of high tension.

5E225.

Anode Potential.	Auxiliary Grid Potential.	Grid Bias.	Anode Current.	Auxiliary Grid Current.
100 volts	100 volts	−4½ volts	6.5 mA.	1.2 mA.
		−6	5.0 mA.	1.0 mA.
150 volts	120 volts	−6	7.9 mA.	1.5 mA.
		−7.5	6.1 mA.	1.2 mA.
		−9	4.4 mA.	1.0 mA.

Under normal amplifying conditions the average A.C. resistance was found to be 83,000 ohms, amplification factor 83, and mutual conductance 1.0 milliamp. per volt. These measurements were made at −7½ volts grid bias, 120 volts on the auxiliary grid, and between 100 and 150 volts anode potential. With 100 volts on both anode and auxiliary grid the average values were found to be, A.C. resistance, 91,000 ohms, amplification factor 91, and mutual conductance 1.0 mA. per volt. The efficiency of the device does not alter, therefore, appreciably with variation in anode and auxiliary grid potentials, but the power output will be greatest with the highest values permissible.



Average values, A.C. resistance, 83,000 ohms; amplification factor, 83; mutual conductance, 1mA./volt; under normal working conditions.

This valve is suitable for operating loud speakers at moderate volume. If larger power outputs are desired there is the possibility of using two valves in parallel. This will naturally double the drain on the H.T. battery, and it would be desirable to adopt this arrangement only in cases where mains or H.T. accumulators are available.

Valves We Have Tested.—

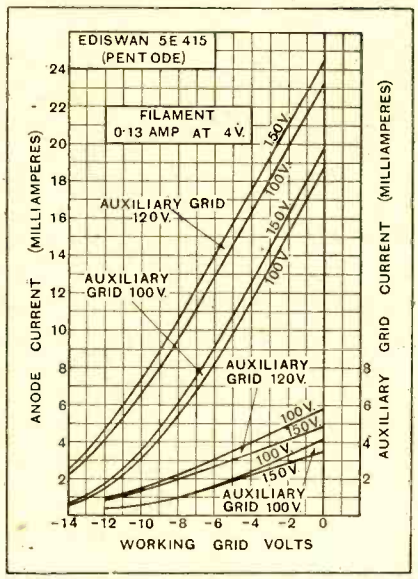
Ediswan 5E415 Valve.

This is the four-volt counterpart of the 5E225. The filament current taken by the specimen tested was 0.13 amp. at 4 volts, and in spite of the fact that the filament wattage is very little more than that of the 2-volt type, the valve shows a 40 per cent. better mutual conductance. The electrodes are arranged on the same general lines as in the 2-volt type, the main difference being the shape of the filament.

5E415.

Anode Volts.	Auxiliary Grid Volts.	Grid Bias.	Anode Current mA.	Auxiliary Grid Current mA.
100	100	−6	8.2	1.7
		−7½	6.0	1.2
		−9	4.3	0.8
150	120	−7½	11.4	2.1
		−9	9.0	1.6
		−10½	6.7	1.2

In the 5E225 this is an inverted "V," while in the 5E415 it takes the form of an "M." The high-tension current demand is about equivalent to the economical discharge rate of the large-capacity dry-cell H.T. battery, but as the other valves in the set also add their mite to the total it would be advisable to employ either accumulator H.T.s or an eliminator, if supply mains are available. The average characteristics measured under normal operating conditions were found to be, A.C. resistance 59,000 ohms, amplification factor 83, and mutual conductance 1.4 mA. per volt. These were taken with 120 volts on the auxiliary grid-9 grid bias, and between 120 and 150 volts on the anode. By reducing the battery voltage to 100 on both anode and auxiliary grid and measuring the average A.C. resistance and amplification factor with -7.5 volts grid bias, these were found to be 62,500 and 91 respectively. The mutual conductance improved very slightly, being 1.45 mA. per volt.



Average values, A.C. resistance, 59,000 ohms; amplification factor 83; mutual conductance, 1.4mA./volt, under normal working conditions.

It has been mentioned from time to time in this journal that pentodes should not be preceded by a first L.F. stage, but must be the only amplifier after the detector. The high amplification factor imposes a strict limitation on the permissible grid swing and generally a regenerative detector preceded by a good H.F. amplifier will fully load a valve of this type.

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.

WORLD WIDE FOUR.

Sir,—I have read the article in your issue of January 30th, giving a test report of the Gecophone World Wide Four.

The oscillation point to which you refer is due to a fixed voltage on the valve screen grid. It is a known fact that a considerable variation is required for short and long wave; otherwise reaction effects occur.

The ideal way, of course, is the use of a variable control, but in the commercial receiver an additional fixed resistance for the H.T. to the screen grid could be used, and coupled to the waveswitch, so that it could be shorted out.

Screen grid valves are ideal, but the voltage question to produce adequate anti-coupling effects is critical, and can only be found by experiment. J. P. J. CHAPMAN.

Bournemouth.

JAVA SHORT-WAVE TRANSMITTERS.

Sir,—It may be of interest to short-wave fans to hear a few details of the four Dutch short-wave transmitters in Java which are now working. These details are just to hand from the chief engineer of the International Telephone Office at Bandoeng, Java, who tells me that he will much appreciate reports from England of the quality of reception, modulation, fading, and strength. Of the four stations the lowest in W/L is PLE (late ANE) on 15.74m. c.c., and having a power of 25 kW. in the last stage. The second is PLF (late ANH) on 17.4m., same as above. The third is the highest powered and just completed, namely, PLG, c.c. on 18.88m., and a power of about 60 kW. The fourth is PLR on 27.8m., also 25 kW. PLE and PLG are testing with Australian 2ME every Wednesday from 10.30 GMT. to 12.00 GMT.

PLE, PLF and PLG start daily (except Sundays) at 12.00 GMT until about 16.00 GMT, after which PLR is used until 19.00 GMT.

Perhaps I should add that 2ME is on 28.5m., and would also welcome reports to the Amalgamated Wireless Co. at Sydney, Australia. E. T. SOMERSET.

Burgess Hill, Sussex.

PICTURES BY BEAM WIRELESS.

Sir,—*Re* "Pictures by Beam Wireless," I am unable to find any authority for the statement that "the facsimile telegraph preceded the use of the Morse code."

Morse's first instrument transmitted and recorded the Morse characters automatically. After a time the operators became familiar with the sounds, and were, after some experience and practice, enabled to transmit by hand and "read" by ear. This was in the years 1837-1842. In 1842 Bain introduced his chemical Morse recorder as an improvement on the Morse instrument which embossed the characters on a travelling paper ribbon. Bain used a chemically prepared ribbon, which discoloured when a current passed through the "tongue" of the armature to the paper. Bain's chemical recorder was the forerunner of the Morse inker of to-day.

Bain conceived the idea of facsimile telegraphy, but it never materialised because he was unable to overcome difficulties of synchronisation.

In this country at least the Morse and Cook and Wheatstone's needle instruments were the first to be commercially used. There were seventeen pioneers before Morse.

In 1853 Bonelli's system of facsimile telegraphy transmitted at speeds of 300 to 1,000 words per minute.

In 1856 The Abbé Casseli in France invented a tuning fork, "a pendulum rod with an armature of iron oscillated between two fixed electro-magnets, one on each side. The coils of these were connected with a local battery and with a contact worked by the pendulum of a clock." C. G. WISDOM.

Glasgow.

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.

Duration of Accumulator Charge.

I have an L.T. accumulator rated at 30 ampere hours; how can I calculate the period for which it should supply my four-valve set before recharging becomes necessary? D. G. A.

It will first be necessary to ascertain the total consumption of the filaments by adding together the currents taken by individual valves. Duration of discharge (in hours) is then calculated by dividing the rated ampere-hour capacity by this figure.

Assuming your set to consume 0.6 amp., the battery should be capable of supplying current for $30 \div 0.6 = 50$ hours.

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A "Reflex" Eliminator.

Will you please give me a circuit for an A.C. eliminator to supply H.T. current to my three-valve reflex receiver, of which I am sending you a circuit diagram? M. C. L.

It is always a difficult matter to design an eliminator to work satisfactorily with a reflex set. We have examined your circuit diagram, and have come to the conclusion that you would be well advised to abandon the project of operating this very complex set from an eliminator; at any rate, we would hesitate to suggest a suitable design without experimental work on the subject.

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Screening Boxes.

I have made a three-compartment screening box for a two-stage H.F. amplifier. On examining it, I find that the soldering of the seams is not perfect, and that, tested in water, the boxes show several leakages. Does this account for the fact that I have been unable to obtain stability from the amplifier? G. R. W.

Generally speaking, you may take it that the presence of comparatively small holes in your screening boxes will do no harm; but you must take care to avoid long seams in which the metal parts are in imperfect electrical contact.

Very possibly your failure to attain stability will be traced to a badly fitting lid, or perhaps you are attempting to obtain an impossibly high amplification per stage. It may be, also, that there is interstage coupling in a common battery resistance.

Altering an Eliminator.

My three-valve set (neutralised H.F. amplifier with transformer coupling, anode bend detector, and resistance-coupled L.F. stage) works well on a simple eliminator giving a single output voltage (in the neighbourhood of 140). I now propose to modify the receiver and to use an S.G. valve, which will require a voltage of about 80 on the screen. How can this conveniently be obtained, preferably by the potentiometer method? D. P. S.

We suggest that you add a potentiometer consisting of one fixed and one variable resistance; this will be connected to the present output terminals of your eliminator in the manner shown in Fig. 1, perhaps as a separate unit or built into either eliminator or set. In the diagram, additions to the wiring are shown in heavy lines; you may find it unnecessary to include the by-pass condenser C (ordinarily of 2 mfds. capacity), particularly if the screen is already "by-passed" in the set itself.

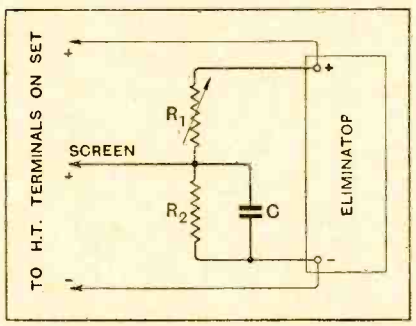

Fig. 1.—A potentiometer for screen grid voltage control.

The fixed resistance R_2 may be of some 50,000 ohms, while a maximum of about the same value is suitable for R_1.

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Increasing Condenser Capacity.

I have a 0.0003 mfd. condenser, and wish to increase its capacity to 0.00035 mfd. Is it possible to do this in a reasonably efficient manner? A. R. B.

In practice we are afraid that you will find it impossible to modify your condenser. Its capacity can, of course, be increased by adding two or three extra vanes, but this course is seldom possible. Again, you could connect a 0.00005 mfd. fixed condenser in parallel, but this would have the result of unduly increasing the minimum capacity, and consequently the tuning range of the circuit of which the condenser forms part.

In all probability you will be able to use your condenser as it is, although it may be necessary to add a few turns to your inductance coils.

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Precautions with D.C. Mains.

I am thinking of trying my "Kilo-Mag Four" with a D.C. eliminator, and in order to isolate the normal receiver-earth connection from the earth mains, I propose to use an "aperiodic" double-wound aerial-grid transformer instead of the tapped coils originally specified. Can you give me data for the windings? R. P. C.

We think you might well use the coils included in the original set, but you could over-wind an aerial coil, adopting the method of construction exemplified in the intervalve couplings of this set. Using fine wire, we suggest respectively 5 and 30 turns for medium- and long-wave coils, although the degree of aerial coupling depends to a certain extent upon your requirements as to selectivity.

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Decoupling Condensers.

There seems to be no hard-and-fast rule as to the value of decoupling condensers for use in the anode circuit of an H.F. valve. Can you give me a ruling on this matter? S. M. L.

Broadly speaking, all that is required is that the condenser shall have a very low reactance over the band of frequencies for which the set is designed, and this condition will almost invariably be satisfied by the use of a capacity of 0.1 mfd. Of course, there is no objection whatsoever to using a larger capacity, which, indeed, may help in eliminating ripple when an eliminator is used.

A condenser of low resistance should be chosen.

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.